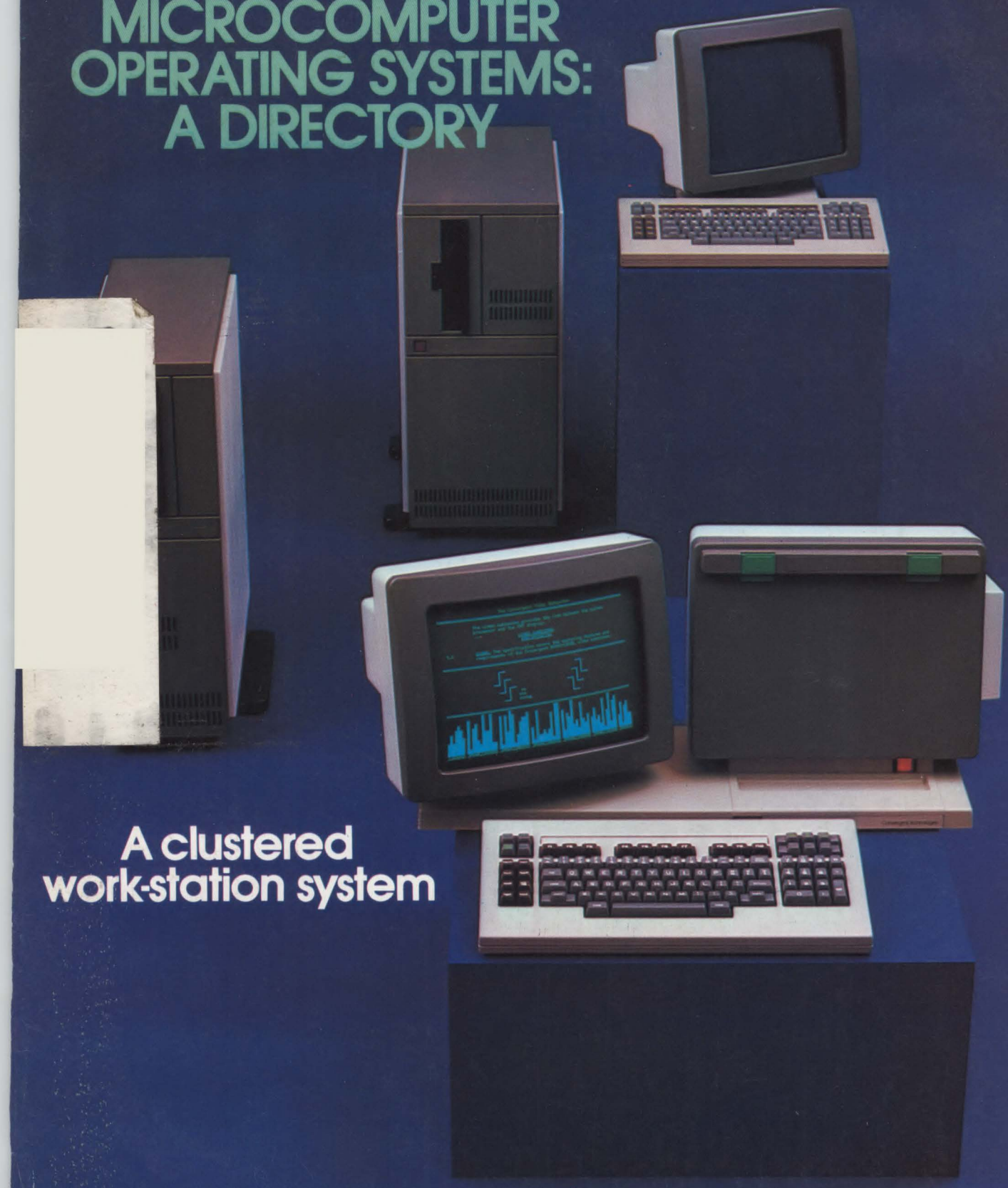
Mini-Micro Systems
A CAHNERS PUBLICATION
OCTOBER 1980

MICROCOMPUTER OPERATING SYSTEMS: A DIRECTORY



A clustered work-station system

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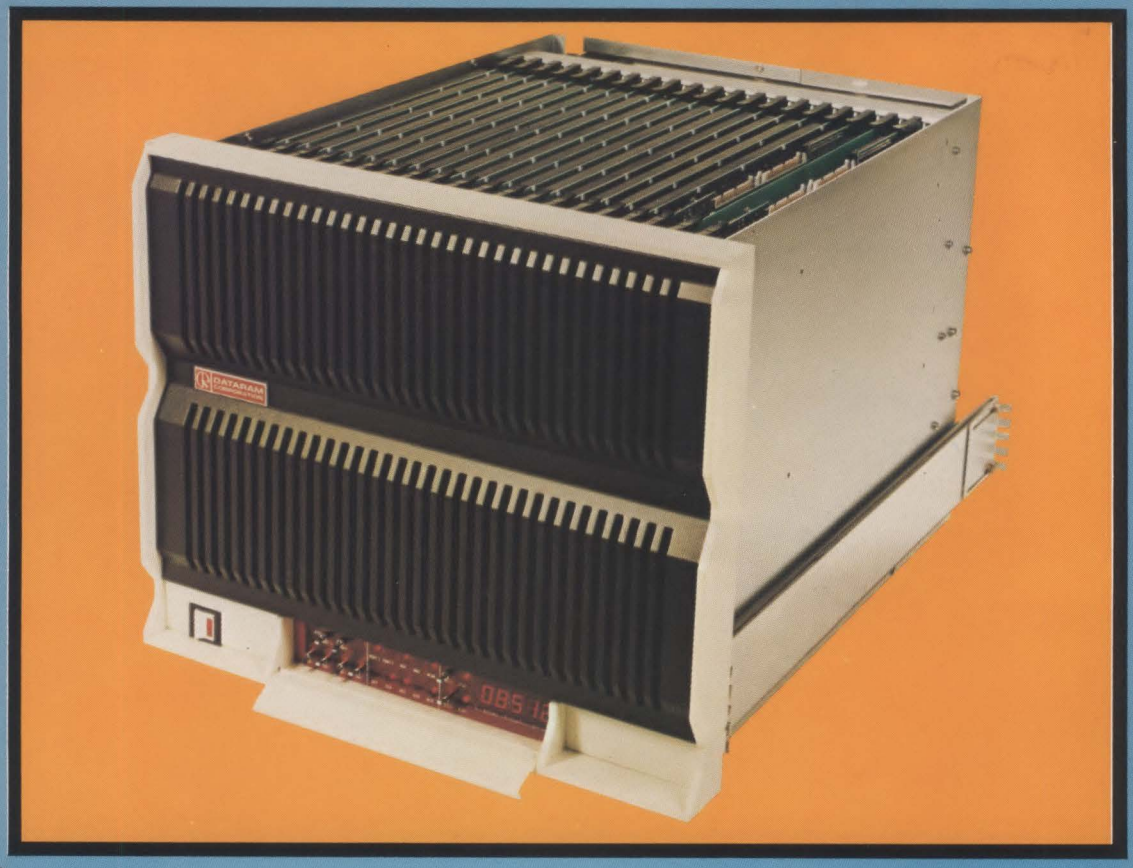

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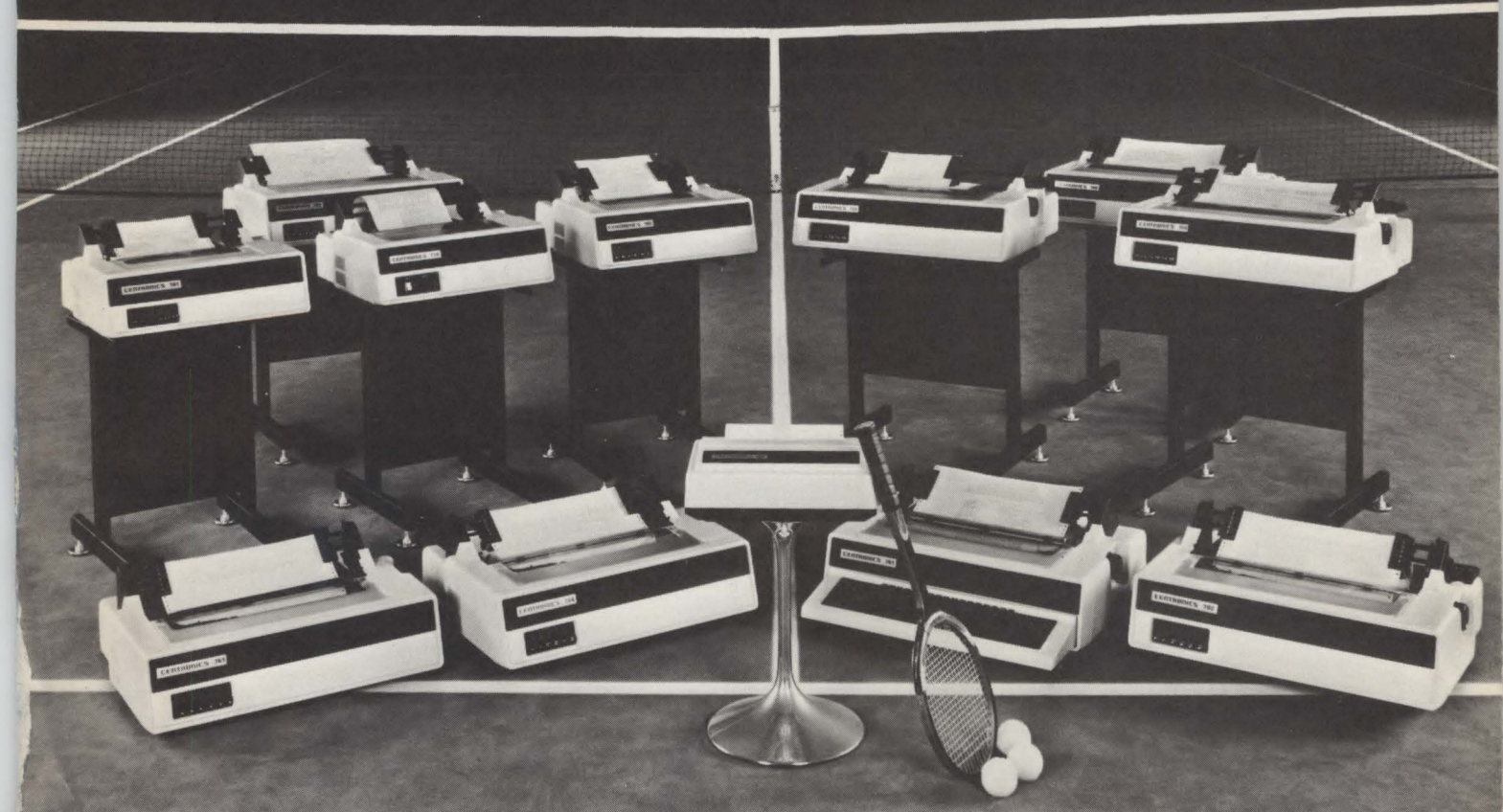
Always use genuine Centronics ribbons and accessories.



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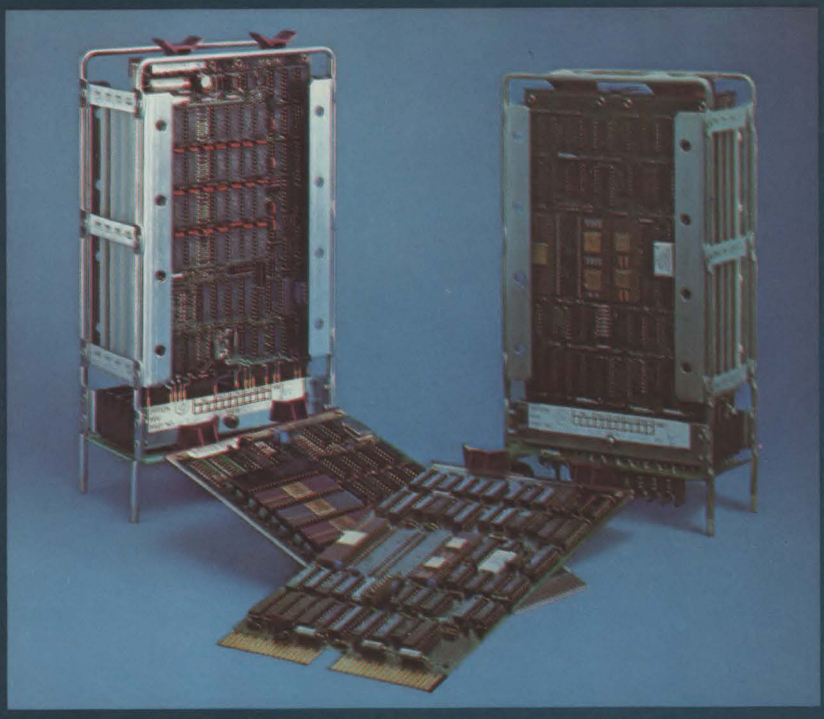

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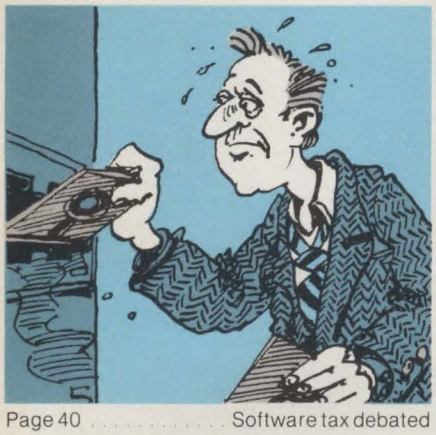
Convergent Technologies, Inc., has combined microprocessor technology and affordable Winchester storage to make distributed information processing—with a complete CPU, main memory and mass storage for each user—a low-cost reality. See p. 85. Photo by Don Shapiro, courtesy of Convergent Technologies.

Page 132 . . . . . A removable Lynx



Page 40 . . . . . Software tax debated

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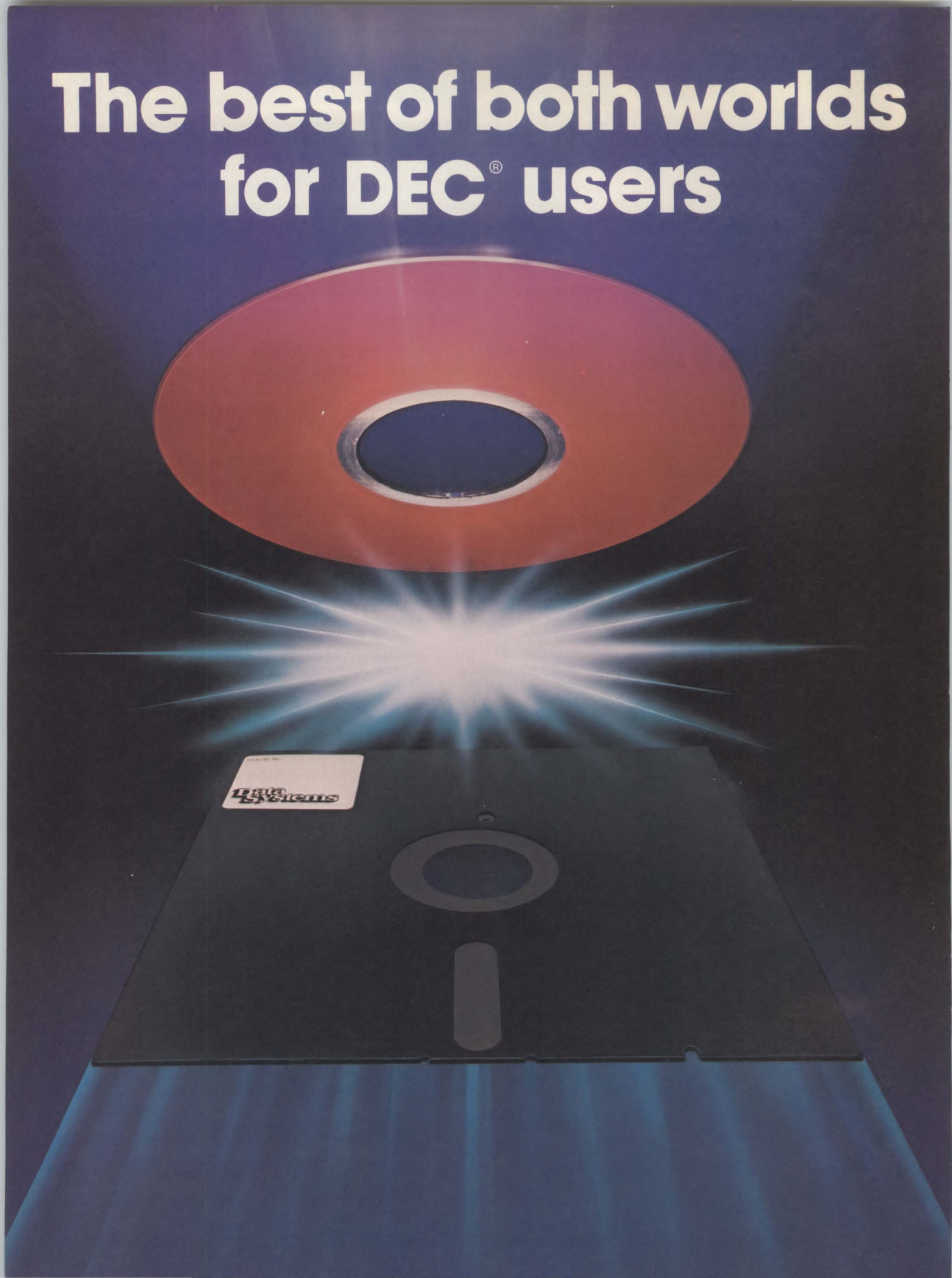
FEATURES

MINI-MICRO WORLD

DEPARTMENTS

The best of both worlds for DEC® users



Data Systems Design's DSD 880

Introducing the DSD 880 — A DEC-compatible disk system combining eight-inch Winchester and flexible disks

For DEC users who need more capacity and performance than a dual RX02, the DSD 880 now offers a more cost effective alternative than a dual RL01. Consider these benefits offered by the DSD 880:

- significantly lower initial and total life-cycle costs
- the reliability of a Winchester, with 7.5 Mbytes, emulating RL01
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- valuable saving in rack space (5¼" vs. 21" for dual RL01)
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- one half-quad backplane slot vs. two quad boards for the RLV11
- versatile interface card for easy integration with any LSI-11 backplane, unlike DEC's RLV11 interface that needs a special backplane and cannot be used with the VT 103 terminal

Compare for yourself and see why nothing compares to the DSD 880.

Data Systems

The Intelligent Alternative to DEC Disk Systems

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CIRCLE NO. 5 ON INQUIRY CARD

Breakpoints

SHUGART SCHEDULES DELIVERIES OF 5¼-IN. FLOPPIES

Look for Shugart Associates to introduce its first 96 track-per-in., 5¼-in. floppy-disk drives this month, following a showing in Paris at SICOB in September. A spokesman for the Sunnyvale, Calif., company says the double-sided model, the SA460, will use the firm's "bi-compliant" head, the mechanism that was recently the object of controversy with rival drive maker Tandon Magnetics, Inc. The single-sided drive, the SA410, will use Shugart's standard head mechanism, the company says. Both drives will be available in single- or double-density versions. Evaluation units of both drives will be ready by the end of this year, with production quantities being shipped the first quarter of 1981. The company spokesman says that in 100-unit quantities the SA460 will sell for $400, and the SA410, $325.

WANG CHALLENGE TO IBM DISPLAYWRITER IS IMMINENT

Wang Laboratories' challenge to the IBM Displaywriter—a low-end stand-alone word-processing system (MMS, August, p. 35)—is already being offered to large Wang users, according to industry sources. The Lowell, Mass., company is expected to introduce the as-yet-unnamed product the first week of December, according to a company source. However, large users that order in quantity may have systems delivered by the end of November. The system is a stand-alone work station that is expected to use minifloppy-disk drives and a Z80 microprocessor. It will have printer and communications options. It can serve as a backup for Wang's large OIS systems and for archiving functions on those machines. The system will probably have a 48K- or 64K-byte backup capacity, and can also act as a stand-alone word processor. One source notes that—at $6000 to $8000—the product will cost less than the Displaywriter. According to one industry analyst, the system can draw on existing Wang word-processing software that has been in the field for three to four years.

TEKTRONIX UNVEILS THREE MICROCOMPUTER DEVELOPMENT SYSTEMS

Three new microcomputer development systems being introduced this month by Tektronix, Inc., indicate the Beaverton, Ore., company's commitment to that market. The new family is called the 8500 modular MDL series; the first member is the single-user 8550, which sells for $14,300 and can be ordered now. The 8550 can emulate 23 8-bit microprocessors, and will soon be able to emulate the Intel 8086, Zilog Z8001/2 and Motorola 68000 16-bit processors. The 8560 multi-user system and 8540 host computer versions of the Tektronix development systems will follow the 8550 next year. All three family members are fully compatible with each other, including software support and all the multivendor microprocessor emulation packages Tektronix offers. Users of existing Tektronix 8002A and 8001 development labs can also run their emulator software on the 8500 series.

HIGH- AND LOW-END WINCHESTERS SET FOR 1981

With venture capital funding firmly in hand, one-year-old Ontrax Corp., Sunnyvale, Calif., plans to have its first product offering—a high-end 116M-byte 8-in. Winchester-disk drive—available for evaluation by February. The drive reportedly will incorporate a patented actuator that is faster, more accurate and easier to produce than conventional voice-coil motors found on most Winchester drives, and will incorporate an as-yet-unspecified servo concept. Ontrax's 3350-technology hardware will use 210-mm media, and will come with power supply and controller. The drive will be available in three versions—29M, 58M and 116M bytes, each with five platters . . . . Also due next year is a low-end Winchester, reportedly a 5¼-in. device, from the two-month-old Rotating Memory Systems, Inc. Also located in Sunnyvale, RMS now employs 12 people and is privately funded. The company plans to introduce its product line at next year's National Computer Conference in Chicago.

Breakpoints

ADDS WILL MARKET REALITY-COMPATIBLE SYSTEM

Applied Digital Data Systems, Inc. (ADDS), has targeted another niche to further its expansion into the small business systems market. At next month's COMDEX dealer show in Las Vegas, the Hauppauge, N.Y., CRT terminal maker plans to unveil a Z8000-based microcomputer system compatible with Microdata Corp.'s Reality business system. The new system will use 14-in. Winchester disks supplied by Shugart and Memorex, and will cost roughly half as much as the minicomputer-based Reality system, according to Brian Wiltshire, vice president and general manager of the recently formed ADDS systems division. Wiltshire says prices on the ADDS system will range from $20,000 to $50,000, while the Reality system sells for $50,000 to $150,000. ADDS is aiming the new system at the some 40 small business system dealers that have been adding applications software to Reality systems and reselling them to end users. "Those dealers desperately want a lower-priced system to broaden their market," Wiltshire says.

WESCON'S EMPHASIS IS ON BOARD-LEVEL PRODUCTS

Microprocessors and microcomputer board-level products got considerable attention at the recent Wescon show in Anaheim, Calif. Among the more important developments at the show were **Hitachi America Ltd.'s** announcement that its HD68000 alternate-sourced version of the Motorola Semiconductor 16-bit microprocessor will be available in sample quantities in December. A DMA controller chip for 68000-based systems will follow from Hitachi in the third quarter of 1981. . . . For its part, **Motorola** unveiled the first of a new 6800 family of 8-bit CMOS microcomputer parts, built around the MC146805E2 microprocessor, which is available from stock, along with seven peripheral chips in the family . . . .

Intel Corp. announced that it is sampling a 10-MHz version of its iAPX-86 microcomputer, the 8086-1. The Santa Clara, Calif., company claims that the 8086-1 is the fastest 16-bit microcomputer available. Benchmarks, says Intel, indicate that the 8086-1 is 15 to 20 percent faster than competitive 16-bit microcomputers.Intel also announced the availability of two "numeric microprocessor" chip sets. The two-chip iAPX-86/20 pairs an 8086 CPU with an 8087 math co-processor. For 8-bit bus applications, the company's iAPX-88/20 joins an 8088 with the 8087. . . . **Zilog, Inc.**, Cupertino, Calif., has applied its Z-Net network technology to microprocessor development with Z-Lab. The networked development system is designed for users developing products based on the company's Z8, Z80 and Z8000 microprocessors. Built around a new Z80-based program development station, the system also incorporates components introduced with Z-Net last May, specifically, the SDS 2/01 shared-data station and the NST 2/01 network station transceiver.

Piiceon, Inc., said it would begin delivering its Sword-100 intelligent terminal before year-end. The San Jose, Calif., firm's 8086-based device is aimed at the word-processing and distributed-processing markets. The system includes local memory—as much as 64K bytes of RAM and 2K bytes of ROM—two Qume double-sided, double-density floppy-disk drives, data rates as high as 19.2K baud and a 5280-character screen. . . . Wescon organizers hoped to attract more than 60,000 visitors to this year's show, and they succeeded. Total attendance was 63,520, the number to beat next year when the conference meets in San Francisco's Brooks Hall.

DEC READY TO ANNOUNCE NEW VAX FAMILY MEMBER

The second entry in Digital Equipment Corp.'s 32-bit VAX computer family is expected to be unveiled Oct. 21 at DEC's Hudson, Mass., facility. Typical configurations of the new system, designated the VAX-11/750, are said to be priced at just 40 percent of the price of similar configurations of the VAX-11/780, the original VAX product, which was announced exactly three years ago this month. DEC officials won't comment on the pending announcement, but the 750 is said to make extensive use of semiconductor gate-array technology in its logic portions, achieving a level of integration that allows the number of integrated circuit components to be reduced by a factor of about eight to one compared with the 780.

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Dr. Hanratty summarized his enthusiasm for Megatek with this graphic display of confidence:

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For details call or write Megatek Corporation, 3931 Sorrento Valley Boulevard, San Diego, California 92121. (714) 455-5590.

MEGATEK/WHIZZARD

COMPUTER GRAPHIC SYSTEMS

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Talos highlights its long line of fine digitizing devices with two new products, the Wedge and the 800 Series, each with advanced electromagnetic technology. The Wedge, with a five-degree sloped surface gives you greater operating ease. And the 800 Series, available in a variety of tablet sizes, allows for dual tablets, cursors and multiple interfaces for your varied applications.

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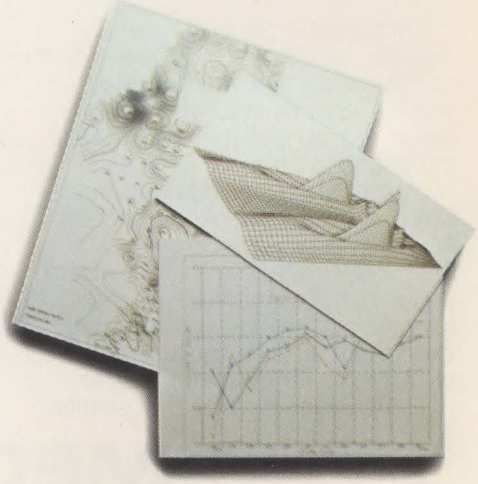

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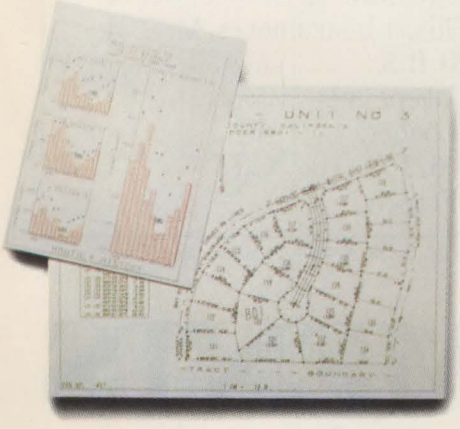

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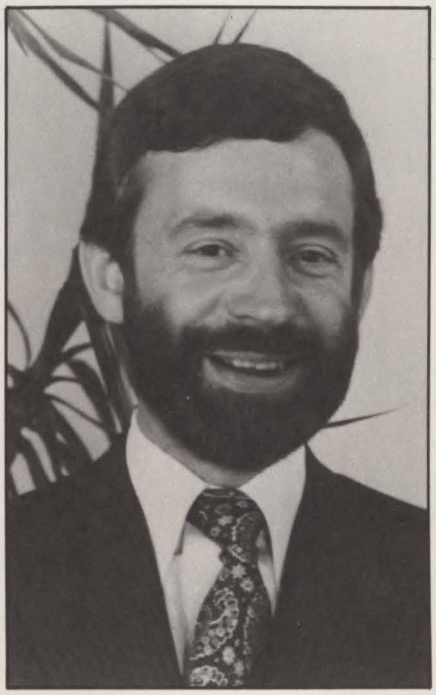
CIRCLE NO. 7 ON INQUIRY CARD

IEEE standards moving, but not without some delays

Efforts by the IEEE's Computer Society to establish standards for microprocessors—especially for bus structures, networks and languages—are, for the most part, moving along well. Several of the subcommittees are ready to publish final drafts of their standards. Some are waiting for comments on their preliminary drafts. Others, confronted by diverse problems, are trying to keep much-needed standards efforts alive.

Three of the 11 subcommittees expect to publish a final version of their standards within the next three to six months. One of these is the S-100 backplane (IEEE task number P696) group. Chairman Howard Fullmer says he hopes to submit a final draft to the IEEE Standards Board—the IEEE body with final approval power—this month or next. "We have one more decision to make before we're happy with the final standard," he says.



The IEEE's backplane *bus subcommittee anticipates publication of its standard by early next year, says Andrew Allison.*

Hoping to end the chaos brought about by the proliferation of incompatible S-100 products, the S-100 bus standard as established by the IEEE specifies all mechanical, electrical and timing requirements. It will handle 16-bit data transfers and 24-bit memory addressing, as well as define DMA and bus-master arbitration protocols. A double-size card format is optional. According to Fullmer, some companies have already built products following the proposed standard, and they work well.

Also ready for publication this month is the system bus standard, P796, which is an attempt to eliminate the ambiguities of Intel's Multibus—the de facto 8-bit system bus. Subcommittee chairman Rich Boberg says, "We've been ready for publication for a long time." Boberg has set Nov. 1 as the deadline for comments on the standard, and hopes to submit a final version to the IEEE standards committee by December or January.

The system bus is a "slightly modified version of the Multibus," Boberg explains. The subcommittee has added the concept of compliance levels, he says, which will permit the bus to operate with 8- and 16-bit processors. The system bus will be able to address 16M bytes via 24 address lines, he says. System-bus-compatible boards will have to include literature that states that their compliance levels are 796-compatible, says Boberg.

The backplane bus subcommittee anticipates publication of its standard by early next year, says chairman Andrew Allison. P896, a spin-off of another standard, the future bus, proposes a manufacturer- and processor-independent bus optimized for 16- and 32-bit data paths. The subcommittee recently changed the original pin-out configuration and chose to specify the bus on a single connector. Allison hopes to present the final draft to the standards committee by next spring.

The local area network subcommittee, another offshoot of the future bus, met in August to vote on some of the functional requirements for its standard. Chairman Maris Graube says the standard will permit various devices to communicate with one another "over a reasonable distance, about 1 kilometer, and at a reasonable speed of about 5M bps."

Graube's committee has been broken into three smaller groups, and each has defined one aspect of the overall standard: a linked protocol, an addressing scheme and a basic network architecture. There is agreement on the network's interface specifications, he says.

Graube says the committee has evaluated some of the commercially available networks, such as Zilog's ZNet, the proposed Ungerman-Bass Net-One and Xerox's Ethernet. He is careful to say that the committee is not blessing any one of these products, but "we are listening to what they have to say." He says that the final standard may incorporate some aspects of each, however.

He expects to have final technical specifications prepared this month. Semiconductor houses can begin designing their local area network chips based on these specifications, Graube says. Among the semiconductor companies represented on the subcommittee are American Microsystems, Inc., Western Digital, Inc., Motorola, Texas Instruments Inc. and Intel.

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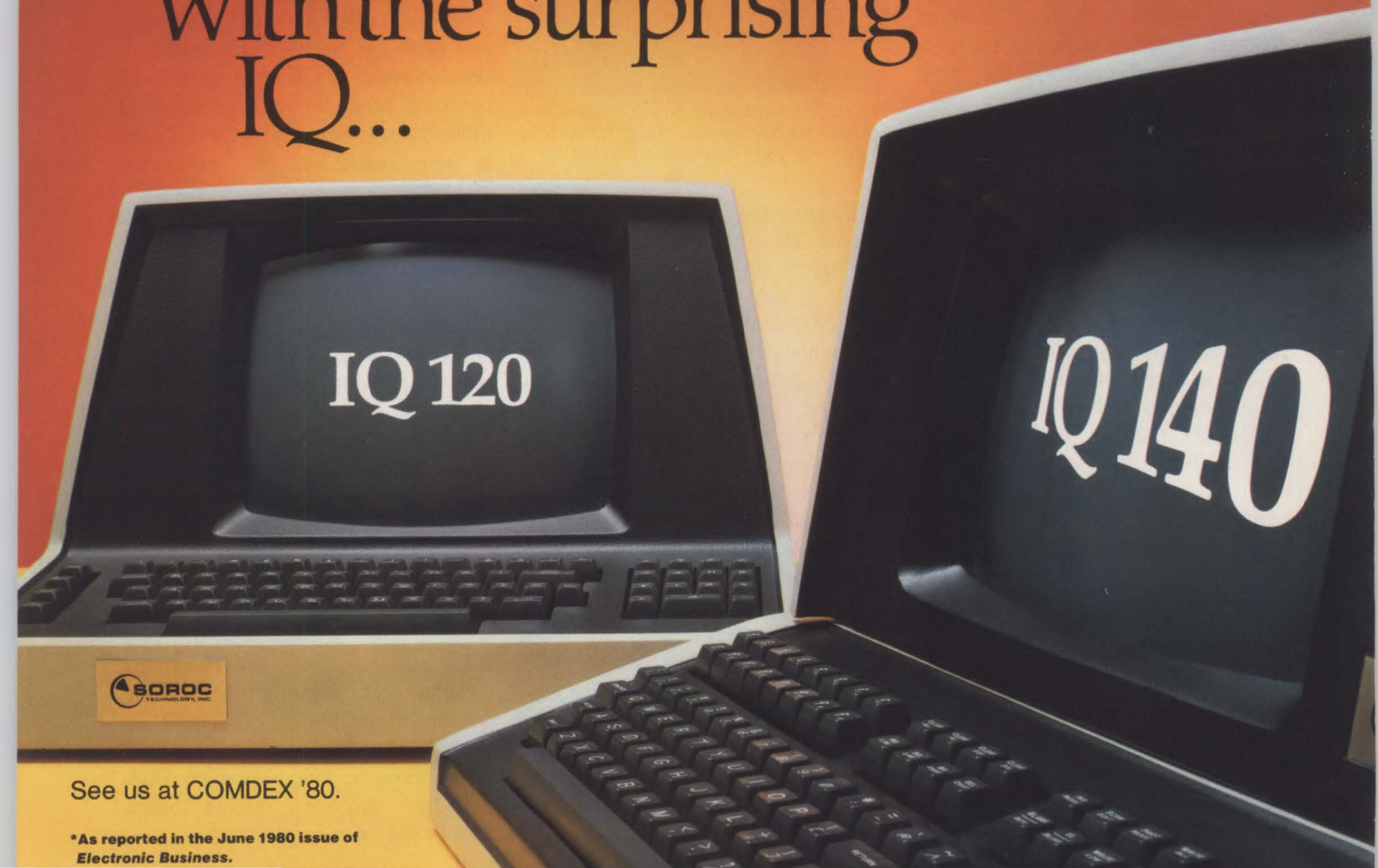

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*As reported in the June 1980 issue of *Electronic Business*.

Graube thinks that the committee will agree on the "language of the standard by next spring," but he doesn't expect a final standard for at least another year.

Although not quite ready for publication, the assembly language mnemonics subcommittee (P694) has been active as well. P694 intends to establish a common set of instruction names and mnemonics, plus conventions for naming new instructions for microprocessor assembly languages.

"We got a less-than-positive reaction to our December draft," says chairman Wayne Fischer. "Those responding preferred an all-consistent operand ordering system." According to Fischer, such a system would have operands following a source-destination sequence. The best example, he says, would be a "load-store" command. The latest draft will include a consistent operand ordering system, Fischer says. "We're adding extensions for 16- and 32-bit processors, as well," he explains. He expected the draft to be completed by the end of last month, but he does not foresee publication for perhaps six months.

The floating-point subcommittee plans to have a revised version of its standard P754 ready for publication in late fall or early winter. The original draft appeared in the October, 1979, issue of the ACM's *Signum News*. "We went out for a mail ballot last May," says chairman Dave Stevenson, "and we've just finished considering all the suggestions received." The revamped proposal will be published to a wider audience for a broader response, he points out. The floating-point standard addresses the need to specify methods of implementing binary floating-point arithmetic on a single chip.

The high-level language (P755) subcommittee is preparing a draft of its standard, which will attempt to add certain abilities to high-level languages (HLLs) to increase their flexibility among processors. Chairman Dick Karpinski says the committee has agreed on two capabilities to be included in HLLs: a convention for calling arbitrary subroutines into a program or an operating system, and a method of allocating code and data to specific areas of memory, such as assigning read-only data to ROM.

The group has been working primarily with BASIC, FORTRAN and Pascal, Karpinski points out, but he adds that it wouldn't be difficult to include PL/1, Lisp or Algol. He stresses that the standard won't make these HLLs portable, but

MINIBITS

INTEL UNVEILS LOW-COST DEVELOPMENT SYSTEM

Intel Corp. has introduced a bare-bones version of its Intellec Series II development system aimed at 8048 and 8085/8080A microprocessor users. Priced at $6990, the model 120 version slashes the entry-level price of Intel development systems by $4000, thus bringing them within a range that garage shops and other small operations can afford. However, the system limits program sizes to 8K bytes and does not include high-level languages or an in-circuit emulator, although these items are available as extra-cost options.

Other recent Intellec series product introductions include a new high-end system, a multistation system and a 16-bit Pascal compiler. The Intellec Series III model 286 system, which starts at $16,500, includes two CPUs—an 8086 and an 8085—to enable users to develop both 8- and 16-bit applications on the same machine. The model 290 multistation system supports as many as eight work stations, all sharing as much as 15M bytes of hard-disk storage. A basic system that includes a master station, shared disk and operating software sells for $25,105. Upgrade kits are available to convert earlier Intellec systems to the new configurations. The Pascal compiler, which runs on the new Intellec Series III, sells for $4000.

SMALL WINCHESTER DISKS WILL LEAD MARKET GROWTH

Sales of moving-head hard-disk drives will grow from $3.8 billion annually in 1979 to $9 billion by 1983—a healthy 24 percent annual growth rate. However, sales of OEM disk drives, whose market share was 17 percent in 1979, will grow at an even faster rate, according to the *1980 Disk/Trend Report* published by James N. Porter, a Mountain View, Calif., management consultant. The $635 report forecasts an especially strong growth for small Winchester fixed-disk drives. Total shipments for small (less than 30M-byte) fixed disks are expected to soar from 53,000 units annually in 1979 to 471,500 by 1983. By then, Winchesters with 8- and 5¼-in.-diameter disks will have captured a dominant 84-percent share of this market, the study forecasts, with 14-in. drives dwindling to a mere 16-percent share. As might be expected, IBM will outpace all other suppliers. Porter predicts that by 1983, IBM's Piccolo 8-in. Winchester will reach the highest annual production level of any disk drive in history—127,200 spindles.

DAY AT THE RACES MARKS PASCAL DEBUT

What do computer languages and bookmaking have in common? They both can trace their roots to Blaise Pascal, the 17th century mathematician and philosopher who invented the first calculating machine and was the father of probability theory. Thus, it was appropriate when Perkin-Elmer Data Systems used the promise of an afternoon at the races to lure reporters to its Oceanport, N.J., headquarters, which adjoins Monmouth Park race track, for the introduction of a Pascal language compiler. Perkin-Elmer is betting that the new optimizing compiler, an extended version of a proposed ANSI standard, will give its 3200 series machines an edge in the 32-bit minicomputer sweepstakes. The compiler, which generates reentrant code, supports separate compilation of Pascal procedures, 8- and 16-bit integer data types and other language extensions. It's available now and sells for $5250, with additional copies costing $525 each.

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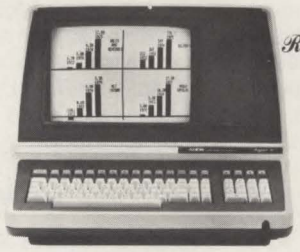

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CIRCLE NO. 9 ON INQUIRY CARD

rather will try to minimize the amount of work that would need to be done in hardware.

Reaction to the proposed standard has been mixed, he says, with engineers and hobbyists showing the most excitement, and the language groups expressing a parochial caution about tampering with the languages. Karpinski says that the committee must develop the expertise to improve understanding of the languages before it can proceed with the specific points in the standard. Regardless, an HLL standard is at least a year away from publication, he says.

The residential future bus, or the home bus, has been suffering from the lack of a document to serve as a starting point, says subcommittee chairman Cash Olsen. The home bus, as its name implies, is a low-cost microprocessor bus structure for home use. However, a document has now been supplied by Philips, a large Dutch electronics firm. The document describes a bus that the company has used in its labs in the Netherlands. "Basically, it describes a data communications protocol for transmission at about 10K characters a second," Olsen says.

The Philips bus will be a useful starting point. "This should stir up interest," Olsen says, adding that he expects to start announcing meeting dates soon.

Some of the standards projects are facing more severe problems than those of Olsen's home bus. The relocatable object code effort, for instance, is suffering from "a lack of both ability and commitment," according to chairman Tom Pittman. Clearly, such a standard would not be popular among microprocessor manufacturers because it would enable a user of one microprocessor to easily take advantage of the software of another vendor.

Pittman's committee has no proposal in the works, but he hopes that some interest will be raised to get one going. He says, "it's not dead yet."

While there may still be life in the relocatable object code group, the same may not be true for two other standards committees. According to Hermann Schmid, the microprocessor/peripheral interface (P698) group is "totally inactive." A name change had been contemplated for the standard, Schmid says, but there were also questions concerning that.

Similarly, the microbus subcommittee is no longer operating. The microbus was developed by National Semiconductor Corp. as a protocol for interconnecting components on a single board. Chairman Gordon Force says the program is "effectively on hold." While there may be attempts to revive the standard in the future, Force says, "There's just not enough interest" within the industry.

According to sources close to the subcommittee, activity on the standard suffered substantially when Force, who had been employed by National, left the company. *—Larry Lettieri*

Single-board controller ties disk and tape drives

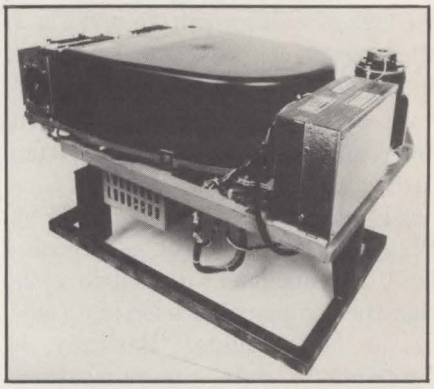
A number of controller houses offer the hardware needed to support Winchester- disk drives equipped with storage module device (SMD) interfaces or to handle ½-in. tape transports. But only one company claims to have packed both functions onto a single board.

Spectra Logic Corp., a Santa Clara, Calif., startup firm (MMS, December, 1979, p. 58) designed the new dual-function controllers. They are aimed at designers planning to tie high-end Data General Corp. or Digital Equipment Corp. minicomputers to large-capacity 14-in. Winchesters and backup start/stop or "streaming" ½-in. tape drives.

On one side, the new Spectra Logic offering emulates as many as

Mini-Micro World

four 80M-byte removable-pack 3330-technology disk drives equipped with the widely used SMD interface. "Expanded emulation" permits the new Spectra Logic hardware to handle drives in the 300M-byte range. The SMD interface is standard on drives such as DG's 6067 and DEC's RM02. It is also commonly found in higher-capacity, higher-performance fixed-disk Winchesters, such as Control Data Corp.'s 9730 "Mini Module" 160M-byte drive, Kennedy Co.'s 5300 series devices, and Priam Corp.'s 33M- and 66M-byte "Diskos" 14-in. 3350-technology hardware.



Most 14-in. OEM Winchester-disk *drives, such as this Memorex Corp. model 612, are equipped with older SMD interfaces.*

On the other side, the new hex-wide controllers will emulate as many as eight formatted Data General 6021 ½-in. tape transports, or an eight-drive DEC TU10/TM11 tape subsystem. In both cases, emulation permits OEMs to use other higher-performance start/stop hardware, as well as the newer streaming tape drives developed specifically for Winchester-backup applications—including the recently announced 3200-bit-per-in. device from Cipher Data Products, San Diego, Calif.

In all cases, the controllers are completely transparent to the DG and DEC operating systems, and will handle the standard utilities and diagnostics supplied by the mini-

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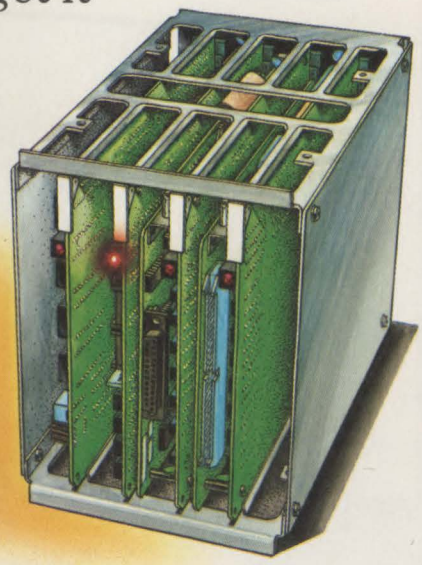

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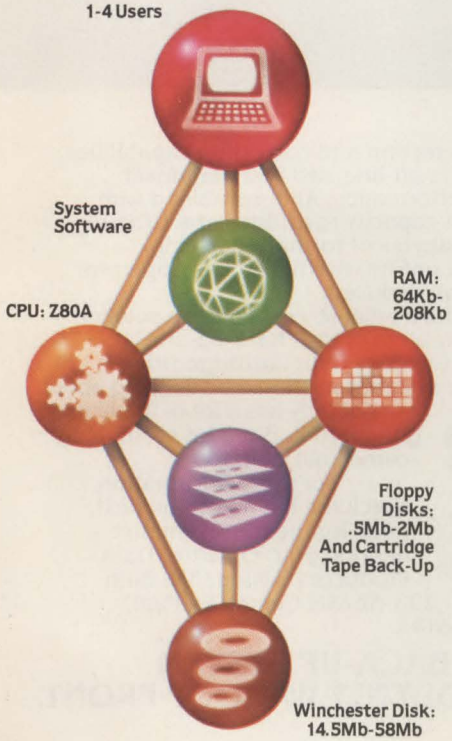

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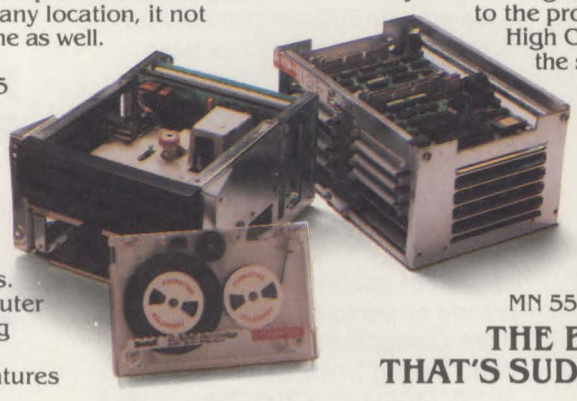


THE BACK-UP SYSTEM THAT'S SUDDENLY WAY OUT FRONT.

computer vendors, says Steve Roberts, Spectra Logic co-founder and executive vice president.

Roberts anticipates that some peripheral subsystem costs will drop dramatically if his firm's single-board, multifunction controllers are used. "Tape subsystems used in high-end minicomputer applications have a very low duty cycle," Roberts points out. "Aside from archival and loading applications, most are used only at the end of the day to run disk-drive backup jobs." These include applications in which removable-pack SMD drives are used, Roberts adds. One way of increasing the reliability of these older drives has been simply to let the packs sit permanently on the spindles, he says. "This practice has been commonplace for years."

Dick McCormick, marketing vice president of Rianda Electronics, Anaheim, Calif., a vendor of tape-drive adaptors for minicomputers, agrees with Robert's assessment. "Tape subsystem utilization at these sites is very low," he says. "Typically these drives are used only five to 10 percent of the time."

This low amount of tape system use imposes a significant cost penalty on the user, says Roberts. Until the introduction of his firm's multifunction controller, he maintains, users planning tape and disk drives were forced to buy two controllers—one for each device. The price for such a combination could exceed $10,000 he says.

In comparison, Spectra Logic's Spectra 20 (for DG Nova and Eclipse minis) is priced at $5800 in single-unit quantities and $4500 in 25-unit orders. The Spectra 21 (DEC PDP-11s via a Unibus attachment) is priced at $5100 for one and $3900 in quantity. Board controllers include an SMD adaptor and formatter and a tape adaptor. Roberts says that tape formatters are typically supplied by drive makers for about $800 extra.

But many industry observers feel that Winchester/tape interfacing costs may drop even lower as the older SMD concept gives way to

Spectra Logic Corp., *which was founded by Steve Roberts (l.) and Alan Abbott, is the first company to pack interfaces for both Winchester and tape drives onto a single board.*

newer interface standards developed especially for Winchesters. "SMD interfaces are expensive," says Rianda's McCormick, indicating the large amount of Schottky TTL components needed to handle SMD hardware.

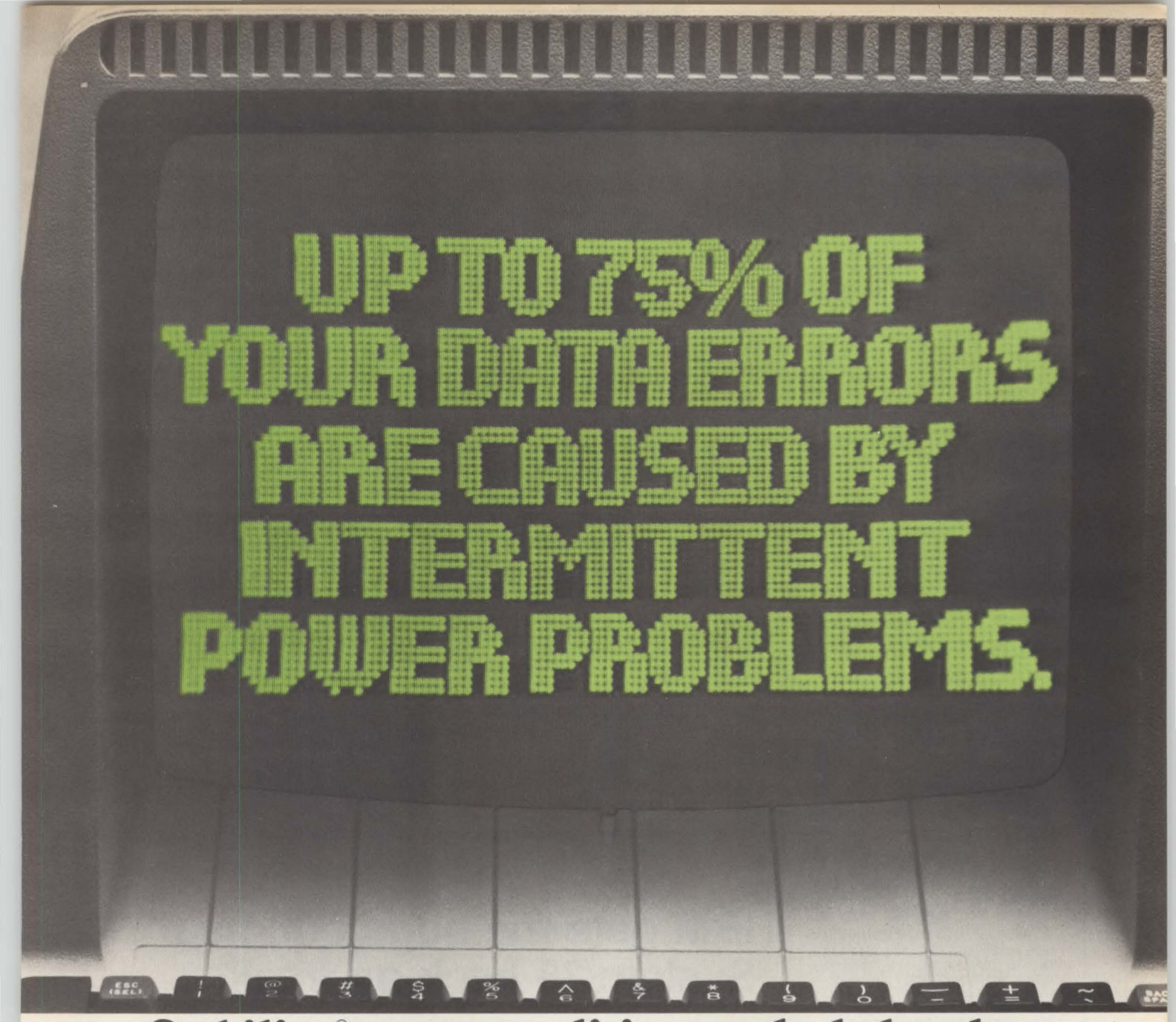
McCormick says his firm is looking at single-board disk/tape controllers for minicomputers, but will use a Winchester interface instead of an SMD interface. An industry-wide Winchester interface standard does not exist yet, and McCormick says it might be some time before one is developed. As a result, the SMD interface may be around for some time, says industry analyst Raymond Freeman Jr., Santa Barbara, Calif.

"Despite its higher cost, it's the product of the moment," Freeman says, "and over the next two years, more than 60 percent of the 14-in. Winchesters shipped into the OEM market will be equipped with it." Fred Cox, president of Emulex Corp., Irvine, Calif., agrees, pointing out that the SMD interface will remain the standard for larger drives. "It's impossible to conceive of its dying out," he says. "You can expect it to continue for a long time—especially through the life cycle of 14-in. SMD and Winchester-disk drives."

Others, however, feel that its dominance will not last forever. "It's riding the crest of a wave now," says McCormick, "but like any product, it too has a life cycle."

George Toor, marketing vice president at Priam Corp., San Jose, Calif., sees the SMD interface being phased out a little sooner. "The market for SMD-compatible drives is diminishing," he says. "The SMD interface has served its purpose as far as the Winchester vendors are concerned. It gave systems builders an easy way to incorporate the bulk storage of a Winchester into a system built around removable-pack drives," he says.

But this market is rapidly



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disappearing, says industry analyst Jim Porter. "These users are now soaking up all the Winchesters they can use," says the Mountain View, Calif., consultant and publisher of the *1980 Disk/Trend Report*. "At the same time, the market for pure Winchesters tied to tape backup has not developed as quickly as some had anticipated."

That being the case, Spectra Logic's new offering may give the 14-in. disk-drive business a shot in the arm by cutting installed costs and making the SMD a more palatable interface, while users wait for the emergence of a pure Winchester interface standard. But Spectra Logic president and co-founder Alan Abbott isn't sure that people should hold their breath. "The ANSI standard now being worked out for 8-in. Winchesters could also be used for 14-in. devices—possibly," he says. "On the other hand, a de facto standard such as the SMD interface may come along. The result: The SMD interface could be around for another four to five years," he says.

Abbott stresses that his firm is not working on any Winchester interface at the moment. If one evolves, however, he feels that the microprocessor-based design of the Spectra 20 and 21 controllers will make it easy to modify the product line to incorporate whatever emerges. Also planned by Spectra Logic is on-board software that will directly connect the disk and tape controllers. This will eliminate the need to shuffle data through the CPU during backup runs, and will create a low-cost back-end processor for minicomputers.

Prototype versions of the controllers are scheduled to be shown at the Mini/Micro Computer Conference this month in San Francisco. Evaluation units will be available by the end of the year, with production slated to begin late in the first quarter of 1981. —*John Trifari*

IBM gets the bugs out, has System/38 back on track

With the start of deliveries in July, IBM Corp. appears to have its troubled System/38 business computer back on track. Introduced in October 1978, the System/38 was originally scheduled to be shipped to customers beginning the following summer (MMS, December, 1978, p. 40). But in August 1979, IBM announced that it would need additional time "to integrate and test system programming elements to achieve planned levels of performance."

Industry observers speculated at first that the System/38's poor performance might have been caused by excessive virtual memory page swapping—a condition known as "thrashing." But Brian Utley, System/38 program manager, gave a different explanation at a press briefing last January. He said the system's software components performed well when running alone, but when integrated, batch performance fell off. This was a serious failing because the System/38 is intended to replace IBM's aging System/3 computer, which is primarily a batch machine. In addition, Utley said, IBM needed to clean up software interfaces that were causing system failures.

IBM now says these problems have been ironed out—a claim supported by test site customers, who have had the system since February. "The system's performance exceeded our expectations," says Chuck

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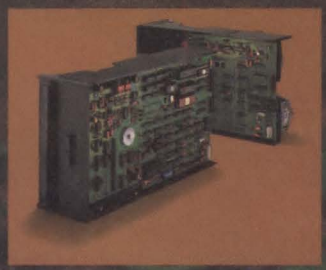

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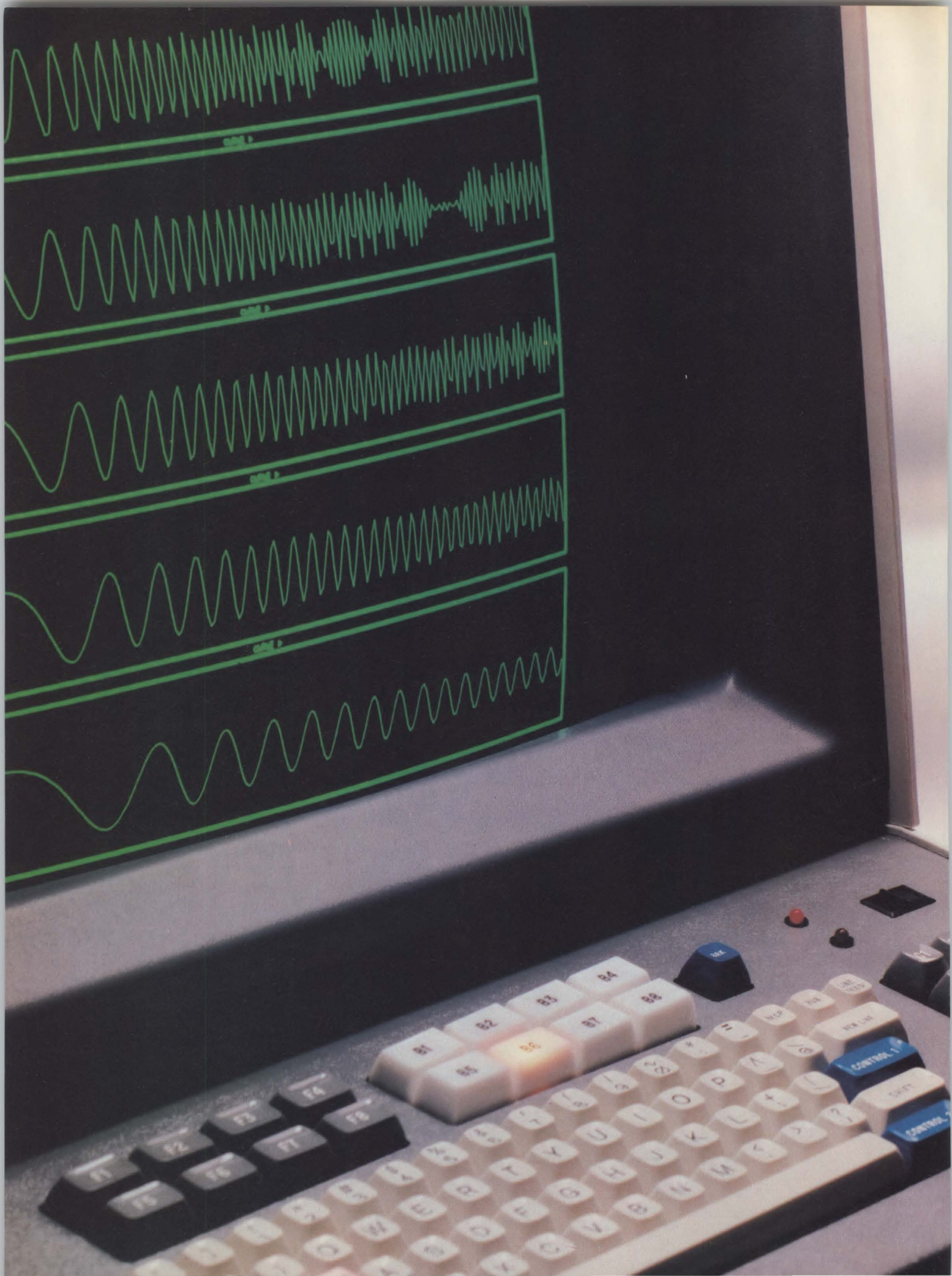

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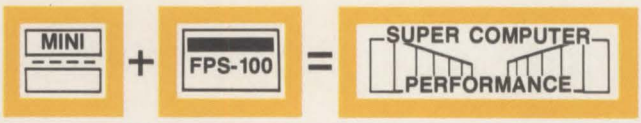

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Petter, data processing manager at Road Machinery & Supplies of Minneapolis, Inc., one of three test-site customers. Road Machinery plans to replace its present IBM System/3 model 10 and System/34 computers with the new machine. To test the System/38's batch performance, Petter benchmarked it against the System/3. The result: "The System/38 ran 4.5 times faster," Petter says.

IBM System/38 computers *get a final check before shipment.*

Another test-site customer, St. Olaf's College in Northfield, Minn., also is pleased with the System/38's performance. "Its batch performance is good, and its response on the tubes is excellent," says Wayne Briggs, assistant data processing manager. However, St. Olaf's has not benchmarked the system, which will replace a System/3 model 15D.

Besides a protracted gestation, the System/38 also has run afoul of a shortage of 64K-bit memory chips, which are used in the smaller (model 3) version of the system as well as in IBM's 4300 series mainframes. IBM

has been unable to manufacture the chips, which are not yet available from outside suppliers, in sufficient quantity to meet an unexpectedly high demand for memory from its mainframe customers. Consequently, IBM announced in July that it would ship some System/38 model 3 units with 16K instead of 64K chips. The difference, however, will be transparent to customers, says an IBM spokesman, who declined to specify what proportion of the systems would contain the smaller chips.

Despite the year-long delivery delay, IBM officials maintain that there has been no significant cancellation of System/38 orders—estimated at about 50,000 by Frost & Sullivan, Inc., a New York City market research firm. Bob Francipose, sales manager at IBM's general systems division, which markets the System/38, attributes this customer loyalty to the system's advanced programmer support features, such as single-level memory management and an integral data base management subsystem. "Our customers tell us the system was worth waiting for," Franciose says. *—Paul Kinnucan*

The data processing staff *at Road Machinery & Supplies, Inc., a heavy-equipment distributor in Minneapolis, was one of two in Minnesota to test the IBM System/38 before regular shipments began in July.*

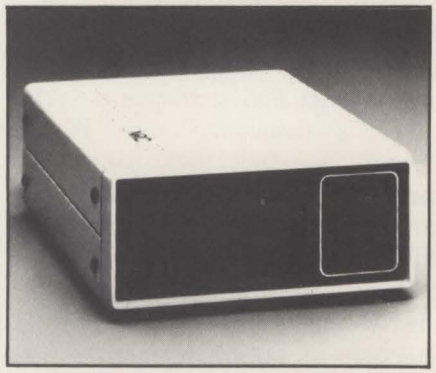
Datacomm consultants branch into hardware

After two years' experience designing large-capacity networks and data-communications software for aerospace and commercial end users, Sytek, Inc., is getting ready to jump into the hardware market.

At the same time, the $2-million Mountain View, Calif., firm is developing a management philosophy aimed at reconciling the hardware independence needed for a consulting operation with the narrow requirements of a hardware vendor promoting its own product line.

Sytek's first offering as a data-communications hardware supplier is a packet-switching network called the System 20, which operates with broadband (5- to 300-MHz) cable TV links. On one side, the system interfaces to the lines via a proprietary protocol; on the other, it interfaces to a variety of RS232-compatible terminal subsystems, processors and office equipment. The System 20, claimed to be the first product of its type, is aimed at existing large-scale, local-area networks based on telephone circuits, and at those planned around baseband coaxial networks, such as Xerox Corp.'s Ethernet (MMS, July, p. 17; February, p. 53).

According to Sytek president Michael Pliner, more than 100 logical channels can be established per broadband CATV link, each able to support more than 100 terminal devices operating at 9600 bits per



The System 20 packet-switching network *is the first hardware offering from Sytek, Inc., a company that started as a data communications consulting firm.*

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sec.—the maximum data rate for voice-grade telephone circuits. Transmission speeds through the CATV circuits are approximately 150M bps per link, Pliner adds. Baseband circuits operate at a maximum of 10 MHz and must be considered as one logical channel, he points out.

Moreover, the baseband circuits are limited in their reach. Pliner says that both Ethernet-type systems and CATV circuits may be suitable for a local-area network, if the network is limited to one building or to a group of buildings less than 2 mi. apart. If the network must be further expanded, however, users may be forced onto costly telephone circuits or private common carriers. CATV lines, however, can transmit and receive data to or from sites as far away as 40 mi., and are already established in most U.S. urban and rural locations.

Installing a CATV connection is inexpensive, Pliner points out—30¢ per ft. for full-duplex broadband coax versus 20¢ per ft. for half-duplex baseband. Sytek's new Mountain View facility was wired with 40 taps for less than $1500 including labor. Tapping into a CATV link is simply a matter of connecting to the nearest trunk—a process no more involved than contracting for entertainment.

Data Communications users already can use CATV. To do so, they contract with local cable companies and lease part of those companies' unused bandwidth. Manhattan Cable TV has offered such a service to New York banks for years.

System 20 hardware is also intended for users who want their own networks for reasons of cost, capacity or security. This is done by stringing a private line through existing passageways set up by cable TV companies. In leased or private CATV lines, the RF modems incorporated into the System 20

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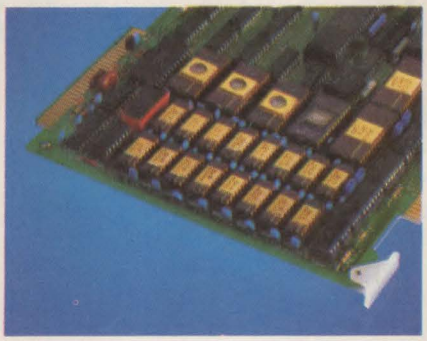

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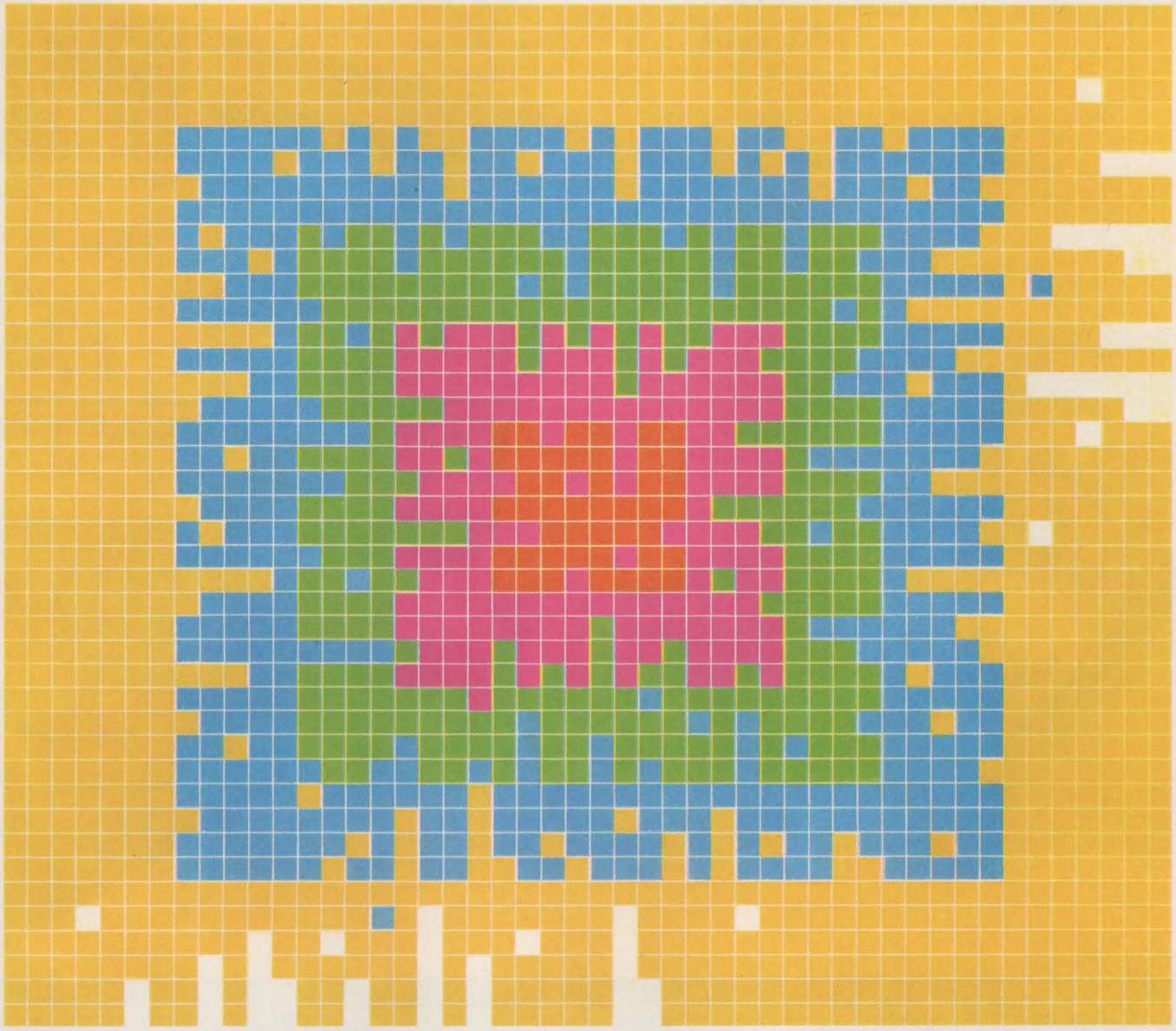

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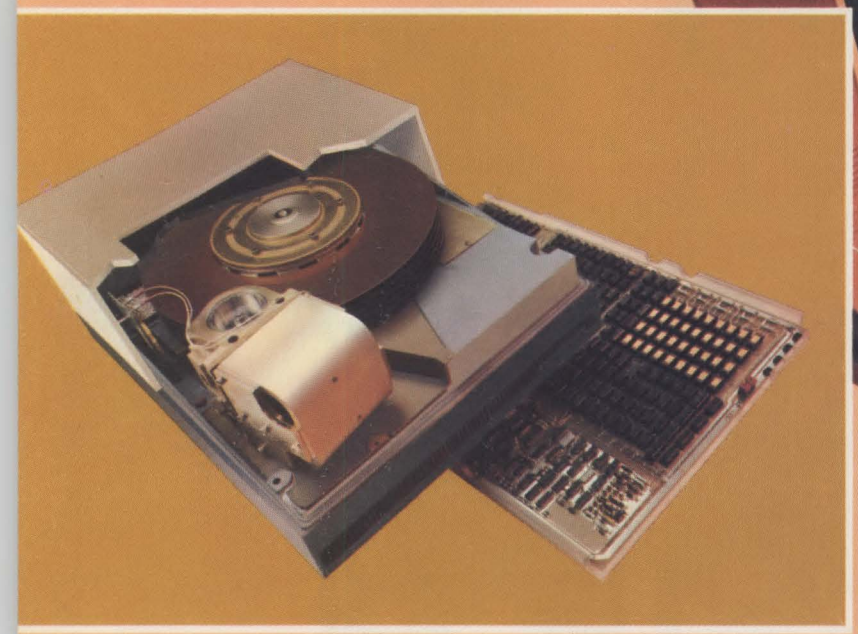

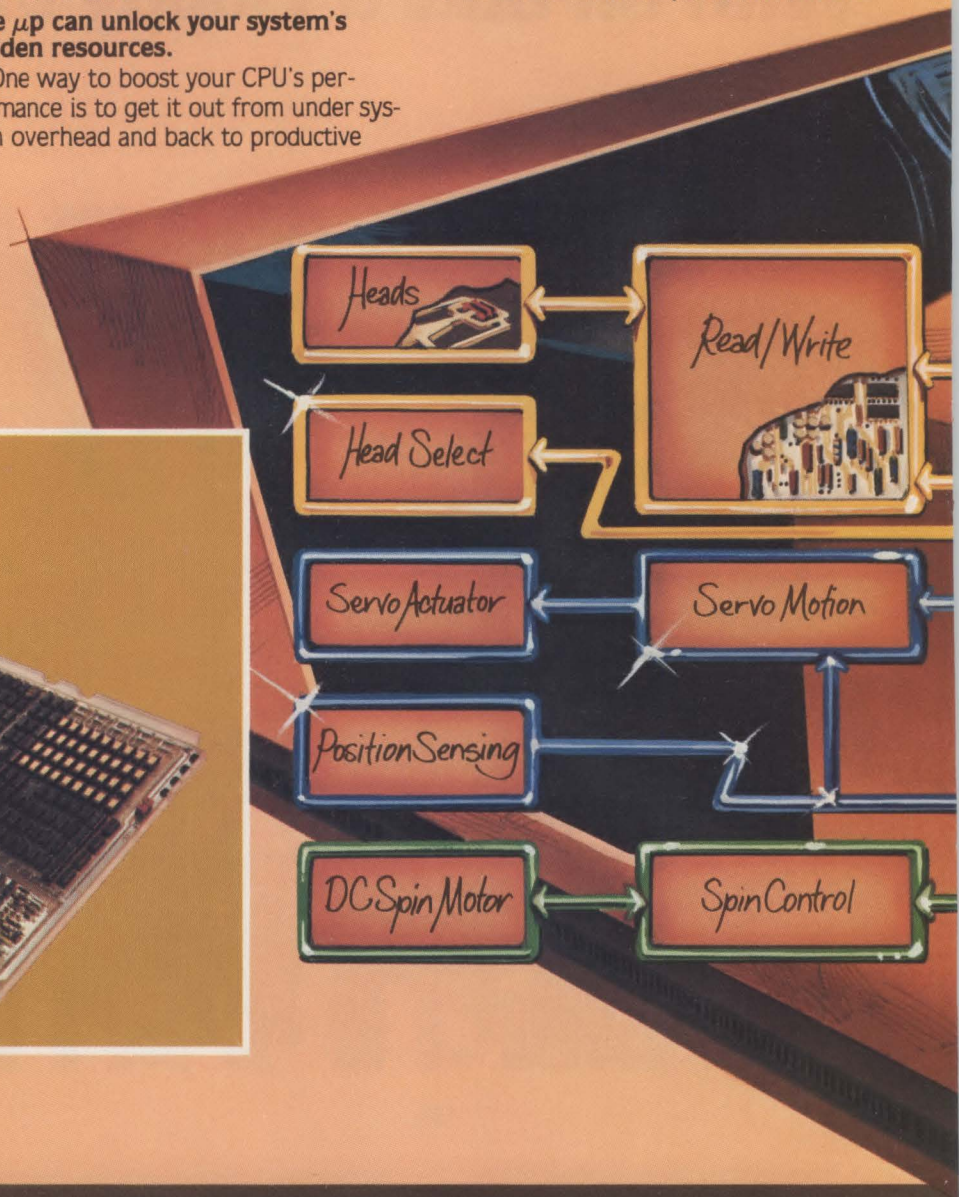

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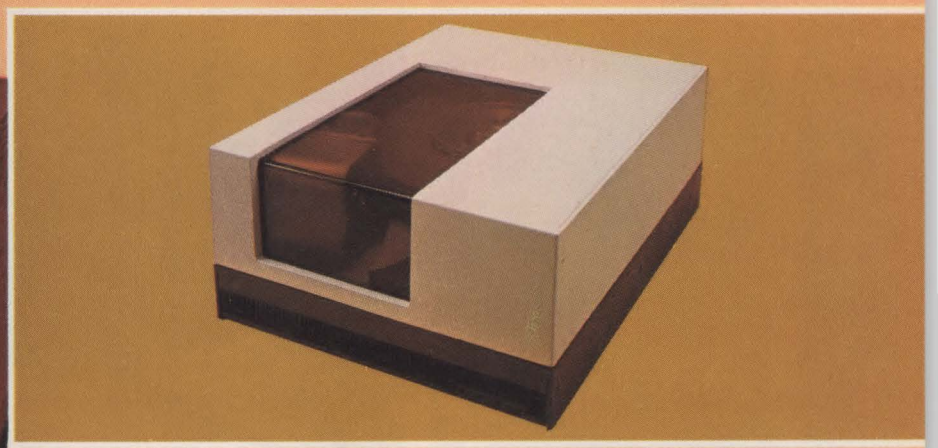

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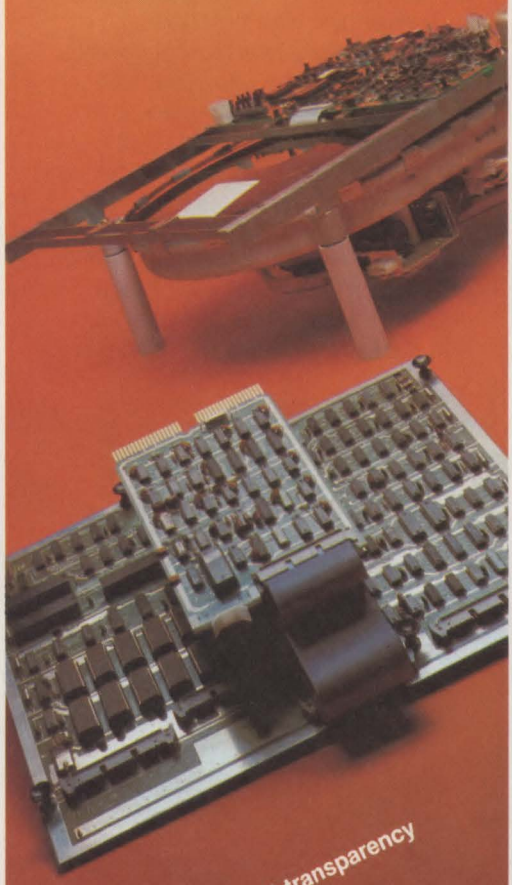

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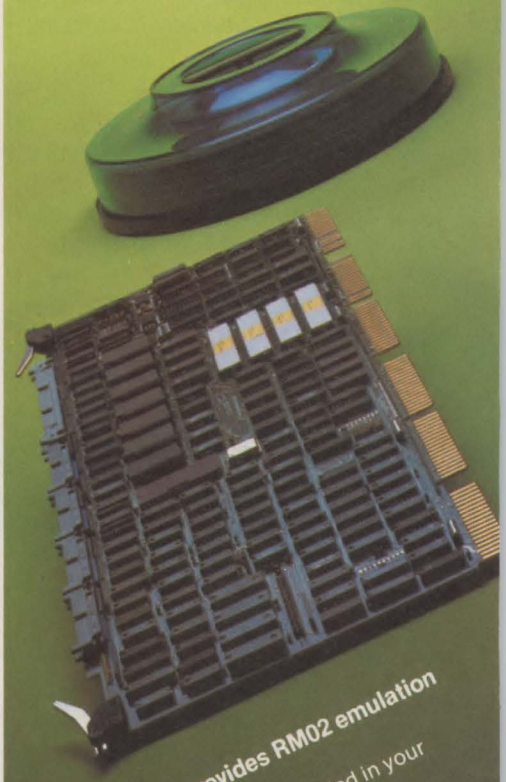

STORM 02 provides RM02 emulation for PDP-11 users

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handle protocol conversions, packetizing and depacketizing and errors that may result from two or more packets of data simultaneously using the same channel.

System 20 hardware is operating at four beta test sites—one government agency, two commercial end users and one eastern university, where it is interconnected to a network based on DEC PDP-11s and one VAX-11/780. Network Resources Corp., (NRC) a division of Sytek, is scheduled to start shipping production quantities of 200 per month in the first quarter of next year. Networks designed by Sytek in its role as a contract data communications consultant will be initial customers for the System 20.

NRC will handle manufacturing and engineering of the product, and Sytek will handle marketing and research. But consulting, which has so far sustained the company, and its new role as hardware vendor, could come into conflict, says Jack Goldsmith, chairman of the board of Sytek. "We'll make a study of a user's needs," he explains. "If Sytek's hardware fits the bill, we'll recommend it; if it doesn't, we'll recommend somebody else's."

Bob Lowry, chairman of the board of Technology Marketing, Inc. (TMI), a Costa Mesa, Calif., contract designer of computer hardware, feels that combining a service business with hardware sales can be dangerous. "It's hard to get away from the bias associated with your own product line," he points out. He also notes that while TMI has designed its own processors in addition to building minicomputers and controllers to be sold later under other companies' labels, the company has not sold any—only licensed others.

Other markets for the System 20 also may cause trouble, Lowry says. According to Goldsmith, Sytek is considering selling the System 20 hardware to outside OEMs and sophisticated end users, who will then install their own networks. "You can create a lot of bad feelings in this type of situation," Lowry claims. "If the guys in the new venture (in this case NRC) do better than the guys doing the consulting work, you've got a problem at home. Conversely, if hardware sales aren't going too well, the consultants may feel they're supporting an unprofitable venture." For a company in this position, there are only two alternatives: "You've got to be either fish or fowl," he says.

Goldsmith however, feels that there is an overriding issue at Sytek: "Branching out like this is the only way we can make Sytek grow while keeping things under control," he explains. "We have a small kernel of highly motivated people here, and I am concerned with losing that capability."

According to Goldsmith, Sytek plans to keep the parent company small and concentrated—a central "think tank" that will provide consulting services to acquired operations. He foresees as many as 100 people working at Sytek versus the 33 currently employed. Some of these employees will manage the company's new ventures, providing the growth path Goldsmith feels is necessary to keep people interested in staying with the company. "We could have grown faster by now," he says, "but we couldn't get the people we needed."

He also feels that above all, Sytek's employees value "meaningful work." The System 20 is a step in that direction, even though conflicts may arise between consulting and hardware. "Our main task is to keep the excitement going," says Goldsmith, "and for that reason, Sytek has to stay small." He stresses that hardware was always in the firm's business plan, but until the acquisition of NRC, he and Pliner were unsure what form the hardware would take. "Now we know we've organized our ignorance," he says.

—John Trifari

Mass. software tax plan could have broad impact

An attempt by the Massachusetts Department of Revenue to tighten tax laws governing software, timesharing and other data-processing services could have widespread implications on other states considering the controversial issue of software taxation.

The Massachusetts department is considering adopting a new regulation that would amplify and clarify an existing—but confusing—law on tangible personal property tax as it affects software and other data-processing services. The regulation calls for a five percent tax on application software, timesharing services, keypunching, data conversion and some other computer services. The effort to establish the new regulation ran into unanimous opposition from representatives of the data-processing industry at a recent public hearing. Industry representatives termed the effort misguided and an overreach of existing statutes.

The question of whether software is tangible personal property subject to taxation has been debated in nine other states in the past year, according to the Data Processing Management Association's position paper on the tax. Each of them—Alabama, Florida, New Jersey, New York, Vermont, Louisiana, Minnesota, Wisconsin and Iowa—classified the software as intangible and nontaxable. California, however, taxes software (see "The California Example," p. 41).

With the heavy concentration of data-processing hardware manufacturers and service organizations in the Northeast, the tax becomes a major cost/competitive/economic issue for Massachusetts. Neighboring Rhode Island last year declared off-the-shelf software nontaxable as well.

Pricing, bundling of software and less-purchase agreements are only a few of the issues to be confronted in

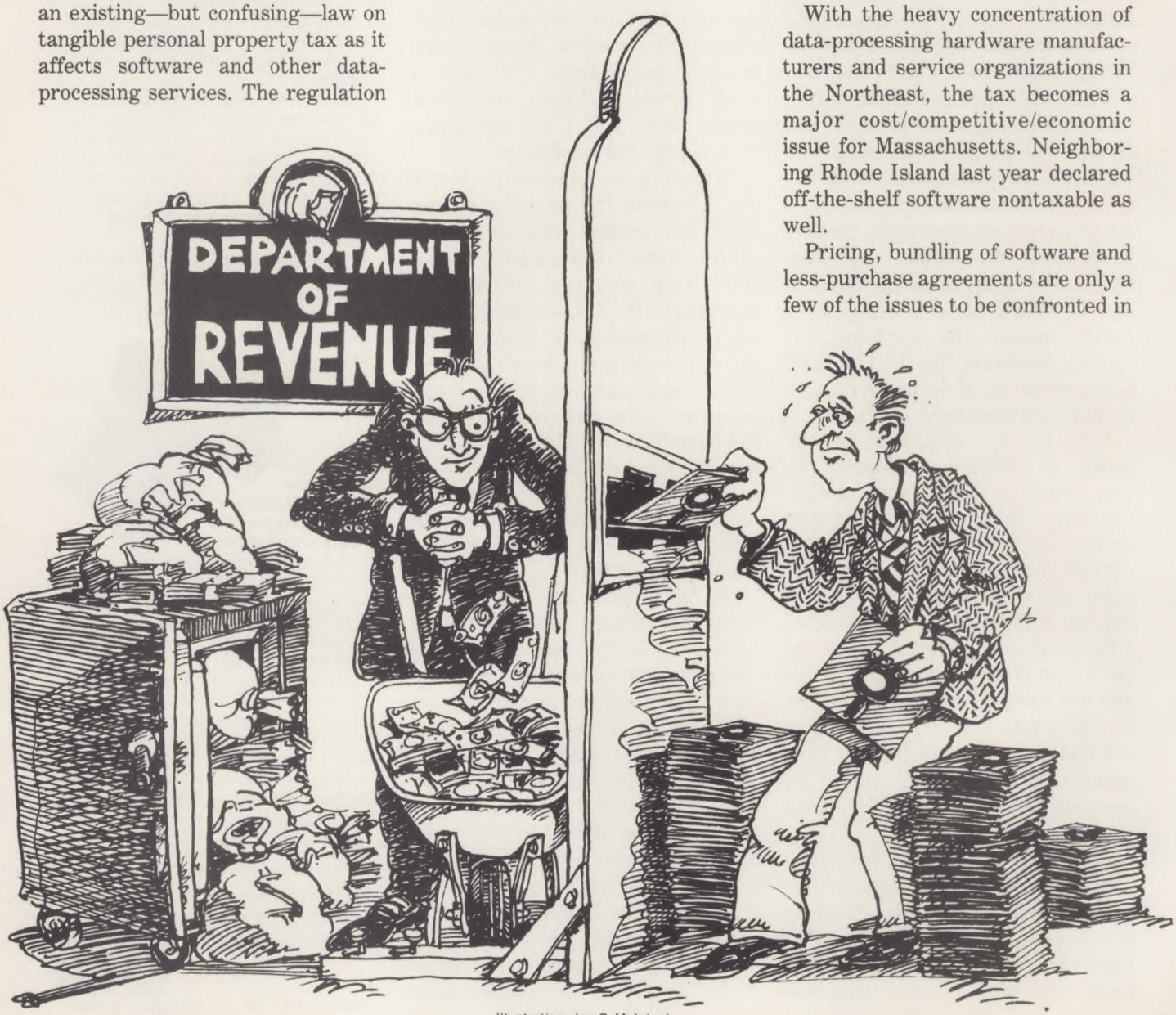

Illustration: Jon C. McIntosh

levying such a tax. In the case of timesharing services that will use the X.25 data-communications protocol, billing for service by point of origin and/or reception will become difficult, one source claims. A DPMA spokesman notes that in the case of New York, the tax commissioner found that old laws did not apply equitably to the new, state-of-the-art data-processing business.

The main issue in software taxation revolves around defining whether or not software is tangible personal property. The regulation states that "sales of pre-written (canned) programs recorded on tangible media, whether human- or machine-readable, generally are subject to tax," as are custom programs on machine-readable media. Custom programs recorded on human-readable media are not taxable under the regulation. Also, the transfer of programs from tangible media into a computer is taxable. Canned software is not taxed when it is modified at a charge greater than that of its original cost, at which point it is considered custom.

Many observers point to the object of a transaction as the true test of tangibility. The question is whether the user actually wants the physical medium housing the software, whether it be a tape, punched cards, a diskette or the information contained thereon. There's widespread agreement that the user is paying for the intellectual value and expertise expended on the information itself. It is contended that this information is dynamic in that it must be kept updated.

The cost of the storage medium is

THE CALIFORNIA EXAMPLE

The California software sales tax, which began as a tax on keypunching in 1968 and was expanded in 1972 to include almost all software, is coming under criticism after almost a decade of passiveness in that state's data-processing community. Among the opposition are two companies filing suits for tax refunds and the Sales Tax Action Group (STAG), which intends to support a lawsuit filed by one of its 150 member companies challenging the legality of software taxation.

The recent flurry of opposition was spurred by a late-August decision by the California Supreme Court in a case involving the Simplicity Patterns Co. vs. the state's Board of Equalization. Simplicity "sold" the assets of one of its subsidiary companies, which produced audiovisual materials, to another company in return for stock in the latter company. Simplicity, however, retained responsibility for paying the taxes of its former subsidiary. One of the main issues to emerge from the highly complex case is the transfer of tangible property that is taxable, or container versus content.

Simplicity initially asked a lower court in California for a refund on taxes paid for the sale of the audiovisuals as intangible items. They were denied a refund and appealed.

During the Supreme Court case, STAG filed a brief on behalf of Simplicity as a friend of the court, equating the tangible property question with that of software. STAG held an emergency meeting in late August after the court's most recent decision, and is planning legal action against the 6½-percent tax regulation 1502 through a member company.

One source points to what he considers the most critical issue for data processing software in the Simplicity case. STAG president Donald B. Mulvey says the true test of taxability is the true object of the contract, which is the subject of the state's regulation 1501: Is it the providing of services or ideas or the delivery of tangible media that is taxable? He says the law holds that 500 hours of work for a program valued at $20,000 is totally taxed because it is delivered on a $6 medium.

STAG's Mulvey says the tax regulation is so confusing in light of current technology that professional businessmen cannot tell what is taxable in some cases. He adds that it lends itself to misinterpretation and that the law has been applied inconsistently.

Misinterpretation can be an especially difficult problem for small companies. Mulvey explains that his company, Computer Services Associates of Oakland, Calif., which is a small company selling custom software, had been in business for three years and had not charged a software tax. In 1976, Mulvey's company was audited by the state and given a bill for $20,000 for the uncollected sales tax. Software taxes have added millions of dollars to California's revenues yearly, says one source, and similar revenues are expected to be reaped in Massachusetts.

Another sore point is a royalties tax that one observer calls an "unfair burden of double taxation." In California, for example, a software company that markets software but does not develop it can be taxed twice, according to Gordon Davidson, an attorney, for Fenwick, Stone, Davis and West, Palo Alto, Calif. Davidson says such a company might pay a 6½-percent tax on software acquired as an end user, pay royalties for use, and pay a 6½-percent tax on the royalties.

Many industry observers could not cite instances of hardship to California's economy because of the software tax. Some observers claimed that some companies are considering moves to other states, and others are hesitating to locate into California.

One source has seen an increase in the hiring of consultants and the use of commercial packages because of the high cost of maintaining in-house staffs. But others have seen an increase in in-house-developed software.

For a standard financial package, for example, a $30,000 off-the-shelf package costs $300,000 to $500,000 to develop in-house, according to Steven A. Epner, president of the Independent Computer Consultants Association. Epner says that software development, including front-end design, six to twelve months debugging and programming costs 10 to 15 times more in-house.

insignificant compared with the price of a computer program, says Ronald J. Palenski, chief attorney with the Association of Data Processing Service Organizations (ADAPSO). He contrasts a $20 tape with a $20,000 program. One way around the tax, it was noted at the hearing, is to transfer the program into the computer via telephone lines or laser-based communications.

One software vendor was concerned about protecting his investment should software become tangible. "Our only protection is (protection of) trade secrets, which are embodied in the programs," said a spokesman from Software International, Andover, Mass. He added that trade secrets must remain intangible. Obtaining software patents protection is a tricky issue, some sources claim, because algorithms and programs solving mathematical problems are not patentable.

The spokesman likened the problem to that of leasing a food recipe to a bakery. In that case, the bakery is provided with the benefit of another's knowledge and experience, rather than with foodstuff ingredients. When the recipe is returned after the designated lease time, the information is not returned in its entirety with the printed tangible recipe, because the user could remember the recipe.

An additional problem emerges from the distinction defined between custom and off-the-shelf software. Massachusetts Commissioner of Revenue Joyce Hampers noted that almost any software could be manipulated to become customized.

The software companies most likely to be hurt by the custom/canned distinction are those that supply personal computer software, most of which is off-the-shelf, one source noted. In New York, when ADAPSO and DPMA strongly represented those selling large mainframe software, personal computer software suppliers acted as the sacrificial lambs, says Gordon Davidson, an attorney for Fenwick, Stone, Davis and West, Palo Alto, Calif., which has represented a number of clients in software tax cases. He explains that it is difficult for personal computer software vendors to meet the definitions for custom software. In California, he adds, everything, in essence, is canned and subject to taxation, with the exception of software transmitted by telephone.

Another problem for data-processing service users is the proposed tax on timesharing services. The proposal states, "A transaction whereby a person secures access to equipment not on his premises by means of telephone

BOX SCORE OF EARNINGS

This table, which appears every month, summarizes the latest earnings reports of companies in the minicomputer industry and related industries. Included are total revenues, net earnings and earnings per share for the periods indicated.

Company	Period		Revenues	Earnings	EpS
Astrocom	6 mos.	6/30/80	1,899,335	(241,783)	(.19)
	6 mos.	6/30/79	1,601,969	56,873	.07
Beehive International	9 mos.	6/30/80	23,418,965	1,397,492	1.10
	9 mos.	6/30/79	17,377,023	864,517	.69
Comshare	Yr.	6/30/80	78,207,900	4,164,700	1.10
	Yr.	6/30/79	52,980,400	4,732,400	1.42
CPT	Yr.	6/30/80	59,700,000	6,100,000	1.36
	Yr.	6/30/79	34,100,000	3,500,000	.91
Decision Data Computer	6 mos.	5/31/80	22,220,000	1,049,000	.25
	6 mos.	6/2/79	19,811,000	299,000	.07
Digital Equipment	Yr.	6/28/80	2,368,045,000	249,861,000	5.45
	Yr.	6/30/79	1,804,092,000	178,434,000	4.10
Dranetz Engineering Laboratories	6 mos.	6/30/80	7,266,403	1,001,738	.73
	6 mos.	6/30/79	5,474,487	706,388	.52
EG&G	26 wks.	6/29/80	287,365,000	11,616,000	.87
	26 wks.	7/1/79	248,678,000	8,541,000	.65
Fujitsu	Yr.	3/31/80	2,004,000,000	62,580,000	.08
	Yr.	3/31/79	1,763,684,000	42,928,000	.06
GenRad	Yr.	6/28/80	140,674,000	9,930,000	2.91
	Yr.	6/30/79	100,747,000	6,680,000	2.12
Gould	6 mos.	6/30/80	1,066,874,000	39,525,000	1.39
	6 mos.	6/30/79	990,007,000	48,007,000	1.72
Harris	Yr.	6/30/80	1,300,932,000	79,682,000	2.63
	Yr.	6/30/79	1,074,881,000	68,772,000	2.32
Hewlett-Packard	9 mos.	7/31/80	2,228,000,000	189,000,000	3.15
	9 mos.	7/31/79	1,680,000,000	147,000,000	2.50
Int'l. Telephone and Telegraph	6 mos.	6/30/80	8,830,803,000	411,022,000	2.82
	6 mos.	6/30/79	7,991,656,000	368,530,000	2.57
Management Assistance	9 mos.	6/30/80	221,550,000	(2,341,000)	(.29)
	9 mos.	6/30/79	186,070,000	22,792,000	2.87
Plessey	Yr.	3/31/80	1,622,200,000	75,400,000	3.18
	Yr.	3/31/79	1,400,300,000	60,500,000	2.56
Scan-Data	6 mos.	6/30/80	7,181,485	(971,028)	(.43)
	6 mos.	6/30/79	8,605,686	(65,512)	(.04)
System Development	53 wks.	6/29/80	167,695,000	7,033,000	4.89
	52 wks.	6/24/79	165,964,000	3,750,000	2.29
Systems Engineering Laboratories	Yr.	6/27/80	79,629,000	5,349,000	1.80
	Yr.	6/29/79	65,125,000	5,002,000	1.71
Timeplex	Yr.	6/30/80	17,928,000	1,408,000	.69
	Yr.	6/30/79	12,744,000	1,007,000	.50
Tymshare	6 mos.	6/30/80	59,373,000	4,725,000	.91
	6 mos.	6/30/79	48,130,000	3,602,000	.76
Wyly	6 mos.	6/30/80	56,900,000	30,300,000	2.63
	6 mos.	6/30/79	41,400,000	1,600,000	.14

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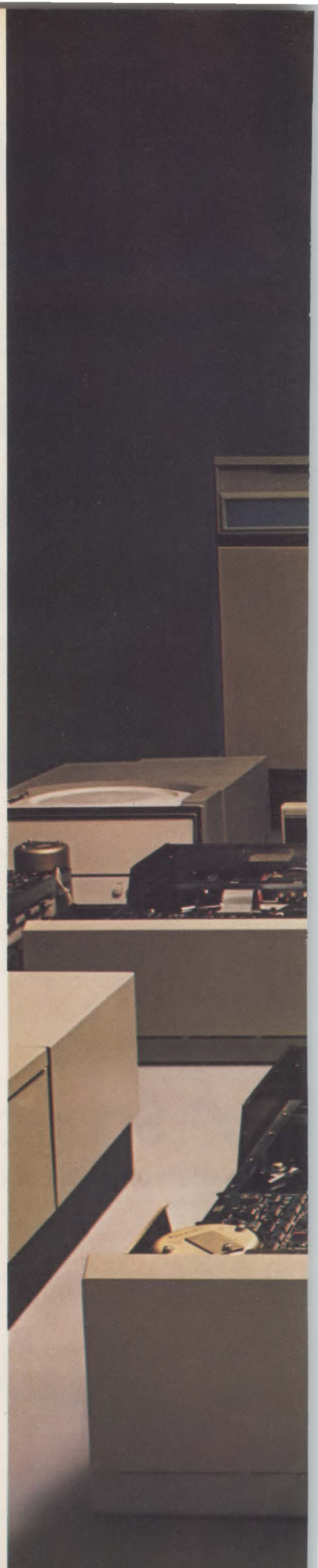

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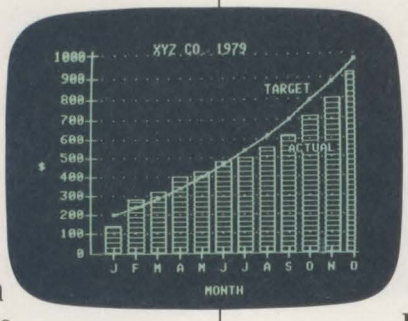

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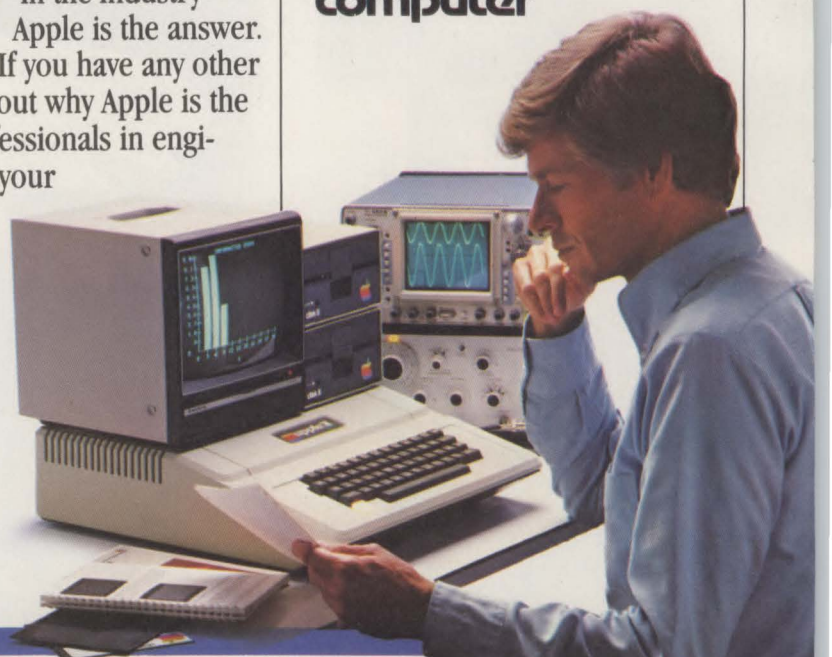

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or other lines is subject to tax if the person or his employee, while on or off the premises where the equipment is located, operate the equipment or direct and control its operation." Out-of-state access to Massachusetts-based timesharing equipment is not taxable.

Robert Sherin, representing the DPMA, pointed out that the nature of timesharing services has changed. In the past, users rented straight computer time and assumed control of the system. Now, however, the users control only their own applications, not the system itself.

ADAPSO's Palenski noted that the proposed regulation is based on the "erroneous" concept that operation is controlled by the customer. Palenski said that Connecticut is one of the few states that taxes timesharing, and those services are taxed at 3½ percent for use rather than the 7½ percent normally charged for sales or leases of tangible personal property. California does not tax timesharing services.

The Savings Banks Association of Massachusetts, representing 163 state-chartered savings banks, opposed the regulation, noting that computers have enhanced bank services. An association spokesman said the timesharing tax parameters may have an unintended result in the bill-paying service called "pay-by-phone." One interpretation of the proposed regulation would require a savings bank to assess a sales tax for a customer to secure "access to equipment not on his premises by means of telephone."

The Massachusetts proposal and all arguments against it are being evaluated by the Department of Revenue until later this month. Many observers expect that the department will not pass the regulation, but if it does pass, one company representative said he would expect a court challenge.

—Lori Valigra

People in the news . . .

James S. Campbell was named president, and **Joe T. Booker** was named executive vice president, engineering and manufacturing, of Shugart Associates, Sunnyvale, Calif. Campbell, who was vice president, international operations, for the corporation's Information Products Group, replaces **James J. Bochnowski,** who resigned to participate in forming a venture capital firm. Booker moves up to the newly created executive vice president position from his post as Shugart vice president, operations and manufacturing.

Robert M. Price has been elected president and chief operating officer, and **Norbert R. Berg** has been named deputy chairman of the board of Control Data Corp., Minneapolis, Minn. They will join **William C. Norris,** chairman and CEO, in managing the firm and its subsidiaries.

David R. Fernald has been appointed director of marketing at Digital Equipment Corp.'s commercial products group, Maynard, Mass. Fernald formerly served as a product line manager in the manufacturing, distribution and controls group at the company. He will be responsible for strategies, business evaluation, product planning, executing common promotional efforts, advertising, product-performance evaluation and sales-aid development.

Peter R. Eisenhauer has been appointed vice president of marketing and sales for Integral Data Systems, Inc., Natick, Mass. Formerly director of marketing and sales at the company, Eisenhauer continues his responsibilities for worldwide sales and marketing activities, and assumes responsibility for long-range strategic planning and corporate development.

Calendar

SHOWS & CONFERENCES

OCTOBER

20-22 International Telecommunications Regulation and Policy Symposium, Washington, D.C. Contact: Kathleen Kerns, Telecom Systems Group, Inc., 579 Pompton Ave., Cedar Grove, N.J. 07009, (201) 239-5700.

20-23 ISA/80 Conference and Exhibit, Houston, sponsored by the Instrument Society of America (ISA). Contact: Lori Cooke, Instrument Society of America, 67 Alexander Drive, Research Triangle Park, N.C. 27709, (919) 549-8411.

20-23 FORUM/10, Chicago sponsored by Forum International. Contact: W. Leahy, Director of Communications, 4300-L Lincoln Ave., Rolling Meadows, Ill. 60008, (312) 359-8160.

21-22 Second Annual Symposium on the Home Information Utility, New York, sponsored by The Yankee Group. Contact: Marjorie Sugarman, The Yankee Group, P.O. Box 43, Harvard Square, Cambridge, Mass. 02138, (617) 725-1100.

23-24 Third Annual Newport Conference on Fiber-Optic Markets, Newport, R.I. Contact: Kessler Marketing Intelligence, 22 Farewell St., Newport, R.I. 92840, (401) 849-6771.

25-29 29th Annual International Data Processing Conference & Business Exposition, Philadelphia, sponsored by the Data Processing Management Association. Contact: Conference Coordinator, DPMA International Headquarters, 505 Busse Highway, Park Ridge, Ill. 60068, (312) 825-8124.

27-30 Fifth International Conference on Computer Communication (ICCC/80), Atlanta, Ga., sponsored by the International Council for Computer Communications. Contact: Wayne Adams, ICCC '80 Publicity Chairman, Sperry Univac, Blue Bell, Pa. 19424, (215) 542-4673.

27-29 1980 Annual Conference of the Association for Computing Machinery, Nashville, Tenn., sponsored by ACM. Contact: Dr. Gordon Sherman, Technical Program Chairman, ACM '80, University of Tennessee Computer Center, Knoxville, Tenn. 37916, (615) 974-6758.

28-30 Interface West, Los Angeles, sponsored by the Interface Group and *Datamation* magazine. Contact: Peter B. Young, The Interface Group, 160 Speen St., Framingham, Mass. 01701, (617) 879-4502.

29-31 Computerized Office Equipment Expo, Houston. Contact: Industrial & Scientific Conference Management, Inc., 222 West Adams St., Chicago, Ill. 60606, (312) 263-4866.

OCT. 30-NOV. 1

Fourth Annual National Small Computer Show, New York. Contact: Ralph Ianuzzi, Show Manager, 110 Charlotte Place, Englewood Cliffs, N.J. 07632, (201) 569-8542.

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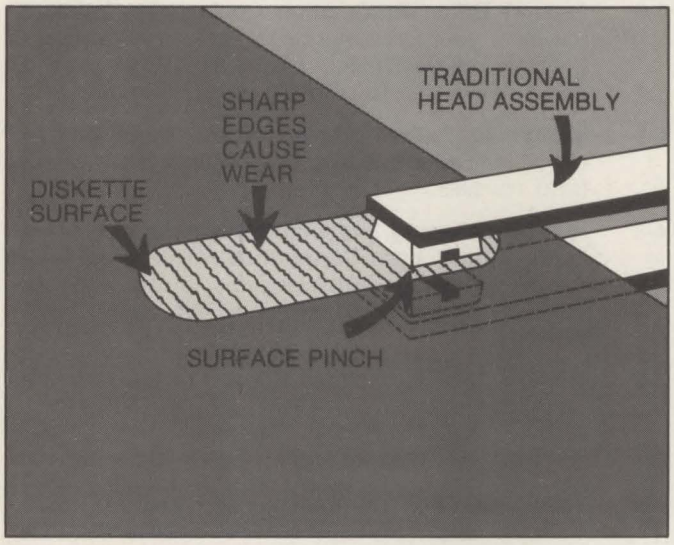

Dual-sided diskette drives require contact of both heads with the media to read or write. This causes head wear and a pinching action that deforms, mars and scratches the media surface, shortening head and media life.

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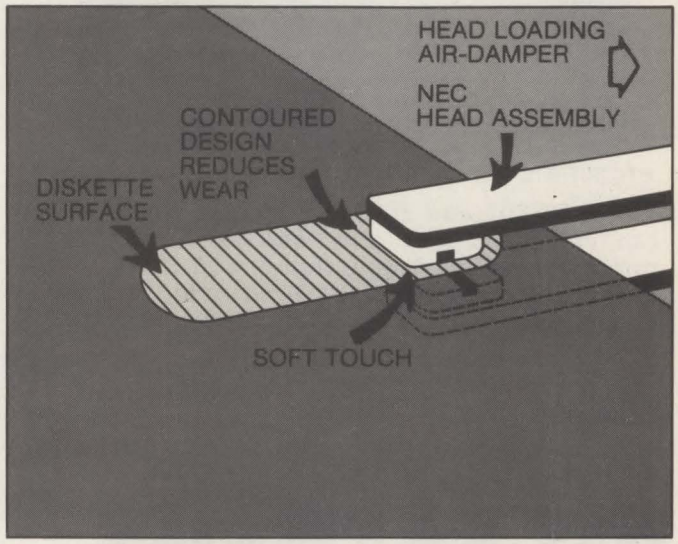

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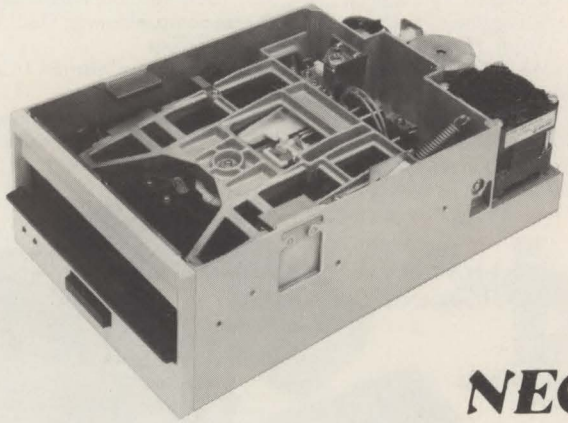

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West Coast Office: 8939 S. Sepulveda Blvd., Los Angeles, CA 90045 (213) 670-7346
Southern Office: 2945 Flowers Road South, Atlanta, GA 30341 (404) 458-7014

CIRCLE NO. 39 ON INQUIRY CARD

Calendar

NOVEMBER

2-5 **Fourth Annual Symposium on Computer Applications in Medical Care,** Washington, D.C. Contact: Michael J. Ackerman, Ph.D., Exhibit Chairman, Naval Medical Institute, Mail Stop 38, Bethesda, Md. 20014, (202) 295-1810.

3-4 **NASA/AIAA Workshop on Aerospace Applications of Microprocessors,** Greenbelt, Md. Contact: John Y. Sos, NASA/Goddard Space Flight Center, Code 560, Greenbelt, Md. 20771.

4-6 **Federal Office Automation Conference,** Washington, D.C., sponsored by the Federal Office Institute. Contact: Federal Office Automation Conference, P.O. Box E, Wayland, Mass. 01778, (617) 358-5110.

4-6 **Midcon/80,** Dallas. Contact: Robert Myers, Midcon, 999 North Sepulveda Blvd., El Segundo, Calif. 90245, (213) 772-2965.

4-6 **Word Processing and Office Business Equipment Trade Show and Conference,** San Jose, Calif. Contact: Cartlidge and Associates, Inc., 491 Macara Ave., Suite 1014, Sunnyvale, Calif. 94086, (408) 245-6870.

5-7 **Military Communications System Control Symposium,** Bedford, Mass., sponsored by the Mitre Corp. Contact: Elaine Normoyle, The Mitre Corp., P.O. Box 208, Bedford, Mass. 01730, (617) 271-2511.

8-9 **1980 Personal Computer Fair,** Seattle, Wash. Contact: Ken Burkun or Joe Felsenstein, Co-Chairpersons, Fair Committee, Northwest Computer Society, P.O. Box 4193, Seattle, Wash. 98119, (206) 284-6109.

10-13 **Fourth Annual Data Entry Management Conference,** Orlando, Fla., sponsored by Data Entry Management Association. Contact: DEMA, P.O. Box 3231, Stamford, Conn. 06905, (203) 322-1166.

12-14 **Pacific '80 Conference on Distributed Processing,** San Francisco, sponsored by the Association for Computer Machinery (ACM) and its Chapters of the Pacific Region. Contact: Robin Williams, General Chairman, IBM, K55-282, 5600 Cottle Road, San Jose, Calif. 95193.

18-20 **Information Management Exposition & Conference for Manufacturing Companies,** Chicago. Contact: Clapp & Poliak, Inc., 245 Park Ave., New York, N.Y. 10017.

18-21 **COMDEX '80,** Las Vegas, Nev., sponsored by the Interface Group. Contact: Peter B. Young, The Interface Group, 160 Speen St., Framingham, Mass. 01701, (617) 879-4502.

20-23 **Northeast Business & Home Computer Show,** Boston. Contact: National Computer Shows, P.O. Box 678, Brookline, Mass. 02147, (617) 524-4547.

JANUARY

7-9 **Second Annual Western Conference & Exposition,** Anaheim, Calif. Contact: Judith H. Shreve, Armed Forces Communications and Electronics Association, One Skyline Place, 5205 Leesburg Pike, Suite 300, Falls Church, Va. 22041, (703) 820-5028.

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CIRCLE NO. 42 ON INQUIRY CARD

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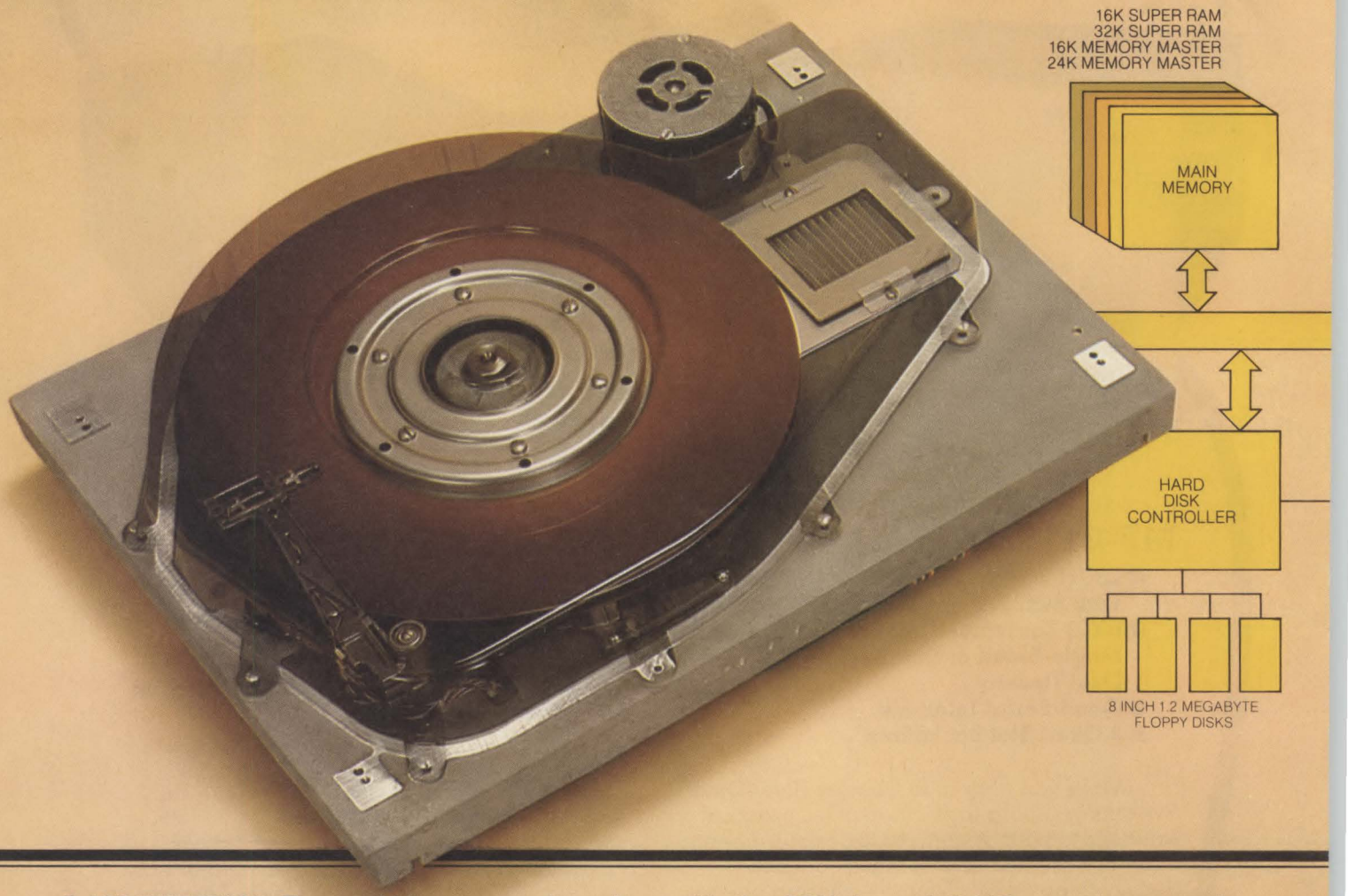

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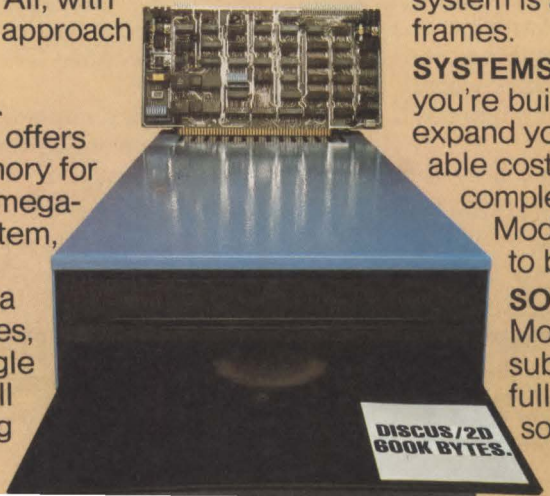

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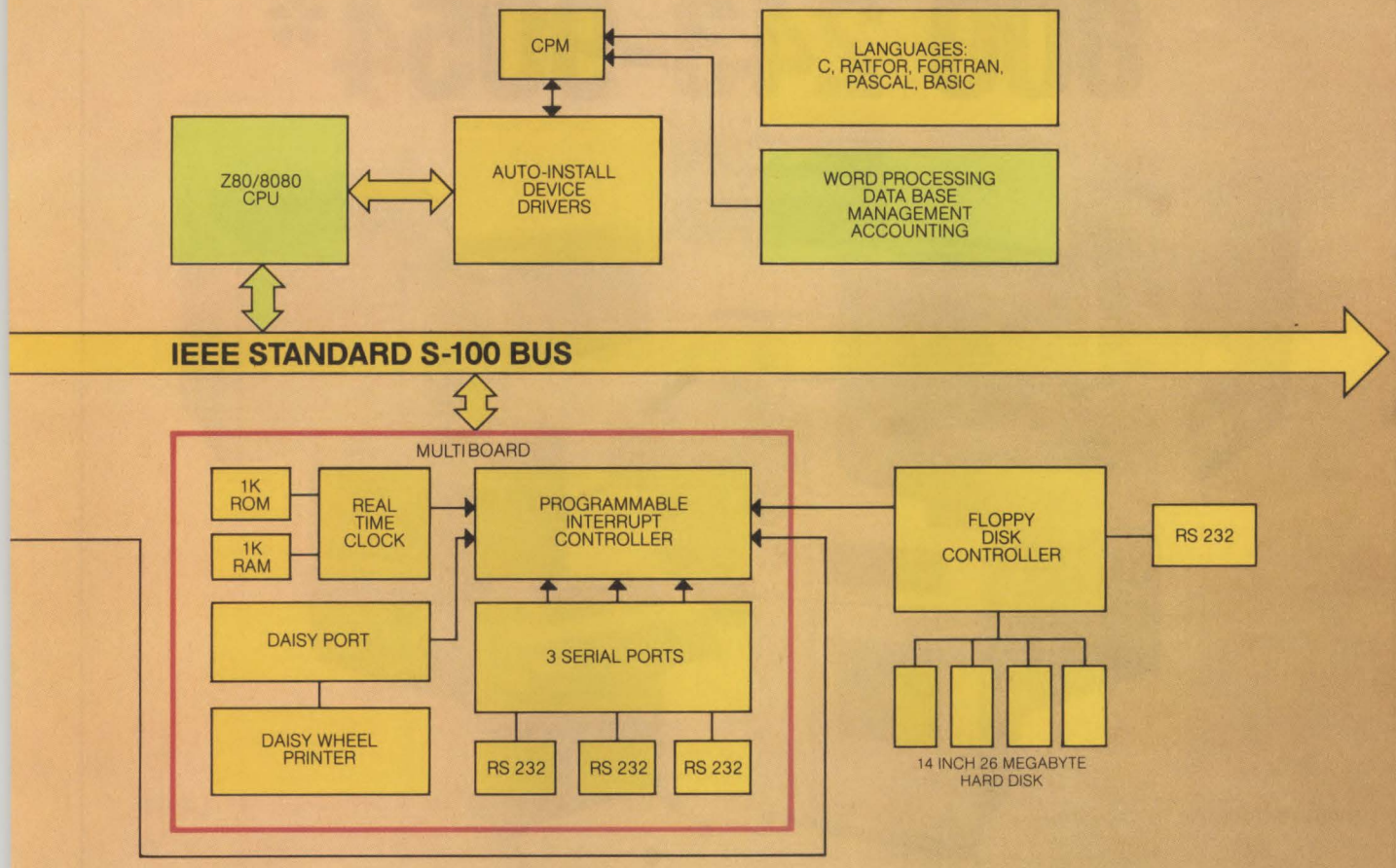

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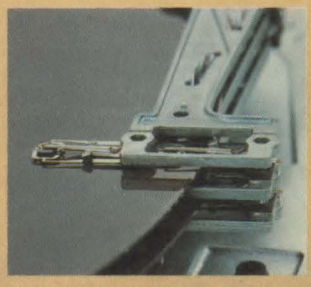

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CIRCLE NO. 43 ON INQUIRY CARD

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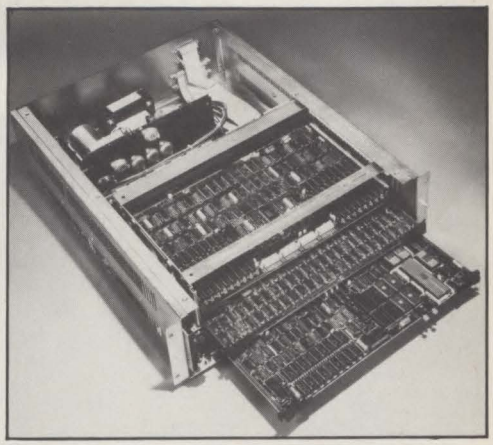
CIRCLE NO. 44 ON INQUIRY CARD

68000-based board family launched by Motorola



A VERSAmodule *four-slot chassis, with top removed, shows card cage, 15A power supply and representative I/O cabling.*

A single-board microcomputer based on the MC68000 16-bit microprocessor and a real-time executive software package are the initial offerings in the VERSAmodule family of board-level products from the Integrated Circuits Division of Motorola, Inc.

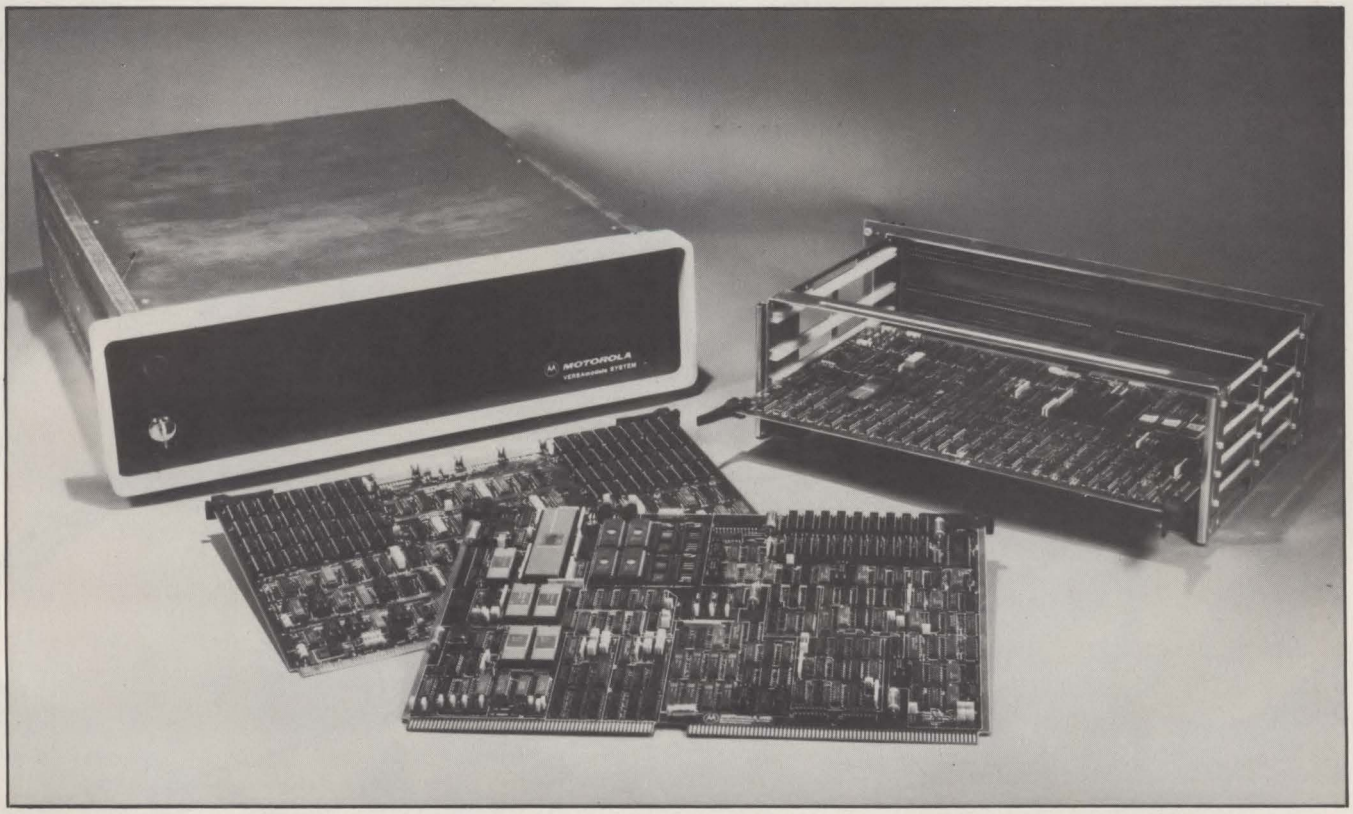
Officials at the Phoenix, Ariz., company, which will introduce the members of the new board family over the next six to 12 months, say deliveries of the CPU board and software will begin this month.

The VERSAmodule monoboard microcomputer (VMM) uses an 8-MHz 68000 and takes full advantage of the capabilities of the microprocessor, according to L. Jefferson Gorin, product application manager for microsystems. The VMM runs on Motorola's 16-bit backplane bus, the VERSAbus, and includes a VERSAbus interface that allows asynchronous, bidirectional operation, direct memory access and multiprocessor system operation.

The VMM contains both RAM and ROM that are accessible by the 68000. Gorin says RAM will be available in two sizes: 32K or 64K bytes. The VMM's ROM capability is provided by eight sockets that can accommodate industry standard 5V-only ROM, PROM or EPROM devices, Motorola says. ROM capacity is 16K, 32K or 64K, depending on the device chosen.

Two onboard serial I/O ports provide RS232C modem or terminal interfaces and full- or half-duplex operation at speeds as high as 19.2K bps. Four parallel ports provide 32 lines of general-purpose parallel I/O.

A 32K VMM will cost $2500 in single-unit quantities; a 64K CPU will cost $3000, with volume OEM discounts available. Chassis and card cages designed for the VERSAmodules will also be introduced. Gorin says the standard 5¼-in.-high, front-loading, four-slot chassis is expandable to 12 slots in four-slot increments. A 30A switching power supply is standard; a 15A supply is optional. The VERSAmodule board measures 9¼ × 14¼ in.



Principal elements *of Motorola's VERSAmodule product family include VERSAmodule boards, four-slot chassis and card cage.*

We have a very simple philosophy about high performance 16-bit micros.

They shouldn't fail.

Since 1975, Digital Equipment Corporation has sold more 16-bit micros than any other company.

More than 100,000 of them.

And from the very beginning, our goal has been simple: to build failure-free microcomputer products.

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In production, we give every component a complete battery of functional and package tests. As the micro board moves through manufacturing, we test extensively at every important stage.

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At Digital, we've been refining and enhancing the RT-11 family of development and application software for more than seven years.

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RT-11 family capability ranges from multitasking, multiterminal support for larger configurations to a very small kernel for single-task applications. There's also a subset of RT-11 designed specifically for PROM applications. This subset, called SIMRT, is an integral part of FORTRAN IV.

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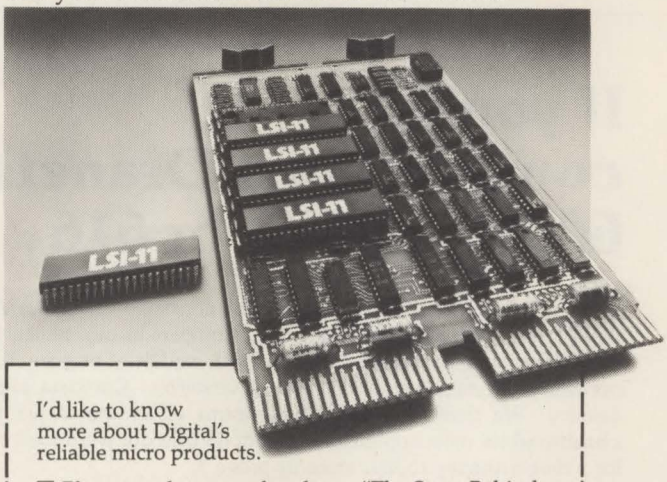

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CIRCLE NO. 45 ON INQUIRY CARD

Motorola expects to begin delivering a real-time executive software package with the first VMMs to provide real-time multitasking. The software can be resident in ROM, RAM or both, Gorin says, and will be available to OEMs through a licensing program.

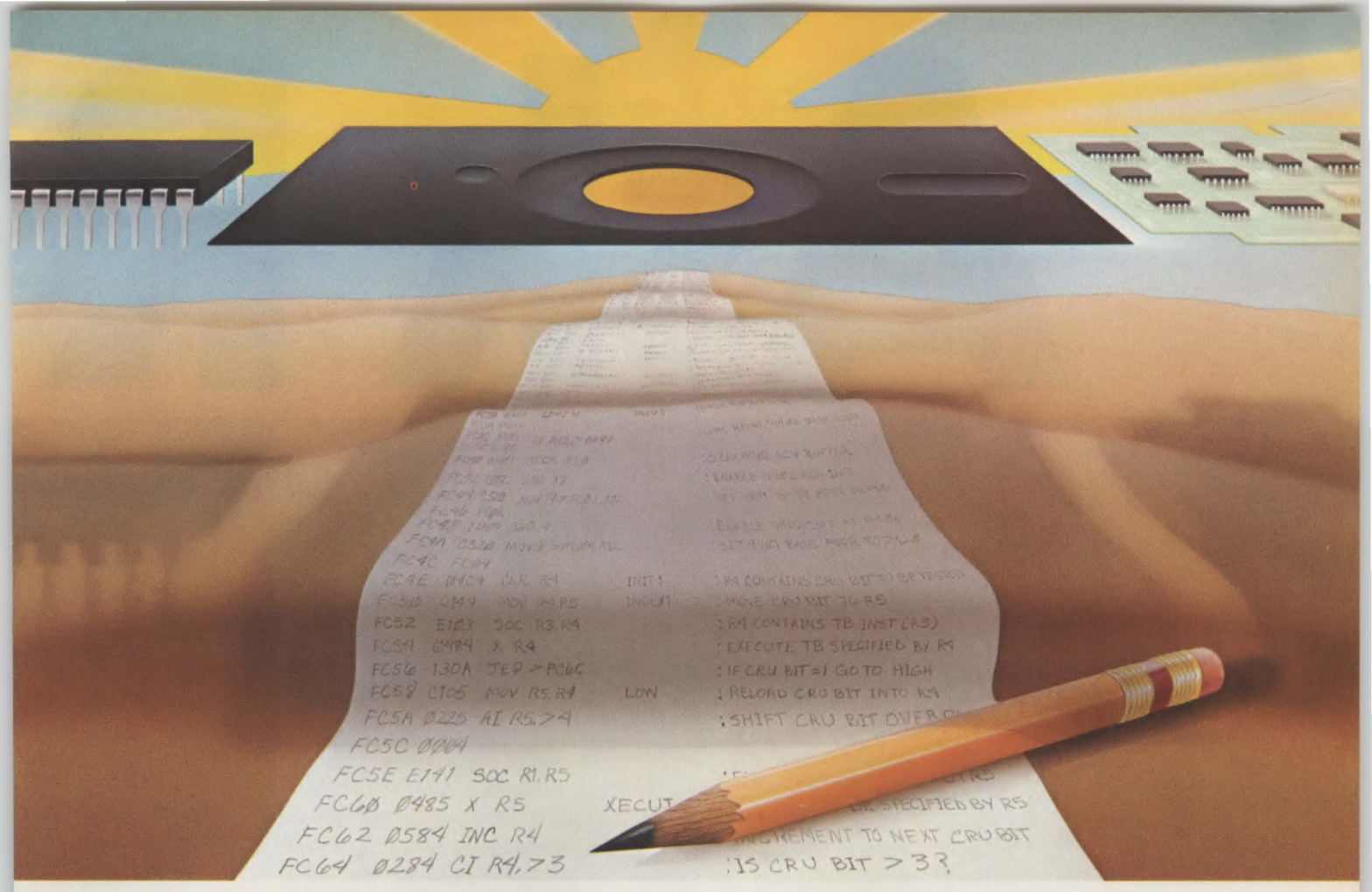
In addition to the real-time executive, Motorola expects to deliver self-test and debug software, which will reside in onboard ROM. Future software will include a real-time disk-operating system, scheduled to be released next February, a floating-point math package and test and diagnostic software. Motorola indicates that it is gearing up for extensive applications software support.

VERSAmodule hardware, which will be introduced by year-end, says Gorin, will include a rigid-disk controller and a multichannel communications board with four serial and one parallel Centronics-type printer port. Motorola plans to introduce another CPU board, a RAM/ROM/I/O expansion board, 500K-byte and 1M-byte RAM boards and an analog-conversion board during 1981 and 1982.—*Larry Lettieri*

H-P adds two terminals to intelligent display line

With the announcement this month of the HP2624A, Hewlett-Packard Co. fills in a gap in its 262X intelligent terminals family, which was topped off a few months ago by the multiscreen, multiconnection HP2626A. The Data Terminals Division of the Palo Alto, Calif., company is simultaneously introducing a high-end unit in the 264X product line—the HP2642A—the first H-P intelligent terminal to use a floppy-disk drive for data storage.

The HP2624A's user-definable *soft-keys are displayed on the screen's 25th and 26th lines, which also display error messages and terminal status.*



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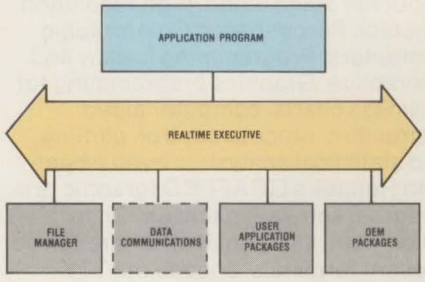
The "software bus"

TI's Realtime Executive, the interface for the Component Software, serves, in effect, as a software bus. For less than 6K bytes, it handles the executive functions such as system initialization, concurrent process synchronization (multiprogramming), interprocess communication, interrupt linkage, memory management, and priority scheduling.

File Manager Software

The File Manager package operates with the software bus to perform file management functions like: read/write to a floppy diskette. Install formatted volume. Open/close/read/write files. Random access to files. Rewind/forward, backspace to files.

Component Software Series



Customization capability

The Component Software Series includes source code in Pascal for unique customization of each package. The object code is language independent, allowing execution of programs written in 9900 assembly, Microprocessor Pascal, or Power Basic. Once selection and customization are complete, your application program can even be ROM resident.

Available today, more to come

The Realtime Executive (TMSW330R) and the File Manager (TMSW340F) are available now at $915.00* and $860.00*, respectively, on either floppy or hard disk. Coming soon: HDLC Data Communication packages.

For more information, call your TI distributor or TI field sales office. Or write Texas Instruments Incorporated, P.O. Box 1443, M/S 6404, Houston, Texas 77001.

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CIRCLE NO. 47 ON INQUIRY CARD

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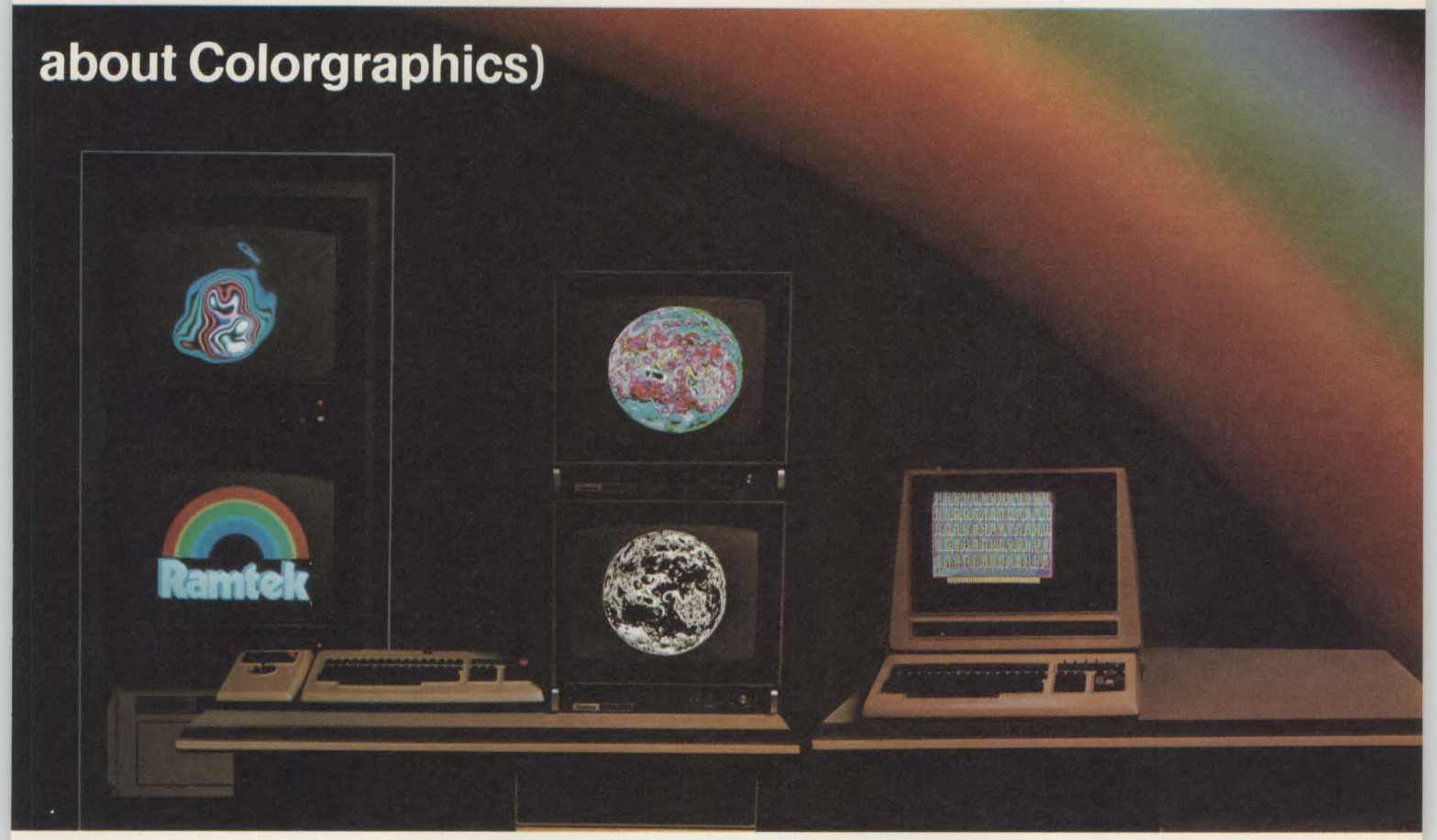

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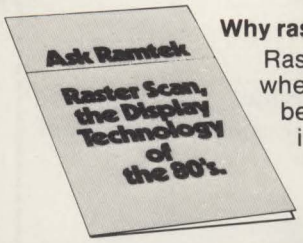

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CIRCLE NO. 48 ON INQUIRY CARD

Company officials say both terminals are compatible with all previous H-P models. The terminals are aimed at the text editing, program development and data entry markets.

The HP2624A, a block-mode CRT, includes user-definable, screen-labeled soft keys. A 16K RAM standard memory is four pages of 80-character lines; an optional RAM provides another five pages. The increased memory space is especially useful for program development applications, say company officials.

Like other 262X terminals, the 2624A has an optional built-in 120-cps thermal printer. A compressed printing mode will expand the standard 80 columns to 132. An extended mode prints enlarged characters at 40 cpl. The terminal also includes an RS232C standard serial port for an external printer.

The eight user-definable soft-keys permit a preprogrammed message of as many as 80 characters for log-on data or frequently used commands. The soft-keys are implemented in 256 characters of battery-powered RAM, and are displayed in the 25th and 26th lines on the screen, which also display error messages and terminal status.

Dual minifloppy-disk *drives provide 540K bytes of storage for the HP2642A.*

H-P officials say the terminal supports both full- and half-duplex asynchronous data communications. Several handshaking protocols enable the terminal to be connected to a wide range of printers and non-H-P computers. A 300-bps modem is available for the U.S. market.

Six foreign-language keyboards are optional on the HP2624A. Each supports ISO substitution characters for each language, plus the terminal's standard 128 ASCII characters. A 64-character line-drawing set is standard, and a math-symbol set is also available.

The HP2642A's floppy-disk drive provides the terminal with a dedicated file system. The 5¼-in. double-density, double-sided drive stores 270K bytes of data. A second floppy-disk drive, which doubles

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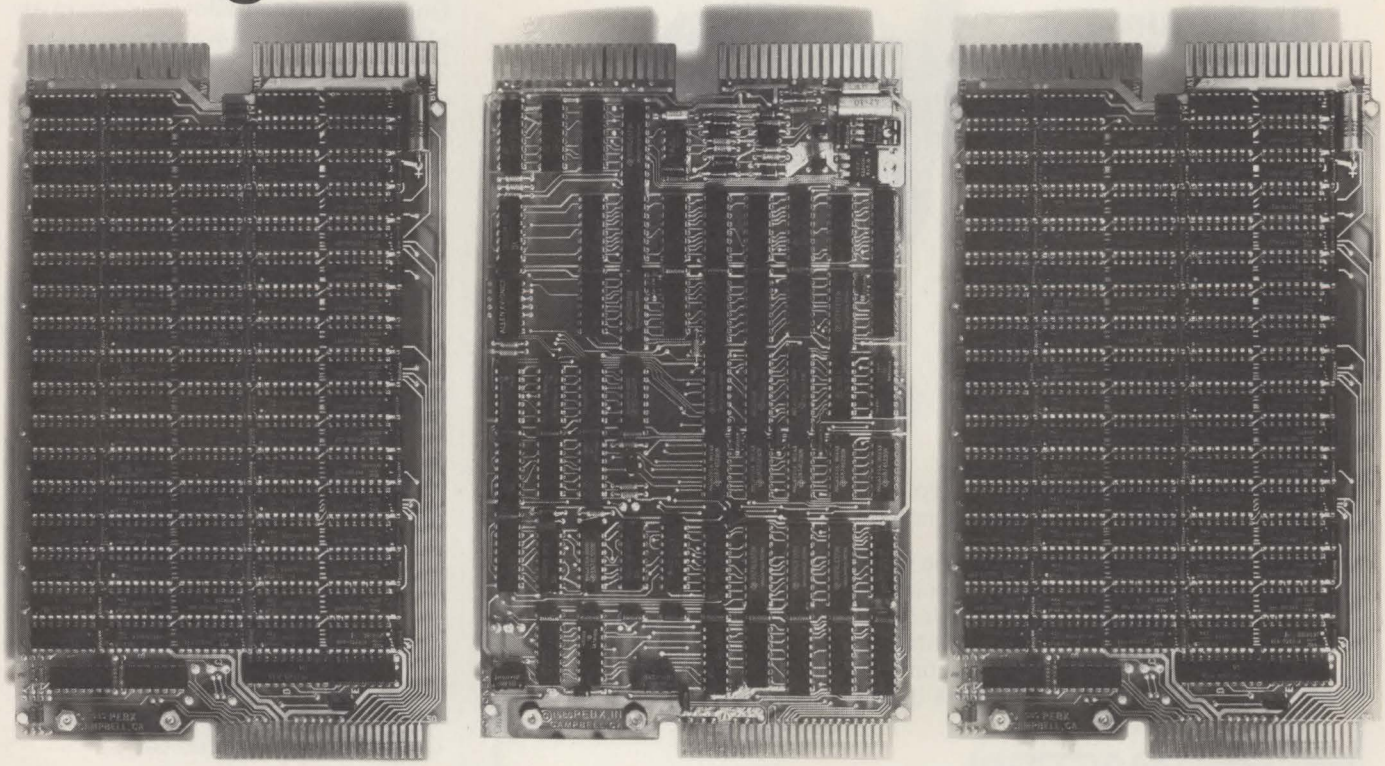


*LSI-11 is a registered trademark of Digital Equipment Corporation.

CIRCLE NO. 50 ON INQUIRY CARD

Mini-Micro World

that amount, is optional. The drive supports named, sequential and variable-length files, which can have names as long as 10 characters.

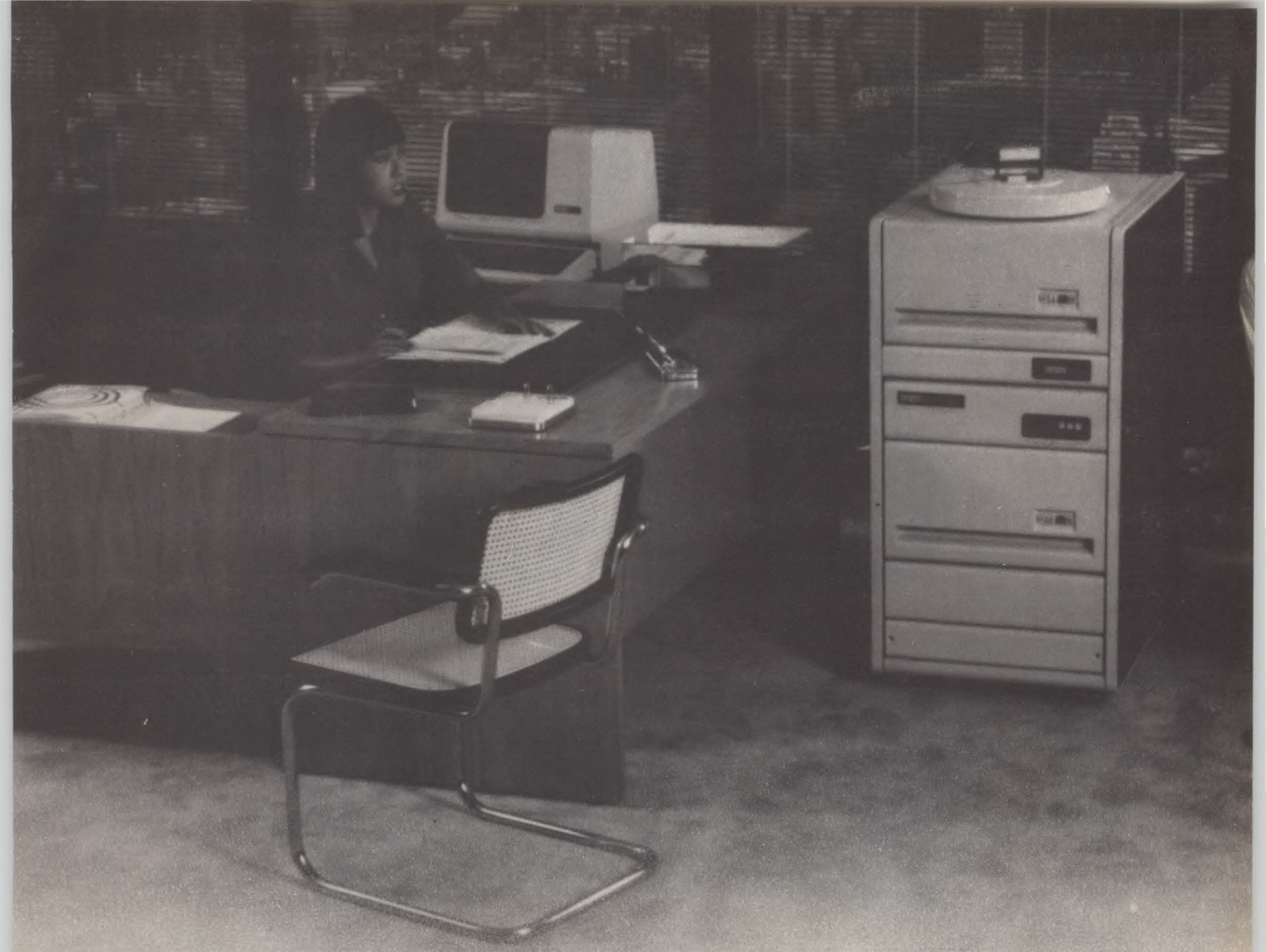
H-P has added some new text-preparation commands to the 2642A. The company claims that these commands will improve formatting and editing text off-line. They include the ability to realign paragraphs, justify text, copy paragraphs to other locations in the text and perform search and replace operations. A word wraparound ability enables the terminal to recognize words that overlap the right margin and to transfer them to the next line, eliminating split words.

Like the HP2624A, the 2642A has eight user-definable screen-labeled soft-keys. It also has an RS232C serial printer port, an 8-bit parallel printer interface, and H-P's shared peripheral interface (a version of the HPIB), which allows as many as eight devices to be interconnected. The 2642A also supports an automatic-dial, 300-bps modem. It is the first HP264X series terminal with that ability, says the company.

A standard HP2642A includes one floppy-disk drive and sells for $6750. A second drive is $1000 extra. H-P will deduct $500 from the price for customers ordering the HP2642A with dual 3M tape-cartridge drives instead of a minifloppy. The 300-bps modem is $375. The company is considering making foreign-language keyboards available on the HP2642A.

The list price of the HP2624A is $2750. Options include the thermal printer for $1150, RAM for an additional five pages of memory for $200, foreign-character sets for $100 each, and a math- and large-character set for $100 each.

H-P will begin delivering the 2624A this month and expects to begin delivering the 2642A by year-end. —*Larry Lettieri*



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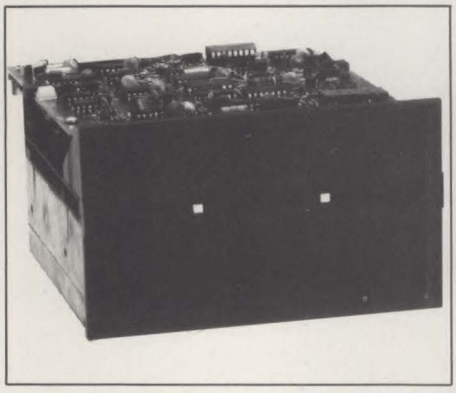
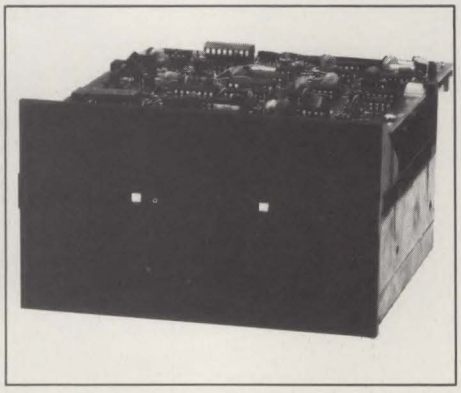
Recording density:
5535 BPI
Access time:
• Track to track: 3ms
• Average: 90 ms





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CIRCLE NO. 54 ON INQUIRY CARD

Home information systems: The big push begins

Electronic home information systems that tie television sets to computer data bases appear to be on the brink of widespread commercial implementation. Until recently, there had been considerable talk but little action in connection with home information systems. Then in June, Radio Shack introduced its TRS-80 Videotex home information terminal—the first such device aimed at the U.S. market.

Other recent developments also reflect a quickening tempo in this nascent market. They include:

- The signing of a marketing agreement between Source Telecommunications, Inc., and Cox Cable Communications, Inc., under which STI's home information service will be made available to Cox cable television subscribers.
- The inauguration of an experimental viewdata service in Coral Gables, Fla., jointly sponsored by American Telephone and Telegraph Co. and the Knight-Ridder newspaper chain.
- The petitioning of the Federal Communications Commission by CBS, Inc., to have Antiope—a French teletext system—adopted as a U.S. broadcast standard.

Perhaps the most significant development was the introduction in June of the TRS-80 Videotex home information terminal by Radio Shack. The device contains a keyboard, modem and RF modulator—all the equipment necessary to combine a home user's TV set and telephone into a video display terminal for access to a computer data bank.

There are only two such services that cater specifically to home users, and Radio Shack has signed a marketing agreement with one of them—CompuServe, Inc., in Columbus, Ohio. Under the agreement, Radio Shack will furnish an instruction booklet with the Videotex terminal that will tell users how to access the Compuserve network, and also provide a block of introductory usage time.

Mark Smith, CompuServe director of information services, sees the Radio Shack agreement opening a whole new market beyond the hobbyists who make up the majority of its 3000 subscribers.

He says, however, that new information services will have to be developed to make it worthwhile for the general public to use them instead of the printed word. "Otherwise the equipment will just collect dust," Smith says.

He doesn't see cost as a barrier to widespread implementation of electronic home information systems. He points out that equipment costs are low, as evidenced by the Radio Shack terminal, which will sell for less than $400. And he believes use charges will be defrayed by advertising and by sponsorship of organizations that wish to disseminate information, such as government agencies.

In fact, this already has begun to happen. The U.S. Weather Service is using a videotex terminal jointly developed by Radio Shack and Motorola to distribute agricultural information to farmers in two Kentucky counties. The experiment, known as the Green Thumb project, has been going on for more than a year.

While CompuServe is relying on Radio Shack to supply home information terminals for access to its services, arch-rival Source Telecommunications, Inc., plans to market its own terminals, according to a company spokesman. The Alexandria, Va.-based firm, which has about 5000 subscribers, is developing a terminal with a French manufacturer, whom the spokesman declines to identify. The terminal will include a monitor, keyboard and modem and will be introduced in January, he says.

Meanwhile, STI has found a new non-hobbyist market—cable TV subscribers. The company has signed an agreement with Cox Cable Communications, Atlanta, under which the Source, as STI's service is known, will be made

Radio Shack's TRS-80 Videotex *home information terminal includes a keyboard, modem and RF modulator—all the equipment necessary to combine a home user's TV set and telephone into a VDT for access to a computer data bank.*

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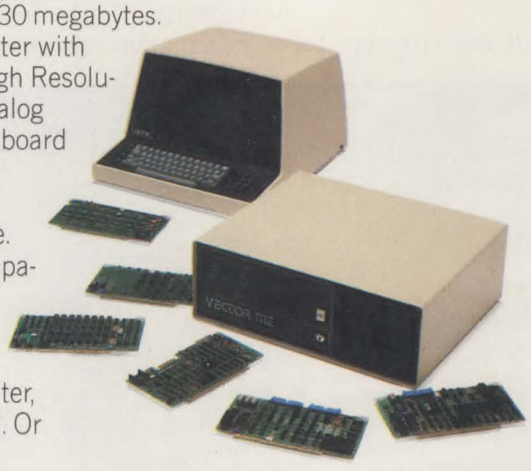

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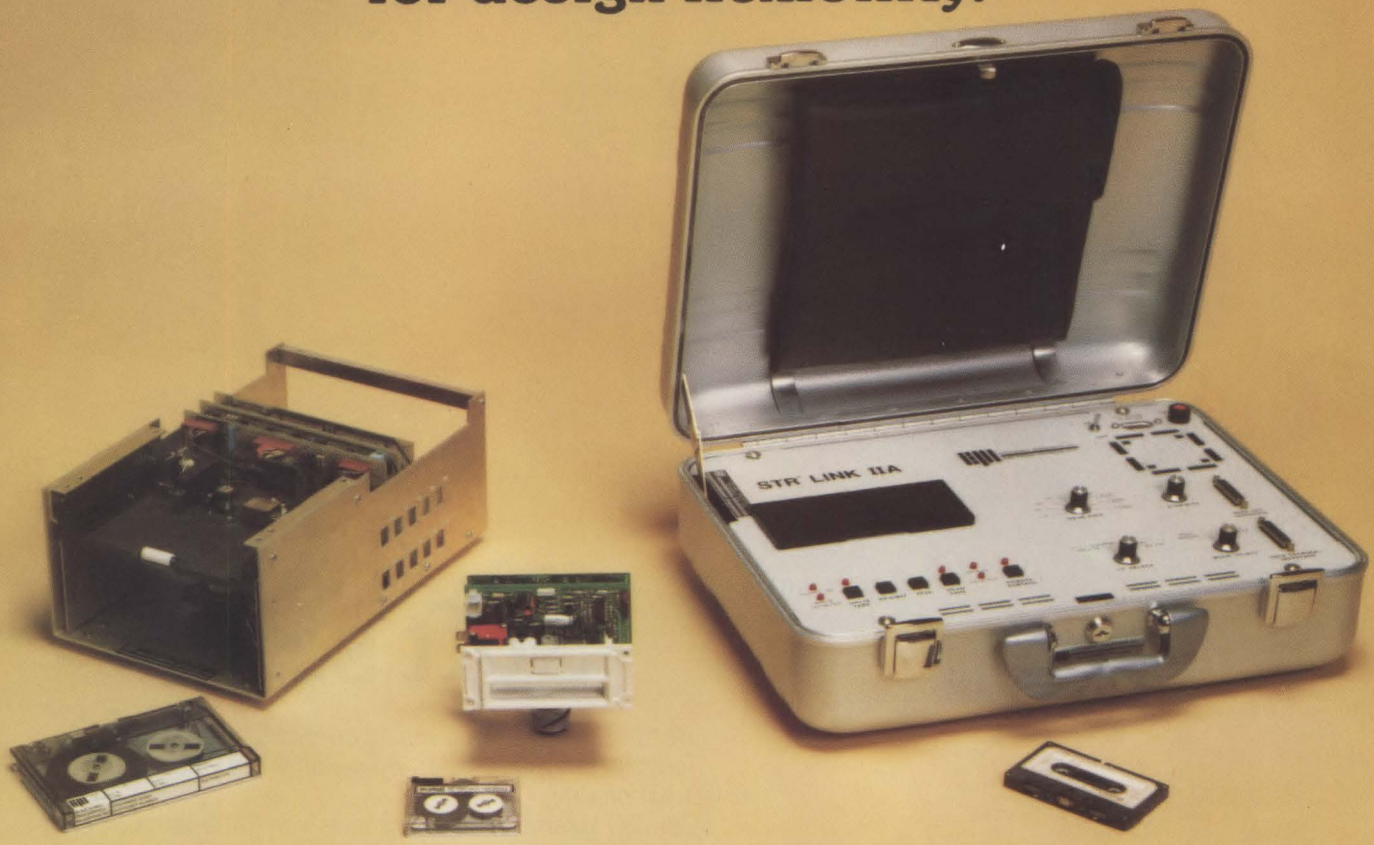

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The STR-810 digital recorder is designed for data logging, data acquisition and as a system loader. Using either the 3M DC-300A or DC-300XL cartridges, packing density is 1600 bpi, for respective data capacities of 2.3M bytes and 3.4M bytes per cartridge, using four tracks. Features include microprocessor-controlled tape movement and read/write electronics. For maximum versatility, interfaces include RS-232 and IEEE-488. Or, using control and status lines available, you can interface to specific microcomputers such as LSI-11 and 8080. EPI's optional ANSI X3.56 formatter, with NRZI or phase-encoded personality cards, turns the 810 into a plug-in component for industrial instrumentation and mini/microcomputer-interfaced peripheral markets. Price: $756 in quantities of 100. **STR-STREAM** is a high-speed, high-capacity version of the 810 designed for Winchester disc backup. Density is 6400 bpi for 17M bytes capacity per cartridge. Features include advanced head design, MFM formatting and compatibility with 8" or 14" discs.

EPI's STR-610 is a compact, low cost digital recorder that's ideal for use with POS terminals, smart CRT terminals and as a general peripheral for mini/microcomputer-based systems. The 610's recording density is 800 bpi for a capacity of 168K bytes/track, using a two-track 3M DC-100 mini-cartridge. Formatting is ANSI Standard and interfacing is parallel, with a variety of options. Price: $280 in quantities of 1,000. **The STR-LINK III** is a high-speed (9600 baud), portable program loader that uses the STR-610's drive system and shares the same specifications. It is used as a field service tool for diagnostic work or as a peripheral in a mini/microcomputer system. STR-LINK III uses a serial RS-232 interface for data communications or data terminal applications, and it can be controlled through RS-232, ASCII control codes, or manually. Price: $1,561 in single quantity.

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CIRCLE NO. 56 ON INQUIRY CARD

available to Cox cable TV subscribers. According to the STI spokesman, Cox will provide the hardware required to tie its subscribers' TV sets into the Source. The service is scheduled to begin in January.

With their potential of becoming a mass market, home information systems are attracting other major companies besides Radio Shack. One example is the AT&T and Knight-Ridder viewdata experiment in Coral Gables, a Miami suburb. Some 200 users will be able to access shopping information and news via terminals supplied by AT&T. The Coral Gables project is the third in a series of viewdata tests conducted by AT&T. (Viewdata has come to be the generic term for two-way transmission schemes that tie a TV set to a data bank via telephone or cable TV lines. Another one-way method, called teletext, ties TV sets to a data bank via television broadcast signals.)

Television broadcasters, notably CBS, have also felt the lure of the home information market. CBS, which has been conducting tests at network-owned TV stations in St. Louis and Los Angeles, has pushed hard for the adoption of a teletext standard. A year ago, at CBS's instigation, the Electronic Industries Association (EIA) formed a teletext standards committee to set the stage for adoption of a standard by the FCC. The committee has been considering systems developed in France (Antiope), England (Ceefax/Oracle) and Canada (Telidon), but has been unable to agree on a standard or even whether a standard should be adopted. As a result, CBS decided in July to bypass the EIA committee and petition the FCC to begin hearings on a standard immediately. Moreover, CBS has recommended adoption of the Antiope standard because it is software-based and hence more flexible, its proponents claim, than the competitive systems, which are hardware-based. The adoption of a standard would pave the way for CBS and other network broadcasters to offer commercial teletext services.

This, in turn, could be the key to home information systems becoming a mass market. The reason? Teletext is potentially the cheapest of all home information system mediums. Like regular TV broadcasts, it would be free to the general public, with broadcasters deriving their revenues from sponsors. Moreover, proponents estimate that the electronics needed to decode teletext broadcasts would add less than 20 percent to the cost of a conventional TV set. —*Paul Kinnucan*

Data-collection system automates racetrack betting

Off-track betting on horse races is a growing pastime that requires quick verification of bets and payoffs. These tasks are typically performed by mainframe computer systems that automate betting and payoffs and centralize data at the racetrack.

But the South African province of Transvaal has only five tracks, and its government discourages betting. So when the Totalisator Agency began shopping for a mainframe to use at the province's tracks, it was looking for a solution less expensive than a mainframe selling for several million dollars.

The decision took 10 years and culminated in the choice of a data-collection system manufactured by Ontel Corp., Woodbury, N.Y. Although the system has no betting terminals and does not provide same-day bet payoffs, it costs about $350,000—less than 10 percent what a mainframe off-track betting (OTB) system would cost. Furthermore, the system was operating at two locations within six weeks of installation. The company claims that a mainframe would have taken two years to reach that point.

A South African distributor, SACO Systems, Ltd., installed the system and also provides the data-entry software. The system consists of two 10M-byte hard-disk drives, six Ontel intelligent termi-

Ontel Corp.'s *data-collection system has automated off-track betting in South Africa.*

nals acting as central processors, 58 8K-byte remote terminals and matrix printers. It is fully redundant, and, in case of failure, the backup system begins to function within 1 min.

The remote terminals, located in 40 offices throughout the province, are used to collect bets the day before and day of a race. Races are held two to three times per week at one of the five tracks. Each terminal houses a form that requests a horse's identification, the type of bet and the race number. This information is sent to four of the six centralized processor terminals for updating and verification against master parameters. The four processors communicate with one of the two hard-disk drives. They update a bets file and log the batch number and total amount of cash received. All data received by the four processors is passed via a local network to a fifth processor that acts as backup and writes the information onto a separate disk. The sixth processor is a standby. After the race, winners are keyed into the system, and printouts of winners can be made at each branch. Payoffs are made the following day.

All terminals communicate with the central processor locally through a custom software program called network control program (NCP). Interprocessor communications within the local/remote cluster are asynchronous at 19.2K baud.

The Totalisator has been evaluating large mainframe systems that include betting terminals and provide same-day payoffs, and the agency will continue this evaluation for the next five years. In the meantime, however, the local government's disapproval of betting hinders same-day payments, and SACO claims that a large, expensive system is not currently viable or cost-effective. For now, the Ontel system fills the bill. —*Lori Valigra*

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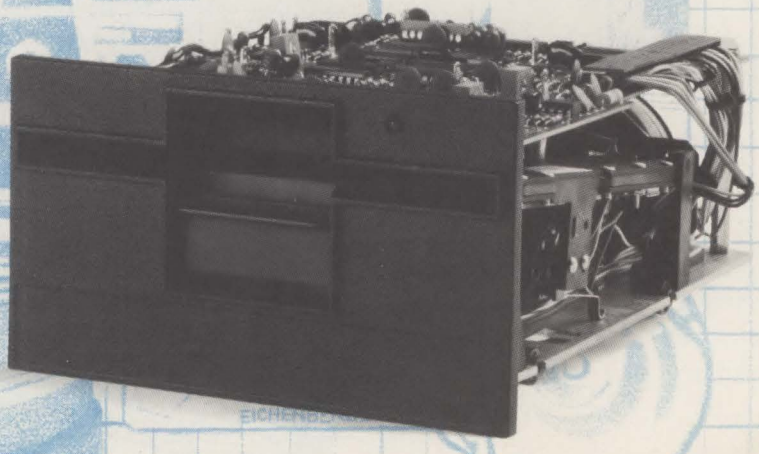

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CIRCLE NO. 60 ON INQUIRY CARD

On software taxation

(Robert Sherin, representing the Data Processing Management Association, testified at a recent Massachusetts Department of Revenue hearing intended to help determine the fate of a proposed regulation that would tax software and other data-processing services as tangible personal property (see story, p. 40). DPMA opposes the regulation. Because of the widespread implications of such a regulation, we have excerpted the following from Sherin's remarks because we believe they deserve wider dissemination.—Lawrence J. Curran)

According to Massachusetts sales and use tax law, tangible personal property is taxable, while intangible services are not, and the Department of Revenue, through the proposed regulation, is seeking to interpret the law's applicability to computer hardware, software and data-processing services.

We believe it is reasonable to include in the tangible classification computer hardware and basic operating software, which is defined as that software which comes as an integral part of the hardware, and is needed to make the computer operate. However, we take issue with the Department's proposed taxability of off-the-shelf software and some data-processing services. DPMA contends that such software and services are just as intangible as activities of law and accounting, and are therefore exempt from Massachusetts sales and use tax imposed on tangible property.

Early on, Massachusetts had rejected this very taxation it is proposing to resurrect. Nearly a decade of official interpretations have pronounced software, output services and timesharing [to be] intangible services. Data processing's intangible roots run deep in Massachusetts. Its factual pattern has been traced back to the beginning of the century by the Massachusetts Appellate Tax Board, the state's highest agency authority in taxing matters. The Board supports data processing's intangible status, citing a 1905 decision in which the state's highest court ruled that the communication of information and the transmission of intelligence "was not the production of goods, wares or merchandise to be kept for sale or use." Hence, they were intangible and nontaxable.

In 1976, the final arbiter of this tangible-intangible distinction, the Massachusetts Supreme Judicial Court, held that data processing is a service that falls within the intangible classification.

The question legitimately arises: can this rule-making body ignore official findings of fact? We respectfully submit that the Massachusetts Department of Revenue can only do so by contradicting the state's own General Law (C58A, 13) declaring decisions of its Appellate Tax Board "final as to findings of fact."

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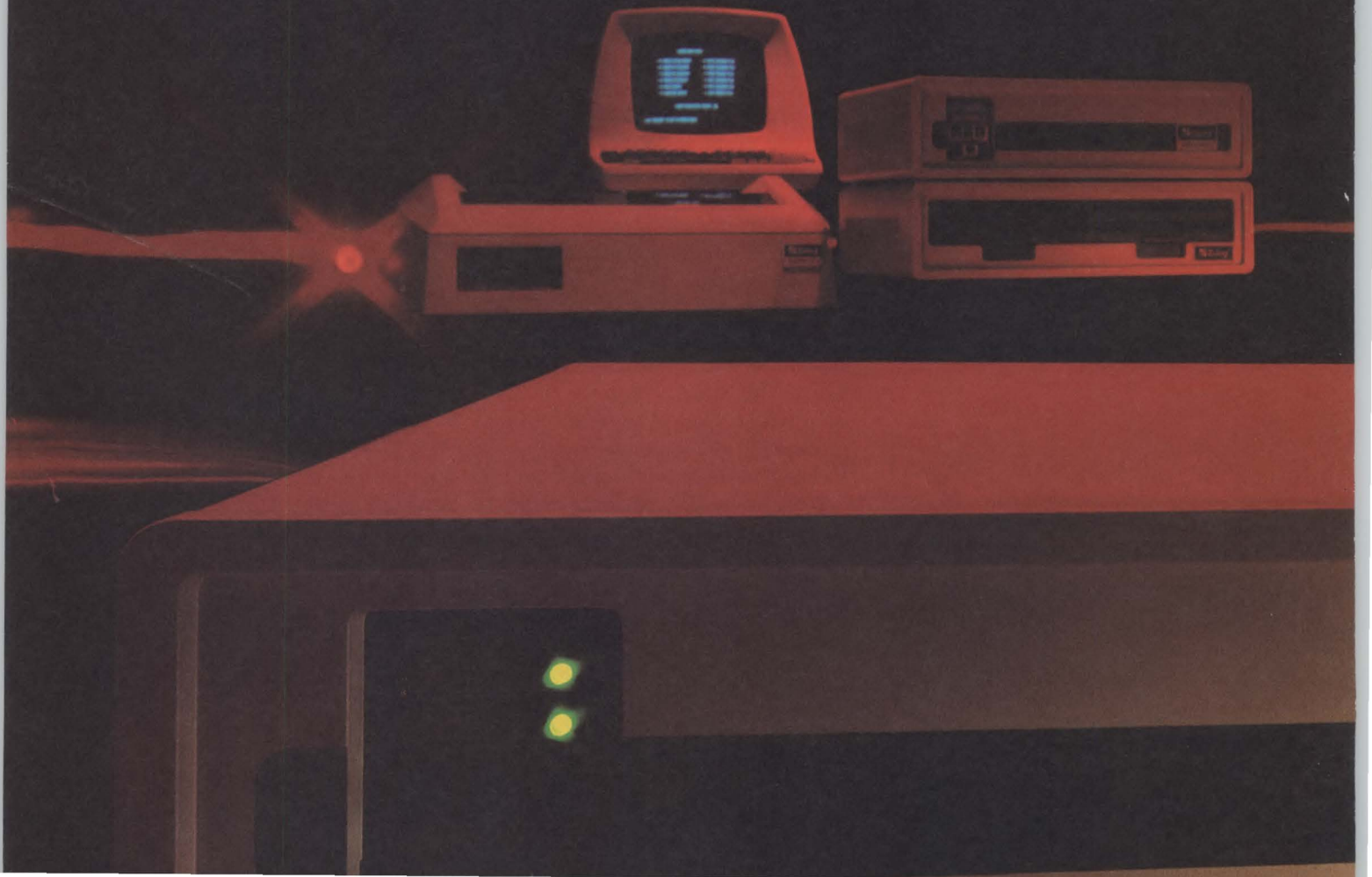

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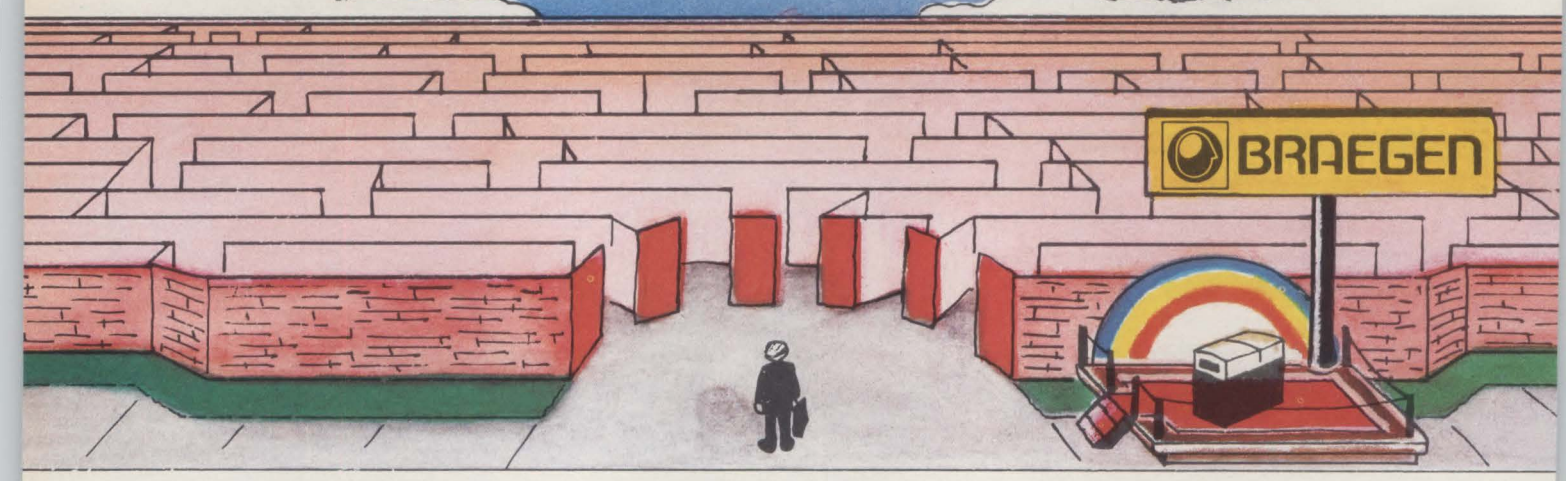

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MORE ON 'DEBUNKING'

(Editor's Note: In our August issue, we published an opinion by Pro-Log, Inc., president Ed Lee, who questioned the need for microprocessor development systems (p. 107). The following several letters are representative of the nearly 170 received both by Mini-Micro Systems *and by Pro-Log.)*

To the editor:

I feel very strongly that Edwin Lee simply does not understand what he's talking about.

In the first place, development systems and higher-level languages are two different subjects. They are not necessarily related. Many, if not most, microprocessor-based products could not be built or debugged without additional hardware support. This support could range from a Pro-Log hardware tool to a software simulator. In this sense, development systems are analagous to an engineer's oscilloscope and VOM. So the question is not whether or not to use a development system, but what type to use.

As for higher-level languages, Mr. Lee has simply missed the point. The advantage in using a higher-level language lies not in development time, but in flexibility. The great power of the modern computer comes from its ease of adaptation (programmability) to a wide range of problems. Higher-level languages are simply a further extension of this characteristic.

Lee's suggestion of "software modules" is just a simplified version of a higher-level language. What is an IF-THEN-ELSE but a "fully specified module" of software? As for the specific language to be used, this has been the major subject of professional programmers for 30 years. It is unlikely that FORTH, assembler or any other language will disappear to take over any time soon. Why don't engineers study programming before they start telling the professionals how to do it?

Charles Hall
U.S. Department of Agriculture
Raleigh, N.C.

To the editor:

I was astonished by Edwin Lee's article. It is rare to find so much doublethink concentrated in three pages.

Example: Mr. Lee asserts that the key to good system design is "software documentation standards . . . modular program design, with fully specified modules, and software documentation that is integrated with hardware documentation." (All that is true.) Then he goes on to boast of developing a medium-sized software package "all by hand ([with] not even an assembler)." If there is any development technique less conducive to all that stuff that makes for good design, I can't imagine it.

Example: After emphasizing the importance of documentation, Mr. Lee dismisses development systems because they offer no aid in generating it. But his system offers no such aid, either. It seems to be a set of standards—nothing more. Standards, while valuable, are no substitute for hardware, any more than software is a substitute for hardware. Can standards plug into a product prototype and emulate a one-chip microcomputer with a few thousand bytes of PROM? Until they can, Mr. Lee has no case.

Example: Mr. Lee cites Pro-Log's experience of developing a 9500-word machine language application in one man-year as proof of his technique's superiority over Intel's MDS-based technique, which would have required 6.5 man-years and 13,000 lines of assembly code, or 1.5 man-years and 3000 lines of high-level code. He ignores the fact that the Intel figures were a "typical" program and an unspecified high-level language, and did not refer to Mr. Lee's project at all.

By the way, I can offer development statistics far more impressive than Pro-Log's. My company specializes in microcomputer software development in FORTH. We recently developed a medical information system that's about 2000 (FORTH) words long, putting it in the same ball park as Mr. Lee's example. Before the client came to use, he talked to some people who had developed a very similar system in FORTRAN on a minicomputer. They estimated that just converting their system to a microcomputer BASIC would take six man-months. We rewrote the program from external specs in one man-month.

I find Mr. Lee's dismissal of FORTH as a "fad . . . inappropriate for professional designers" to be particularly exasperating. Mr. Lee seems to dismiss FORTH because it won't let him do things like optimize a "multiply" routine for speed or memory, as appropriate. In fact, one of FORTH's major strengths is that it allows exactly that kind of tailoring, yet retains many of the design efficiencies of conventional high-level languages such as Pascal. Mr. Lee would do well to learn something about this particular "fad" before trying to debunk it.

I worked in the mainframe world throughout the 1970s, and I jousted with any number of people who had been raised on assembler, and couldn't see the purpose of all the nonsense about high-level languages. That controversy has died down; the advocates of payroll systems in assembler are gone, or at least are no longer taken seriously. Lamentably, engineering types like Mr. Lee have resurrected the same old controversy in the microprocessor world. That man spoke truly, who said, "The only thing we learn from history is that we learn nothing from history!"

Jonathan Sachs
Principal
Orthocode Corp.
Albany, Calif.

To the editor:

I read the article on development systems in absolute amazement. Anyone who advocates hand-coding a 9500-word program has severe problems and belongs in a rubber room.

However, on the slim chance that I am wrong, I would like to take advantage of your offer of a copy of "The Microprocessor User's Guide."

F.D. Hurlston
Section Manager
Schlumberger Well Services
Houston, Texas

To the editor:

First I would like to congratulate you on your courageous presentation of a very controversial approach to microprocessor software development. As a manager of software for microprocessors and minicomputers, I find it difficult to subscribe to some of the concepts that you present. But I feel I owe it to myself to go that one step further in understanding your concepts. Therefore, I would like to read "The Microprocessor User's Guide."

I have long held the theory that a standard assembly language was a realistic, viable answer to the growing software cost problem, and I am delighted to find an organization that seems to be putting the theory into practice.

Ronald G. Damer
Manager, Software Systems
E-Systems, ECI Division
St. Petersburg, Fla.

To the editor:

I have just completed reading Edwin Lee's article, and I enjoyed it thoroughly. We have been making a broad line of SC/MP-based data

Letters

acquisition systems, without benefit of a development system, and in far fewer man-hours than everyone else seems to feel necessary.

We are, however, plagued with the problem of software documentation. I would very much like to see some documentation standards developed to make our efforts in this area intelligible to our users and service personnel. Therefore, I would like to read "The Microprocessor User's Guide."

Mr. Lee's ideas on the subject are in complete accordance with my feelings, and he can count on at least one supporter in the great debate on development systems as they stand today.

D.W. Morris
William Palmer Industries
Los Angeles, Calif.

To the editor:

I find your article to be quite interesting as well as apropos. As a working systems engineer saddled with the task of writing my own software for a variety of projects, I leaned on the in-house development system (Intel MDS220 development equipment) just "because it was there" for our (engineering department) use. Documentation remains a sore issue with me. What appears to be adequate documentation to management does not meet my ideas of adequacy. I must investigate other approaches.

Perhaps "The Microprocessor User's Guide" might indicate some other approaches.

Wilson Gutcheon
Senior Staff Engineer
Kollsman Instrument Co.
Merrimack, N.H.

BUS BREAKDOWN

To the editor:

The article "Integrating the IEEE-488 bus" (MMS, June, p. 125), by Joseph O'Loughlin of Dylon Corp. is either incorrect or requires clarification. Either the photograph of the system is changed to show a vacuum-column transport (photograph shows Kennedy 9800 series tension arm), or the specifications referring to a 100K-byte-per-sec. data-transfer rate needs correction. Tension arm ½-in. tape transports are typically 45 ips (Kennedy 9800 series) operating either 800 (NRZI) or 1600 (PE) bytes per sec.

Hence, it is impossible to achieve more than 72K bytes per sec. (1600 × 45 ips = 7200), regardless of front-end buffering.

Also, you may want to tell Mr. O'Loughlin that the IEEE 488 is not called 1975 standard, but 1978 (when it was updated), and RS232C and RS449 have never been instrumentation buses but serial communication standards used primarily for communication over telephone line networks.

Aldo Falossi
Technical Support
Innovative Data Technology
San Diego, Calif.

WHY NOT FORTH?

To the editor:

Lately the computer language FORTH has received a good deal of coverage. However, as with most novel languages, misconcpetions arise. In particular, Carol Ogdin (MMS, August, p. 81) states that FORTH is "unsuited for high-speed,

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Lower Case	Standard, with descenders and underlining	Standard, but no descenders or underlining
Buffer	512 expands to 2048	Fixed 1280
Space/Blank Compression	Yes	No
Interfaces	Serial and parallel	Serial only (parallel not available)
Current Loop	Standard	Optional
Forms Control	14 settings standard	Optional
Elongated character sets	Standard	Optional
Price	Base Price $2045 Expanded buffer 100 Price as shown $2145	Base Price $1995 Options 310 Price as shown $2305

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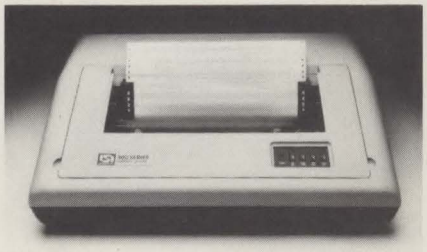

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CIRCLE NO. 64 ON INQUIRY CARD

repetitive tasks that will be burned into mask-programmed ROMs." FORTH can exist in many configurations, not all require that the text interpreter be present. Once an application is coded and debugged, the resulting threaded code and FORTH "inner interpreter" are all that are needed to run. Several of my colleagues develop such PROM-based systems that perform repetitive high-speed tasks. One such example is a laser fusion targeting system at the Laboratory for Laser Energetics.

Because FORTH allows the user both low-level functions (examine/modify memory) and high-level functions (access virtual data structures), he has a consistent language throughout all stages of program development.

FORTH does not have the shortcomings of most development systems, in which the programmer must be familiar with the separate syntax of the debug software, the assembler, the linker and the system text or command line interpreter.

Additionally, program development for many applications involves the building of a text interpreter that translates the users inputs into useful machine outputs. Why not use FORTH, for which the interpreter is already supplied?

Michael McCourt
Laboratory Engineer
University of Rochester
Rochester, N.Y.

ZILOG'S Z-NET

To the editor:

I enjoyed reading the article on local computer networking (MMS, July, p. 17). The description of Zilog's Z-Net network contained one error, however. Z-Net was described as operating at a rate of 100,000 bits per second; it actually communicates at 800,000 bps. This speed was chosen to optimize the cost/performance advantage made possible by Zilog's advanced VLSI technology. Zilog expects the Z-Net system eventually to take its place in a hierarchy of local computer networks in which higher-speed products will segment the market.

Dale Way
Marketing Manager, MCZ-2 Series
Zilog
Cupertino, Calif.

NO WINCHESTER SHORTAGE

To the editor:

I read with interest your item in "Breakpoints" (MMS, July, p. 5) indicating Scientific Micro Systems has not been able to get the quantities needed of 8-in. Winchester-disk drives.

Shugart Associates has the manufacturing and engineering talent to supply all the 8-in. Winchester drives our customers demand. And if your reporters should find anyone else in the market looking for Winchester drives, please send them to us. We'd love to take more orders!

Mike Kirby
Marketing Manager, Fixed-Disks
Shugart Associates
Sunnyvale, Calif.

CORRECTION

In "A guide to tool selection" (MMS, August, p. 68), the STEP-2 and STEP-3 bit-slice microcomputer development systems manufactured by Step Engineering, Sunnyvale, Calif., are erroneously listed as products of Smoke Signal Broadcasting. For more information on the STEP-2 and 3, **Circle No 329 .**

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PRODUCT FOCUS

Technologies converge in multifunction system

ROBERT A. GARROW, PAULINE LO ALKER
and PAUL ROSENFELD, Convergent Technologies

8086 microprocessor, mathematics co-processor and operating system concept of 'foundation software' give computer its power

The combination of microprocessor technology and affordable Winchester storage has made true distributed information processing—with a complete CPU, main memory and mass storage for each user—a low-cost reality. A new computer system, and the company that developed it, both trace their name and existence to the convergence of these technologies. The company is Convergent Technologies, Inc., Santa Clara, Calif., and its first product is a multifunction work station-based computer system intended primarily for OEM system builders. First shipments begin this month.

The company was founded in mid-1979 by former executives of Intel Corp. and Digital Equipment Corp. They have developed a multifunction work station that can integrate text, numeric and graphics processing with data entry, document preparation and data communications. Convergent also furnishes a proprietary OEM-oriented real-time operating system (see "The CTOS operating system," p. 87), and a complete support package of development tools.

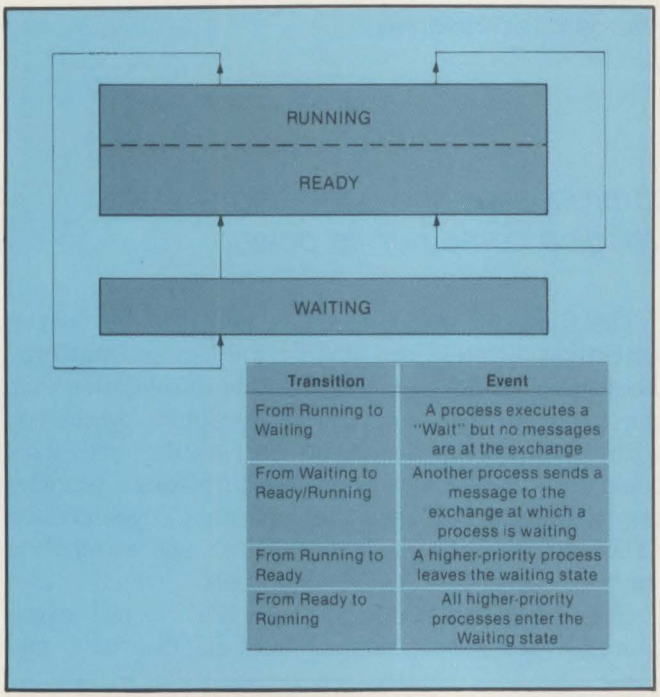
Supporting the work stations are various mass-storage subsystems, ranging from floppies to 8- and

Convergent Technologies' *new system combines microprocessor technology and affordable Winchester storage.*

Convergent designed its own dual-bus architecture to maximize performance of advanced VLSI electronics.

14-in. Winchester-disk drives. The system has the processing power of a minicomputer, roughly comparable to PDP-11/34 or PDP 11/44 class machines, yet looking like an intelligent terminal and base-priced to compete with microcomputers.

The Convergent product line consists of a full range of configurations from stand-alone, single-user floppy-based systems to 16-user cluster-processing systems. A basic integrated work station includes a processor, 64K bytes of RAM, 4K bytes of ROM, a 15-in. display screen, two serial ports and one parallel printer port. Without software, it is priced at $3990 in 25-unit orders. The 16-station cluster with 58M bytes of 14-in. Winchester storage and 0.5M bytes of floppy-disk storage, has a list price of $128,600. Regardless of entry configuration, all Convergent systems are said to be conveniently field-upgradeable to higher levels of functionality or performance along multiple upgrade paths.



Transition	Event
From Running to Waiting	A process executes a "Wait" but no messages are at the exchange
From Waiting to Ready/Running	Another process sends a message to the exchange at which a process is waiting
From Running to Ready	A higher-priority process leaves the waiting state
From Ready to Running	All higher-priority processes enter the Waiting state

Fig. 1. Relationship between *process states.*

The power of the Convergent work station stems from a 16-bit Intel 8086 microprocessor used in conjunction with an optional 8087 high-speed mathematics co-processor. Memory in each work station begins at 128K bytes, and is extendable to 1M bytes.

Convergent designers selected the Intel 8086 for several reasons: it is a high-performance microprocessor supported by a full range of hardware and software development tools; it is second-sourced (by Mostek, Siemens and Fujitsu); and it is the first of a family of products with a logical series of extensions planned over the next three to five years. To develop all the systems software, Convergent Technologies has written more than 500,000 bytes of code, a feat the company believes would not be possible with other microprocessors for which fewer development tools are available.

Dual-bus architecture

Convergent Technologies designed its own dual-bus architecture—the CT-Bus—to maximize the performance of advanced VLSI electronics, and to ensure easy user hardware extendability. The same motherboard

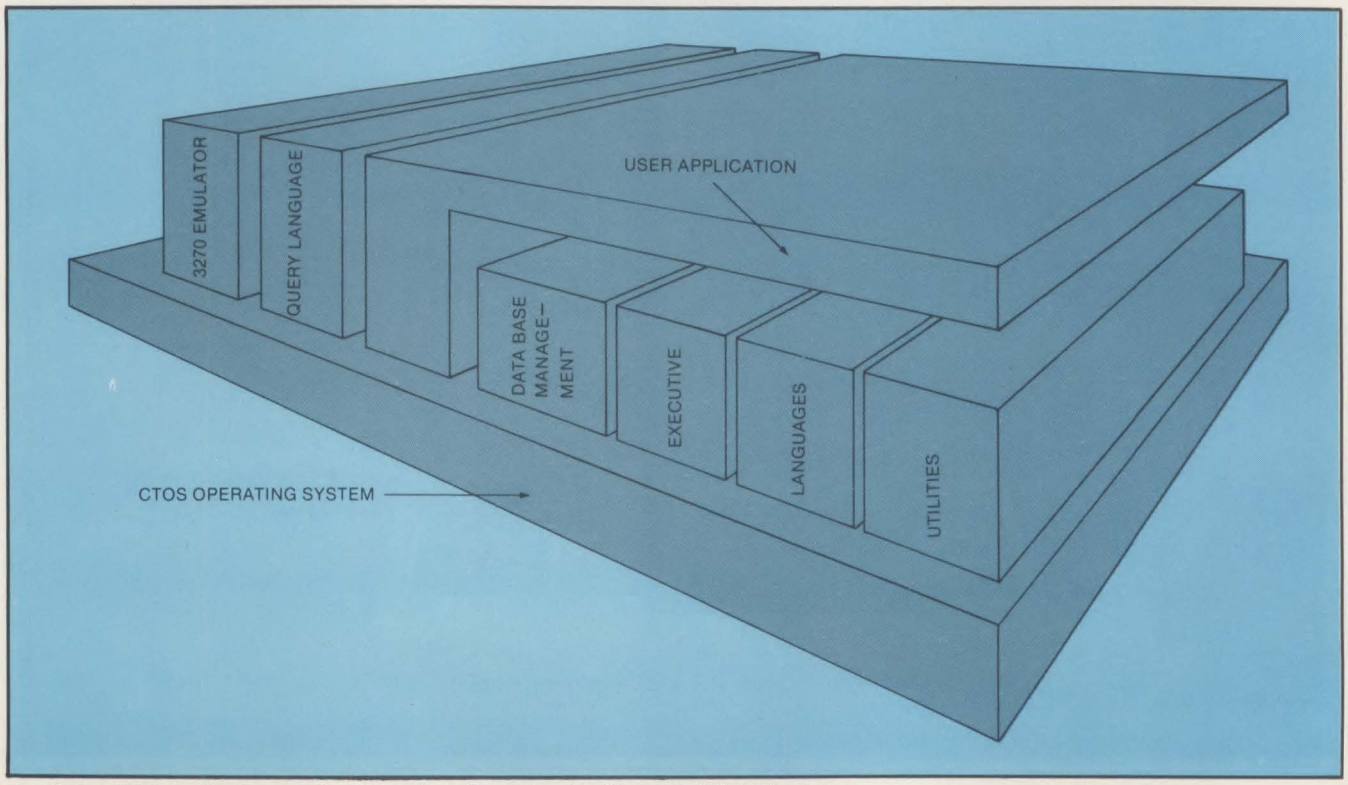


Fig. 2. An OEM application system *based on Convergent software building blocks.*

provides as many as four Intel Multibus-compatible card slots for multiprocessor applications or for user hardware extensions, such as additional device controllers and memory. The Multibus signals are distinct from CT-BUS signals, yet the Convergent processor can link modules on the two buses through a DMA channel. This dual-bus architecture provides for high-speed operation without Multibus contention, plus crucial system operations are protected from user hardware executing in the Multibus area.

Along with the 8086 CPU, each Convergent work station provides an eight-level external interrupt system, four high-speed DMA channels, power fail/auto restart, a real-time clock and interval timer, two high-speed serial communications channels and a parallel printer interface.

Four of the eight external interrupts are reserved for system use, leaving four to be defined by the OEM. However, these four can be expanded to 32 levels by cascading 8259A interrupt controllers through user hardware residing in the Multibus slots. Flexibility in interfacing unique I/O devices is achieved through the Multibus expansion area, and through features of the I/O subsystem that can be customized. Four DMA channels are provided with each work station for high-speed I/O interfacing. Operating at 3.3M bytes per sec., one DMA channel refreshes the video display from system memory, another drives the main storage

THE CTOS OPERATING SYSTEM

The CTOS operating system was developed to meet the broad needs of OEM system builders. The underlying concept is "foundation software" to support system builders' needs to develop a system with its own special devices, its own look and its own feel.

CTOS provides a real-time, multiprogramming environment for real-time, interactive applications. The operating system "kernel" is an event-driven priority scheduler for an unlimited number of "processes" (the basic element of computation). Each process is assigned one of 255 priorities. When an event, such as the completion of an I/O operation, makes a higher-priority process eligible for execution, rescheduling occurs immediately. Convergent believes this provides a more responsive system than time-based scheduling techniques.

Besides the kernel, the CTOS operating system consists of a number of "system service processes" that are scheduled by IPC messages for execution in the same manner as application processes. Because of this internal use of IPC, the CTOS is classified as "message based."

The CTOS operating system supports as many as 16M bytes of virtual code, video display with multiple split screens, keyboard, sequential access method, direct access method, indexed sequential access method and communications management.

Each system service process acts as the guardian and manager for a class of system resources, such as disk files, memory or keyboard. System service requests are directed to the appropriate system service process through reference to a table that is available for modification. Because the system service process is the only software element that accesses the resource, and because the interface to the system service process is formalized through the use of IPC, a highly modular environment results. This increases reliability by localizing the scope of processing and enabling a system service process to be replaced as a complete entity. System builders can also include their own system service processes, which are then indistinguishable from those provided by Convergent.

The CTOS operating system supports local resource-sharing networks (clusters) as well as stand-alone work stations. In a cluster configuration of as many as 16 work stations, essentially the same operating system executes in each work station and in the shared resource processor (SRP)

In the cluster environment, the IPC facility is extended to provide transparent access to system service processes that execute in the SRP. While some services, such as file management, printer management, 3270 emulation and data base management, migrate to the SRP, others, such as video and keyboard management, remain at the work station. In a master work station, which combines the functions of SRP and work station, the CTOS concurrently supports local application processing and resource sharing for the other work stations of the cluster.

The CTOS file managment system is hierarchical by volume, directory and file. Volumes are automatically recognized when placed on-line. Each file can have a 50-character file name, a 12-character password and a file-protection level. A file can be dynamically expanded or contracted without limit as long as it fits on one disk. Concurrent access is controlled by shared-read and exclusive-modify access modes.

While providing convenience and security, CTOS disk file management includes reading or writing a sector of an open file with one disk access, reading or writing as many as 65K bytes with one disk access, I/O overlapped with process execution and optimized disk arm scheduling.

Duplication of critical "volume control structures" protects the integrity of disk file data against hardware malfunction. A system utility can recover a file if either of its redundant file header blocks is valid.

Accommodation of OEM-written device handlers was a major design goal of the CTOS operating system. A device handler can be part of the application or it can be a system service process. Its interrupt handler can enable the kernel to save process context (in which case it can be written in FORTRAN or Pascal), or it can receive the interrupt directly from the hardware. IPC provides an efficient, yet formal, interface from interrupt handler to device handler and from device handler to application process.

Interaction with the work station operator is a function of the Convergent Executive, not of the CTOS operating system. This allows the system builder to choose the manner in which the keyboard and video display are used. The Convergent Executive is a forms-based command interpreter that provides an operator interface including a HELP facility and interactive command files. The executive is available for program development and for system builders that find its user interface compatible with their users' needs. However, the Executive is a normal application-level program that can easily be replaced by a system builder's customized command interpreter.

Flexibility in interfacing unique I/O devices is achieved through features of the I/O subsystem that can be customized.

interface channel, a third drives the high-speed RS422 communications channel, and a fourth DMA channel is used for Multibus-to-CT-BUS communications.

Programmable video, keyboard

Almost every feature of the video display is "soft" and can be customized by the OEM. The system's character set is RAM resident. Changing to a different character set is a matter of merely loading the desired set from a disk file.

Screen format is either 34 lines by 80 columns or 34 lines by 132 columns, with other formats also available. The 15-in. flicker-free display swivels and tilts for operator comfort. The horizontal display can be split into any number of logical windows and divided vertically, horizontally or both. Each window, or frame, may have its own cursor. Scrolling within each frame—up and down, left and right—is performed independently of other frames on the screen. Each character on the display, as well as complete lines, may have a number of attributes, including reverse video, intensification, underline and blinking. An optional

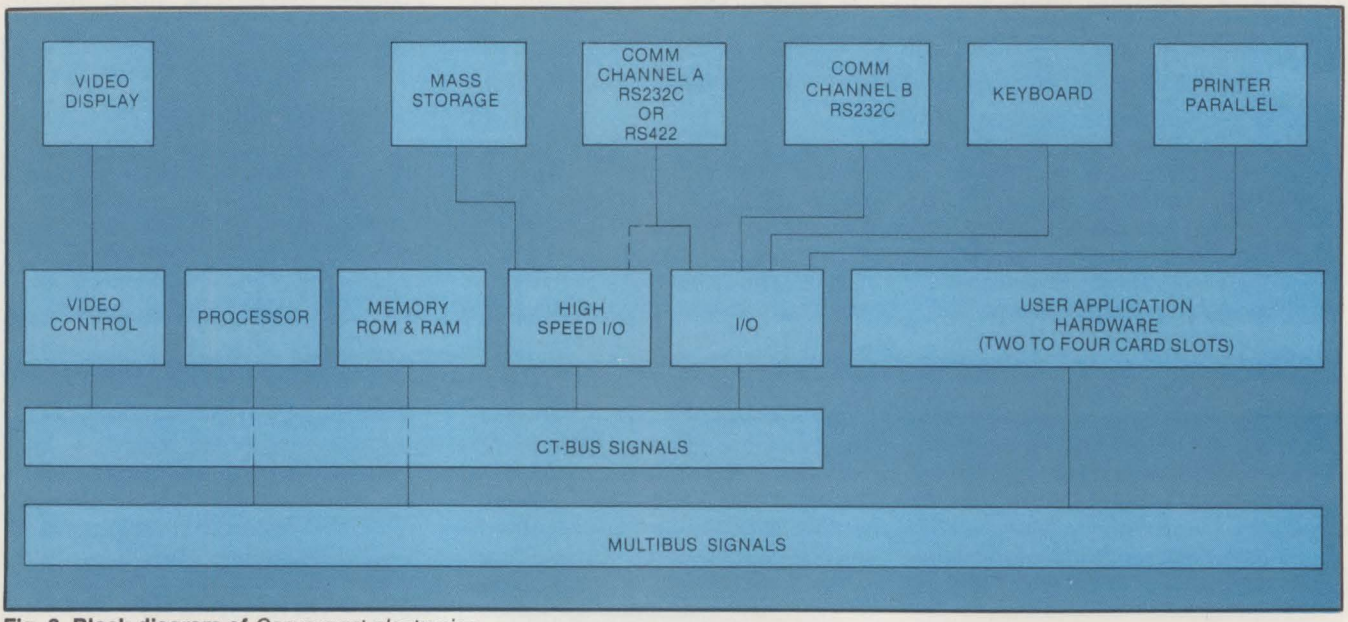


Fig. 3. Block diagram of *Convergent electronics.*

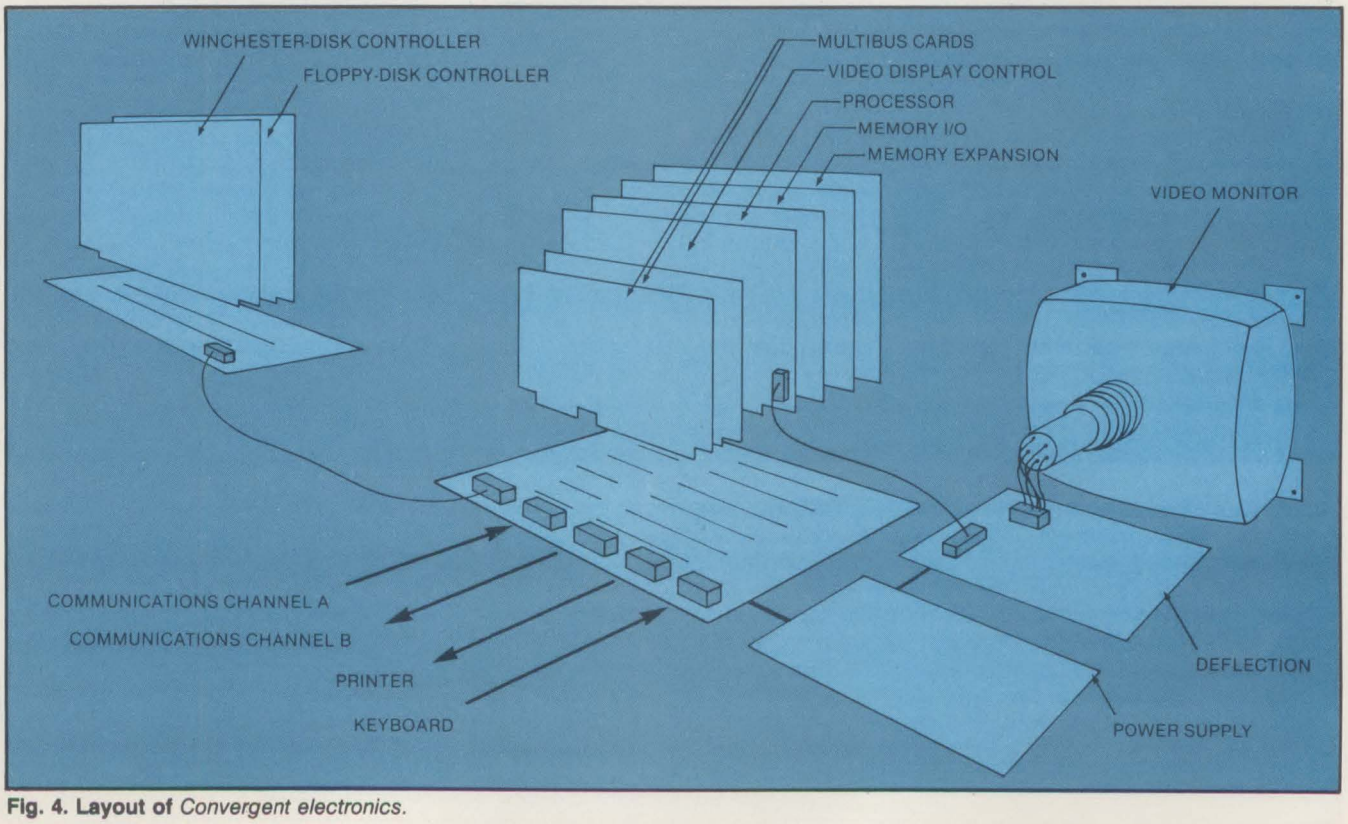
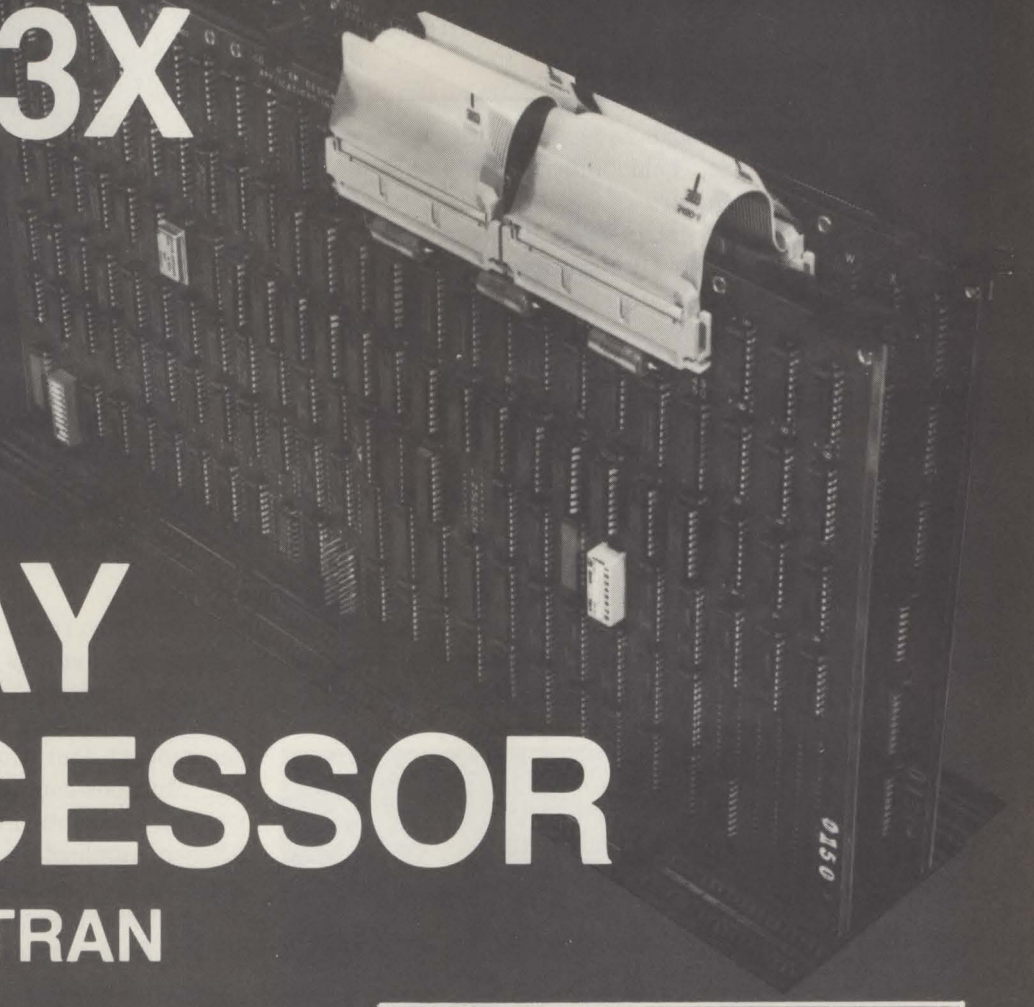


Fig. 4. Layout of *Convergent electronics.*

introducing the

MSP-3X



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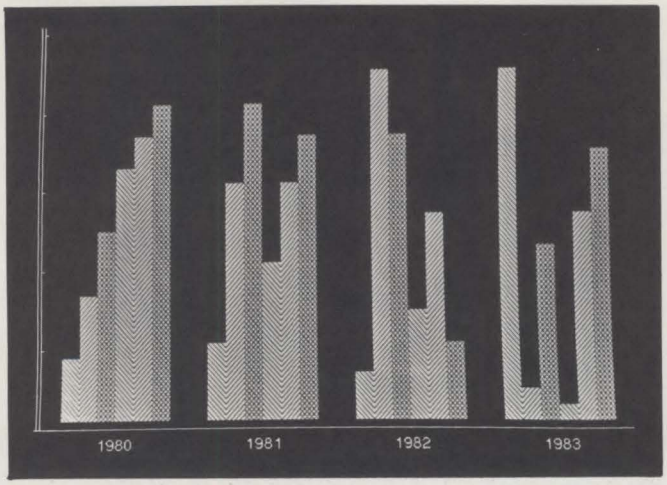
The system's software mirrors the modular approach taken in the hardware. Heart of the software is the CTOS operating system.

video expansion board adds subscript, superscript, double underscore, bold, offset, double-height and double-width characters.

The 98-key detachable keyboard is also "soft." It offers 10 user-definable application function keys with eight built-in LED indicators, a 14-key numeric pad, an eight-key status control pad and a six-key cursor control pad. The entire key-encoding scheme can be changed by the user.

High-speed communications

Two serial channels are provided through a Zilog programmable communications processor. One of these is configured to be RS232C-compatible while the other operates in either RS232C or RS422 modes. The RS232C channels have software-selectable baud rates ranging from 110 bits per sec. to 19.2K bps. The RS422 channel may operate at rates as high as 615K bps to support high-speed operations.



Each character in the Convergent *work station is built in a 10 × 15 pixel cell, and character sets can be easily changed by loading another set into RAM from a disk file.*

The serial communications channels can be programmed independently to support a variety of asynchronous and byte- and bit-oriented synchronous protocols, such as IBM's Bisync, SDLC and HDLC. The communications subsystem uses the Zilog communications processor to implement these protocols.

In a cluster configuration, the shared resource processor (SRP) electronics can support six work stations in a minimum configuration. A separate Multibus communications expansion board is added to support the full complement of 16 work stations.

Common packaging, subassemblies

The circuitry in a Convergent work station is distributed over three printed-circuit boards that are also used in the shared resource processor, which is the hub of a Convergent resource-sharing cluster system.

The Convergent work station *has a 15-in. high-resolution video display mounted horizontally in a "landscape" mode.*

Each SRP contains an 8086 CPU and a standard 128K bytes of memory expandable to 1M byte. These assemblies are mounted vertically in a card cage that can support four Convergent electronics boards and four Multibus-compatible boards. By means of such common elements in various packaging alternatives, different application environments can be served by using common subassemblies. This, in turn, minimizes OEM customers' spare parts stocking requirements and reduces field-service support costs.

OEM-oriented software

The system's software mirrors the modular approach taken in the hardware. Heart of the software is the compact, modular CTOS operating system. Software development tools include an executive command interpreter that uses form fill-in techniques to allow interactive access to CTOS functions. Through the executive, users can log on, run programs and manipulate files. The executive is used to invoke the Convergent editor, a cursor-oriented editor for developing source programs and project documentation.

Convergent also provides five widely used programming languages: an assembler with macro and conditional assembly capability, BASIC interpreter, Pascal, COBOL and FORTRAN.

Application development utilities include a symbolic debugger, an ISAM package, a SORT/merge package, a forms facility and a data base management system. Also available are a Query Language for operator access to the data base management system and a 3270 terminal system emulator. ■

Robert A. Garrow, Pauline L. Alker and Paul Rosenfeld are, respectively, vice president of engineering, vice president of marketing and director of marketing for Convergent Technologies, Santa Clara, Calif.

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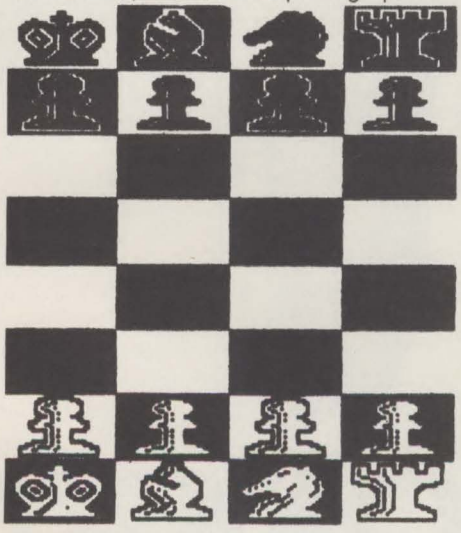
When our customers range from hobbyists to hard-nosed OEM's, and their applications, from plotting chess moves to planning the next business decision, it's easy to see why more people are moving to the built-in performance and flexibility of Anadex DP-9500 series printers.

Clear Quality

A rugged Anadex-built 9-wire print head combines long life and high resolution for consistently razor-sharp characters and dot resolutions of 72 × 75 dots/inch for high-density graphics under direct control of the data source.

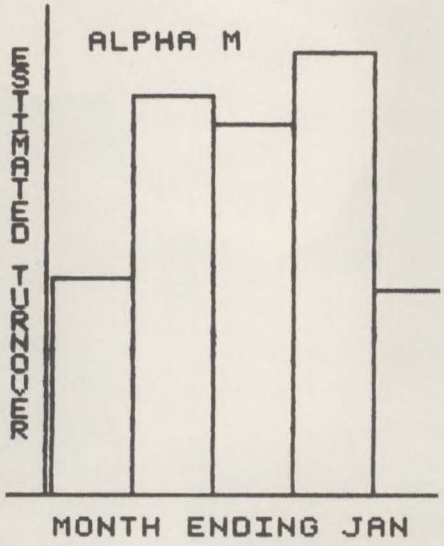
Fun & Games

Actual size, unretouched photograph



Serious Business

Actual size, unretouched photograph



Performance Built-in

The DP-9500 series prints from 132 to 220 columns, depending on print densities. Densities are switch or data-source selectable from 10 to 16.7 characters/inch, and all can be printed double-width by communications control.

The full standard ASCII 96 character set, including descenders and underlining, is printed bi-directionally on the original and up to 5 crisp copies at speeds up to 200 CPS.

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The three ASCII compatible interfaces (parallel, RS-232-C and Current Loop) are standard. Also standard is a sophisticated communications interface for control of Vertical Spacing, Form Length and Width, Skip-Over Perforation, Auto Line Feed, and full point-to-point communications capability. DEC PROTOCOL is standard on every printer.

Features Plus

Other standard features are: forms width adjustment from 1.75 to 15.6 inches, shortest-distance sensing logic, self-test, quick-change ribbon cartridge, and a 700 character FIFO buffer. (An additional 2K buffer is optional.)

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ANADEX, LTD. • Dorna House, Guildford Road • West End, Woking, Surrey GU24 9PW, England • Tel: Chobham (09905) 6333 • Telex: 858762 ANADEX G

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SOFTWARE

Microcomputer operating system comes of age

JACK HEMENWAY, Hemenway Associates, Inc.

Users who formerly settled for primitive operating systems now demand systems that rival those associated with minicomputers

As the song says, "the times, they are a changin.'" Just a few years ago, users of microcomputers were willing to settle for primitive operating systems that were not much better than programmer front-panel replacements. Today's users require and demand systems that rival some of the more powerful minicomputer systems.

In response to that demand, Microsoft, Bellevue, Wash., is migrating the UNIX system from DEC PDP-11s to the newer 16-bit microprocessors. UNIX, an operating system developed at Bell Laboratories, incorporates some of the latest thinking in operating system design. It is written almost entirely in the C-language, and typifies a trend toward coding operating systems in a high-level language (HLL) that is reflected in the accompanying directory (p. 104); almost a third of the entries are coded in an HLL or a mixture of assembler and HLL. Networking is another advanced ability now offered by a substantial number of operating systems in the directory, but caution is suggested about that claim; some vendors say they have a networking capability if they have a serial RS232 port available.

What is an operating system?

An operating system controls a microcomputer and acts as a mediator between a computer and a user. The operating system schedules the use of the microcomputer and relieves the user of writing code that deals directly with system hardware resources—peripherals such as disk drives, printers and system consoles.

Fig. 1 is a model of a total microcomputer system. The inner core contains the hardware, surrounded by the operating-system software. The next ring holds applications programs and system utilities—editors, compilers, assemblers and debugging aids. Microcomputer system users interact with the applications program ring by making demands on the system that are passed to the hardware devices. The operating system fields all requests for services and handles all input and output, interrupt processing and task coordination. Users need concern themselves only with their applications, and not with the mechanics of I/O implementation.

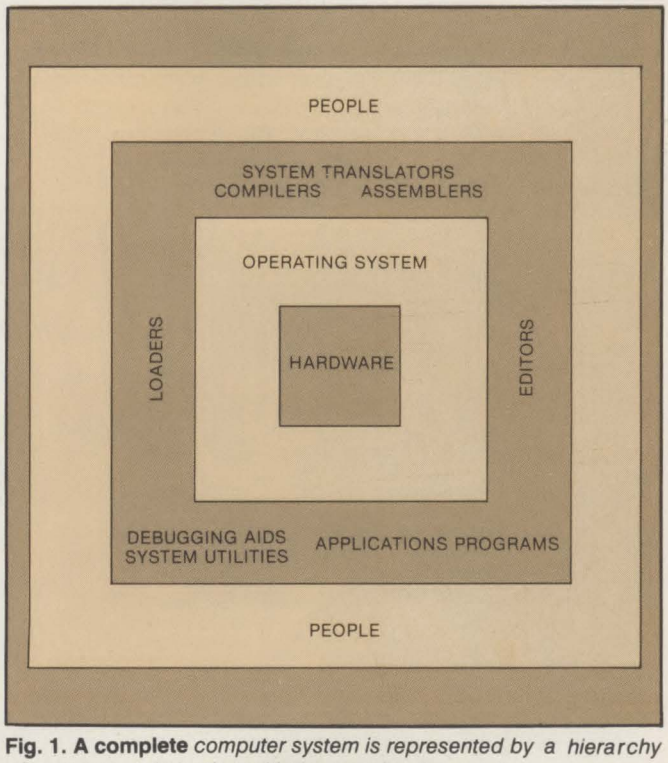


Fig. 1. A complete *computer system is represented by a hierarchy of systems, culminating with the people who use it.*

Operating systems schedule use of the microcomputer and relieve the user of writing code that deals directly with system hardware resources.

Fig. 2 shows the hardware of a typical microcomputer development system. The heart of the system is the microprocessor which can interpret instructions and execute specific operations. The microprocessor communicates with the rest of the hardware over control, address and data buses. Instructions and data are stored in either RAM or ROM. Peripherals not requiring controllers (e.g., CRT terminals and line printers) connect to the system buses through interfaces, while those requiring controllers, such as disk and tape drives, connect to the system buses through them; the controllers, in turn, connect to the interfaces. Interrupt facilities, which allow an I/O device to signal the microprocessor either that it needs service or has completed a request, allow the operating system to coordinate simultaneous activities.

Besides supervising system operation, an operating system provides a collection of programs for a user, including assemblers, compilers, loaders, editors and floating-point routines. All the operating system in the survey provide at least an assembler and text editor, and most provide one or more compilers or interpreters. The operating system also provides a "friendly" environment in which software can operate. For example, a compiler needs the operating system to read a source file, write an object file and print the compiled listing. When that object program runs, it might need similar facilities—termed the run-time environment—to execute successfully.

A user interfaces with the system by submitting a job—a series of steps needed to accomplish some work. These steps are the least-complicated job components and are executed sequentially to perform that work. Presented with a job, an operating system might break the job into tasks and create processes to service the job. Each of these processes is a computation that can occur concurrently with other processes. The term *multitasking* denotes a system that has several processes executing concurrently—either running, ready or waiting (Fig. 3).

The accompanying directory classifies operating systems by user function. Three of the principal kinds are development, process control and general-purpose

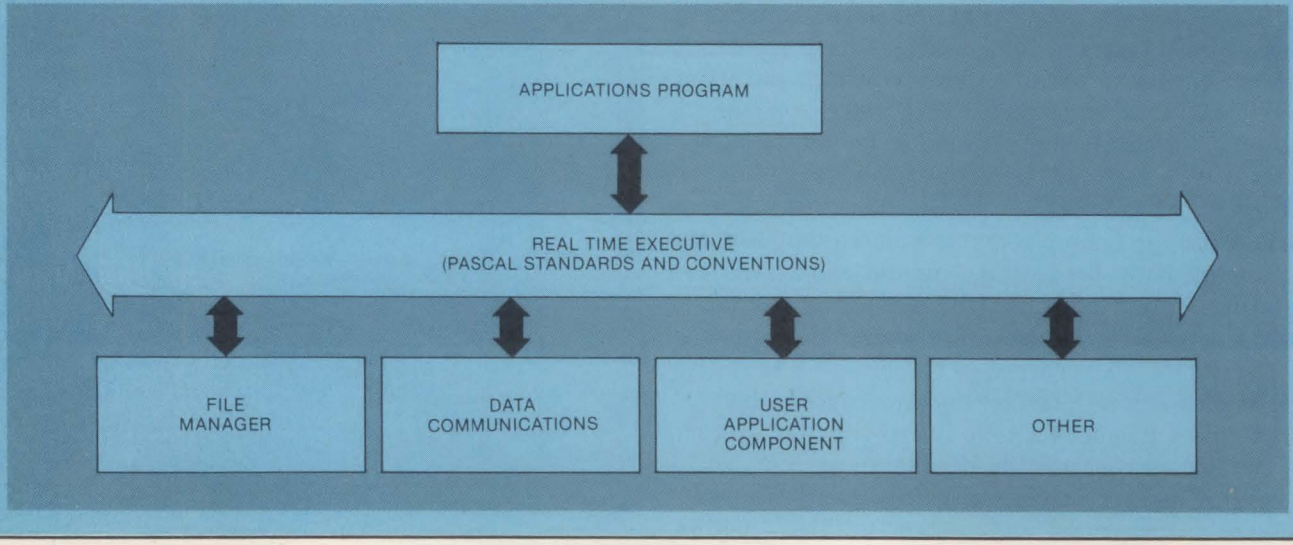
HUMANIZING AN OPERATING SYSTEM

Many operating systems are so complex that most users are unable to fully grasp their organization. In contrast, systems exhibiting object-oriented architectures are easier to understand. Their mechanisms are well defined, and they exhibit a consistency that makes the operating system seem less awesome.

In other words, object-oriented architecture offers a way to humanize an operating system; it uses objects as building blocks that operators can manipulate. The objects are classified into types, such as a semaphore, each of which has a specific set of attributes. Once acquainted with semaphore attributes, users are familiar with all semaphores; there are no special cases. Having learned the attributes and the system calls associated with a type of object, users have acquired complete knowledge of the behavior of the object type.

Intel Corp. is the leading exponent of object-oriented architecture, and its RMX 86 is a real-time modular object-oriented operating system for the Intel 8086 16-bit microcomputer. Its operating system architecture functions much like the 8086 microcomputer. RMX 86 operators, (system calls) manipulate objects (operating system data structures) in much the same way the 8086 operators manipulate operands. Objects include tasks, semaphores, mailboxes, connections, memory segments and jobs. RMX 86 treats data structures symmetrically so that users can create their own objects and write their own operators to achieve custom operating system functions. These user-defined objects and operators are no different in system operation from those provided with the original system.

The main advantage of this type of architecture is that the operating system can be quickly mastered, allowing the user to focus his learning on the objects he plans to use. If he needs only a few object types, he can ignore the others.



Solid engineering and 340 lpm speed make the TermiNet 340 a more rugged, productive line printer.

Any way you measure them, TermiNet® 340 line printers are more productive performers

Don't let the compact size of the General Electric TermiNet 340 line printer fool you. Because no matter how hard you work it, it won't quit on you. It's that tough, that dependable and that much better than typical line printers. And it's available now.

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Unlike ordinary line printers, the TermiNet 340 can take the punishment of the broadest range of operating environments—from front office to factory floor—without complaining. The key reason? A tough, ruggedly engineered design. As a result, it keeps on performing under tough-use conditions when other line printers would sputter and break down.

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One reason: extra-thick, heavy-duty, environment-resistant materials chosen for the base and housing. Together, they provide this rugged printer with the impact strength, dimensional stability and resistance to adverse environments needed to keep working.

More reasons: print and ribbon systems that won't wear out prematurely and won't cause the problems other line printers do. Which is why the proven rotating-belt print system will last billions of characters. And why the ribbon cartridge will maintain very high print quality for at least 100 million characters.

Fewer service problems keep it working longer

The fact is, TermiNet 340 line printers are such productive workers, they require very little attention and very little maintenance once they're up and running. Should service be needed, you can count on getting these printers back on-line in a hurry. That's because of convenient self-test features that make troubleshooting easy and fast. And because of a responsive nationwide service network that keeps downtime to a minimum and operating costs low.

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LSI-11 MAGNETIC TAPE COUPLER, Model DQ 130, interfaces dual density (NRZI/PE) formatted drives • emulates TM11 • handles up to eight 9 track 800/1600 bpi industry standard drives at speeds from 12.5 to 125 ips • "streamer" mode capability • software or switch selectable density • RT-11/RSX-11 software compatibility.

LSI-11 MASS STORAGE DISC CONTROLLER, Model DQ 200, interfaces any two SMD flat cable interface compatible hard disc drives for up to 500 MB on-line storage • mix or match compatible Winchester, SMD or CMD • variable sector size • automatic media flaw compensation with bad sector flagging • optimized logical to physical unit mapping • implements Winchester fixed head option.

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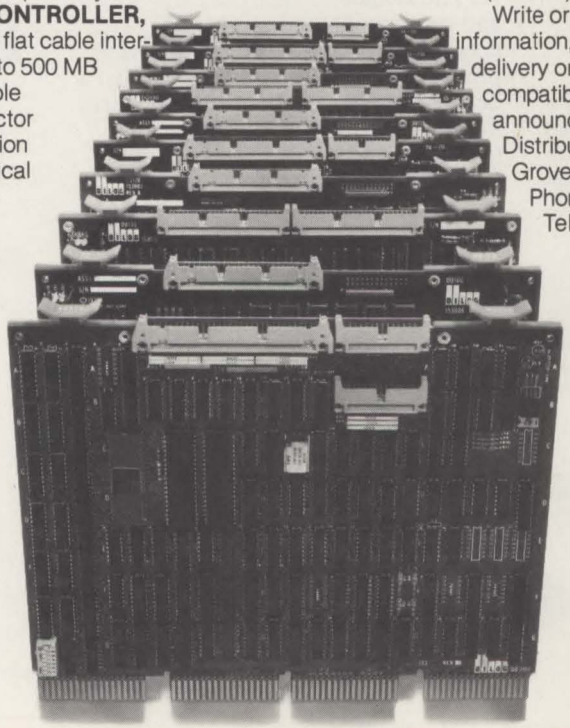

LSI-11 DISC CONTROLLER, Model DQ 100, interfaces 2.5, 5, 10 or 20 MB cartridge and fixed platter drives in combinations to 80 MB • RKV-11/RKO5* emulator • handles front load (2315) and/or top load (5440) drives • automatic power fail/power down media protection • RT-11/RSX-11 compatible.

NEW LSI-11 EMULATING MASS STORAGE CONTROLLER, Model DQ 202. Cost effective interface of two 8 and/or 14-inch Winchesters, SMD or CMD hard disc drives without changing controller . . . 8 to 300 MB capacity • RP emulator • automatic media flaw compensation.

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NEW PDP-11 MAGNETIC TAPE COUPLER, Model DU 130, offers features of Model DQ 130 (LSI unit) • RT-11, RSX-11, RSTS, IAS and MUMPS software compatible.

PDP-11 DISC CONTROLLER, Model DU 100 includes features of Model DQ 100 (LSI unit) • RT-11, RSX-11, RSTS, IAS and MUMPS compatible • emulates RK-11.

NEW PDP-11 EMULATING MASS STORAGE CONTROLLER, Model DU 202, offers same features as Model DQ 202 (LSI unit).

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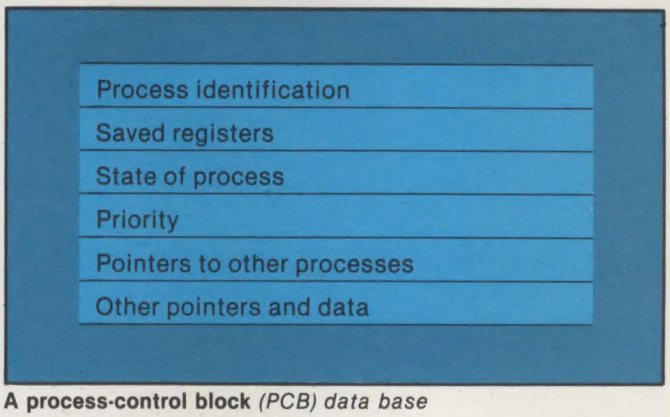
The term 'multitasking' denotes a system that has several processes executing concurrently—either running, ready or waiting.

operating system, but this classification is not meant to be exhaustive or mutually exclusive. Many operating systems in the directory can provide all three functions.

A development operating system develops software to be used either on another target microcomputer or on itself. The target need not be the same microprocessor type if the software is developed using cross assemblers or compilers. Examples of development operating systems include Intel's ISIS, Motorola's MDOS, Omnibyte's ODOS, Digital Research's CP/M, Tektronix's TEKDOS, Zilog's RIO and the Boston Systems Office's UMDS.

A process-control operating system directs an industrial process that places real-time constraints on the operating system's responses. Interrupts from external processes signal the system, and if the system does not respond in a specified time, the processes are



A process-control block *(PCB) data base can track a process's status.*

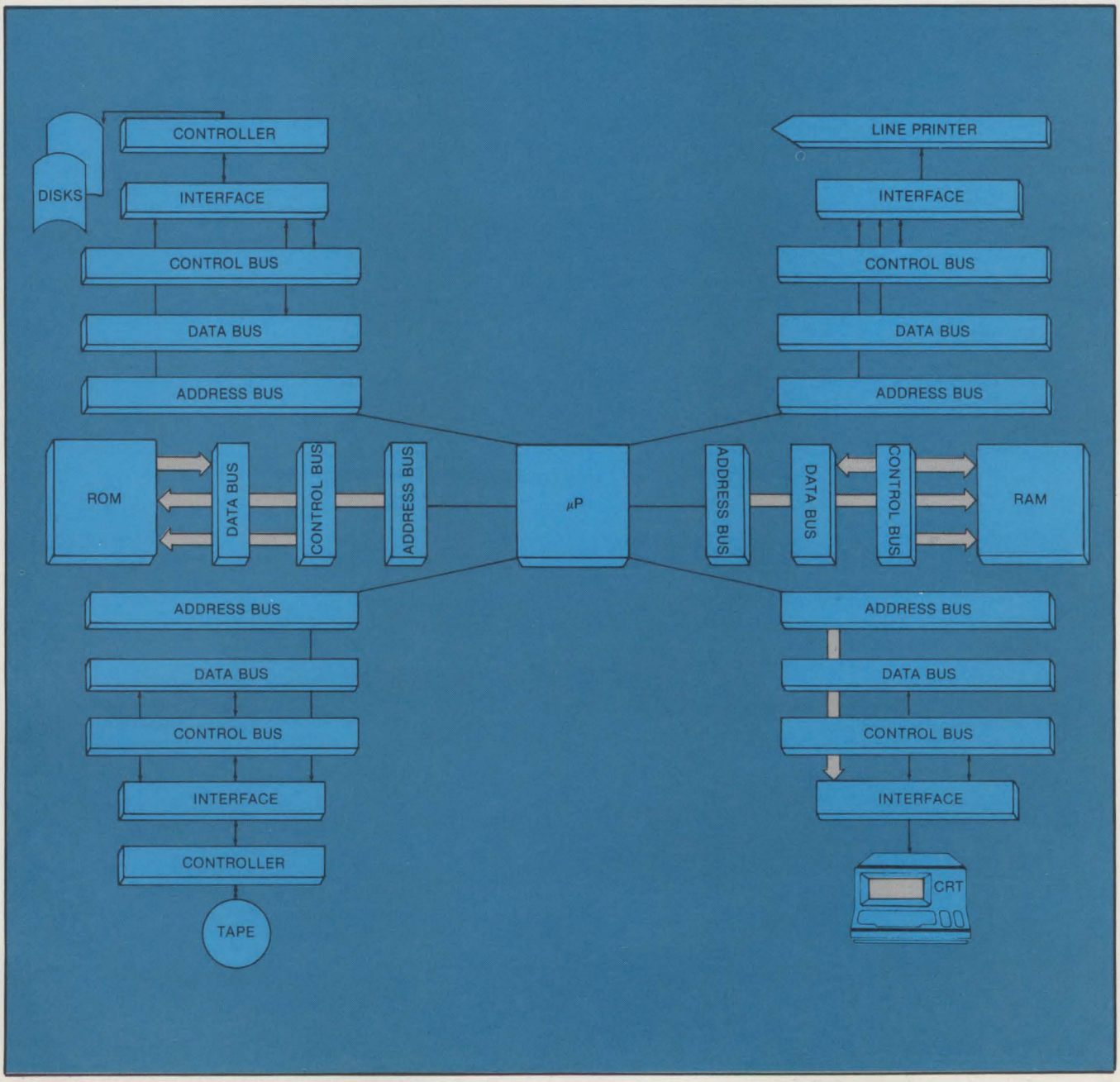


Fig. 2. A typical *configuration includes a variety of peripherals.*

TABLE OF MICROCOMPUTER OPERATING SYSTEM SUPPLIERS

The following table is provided as a guide to vendors of microcomputer operating systems. *Mini-Micro Systems'* staff prepared the table from its own sources. Some suppliers may not be included, either because they did not respond to our survey questionnaire or responded too late to be included.

Company	OS Name	Target Systems; Languages Supported	Min. Hardware Configuration
Advanced Micro Computers	APEX	AmZ8000; assembler, Pascal, C	depends on features supported
Altos Computer Systems, Inc.	AMEX	ACS8000; assembler, ALGOL, APL, BASIC, FORTRAN, Pascal	64K bytes of RAM
American Microsystems, Inc.	AMIX	AMI Phoenix 1, Intel Intellec, Tektronix 8002A, Motorola EXORciser, TI 990/4; assembler, Pascal, FORTRAN 77	48K bytes of RAM, dual disk drives
Apple Computer, Inc.	D.O.S. 3.3.	Apple II, 6502; assembler, floating-point and integer BASIC	16K bytes of RAM, minifloppy-disk drive
	Sophisticated Operating System (SOS)	Apple III; assembler, BASIC, UCSD Pascal, FORTRAN	96K bytes of RAM
	UCSD Pascal	Apple II and Apple II Plus, 6502; assembler, Pascal, FORTRAN (compiles to P-Code)	64K bytes of RAM, one disk drive
Applied Systems Corp.	O/S	8085 or Z80, ASC/80; BASIC, FORTRAN, COBOL	16K or 32K bytes of RAM
The Boston Systems Office, Inc.	UMDS	more than 30 microprocessors	64K bytes of RAM, 512K-byte disk drive
CAP-CPP, Inc.	MicroCobol Business Operating System (BOS)	Series/1, LSI-11, 8080, 8085, 8086, Z80, M6800, TI 9900; MicroCOBOL	48K bytes of RAM, terminal, dual 250K-byte floppy-disk drives
Central Data Corp.	ZMOS	Z8000; assembler, BASIC, all compilers written for the Z8000	64K bytes of RAM, one serial I/O port, one floppy- or cartridge-disk drive, one Central Data Z8000 CPU card
CGRS Microtech	CRS/DOS	6502, Microtech 6502PD, Pet, Kim, Sym, Aim	8K bytes of RAM, 1K byte of ROM, floppy-disk drive
Computer Design Labs	TPM	Z80, TRS-80; macro assembler, QSAL structured assembly language, BASIC, APL, LIST, FORTRAN, COBOL, Pascal	32K bytes of RAM, disk drive
Creative Solutions, Inc.	Multi-FORTH	8080, 68000; assembler, FORTH	16K bytes of RAM, one floppy-disk drive
Cromemco, Inc.	CDOS	Z80; assembler, BASIC, COBOL, FORTRAN, LISP, RPGII	32K bytes of RAM
	CROMIX	Z80A; assembler, BASIC, COBOL, FORTRAN, LISP, RPGII	128K bytes of RAM
Data General Corp.	DOS	microNOVA and NOVA; macro assembler, BASIC, Business BASIC, FORTRAN IV	64K bytes of RAM, disk drive, console
	ICOS	CS/10, CS/20, CS/30; COBOL	64K bytes of RAM, disk drive, terminal, printer
	MP/OS	microNOVA, NOVA 4, MP/100, MP/200, MBC/2, MBC/3; macro assembler, MP/Pascal, MP/FORTRAN IV	2K bytes of RAM, 4K bytes of PROM; for development, 64K bytes of RAM and disk drive
Digital Equipment Corp.	RT-11	LSI-11/2, LSI-11/23; macro assembler, BASIC, multi-user BASIC, FOCAL, APL, FORTRAN IV	24K bytes of RAM, tape-cartridge drive, console port
Digital Research, Inc.	CP/M 2.2	8080, 8085, Z80; assembler, BASIC, APL, FORTH, LISP, FORTRAN, C, Pascal, PL/1, COBOL	20K bytes of RAM, disk drive, console

Primary Applications	Memory Management; File Management	Processor Allocation; Peripheral Management	Price
development, process control, general-purpose	supports swapping and chaining; random organization, disk-space allocation via linked list of sectors and extents	multiprocessing, multitasking, 16 users; interrupt-driven, supports spooling and device independence	
general-purpose	supports chaining; random organization, allocation via extents	multitasking, four users; interrupt-driven, supports device independence	
development	supports overlays and swapping; single-contiguous allocation	single-user; interrupt-driven, supports device independence	$550, plus $125 per assembler
development, general-purpose	supports overlays and chaining; random organization, linked list of sectors	single-user; supports spooling and device independence	$60
general-purpose	supports overlays and chaining; random organization, B-Tree index structure	single-user; interrupt-driven, supports device independence	$250 (free with Apple III purchase)
development, general-purpose	supports overlays and swapping; random organization, single-contiguous allocation	single-user; supports device independence	$495, including 16K bytes of RAM and documentation
development, general-purpose	supports overlays; random organization	multi-user; interrupt-driven	
development	supports overlays, swapping and chaining; random organization, linked list of sectors	multi-user; interrupt-driven, supports device independence	$1200 to $3850
development, process-control, general-purpose	supports overlays, swapping and chaining; random organization, ISAM	multiprocessing, multitasking, multiuser; interrupt-driven, supports spooling and device independence	$9900 for IBM Series/1, $4000 for all others
general-purpose	supports swapping; random organization, ISAM, disk-space allocation via extents	multitasking, 64 users; interrupt-driven, supports spooling and device independence	$450, including boot PROMs
development, general-purpose	supports overlays, swapping and chaining; random organization, ISAM, single-contiguous allocation	multitasking; interrupt-driven	$500
general-purpose	supports overlays, swapping and chaining; random organization, disk-space allocation via extents	single-user; interrupt-driven, supports spooling and device independence	$79.95
development, process-control, general-purpose	supports overlays, swapping and chaining; random organization, single-contiguous allocation	multitasking, multi-user; interrupt-driven, supports spooling and device independence	$1500 to $5000
general-purpose	supports overlays; random organization, ISAM, allocation via linked list of sectors	single-user	bundled
general-purpose	supports overlays, swapping and chaining; tree organization, ISAM, allocation via extents	multiprocessing, multitasking, seven users; interrupt-driven, supports spooling and device independence	$295
development, process-control, general-purpose	supports overlays, swapping and chaining; random organization, ISAM (for Business BASIC), linked/index allocation	multitasking, four users; interrupt-driven, supports device independence	$700
general-purpose	supports overlays, swapping and chaining; random organization, ISAM, single-contiguous and linked list of sectors allocation	multitasking, four users; interrupt-driven, supports spooling and device independence	
development, process-control, general-purpose	supports overlays, swapping and chaining; random organization, ISAM, indexed/element allocation structure	multitasking, multi-user; interrupt-driven, supports device independence	$1500 initial, $500 subsequent
development, process-control, general-purpose	supports overlays and chaining; random organization, single-contiguous allocation	multitasking; interrupt-driven, supports spooling and device independence	$250 (minimum)
development, process-control, general-purpose	supports overlays and chaining; random organization, allocation via extents	single-user; supports spooling and device independence	$150

Company	OS Name	Target Systems; Languages Supported	Min. Hardware Configuration
Digital Research, Inc.	CP/NET 1.0	8080, 8085, Z80; assembler, BASIC, APL, FORTH, LISP, C, COBOL, FORTRAN, Pascal, PL/1	32K bytes of RAM at masters, 20K bytes at slaves; console devices and disk subsystems at both masters and slaves
	MP/M 1.1	8080, 8085, Z80; assembler, BASIC, APL, FORTH, LISP, C, COBOL, FORTRAN, Pascal, PL/1	32K bytes of RAM, console device, disk subsystems
FORTH, Inc.	polyFORTH	8080, 8086, 9900, 6800, 6809, 1802, LSI-11, PDP-11, NOVA 4, IBM Series/1, EXORciser, TI 990, COSMAC; assembler, FORTH	16K bytes of RAM, serial interface, terminal, disk drive
Heath Co.	HDOS	8080, Z80, H-8, H-89; assembler, BASIC, C, FORTRAN	32K bytes of RAM, console, disk system
Hemenway Associates, Inc.	CP/68	6800; macro and cross assemblers, STRUBAL+	16K bytes of RAM, floppy-disk drive, console
	SP/8086, SP/Z8000, SP/68000	8086, Z8000, 68000; macro assembler, Pascal/I	16K bytes of RAM, floppy-disk drive, console
	M²SP/8086, M²SP/Z8000, M²SP/68000	8086, Z8000, 68000; macro assembler, Pascal/I	32K bytes of RAM, floppy-disk drive, real-time clock, console
Hewlett-Packard Co.	RTE-L	HP-1000L; assembler, BASIC, FORTRAN, Pascal	32K bytes of RAM
Hughes Aircraft Co.	DDOS, CP/M	1802, Z80, 8080, 8085, 1804, 8048, 6502, 6800, 6809, others; assembler	16K bytes of RAM
Industrial Programming, Inc.	MTOS-68, MTOS-11	6800, LSI-11; assembler	1K byte of RAM, 3K bytes of ROM
	MTOS-80	8080; assembler, FORTRAN, PL/M	1K bytes of RAM, 3K bytes of ROM
	MTOS-86	8086; assembler, PL/M	1K byte of RAM, 7K bytes of ROM
Infosoft Systems, Inc.	I/OS	Z80, 8080, 8085; assembler, BASIC R, MBASIC, BASIC, FORTH, PILOT, MUMPS, FORTRAN, COBOL, Pascal, AS/Pascal, C	24K bytes of RAM, 80K-byte floppy-disk drive, terminal
Intel Corp.	iRMX 80	8080, 8085; assembler, BASIC, FORTRAN, Pascal, PL/M	2K bytes of RAM, iSBC 80/10, 80/20-4, 80/24 or 80/30
	iRMX 86	8086; assembler, FORTRAN, Pascal, PL/M	16K bytes of RAM, MCS-86, 8253, 8259A
	ISIS	8080,8085,8086, 8088, 8089, Intellec MDS; assembler, BASIC, Pascal, PL/M, FORTRAN	Typically 64K bytes of RAM, plus terminal or printer
Kontron Electronics, Inc.	KOS	Z80A, PSI80; assembler, BASIC, COBOL, FORTH, FORTRAN, Pascal	64K bytes of RAM, 16K bytes of video-refresh memory, video controller, floppy-disk drive controller
Lifeboat Associates	CP/M	8080, 8085, Z80; assembler	24K bytes of RAM, disk system
Microsoft	MIDAS	8080, Z80; Macro-80, BASIC-80, COBOL-80, FORTRAN-80	48K bytes of RAM, real-time clock
	XENIX (enhanced version of Western Electric's UNIX)	Z8000, PDP-11/45, PDP-11/70; assembler, BASIC, C, others	approx. 96K bytes of RAM
Monolithic Systems Corp.	MSOS	Z80, MSC 8001, MSC 8004, MSC 8007, MSC 8009; assembler	16K bytes of RAM, floppy-disk drive controller

Primary Applications	Memory Management; File Management	Processor Allocation; Peripheral Management	Price
development, process-control, general-purpose	supports overlays and chaining; random organization, allocation via extents	multiprocessing, multitasking, multi-user; interrupt-driven, supports spooling and device independence	$150
development, process-control, general-purpose	supports chaining; random organization, allocation via extents	multiprocessing, multitasking, multi-user; interrupt-driven, supports spooling and device independence	$300
development, process-control, general-purpose	supports overlays and chaining; random organization, ISAM, single-continuous allocation	multitasking, multi-user; interrupt-driven, supports spooling and device independence	$4750
development, general-purpose	supports overlays, swapping and chaining; random organization, allocation via linked list of sectors	single-user; interrupt-driven, limited support of device independence	$195
development, general-purpose	supports overlays and chaining; random organization, disk-space allocation via linked list of sectors	single-user; supports device independence	$150
development, process-control, general-purpose	supports overlays and chaining; random organization, allocation via linked list of sectors	single-user; interrupt-driven, supports device independence	$500
development, process-control, general-purpose	supports overlays and chaining; random organization, allocation via linked list of sectors	multitasking, multi-user; interrupt-driven, supports spooling and device independence	$750
development, process-control, general-purpose	supports overlays, swapping and chaining; random organization, allocation via extents	multiprocessing, multitasking; interrupt-driven, supports device independence	$2500
development, general-purpose	supports overlays, swapping and chaining; single-continuous allocation	multiprocessing, multitasking, six to eight users; interrupt-driven, supports spooling	
process-control, general-purpose		multitasking; interrupt-driven	$3500 minimum, including sources
process-control, general-purpose		multitasking; interrupt-driven	$3500 minimum, including sources
process-control, general-purpose		multitasking; interrupt-driven, supports device independence	$4500 to $16,000, including sources
development, process-control, general-purpose	supports overlays and chaining; random organization, ISAM, allocation via extents	multiprocessing, multitasking, multi-user; interrupts allowed, spooling and device independence supported	$150
process-control	supports overlays; random organization, allocation via extents	multitasking; interrupt-driven, supports device independence	$3000
development, process-control, general-purpose	random organization, allocation via extents	multitasking; interrupt-driven, supports device independence	$7500, plus per-use royalty
development	supports overlays, swapping and chaining; random organization	multiprocessing; interrupt-driven, supports device independence	bundled
development, process-control, general-purpose	supports overlays; random organization, allocation via linked list of sectors	single-user; interrupt-driven, supports spooling and device independence	
general-purpose	supports chaining; allocation via extents	single-user; interrupt-driven, supports device independence	$170
general-purpose	random organization, allocation via clusters	multitasking, four to eight users; interrupt-driven, supports device independence	
development, general-purpose	supports overlays, swapping and chaining; allocation via linked list of sectors	multitasking, one to 12 users; interrupt-driven, supports spooling and device independence	
development, process-control, general-purpose	supports swapping and chaining; ISAM, allocation via linked list of sectors	single-user; interrupt-driven, supports device independence	$900

Company	OS Name	Target Systems; Languages Supported	Min. Hardware Configuration
Mostek Corp.	FLP80DOS	Z80; macro assembler, BASIC, FORTRAN	32K bytes of RAM
Motorola Semiconductor Products, Inc.	MDOS	MC68000, MC6809; macro assembler, BASIC, BASIC-M, COBOL, FORTRAN, MPL, Pascal	16K bytes of RAM, terminal, disk drive, printer
	RMS09	MC6809; macro assembler, BASIC, MPL	8K bytes of RAM, Micromodule 19/19A
National Semiconductor Corp.	Starplex-II	8080, Z80A; macro assembler, BASIC, FORTRAN, Pascal, PL/M	64K bytes of RAM
Ohio Scientific, Inc.	OS-65D	6502, C2-C3 series; assembler, BASIC	24K bytes of RAM, floppy-disk drive
	OS-65U Level I	6502, C2-C3 series; BASIC	32K bytes of RAM, dual floppy-disk drives or hard-disk drive
	OS-65U Level III NETWORK	6502, C3-B, C3-C; BASIC	104K bytes of RAM, hard-disk drive, two RS232 ports, real-time clock on floppy controller
	OC-SP/M	Z80, C3 series; assembler, BASIC, COBOL, FORTRAN	56K bytes of RAM
Omnibyte Corp.	ODOS	6800, OB 800, OB 850; assembler, BASIC, STRUBAL+	8K bytes of RAM, 2K bytes of PROM, floppy-disk drive, console
Ontel Corp.	HDOS	8080, 8085, Ontel OP-1; assembler, BASIC, FORTRAN, OPL, Pascal	32K bytes of RAM, hard-disk drive and controller
	MDOS	8080, 8085, Ontel OP-1; assembler, BASIC, FORTRAN, OPL, Pascal	32K bytes of RAM, floppy-disk drive and controller
	MFTOS	8080, 8085, Ontel OP-1; BASIC, OPL	32K bytes of RAM
Pascal Development Co.	PASDOS	Z80, 8080, 6800; assembler, Pascal, BASIC (compiles to P-Code)	Tektronix 8002 development system with 48K bytes of RAM, 2K bytes of RAM in target system
Perkin-Elmer Terminals Division	PETOS	6800; macro assembler, BASIC	16K bytes of RAM
Phase One Systems, Inc.	OASIS	Z80; macro assembler, BASIC, COBOL, FORTRAN, Pascal	48K bytes of RAM, dual disk drives
Point Four Data Corp.	IRIS	microNOVA; absolute and macro assemblers, BASIC, Pascal	48K bytes of RAM, 250K bytes of disk storage, terminal

Primary Applications	Memory Management; File Management	Processor Allocation; Peripheral Management	Price
development	supports chaining; allocation via linked list of sectors	single-user; interrupt-driven, supports device independence	negotiable
development	supports chaining; random organization, allocation via extents	single-user; supports device independence	
process-control		multitasking; interrupt-driven, supports device independence	
development, general-purpose	supports overlays and chaining; random organization, allocation via linked list of sectors	multiprocessing, multitasking, eight users; interrupt-driven, supports spooling and device independence	bundled
general-purpose	random organization, single-contiguous allocation	single-user	
general-purpose	random organization, single-contiguous allocation	single-user	
general-purpose	random organization, single-contiguous allocation	maximum of eight users; interrupt-driven	
development, general-purpose	supports overlays and chaining; random organization, allocation via extents	single-user; supports device independence	
development, process-control	single-contiguous allocation	single-user	$200
development, general-purpose	supports overlays and chaining; random organization and ISAM (for OPL only), allocation via linked list of sectors	multitasking (for OPL only), eight users; supports spooling and device independence	negotiable
development, general-purpose	supports chaining (OPL only) and overlays; random organization and ISAM (for OPL only), allocation via linked list of sectors	multitasking (for OPL only)	
process-control, general-purpose	random organization and ISAM (for OPL only), allocation via linked list of sectors	multitasking,multi-user; interrupt-driven, supports spooling and device independence	
development, process-control	supports overlays, swapping and chaining; random organization, single-contiguous allocation	single-user; interrupt-driven	$3500
development, process-control, general-purpose	supports overlays and chaining; random organization	multitasking; interrupt-driven, supports device independence	
development, general-purpose	supports overlays and chaining; random organization, ISAM, allocation via linked list of sectors	multitasking, 16 users; interrupt-driven, supports spooling and device independence	with source code, $500 single-user, $850 multi-user; OS only, $150 single-user, $350 multi-user
general-purpose	supports overlays, swapping and chaining; random organization and ISAM, single-contiguous, extent and linked list of sectors allocation	multitasking, 128 users; interrupt-driven, supports spooling and device independence	$3600

Company	OS Name	Target Systems; Languages Supported	Min. Hardware Configuration
RCA Solid State Division	CDOS	CDP1802, CDP18S007, CDP18S008; macro assembler, BASIC I, BASIC II, FORTH, PLM 1800, VIS	28K bytes of RAM, single-density disk drive
Smoke Signal Broadcasting	DOS68, DOS69	6800 (DOS68), 6809 (DOS69); macro assembler, BASIC, COBOL, FORTRAN, UCSD Pascal	8K bytes of RAM, disk drive controller
SofTech Microsystems	UCSD System Software	6502, 6800, Z80, 8080, 6809, 9900, LSI-11, PDP-11; assembler, Pascal, FORTRAN (compiles to P-Code)	48K bytes of contiguous RAM, 175K bytes of disk storage, ASCII terminal
Software Dynamics	SDOS	6800, 6809, Motorola EXORciser, Conrac 480, Wave Mate; assembler, MSI BASIC, Business BASIC	48K bytes of RAM, dual floppy-disk drives, CRT terminal, printer
Systemathica Consulting Group Ltd.	DIOS	8080, 8086; assembler, BASIC, FORTRAN, Pascal, PL/1, PL/M	depends on capabilities implemented
Technical Systems Consultants, Inc.	UniFLEX	6809, 68000; macro, relocating and cross assemblers, BASIC, C, Pascal	96K bytes of RAM, memory management, DMA-driven disk controllers, interrupt-driven I/O
Tektronix, Inc.	TEKDOS	2650/280, Tektronix 8002A; assembler, MDL/8080/8085/Z80, MDL/6800, FORTRAN-80, SCI-PLMX	32K bytes of RAM, 8002A MDL
Telecompute Integrated Systems, Inc.	TIS-APL	Z80, Altos Super Brain, TRS-80 Model II, North Star Sorcerer; APL	64K bytes of RAM
Texas Instruments Inc.	Component Software	9900 family; assembler, BASIC, Pascal	3K bytes of RAM, 6K bytes of ROM
Western Digital Corp.	UCSD Pascal	Western Digital Microengine; Pascal	64K bytes of RAM, 8-in. floppy-disk drive, terminal
Wintek Corp.	WIZRD	6800, Sprint 68; assembler, BASIC, C, PL/W	32K bytes of RAM, serial I/O
Xycom, Inc.	Industrial Pascal	all Xycom boards and packages; Z80 assembler, FORTRAN 77, Pascal	60K bytes of RAM in development system, 16K bytes in target, dual floppy-disk drives for development system, CRT terminal
Zilog, Inc.	RIO, Versions 2 and 3	Z80, MCZ 1, ZDS, PDS 8000; assembler, BASIC, COBOL, FORTRAN, Pascal, PLZ/SYS	64K bytes of RAM, Z80 MDC board, Z80 MCB board, disk drives
	RIO/CP (Concurrent Processing)	Z80A, MCZ-2 series, SDS 2/01; assembler, BASIC, COBOL, PLZ/SYS	64K bytes of RAM, MCZ-2 microcomputer or SDS 2/01

Primary Applications	Memory Management; File Management	Processor Allocation; Peripheral Management	Price
development	random organization, allocation via linked list of sectors	single-user; supports device independence	
development, general-purpose	supports overlays, swapping and chaining; random organization, ISAM, allocation via linked list of sectors	multitasking; interrupt-driven, supports spooling and device independence	$75
development, general-purpose	supports overlays; random organization, single-contiguous allocation	single-user, future version will be multitasking; supports device independence	
development, general-purpose	supports chaining; random organization, allocation via extents	multitasking, eight users; interrupt-driven, supports device independence	$700, including BASIC compiler
development, process-control, general-purpose	supports overlays; random organization, allocation via extents or linked list of sectors	multitasking, multi-user; interrupt-driven	
development, process-control, general-purpose	supports overlays, swapping and chaining; random organization	multiprocessing, multitasking, multi-user; interrupt-driven, supports spooling and device independence	$350
development	supports overlays and chaining; random organization, allocation via extents	multiprocessing, multitasking; interrupt-driven, supports device independence	bundled
general-purpose	supports overlays and chaining; random organization, single-contiguous allocation	multiprocessing, multi-user; supports device independence	
process-control, general-purpose	random organization, allocation via extents	multitasking; interrupt-driven, supports device independence	
development, general-purpose	supports overlays; random organization, single-contiguous allocation	multitasking, interrupt-driven	$300
development, process-control, general-purpose	random organization, allocation via linked list of sectors	multitasking; interrupt-driven, supports spooling and device independence	$495
development, process-control, general-purpose	supports overlays; random organization, single-contiguous allocation	multiprocessing, multitasking; interrupt-driven, supports device independence	bundled
development, general-purpose	supports overlays and chaining; random organization (Version 3 only), ISAM (with COBOL only), allocation via linked list of sectors (Version 2) or random-access table of pointers	single-user; interrupt-driven, supports spooling (Version 3 only) and device independence	$500, or free with system
general-purpose	supports overlays and chaining; random organization, ISAM (with COBOL only), allocation via random-access table of pointers to sectors	multitasking; interrupt-driven, supports spooling and device independence	$500

A file-management system can make or break an operating system because it is the most visible resource to the user.

impaired or seriously degraded. Computerized oil-refinery control is a good example of an application requiring a real-time operating system. Intel's RMX80 and RMX86, and RX from Texas Instruments are good examples of process-control operating systems.

General-purpose operating systems are usually associated with business or scientific applications. Digital Research's CP/M, for example, finds applications in word processing, accounts receivable and mailing-list maintenance.

One other classification that cuts across the three above is that of multi-user versus single-user. Any of the three types can be further described as either multi- or single-user. A multi-user operating system provides computational services to many on-line users. It achieves the effect of simultaneous service to each user by sharing system resources in a round-robin fashion. Each user, in turn, gets an equal allocation of system resources, and no user gets more than any other, unless a priority scheme overrides someone's turn or allocates more resources to a higher-priority user.

A single-user operating system usually allows a single user to submit jobs serially for execution. In a development operating system, for example, the user might edit a file, compile it and then execute it.

The key: resource management

Fig. 4 expands on the operating-system layer in Fig. 1. The operating system manages resources by allocating them on the basis of user needs and system capabilities. The operating system is able to allocate because it maintains lists of available resources, noting which user has control of a resource and who has the highest priority. If user requests exceed system capabilities, the operating system must decide what effect granting a particular resource will have on the system, and act accordingly.

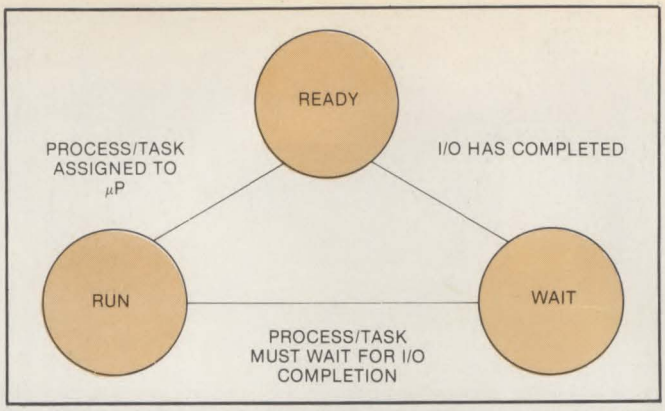


Fig. 3. A state diagram *depicts the possible states a process or task can experience and the reasons for the various transitions.*

The operating system allocates four resources: processor time, memory space, I/O devices and files. In an unsophisticated system, the operating system allocates all hardware as one resource unit; a user either controls the machine or is waiting to control it. Although this strategy is easy to implement, it does not always use equipment efficiently. A running program might not use any I/O devices, for example, causing unused devices to remain idle. A more sophisticated operating system can deal with this problem: Peripherals can operate concurrently with the microcomputer, allowing one program to be executing on the microcomputer while another executes an I/O operation. This scheme makes greater use of each device, but because a program needs the microcomputer to start an I/O operation, allocation of microcomputer time becomes difficult, though not unsolvable.

Main memory is an expensive resource that must be used efficiently. Microcomputer allocation and memory management are closely related. Programs must reside in main memory for execution, and memory is wasted if a loaded program lacks a high enough priority to receive microcomputer time. The operating system requires considerable time to pack memory effectively,

BUILD YOUR OWN OPERATING SYSTEM FROM 'COMPONENTS'

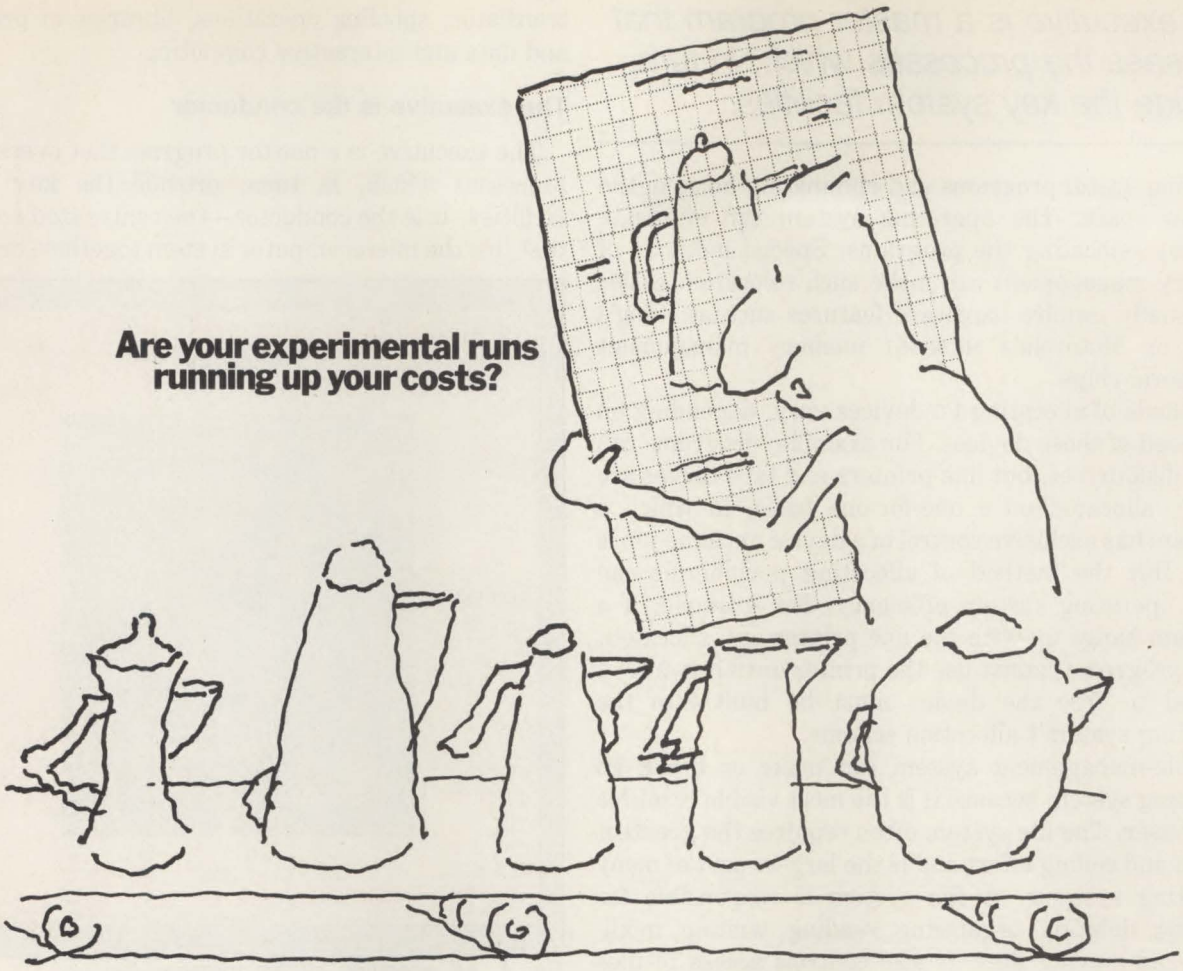
Just as engineers can assemble a microcomputer from a set of semiconductor chips, software designers can build a custom microcomputer operating system for the TI 9900 family from a set of software "components" offered by Texas Instruments Inc. The process requires two steps—selecting the required software components, which TI provides in source form, and customizing them to fit the application.

The real-time executive (TMSW330R) software components is a multitasking executive that supports multiprogramming and reentrancy in code. Independent sites of execution (processes) exist within a single environment and share a single processor. One process may be interrupted by the executive when another, more urgent, process is ready to execute. Various user-transparent constructs within the real-time executive support this multiprogramming environment.

The file manager (TMSW340F) software component is a set of procedures supporting file operations for the TM990 microprocessor family. These procedures are combined to form file-manager packages of different levels of complexity to fit the user's needs.

The file manager creates, manages and manipulates data files on mass-storage devices. It is device independent and operates on hard disks, floppy disks, bubble-meory modules and microdisks. The file manager supports the TM990/303 floppy-disk controller, in both IBM single- or double-density format and TI's DSG double-density format.

Run-time support is available for native code or interpretive execution within the microprocessor Pascal system and for native code execution of assembly language in the real-time executive. Users can custom-fit a file-manager package to meet their application needs by choosing different combinations of these modules.



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CIRCLE NO. 78 ON INQUIRY CARD

The executive is a master program that oversees the processes which, in turn, provide the key system facilities.

retaining useful programs and eliminating holes in the address space. The operating system can eliminate holes by relocating the programs. Special methods of memory management can make such relocation easier but usually require hardware features such as Zilog's Z8010 or Motorola's MC68451 memory-management peripheral chips.

Methods of allocating I/O devices vary, depending on the speed of those devices. For example, programs can share disk drives, but line printers and tape drives are usually allocated on a one-for-one basis, in which a program has exclusive control of a device until the job is done. But the method of allocating peripherals can affect operating system efficiency. For example, if a program hangs up with the line printer still allocated, other programs cannot use the printer until it is free; a method to free the device must be built into the operating system's allocation scheme.

A file-management system can make or break an operating system because it is the most visible resource to the user. The file system often requires the greatest design and coding effort and is the largest part of many operating systems. A file system is responsible for creating, deleting, organizing, reading, writing, modifying and moving files. It also controls access to files and manages the resources used by the files. The file system permits the use of more than one language translator, spooling operations, libraries of programs and data and interactive computing.

The executive is the conductor

The executive is a master program that oversees the processes which, in turn, provide the key system facilities. It is the conductor—the centralized authority that ties the microcomputer system together, organizes

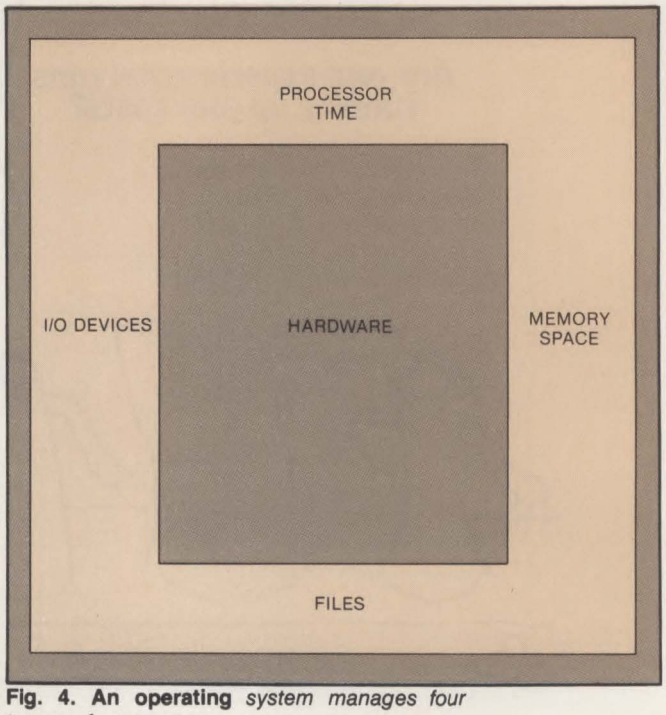


Fig. 4. An operating *system manages four types of resources.*

A CHECKLIST FOR OPERATING-SYSTEM EVALUATION

When faced with evaluating a new microcomputer operating system, an easy way to proceed is to use a checklist. Here is the checklist used to gather information for the accompanying directory.

General

- Name of operating system?
- Primary application—development, process control, general purpose?
- Target processor and model?
- Sysgen program available?
- Languages supported?
- Language(s) system written in?
- System RAM resident? Disk resident? Both RAM and disk resident?
- System ROMable?
- Date first released?
- Minimum hardware required?
- Networking supported? How, and to what extent?
- Source available? Single-unit price?

Processor allocation management

- System vs. user mode supported?
- Multitasking? If yes, how many tasks allowed? Intertask communication? Can tasks start/stop/suspend other tasks?
- Multi-user? If yes, how many users supported? Minimum RAM needed per user?
- Multiprocessing? If yes, how many microcomputers supported? What synchronizing scheme used?
- If multitasking or multi-user, what type of synchronizing scheme used (semaphores, monitors, mailboxes, other)?

Memory management

- Single contiguous allocation?
- Overlays supported?
- Swapping supported?
- Chaining supported?
- Segmentation supported?
- Static relocation supported?
- Dynamic relocation supported?
- When is binding done (assembly/compilation time, linking time, loading time)?
- Memory protection available?

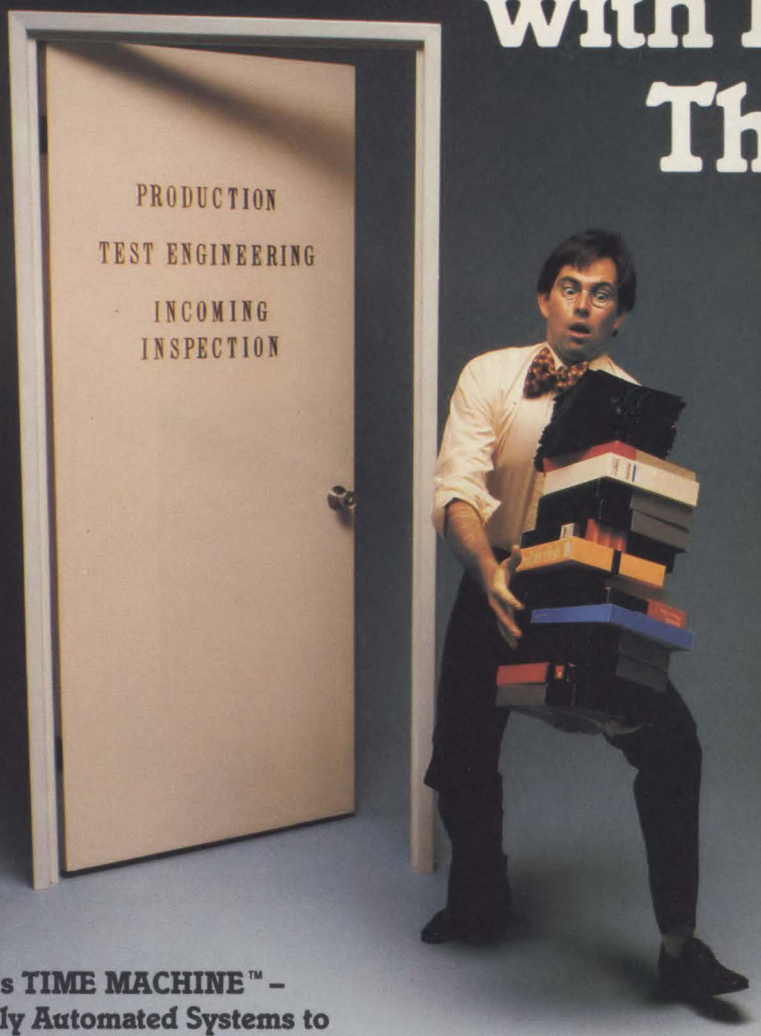
Peripheral management

- What peripherals are supported?
- Are interrupts used?
- I/O multibuffering used?
- Spooling supported?
- DMA supported?
- Device independence supported?
- Can one configuration support more than one different type of mass-storage device (e.g., a mix of hard disks and floppies)?

File management

- Named file system?
- Sequential organization supported?
- Contiguous organization supported?
- Random organization supported?
- Indexed sequential (ISAM) supported?
- Multilevel directory supported?
- What type of allocation used: linked list of sectors, extents, single contiguous?
- Is the file management system accessible from an HLL?
- Are there constructs in the HLL to support file access,or is it done with assembler subroutine calls?
- Password/security protection available?

A Tip for Disk Handlers with No Time on Their Hands.



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At last, you can be first. While your competition is using out-dated disk processing equipment for checking, formatting or copying—your floppy disk operation productivity increases.

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With controllers and additional certification software, you can certify and initialize up to 50 disks in one fell swoop– automatically.

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The Time Machine systems are self diagnostic, and that means faster and easier maintainability.

Whether you're producing, testing or copying floppies for distributing software updates, MST has the answer. It's about time.

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Santa Ana, CA 92705
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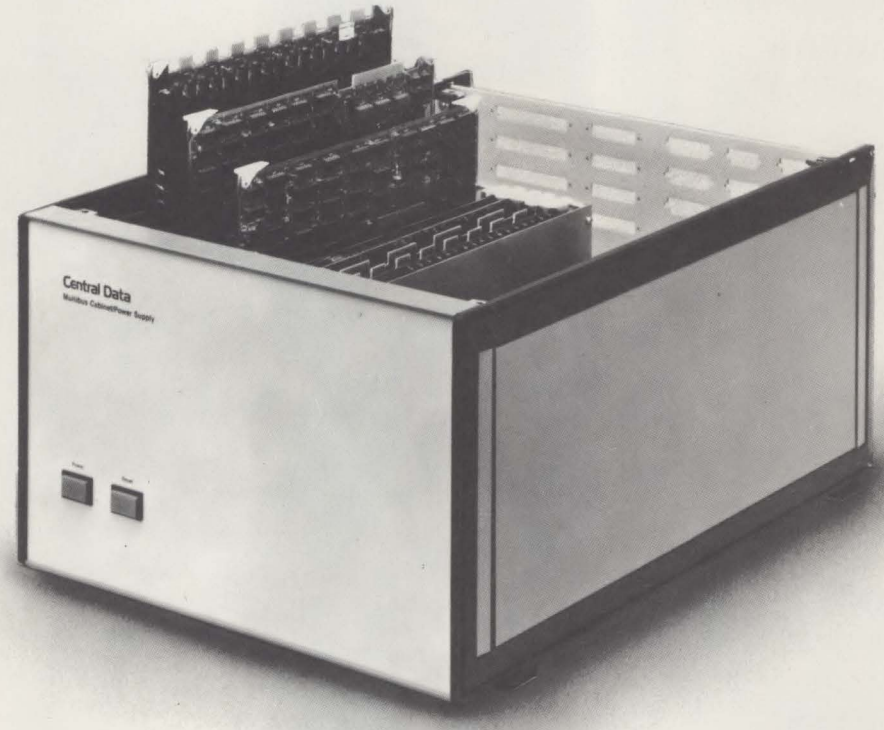
CIRCLE NO. 79 ON INQUIRY CARD

From the experts who designed the heart of the system...



The Roloff System

Until now, the limitations of 8-bit microprocessors made the development of multi-user systems for micro-computers impractical and unattractive. The Roloff System has conquered those limitations by exploiting the performance potential of the 16-bit microprocessor. Roloff system's 16 bit zilog Z8000 processor has five to ten times the throughput of its 8-bit counterpart, giving it the extra power to handle the burden of communicating with several terminals at once. And Roloff systems put that power to work with an advanced operating system never before used in microcomputers.

The Roloff system supports from one to 32 users simultaneously, each running a different program. The system can range from 1-32 terminals or printers and 96K to 16M bytes of internal RAM. For disk storage, it can accommodate from 2M to over 250M bytes using floppy, winchester or cartridge disk interfaces.

A time-saving indexed file system efficiently stores and retrieves data using multiple keyed fields. Searching from an index instead of reading a long file saves many disk operations and allows more than one user to access the same information at once.

Users can "talk" to each other through the terminals with Roloff Systems advanced communications system. Notes files, both personal and general, can be accumulated and displayed using simple commands. A special paging function enables users to conduct typed "conversations" with each other. A tone from the terminal pages the user and the two-way message is displayed on the screen.

A reliable but simple security system protects files from unauthorized access. Every file on the system can have read access or read/write access for certain individuals. Most users will not have to type any passwords once they have signed onto the system, yet all data bases are still protected from unauthorized entry.

Fast response is the benefit of Roloff Systems file cataloging. When all users leave a program, the system can catalog it for quick access later. If a user selects a program that is already being used, in most cases both users can share the program in memory.

System components are "state of the art" and go through extensive quality control tests and burn-in procedures to insure reliability. Floppy disk, Cartridge disk, winchester disk, and cartridge tape drives are available.

Options include selection of internal memory size, disk memory type, arithmetic processing units, and I/O interface boards. The versatile Intel Multibus allows the user to expand the system by purchasing boards from many different manufacturers. You can start with a small system and easily enlarge it, without making any changes in original programming.

And Roloff Systems is Central Data

Since 1975, Central Data Corporation has been designing and manufacturing an innovative line of CPU boards. Central Data's engineers have incorporated their years of experience with the heart of the system into a revolutionary multi-user system. Each system is custom-designed for the user's special requirements. For detailed information on how easily the Roloff System can go to work for you, write or call us:
(217) 359-8010 TWX 910-245-0787

The Roloff System

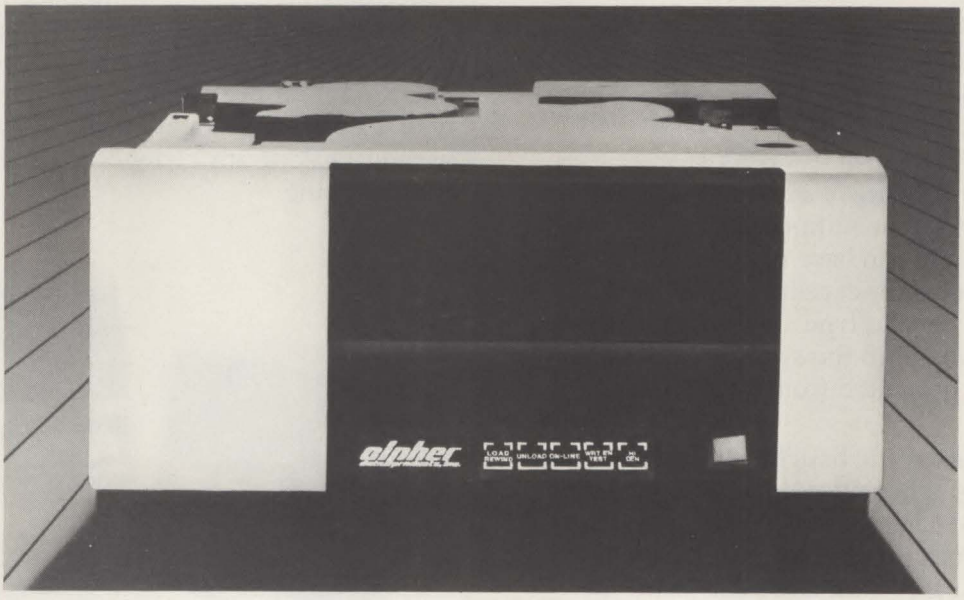
Central Data Corporation

P.O. Box 2530, Station A
713 Edgebrook Drive
Champaign, IL 61820

CIRCLE NO. 80 ON INQUIRY CARD

The Tape technology of the future is here...

...and it costs less than what you're paying for standard 1/2 tape drives.



It's the Microstreamer™ from Cipher Data Products and it's designed with advanced tape motion techniques for applications such as data acquisition, computer output microfilm, computer graphics, mass storage for sequential files. And more.

Performs like a conventional IBM compatible tape drive but has unique new features...

and still costs less.

For most of these applications, the Microstreamer is a perfect replacement for standard start/stop drives and you get auto load, internal diagnostics, advanced packaging, dual speed, plus 100 ips for high speed **disk backup—FREE.**

And anyone can use it,

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Controllers are available for interfacing the Microstreamer to just about anyone's minicomputer or microcomputer. From PDP-11's, LSI-11's and Novas to CPU's that use Multibus, S100 or IEEE-488 interfacing. The kind of system you configure is limited only by your imagination. And using dual purpose Microstreamers can simplify your system design.

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CIRCLE NO. 81 ON INQUIRY CARD

Scheduling job execution, accounting for resources and interpreting a job-control language are all tasks of the executive, which also provides links to connect programs.

DISK-FILE TYPES AND CHARACTERISTICS

TYPE	SEQUENTIAL	
SUBSET	Contiguous	Noncontiguous
DESCRIPTION	Files allocated to adjacent sectors	Files allocated to nonadjacent sectors
ADVANTAGES	Orderly file access; minimum disk-head movement	Allows dynamic file management and efficient data control
LIMITATIONS	File deletion requires packing or compressing	Requires greater amount of head movement
TYPE	RANDOM	
SUBSET	Byte addressable	Record addressable
DESCRIPTION	Files independently accessible by bytes	Files independently accessible by records
ADVANTAGES	Can deal with file subsets without sequential searches through the file	Can deal with file subsets without sequential searches through the file
LIMITATIONS	Files not easily enlarged	Files not easily enlarged

cooperating processes and provides the means of communication and synchronization among processes and devices. The executive also controls allocation of all system resources and facilities.

Further, the executive is responsible for sequencing and controlling system jobs. Scheduling job execution, accounting for the resources those jobs consume and interpreting a job-control language all facilitate job throughput, and are all tasks of the executive, which also provides links to connect programs. When two programs want to communicate with each other, they ask the executive to establish a communications path, over which they can talk by means of a system-defined mechanism, such as an executive call.

To ensure smooth operation, the executive must enforce the rules on both the system and its users. For example, the executive ensures that a process receives only its allocated share of processor time or memory region, governing execution time for that process and the quantity of output to a printer or disk. In addition to allocating resources, the executive provides some facilities itself. It contains a set of utility routines for such processes as dumps and online message handling. It might also house a storage area for communication purposes and tables for the protection system. Finally, it may be responsible for job-control-language processing and the system-console interface. ■

Jack Hemenway is president of Hemenway Associates, Inc., a Boston-based software house specializing in system software for microcomputers.

REFERENCE LITERATURE

For more information on the microcomputer operating systems surveyed in this article, use the reader circle numbers listed below.

Company	Circle No.
Advanced Micro Computers, Sunnyvale, Calif.	362
Altos Computer Systems, Inc., San Jose, Calif.	363
American Microsystems, Inc., Santa Clara, Calif.	364
Apple Computer, Inc., Cupertino, Calif.	365
Applied Systems Corp., St. Clair Shores, Mich.	366
The Boston Systems Office, Inc., Waltham, Mass.	367
CAP-CPP, Inc., Princeton, N.J.	368
Central Data Corp., Champaign, Ill.	369
CGRS Microtech, Inc., Southampton, Pa.	370
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Smoke Signal Broadcasting, Westlake Village, Calif.	400
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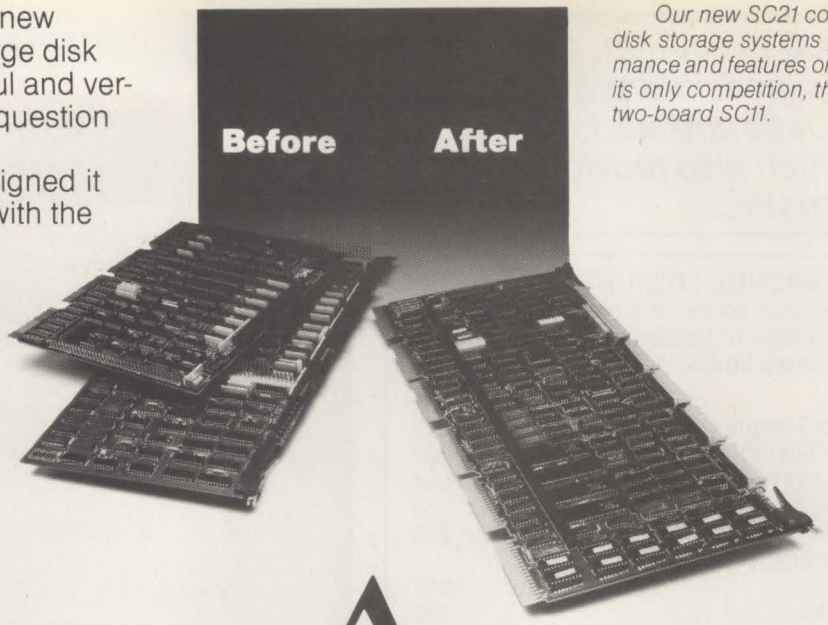
Software Dynamics, Anaheim, Calif.	402
Systemathica Consulting Group, Ltd., Pittsburgh, Pa.	403
Technical Systems Consultants, Inc., W. Lafayette, Ind.	404
Tektronix, Inc., Beaverton, Ore.	405
Telecompute Integrated Systems, Inc., Toronto, Ontario, Canada	406
Texas Instruments Inc., Houston, Texas	407
Western Digital Corp., Newport Beach, Calif.	408
Wintek Corp., Lafayette, Ind.	409
Xycom, Inc., Saline, Mich.	410
Zilog, Inc., Cupertino, Calif.	411

Introducing the new Emulex SC21, the large disk controller so powerful and versatile you're likely to question our sanity.

You see, we designed it to directly compete with the



Our new SC21 controller for PDP-11 disk storage systems packs more performance and features onto one board than its only competition, the industry standard two-board SC11.

A company that redesigns its bestseller ought to be committed.

industry's leading controller for PDP-11/04-60 and VAX users.

Unlike the leader, it requires one board, one slot. Not two. And it delivers more features, flexibility and system-boosting performance than the leader. For less money.

The catch, of course, is that the leader is us. The SC21 is an upgrade of our own SC11, the first product of its kind and a bestseller ever since. Over 750 in the field.

A real winner. Should we be committed for not leaving well enough alone?

Actually, we've been committed from the start.

Committed to bringing the best value to DEC users.

Committed to building a solid, technologically superior company.

Consider the SC21 as proof.

It interfaces up to four drives for greater capacity. Switch-selectable versatility lets you mix drives of varying capacities and configurations. There's new bus efficiency to speed things up. And lower power consumption to cool things down.

And there's a new Emulex exclusive, Adaptive DMA Throttle. It optimizes the controller's DMA thruput while avoiding contention with other bus devices. With dynamic DMA control and three sector buffering, it optimizes operating rates regardless of I/O configuration.

The SC21 is compatible with its trend-setting forerunner. Same proven microcode, in fact. Three versions emulate all DEC disk subsystems using any industry standard drive with SMD interface. Diagnostic and software transparency, of course.

Obviously, there's method to our madness. For details on the industry's broadest line of disk and tape controllers, write us. Emulex Corporation, 2001 Deere Avenue, Santa Ana, CA 92705.

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CIRCLE NO. 82 ON INQUIRY CARD

DISTRIBUTED PROCESSING

Multiprocessing networks vs. mainframes

MICHAEL ROBERTS, ECS Microsystems, Inc.

First of two parts

Systems built around microprocessor-based information stations will soon rival the speed, power and capacity of some mainframes

Multiprocessing networks of powerful microprocessor-based information stations, successors to today's programmable intelligent terminals, soon will offer more usable power and better economics in many applications than do mainframes. The arithmetic of a multiple microcomputer system adds up to 5, 7, 10, to N times the processor power for equal or lower cost. Using a "hyperdata bus," which carries more data at higher speeds than other buses, a multiple microprocessor array expands not only accessibility with the addition of each information station, but also speed and storage capacity. The mainframe does the opposite: more terminals mean less power, speed and capacity.

Until recently, cost has been the major deterrent to such multi-microprocessor systems, because the collection of small processors needed to equal the capability of a mainframe uniprocessor has been more expensive. However, microprocessor and memory technology has evolved to the point that low-cost computer power presents an increasingly attractive alternative to mainframes for many computing tasks.

As technology fuses more systems onto a chip, these information stations, incorporating powerful 16-bit microprocessors and as much as 250K bytes of local memory, will cost little more than today's intelligent terminals. For example, a multiprocessing network of

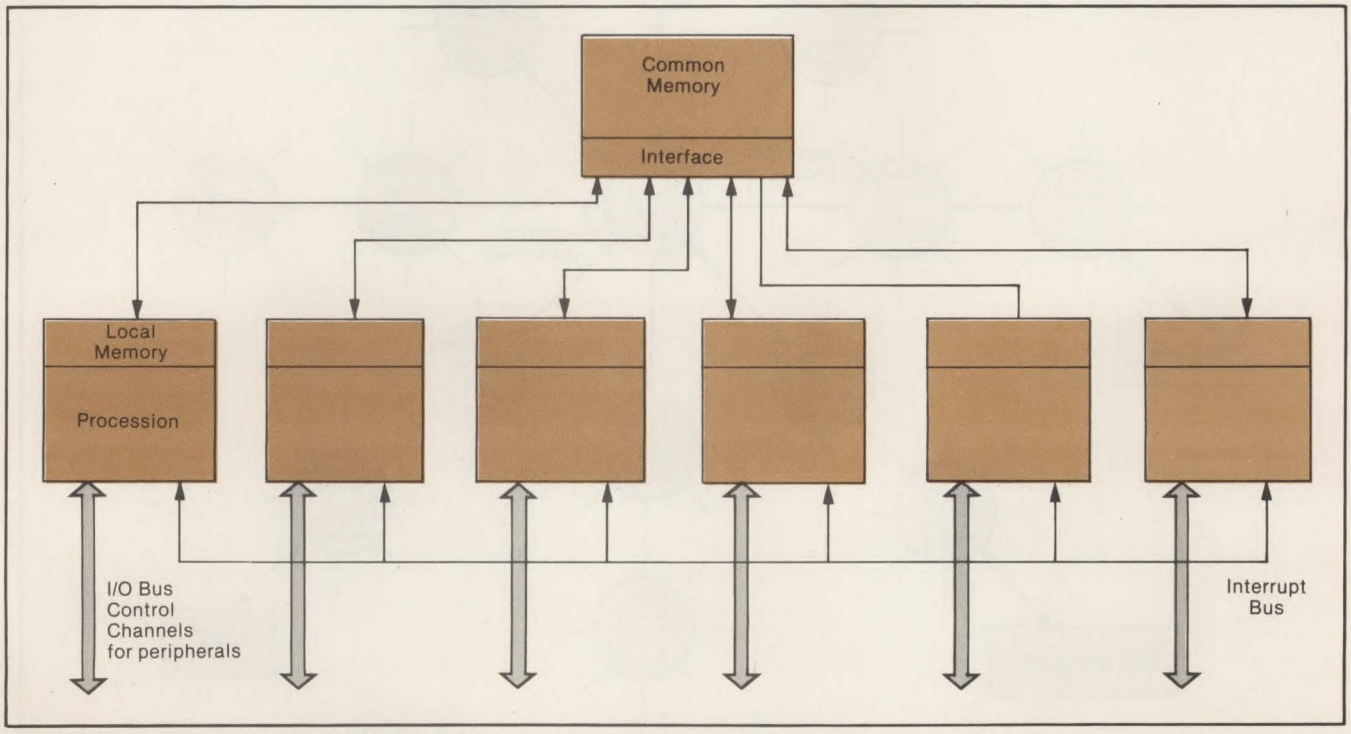


Fig. 1. The Micral-M multi-microprocessor system *interconnects eight single-board 8080s with common memory, to provide 512,000 words of memory and 3 million instructions per sec.*

Microprocessor and memory technology has evolved to the point that low-cost computing power presents an increasingly attractive alternative to mainframes for many jobs.

100 such stations could perform 50 million instructions per sec. and would probably cost no more than $1 million. A $1-million configuration of a mainframe with 100 terminals would be one-fifth as powerful (10 million instructions per sec.). Moreover, the addition of terminals slows a mainframe uniprocessor, while the addition of stations to a multiterminal network increases its processing power and shortens instruction execution time.

With such microprocessor-based networks, a number of alternatives becomes available to hierarchical distributive processing schemes, in which the architecture and software are so structured that each terminal has access only to its own local memory. If it requires additional memory, it has recourse only to the mainframe CPU.

One alternative structure is a "dispersed processing" scheme in which intelligent terminals—i.e., desk-top computers—are configured so that they draw on the memory resources of all the others. In this approach, even if a terminal has only "X" amount of internal RAM, it can draw on 2X, 3X or 10X, as required for specific applications. This can be done by configuring the system memory so that it is stacked in two, three or 10 blocks. For dispersed processing, new software must be developed to solve the problems of contention and the use of new CPU architectures that can access several 10s of megabytes of memory directly.

With the use of such 16-bit microprocessors, such as the Motorola 68000, the National NS16000 or the Zilog Z800—all of which can access 16M bytes or more of memory directly—terminal designs will soon be available that can directly access all the memory in the local dispersed processing network, without the requirement for interfacing to a mainframe CPU. In a typical business application requiring 50 intelligent terminals, each with 256K bytes of memory, the local network would have 12.8M bytes available—much within the capability of these processors.

More terminals—and hence more memory—can be added to meet incremental processing demands in multiprocessor schemes, expanding speed and capacity to meet demand. With uniprocessor limitations, the user usually must buy more power than immediately required, which means that he must pay in advance and hope to recoup.

A compromise to these two alternatives—and one possible technically, if not economically, today without

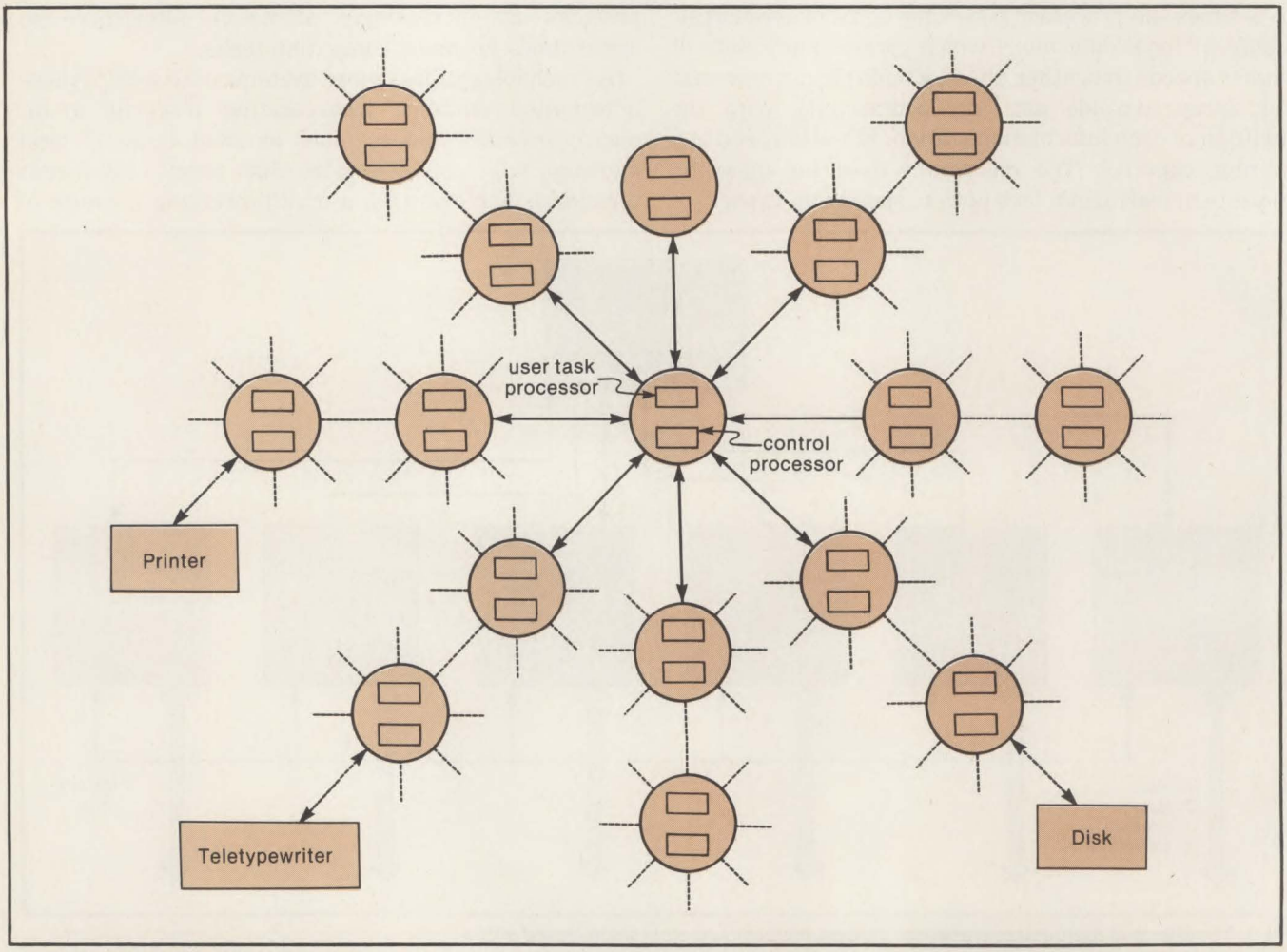


Fig. 2. The IMSAI Hypercube *was designed so that users could write distributed programs in low-level assembly language for each 8080A.*

NOW CLEANING YOUR OWN DISKETTE HEADS COULD SAVE YOU A $40 SERVICE CALL. AND A LOT MORE.

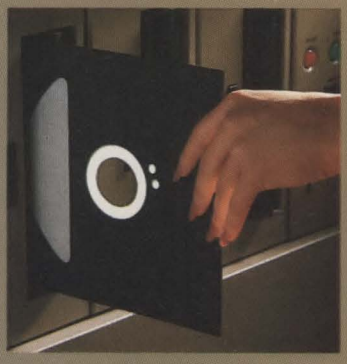
The recording heads on your diskette drives may be dirty—and that can cause you a lot of grief. There's the serviceman you have to call when the machine doesn't perform. (You know how much service calls cost these days!) There's machine down-time. Idle data entry clerks. All the other delays a cranky machine can cause.

And that service call might not even be necessary.

3M solves the problem in seconds—and leaves your heads "Computer Room Clean".

The Scotch® head-cleaning diskette kit lets you clean the read-write heads on your 8″ or 5¼″ diskette drives. In just 30 seconds, without any disassembly, mess or bother, the heads can be completely cleansed of dirt, dust, magnetic oxides—all the things that can get into your machines every day. And foul them up.

Just saturate the special white cleaning pad in its jacket with the cleaning solution. Then insert the jacket into the diskette drive and turn it on. Your machine does the rest. The



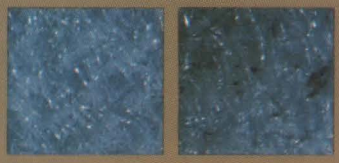
heads are microscopically cleaned without wear, without abrasion.

This 3M head-cleaning diskette kit has been evaluated and approved by major diskette drive manufacturers. It's the best possible way to clean your heads without service calls or machine teardowns.

At only $1 per cleaning—it's the best insurance you can get.

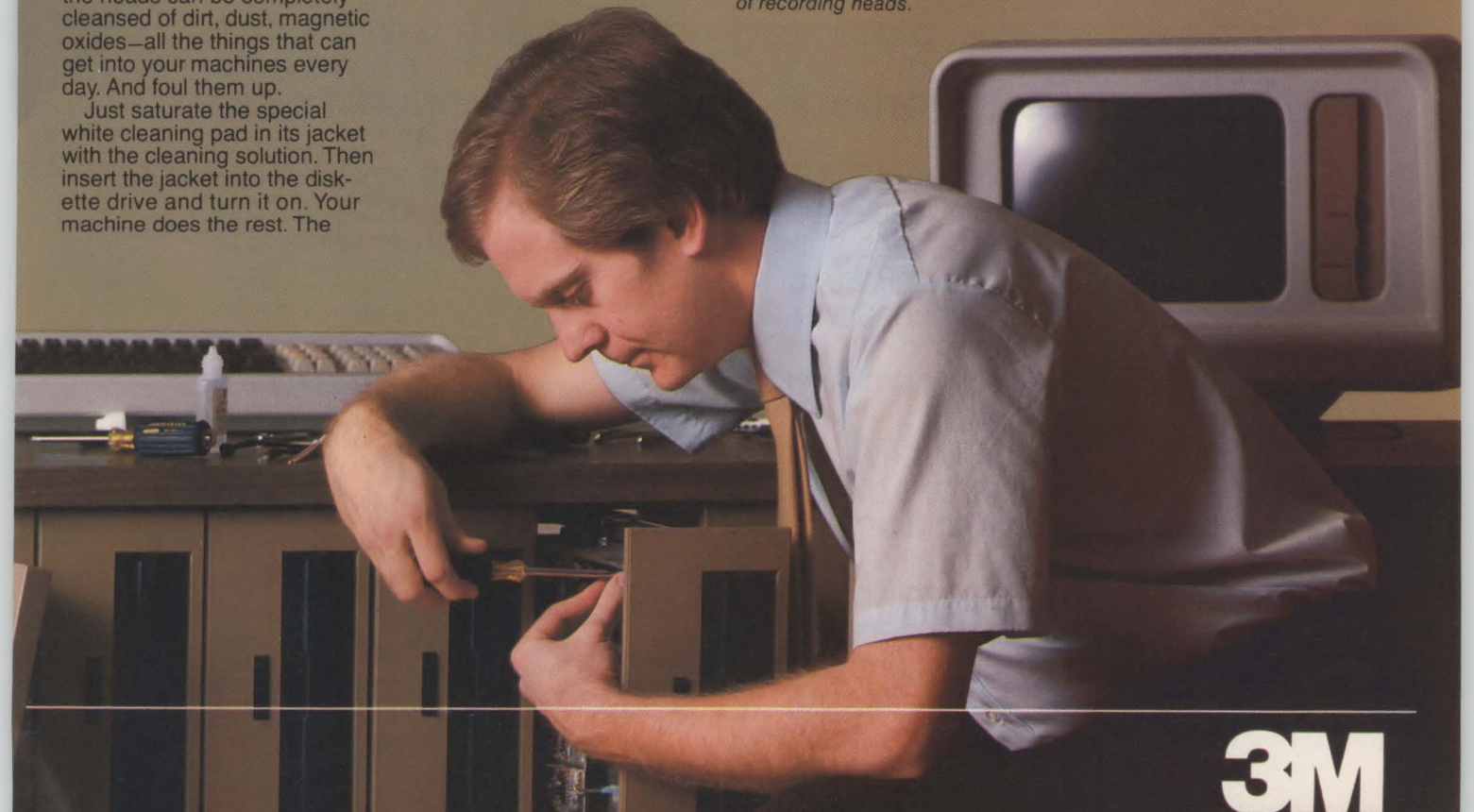
This fast-cleaning new Scotch kit comes with everything you need (including special fluid, applicator tip, cleaning diskettes) to handle up to 30 cleanings. That's only about a dollar a cleaning.

With the Scotch head-cleaning diskette kit, you could save yourself a lot more than just a service call. So try this remarkable kit today. For the name of



A Scotch cleaning diskette shown before use, and after 15 cleanings of recording heads.

the dealer nearest you, call toll free: 800-328-1300. (In Minnesota, call collect: 612-736-9625.) Ask for the Data Recording Products Division.



3M

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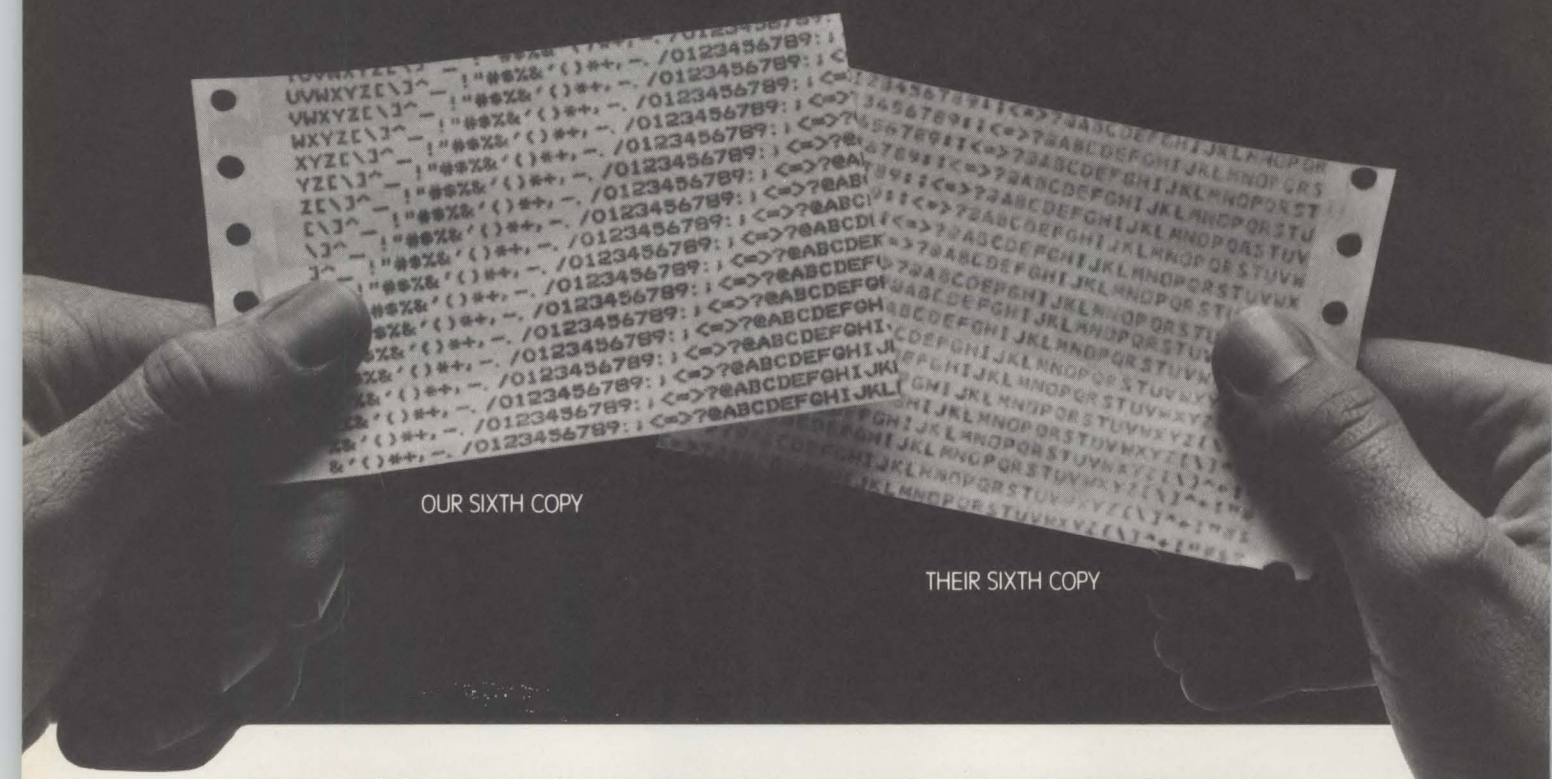

Many printers can give you good print quality on a first copy. The real challenge is to give you that same quality, copy after copy, on multi-part forms.

Obviously, most printers can't. The further they get from the first copy, the more their quality fades. But, as you can see here, the quality of Printronix' sixth copy continues sharp and clear.

This superior quality is achieved through a simple printing mechanism quite unlike any other. It forms characters by printing one dot row at a time, overlapping rows vertically and horizontally, while maintaining uniform hammer impact energy. The result is unequalled print quality and characters that appear solid.

This same design approach also requires fewer moving parts, eliminates most bearing surfaces, and employs simple hammer drive circuits. All of which means there's less to go wrong. And that's why Printronix can give you a full one-year warranty, not the 90-day warranty typical of most other printers.

For more information on the complete line of Printronix printers, call: (714) 549-7700. Or write:

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CIRCLE NO. 84 ON INQUIRY CARD

Careful design can make the multiterminal, multiprocessor approach alleviate many of the problems associated with mainframes.

too much alteration in hardware or software—is a multiterminal distributed-processing scheme with common memory. In this approach, each terminal still has access only to its own local memory, but for additional external storage locally, one of the terminals is the repository for extra memory. An ordinary intelligent terminal with soft-disk storage can be easily adapted to hard disk to handle such a job. And with costs no longer such a barrier, the inherent advantages of multimicroprocessor systems can be applied to a wide array of processing problems.

Disadvantages of mainframe uniprocessors

The advantages of working with mainframe CPUs are well known. Large software libraries are available and manpower may be more readily available. A mainframe's multiprogrammed operating system allows shared computer usage. These advantages, however, muct be weighed against a number of negative factors that make mainframes an expensive approach in many applications. These include:

- **Complex operating systems/expensive hardware.** A mainframe usually is designed for a variety of applications and concurrently can support time-sharing, batch operations, and real-time transactions. Operating systems must provide all these capabilities. Expensive hardware resources must be efficiently used, while at the same time protecting individual users. This creates a processing overhead that can be a burden in some applications. In addition, restart and recovery procedures have to be general enough to serve a larger user base, which results in a typical operating system that may require 300K bytes of storage, making the mainframe large and expensive and creating a mismatch between the computing power required and what is available.

	HYPERCUBE II (Order 2)	HYPERCUBE III (Order 3)	HYPERCUBE IV (Order 4)
Aggregate instruction executions per sec.	16 million	81 million	256 million
Aggregate programmed I/O capacity per sec.	4M bytes	20M bytes	64M bytes
Aggregate DMA capacity per sec.	32M bytes	162M bytes	512M bytes
Number of I/O device controllers attachable	96	216	384
Number of concurrently operating tasks	16	81	256
Standard user program memory size	256K bytes	1M bytes	4M bytes
Optional fully expanded user program memory	1.2M bytes	5M bytes	16M bytes
Cost	$80,000	$400,000	$1,280,000

IMSAI HYPERCUBE CAPABILITIES AND COST

Table 1. IMSAI Hypercube *capabilities and cost.*

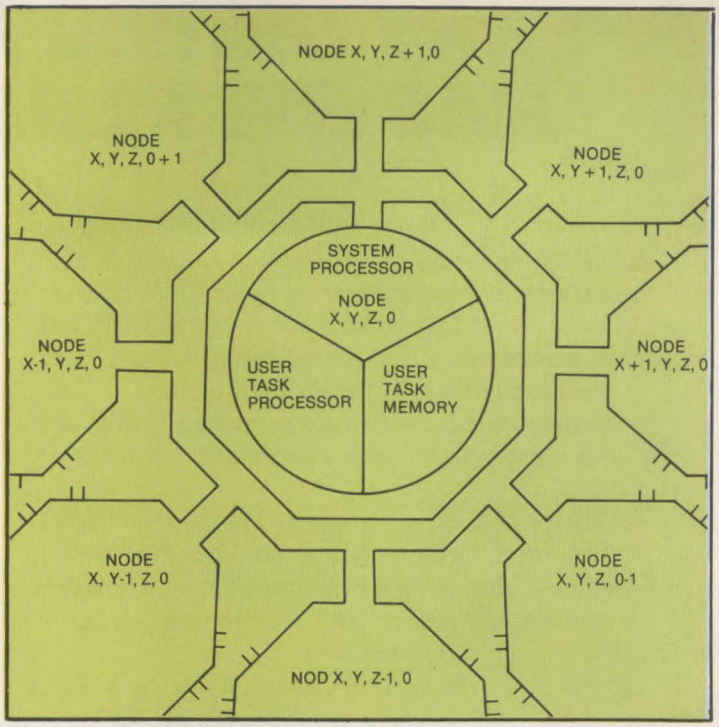

Fig. 3. Each subsystem of the IMSAI Hypercube *is located as a node of the Hypercube and connected to eight other subsystems in adjacent nodes.*

- **Limited file access.** Many computing problems are more demanding of file access than of CPU time. A large powerful mainframe with large word sizes, fast CPU cycles and sophisticated instructions often represents overkill in solving the problem. A smaller, less-expensive system with adequate files is often just as effective a solution at a lower cost.
- **Reliability.** Many computer facilities consist of single expensive mainframes because high cost prohibits the procurement of a second computer for backup. In this environment, jobs with high availability requirements suffer. When the mainframe fails, the job remains idle until the CPU is fixed. A second reliability problem is the sheer complexity of the operating system. Few large operating systems and data base management systems are completely defect-free, which means that a large computer installation may crash more often because of software rather than hardware failures.
- **Lack of responsiveness.** A centralized computing operation often is unresponsive to particular user needs. This may be caused by such things as procedures that are designed to "globally" optimize the central facility, an overloaded facility or ineffective management.
- **Lengthy response time.** Many mainframe CPUs have long or unpredictable response times for real-time applications, caused by the overhead of the operating system and the data base management system plus contention for resources with other nonrelated users.

Careful design can make the multiterminal, multiprocessor approach, which takes advantage of recent

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advances in semiconductor technology, alleviate many of the problems associated with mainframe uniprocessors. Reliability is increased because redundancy can be achieved relatively inexpensively. Unlike the mainframe approach, the entire system need not be duplicated—just those portions that meet a user's reliability requirements. In addition, simpler, more reliable software can be incorporated.

A microprocessor-based multiterminal approach can also be more responsive because the system can be closely tailored to a particular application. Additional processors or terminals can be provided, as needed, to ensure proper response time. A properly designed multiprocessor, moreover, when threatened by overload, can be expanded incrementally at low cost by the simple addition of more processors.

Early multi-microprocessor systems.

Although the concept of a multiprocessor is not new, the concept of implementing such a scheme using microprocessors is. In the 1960s, conventional, relatively expensive mainframe CPUs were linked, making it uneconomical to have more than a few processors. More recently, multiprocessors using minicomputers have been implemented, and configurations exist with as many as 20 minis in a system.

But until the advent of low-cost microprocessors, LSI multiprocessor equivalents of mainframes and minicomputers didn't exist. By mid-1975, however, at least three companies were working on such systems: Grumman Aerospace, using Intel's 3000 series of bit-slice bipolar microprocessors; the now-defunct IMS Associates Inc. (IMSAI); and a French firm, Realizations Etudes Electroniques (REE). The latter two both based their systems on Intel's n-channel MOS 8080A microprocessor.

In the Grumman approach, the aim was to interconnect as many as 10,000 microprocessor modules to solve large problems that take many hours on the IBM 370/168 mainframe. Initially, this scheme involved building one module and replicating it 10 to 20 times to improve performance two to three orders of magnitude (100 to 1000 times) over the level of the 370/168. The key to the potential high performance was that in each system the individual microprocessors operated more or less independently on separate parts of a problem, or even on different problems.

In the REE approach, called the Micral-M (Fig. 1), eight single-board 8080s were interconnected with common memory, to provide 512,000 words of memory and perform 3 million instructions per sec. Each processor had its own local memory, but also shared part of the common memory, which held the program. Similarly, each processor was able to draw on the resources managed by another. The key to the REE system was a custom-designed Schottky TTL LSI hard-wired logic circuit that set the priority of access to the common memory, and resolved any simultaneous accesses of equal priority.

Perhaps the most ambitious approach was that attempted by IMSAI in its Hypercube. (Fig. 2), which was designed so that users could write distributed programs in low-level assembly language for each 8080A in the system. The basic operating unit in the IMSAI Hypercube is a subsystem consisting of two 8080A microprocessors, plus memory and interface circuits, mounted on a pair of PC boards. Each subsystem was located at a node of the Hypercube and connected to eight other subsystems in adjacent nodes (Fig. 3). One of the 8080As executed the user program while the other handled the overhead communications tasks and the operating system software.

With the 8080A's direct memory, access, one subsystem accessed another's memory, while the subsystem at the other node performed its own calculations. Some of the nodes were to process input or output data; interface with a printer, keyboard or disk storage unit; and make data available to other nodes.

The Hypercube approach was configured so that users could program each node to perform its function, and the operating system built into each node would take over internodal communications. This was supposed to make programming not more much difficult than successive programming of single 8080As. Each node in a Hypercube configuration was designed to

System	Physical Size	(Watts) Power 16K User Memory	Consumption 64K User Memory	Average path for 1000-byte		Minimum Path	Maximum Path (1000 byte block)	
				Nodes	Time	One Node	Nodes	Time
Hypercube II	one rack 19 × 22 × 72	1280	3480	2	1053K bytes/ sec.	same for all configurations	4	869K bytes/sec.
Hypercube III	two racks	6480	19,940	3.55	910K bytes/sec.	1.33M bytes/sec.	8	1798K bytes/sec.
Hypercube IV	eight racks	20,480	61,440	5	800K bytes/ sec.	(internal data transfer rate between adjacent nodes)	12	2667K bytes/sec.

Table 2. Comparison *of Hypercube II, III and IV capabilities.*

Several design improvements should be made if a loosely coupled multiterminal local network is to be a cost-effective replacement for a mainframe CPU.

perform 1 million instructions per sec., have a DMA capacity of 2M bytes per sec. and have 16K bytes of user-programmable memory, expandable to 64K bytes. Tables 1 and 2 show that this approach had a potential performance that more than matched that of most mainframe CPUs. The simplest configuration—Hypercube II—consisting of 16 nodes, was designed to have an aggregate execution rate of 16 million instructions per sec., a capacity of 256K to 1.2M bytes of user program memory and the capacity to perform 3 million memory-to-memory additions a sec. Comparable performance figures for the 81-node Hypercube III were projected to be 81 million instructions per sec. 1M to 4M bytes of user program memory and 15 million additions per sec. A 256-node Hypercube III offered 256 million instructions per sec., 4M to 16M bytes of user program memory and 48 million additions per sec.

Drawbacks of early approaches

Despite the advantages of multi-microprocessor systems as an alternative to mainframe uniprocessors, few commercially viable systems have been constructed to date, with the exception of the attempts outlined here. A number of problems had to be resolved before such systems could become practical. These include:

- **System inefficiencies.** The limited address space of most microprocessors requires the use of memory mapping to manage large physical memories. Mapping reduces a processor's effective power by five to 20 percent, depending on the CPU and the application. Increased operating system overhead caused by interprocessor communications can also reduce the processor's effective power. This overhead is a function of the number of messages transmitted between processors per unit of time as well as the physical transfer method involved.
- **Complex interprocessor defects.** Multiprocessor systems are susceptible to defects that cause symptoms to appear in one processor even though the problem is really in another one. The potential for this kind of problem increases with the tightness of the interprocessor coupling and the absence of interprocessor error checks. A certain amount of message overhead may be necessary to isolate the offending processor.
- **Lengthy decomposition.** How should tasks now executed on uniprocessors be decomposed so that they can run on a set of small processors? Can compilers or specialized run-time systems be developed to do this decomposition automatically or must the programmer do the composition explicitly?
- **Interconnection structures.** What are the most effective types of processor/memory and processor/processor interconnection structures and what are the related communication protocols?
- **Address mapping mechanisms.** What mechanisms are appropriate for performing the virtual-to-physical address translation? These mechanisms should allow processors to share code and data while ensuring adequate levels of protection and performance.
- **Software system structure.** What software structures are suitable for large systems containing hundreds of interconnected microprocessors? Among the important problems to consider are resource management, software distribution, protection and reliability.
- **Interprocessor interference.** Even after tasks have been decomposed to run on multiple microprocessors, how should interprocessor interference and contention for memory and I/O resources be minimized?
- **Deadlock avoidance.** With multiple microprocessors contending for resources, the potential exists for a situation in which each of a group of processors is waiting for resources assigned to other processors in the group, and none of the processors is able to proceed until its demands are satisfied. This situation effectively disables all the processors, and special care must be taken in the design to avoid it.
- **Fault tolerance.** What hardware and software structures will allow a multi-microprocessor system to realize its potential to survive failure of components in the system? That is, if one unit of several connected systems goes down, will it affect the other units?
- **Input/Output.** How should I/O devices and secondary storage devices be integrated into a multi-microprocessor system?

Next: Coupling multi-microprocessor systems

Michael Roberts is president and CEO of ECS Microsystems, Inc., a manufacturer of multiprotocol, multifunction computing terminals. He founded ECS in Australia and is now based with the company's marketing and manufacturing headquarters in San Jose, Calif.

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The November issue of Mini-Micro Systems will focus on CRT terminals, with articles in the feature section devoted to:

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- A tutorial on monolithic controllers for alphanumeric displays
- A discussion of ergonomic ("human engineering") concerns in the design and selection of display terminals
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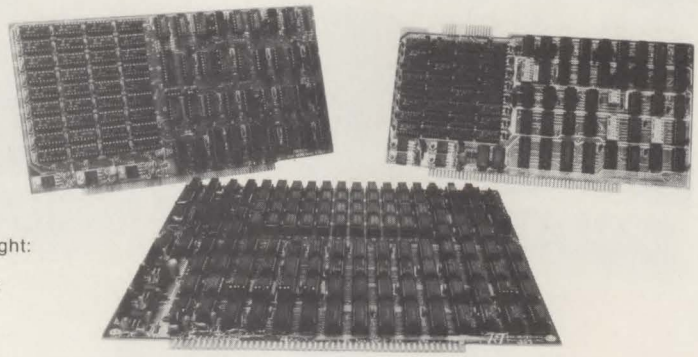

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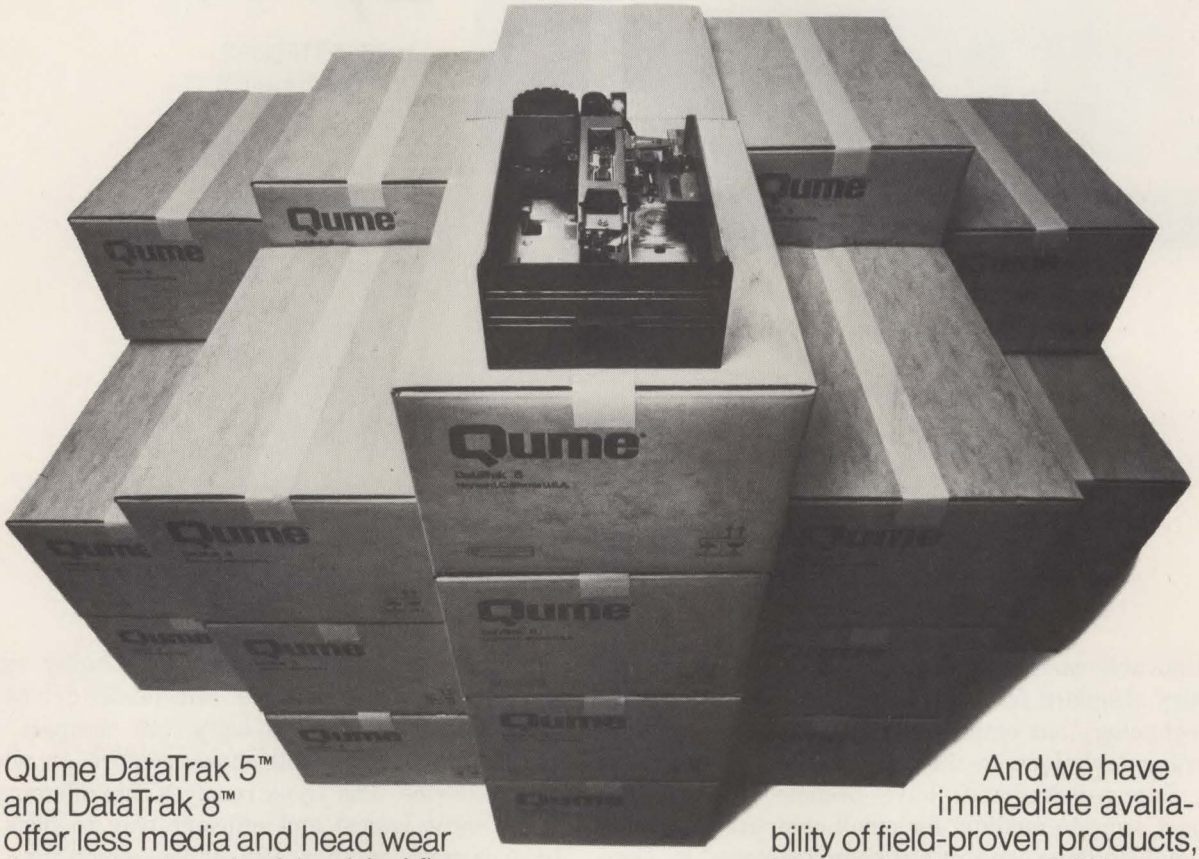

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DISK DRIVES

A removable Lynx

TAZZ PETTEBONE,
Data Peripherals

Data Peripherals' DP-100 combines removable-cartridge Winchester technology with 11M-byte floppy-sized disk drive

Removable-cartridge-disk drives have been an industry standard for nearly 20 years, while Winchester technology has emerged as an industry-acceptable recording technique in the past five years. For their part, floppy-disk drives have become the low-cost, compact storage medium for small computer systems. Now, a disk-drive concept has been developed by Data Peripherals, Sunnyvale, Calif., a subsidiary of CCT Corp., that effectively combines the major advantages of each of these predecessors.

Designated the Lynx, the new DP-100 drive has a removable cartridge, uses Winchester recording techniques and is the same size as a standard 8-in. floppy drive (MMS, August, p. 13). But its storage capacity of 11M bytes (unformatted) is more than 10 times that of a floppy drive. The Lynx may well be called a "hard floppy." It will soon undergo customer evaluations and is scheduled to be in full production during the second half of 1981.

The Lynx was specifically developed to fill a minicomputer and microcomputer storage void. Until now, the system integrator has had few choices when selecting a storage device. If he used a floppy-disk drive, he got compact size at low cost, but would have a storage capacity of just 1M byte, even with double-sided recording. To get higher storage capacities, size constraints have been relaxed in a bulky cartridge drive or a fixed-media drive. Winchester drives deliver the increased storage capacity, but compact models, with their nonremovable disks, require an additional backup device. The Lynx resolves this dilemma.

The most logical and efficient way to back a disk drive is with another disk drive, which may be the answer in systems that have exceeded the storage capacity of floppy disks as a primary storage device. For example, while floppy drives offer small size and low cost, capacity limits and data-transfer rates leave something to be desired. Using a floppy, a system could take as long as an hour to transfer 10M bytes of data.

Fixed/removable-cartridge disk drives have acceptable capacity and performance, but their high cost and large size puts them at a disadvantage for small systems. Magnetic-tape drives are a low-cost solution, but they require complex system controllers to interface with a disk drive, and their inherent high data error rate degrades the system.

After surveying the market about data backup and system storage requirements, Data Peripherals officials determined that users believe Winchester drives would be an ideal solution to both problems, but that removable media would be required. Under development for more than a year, the Lynx was designed to

overcome the limitations of other storage media for small systems, including their nonremovable media. The company established four major criteria for the design of the new drive: removable media, relatively high storage capacity, small size and highly competitive cost and performance.

The Lynx has the same dimensions as a Shugart 8-in. floppy (4.62 × 8.55 × 14.25 in.), making it considerably smaller than Control Data Corp.'s recently announced Lark, which has fixed and removable media (MMS, April, p. 69). The Lynx offers 11M bytes of unformatted storage—more than 10 times the storage capacity of a double-sided floppy with a cost approximately three times that of a double-sided floppy. The removable cartridge, also developed by Data Peripherals, uses E.C.M.A. standard 200-mm., lubricated Winchester media, and is designed for front loading into the Lynx.

Innovative design features

To keep the Lynx size the same as that of a floppy-disk drive, and to improve performance and reliability, Data Peripherals incorporated several design innovations into the drive, including a built-in microprocessor, an embedded track-following servo, a small voice-coil linear actuator, a DC spindle motor, retractable read/write heads that fly higher than standard Winchester heads, and a sealed, lightweight cartridge.

The microprocessor, embedded servo and linear actuator are interrelated to provide accurate track positioning of the read/write heads. The basic function of the actuator in a disk drive is to provide the linear force to the heads as they are being moved from track to track. The Lynx uses a voice-coil linear actuator that is shorter and smaller than typical actuators.

The traditional cartridge-drive approach to track positioning is to use an external transducer to determine head and track positions. This positioning technique is not accurate enough for higher track densities. The most popular approach is to have a single disk surface dedicated to servo information. In a large five-platter Winchester drive, for example, one side of a platter would be dedicated to servo information for signals, resulting in a nine to one data-servo ratio.

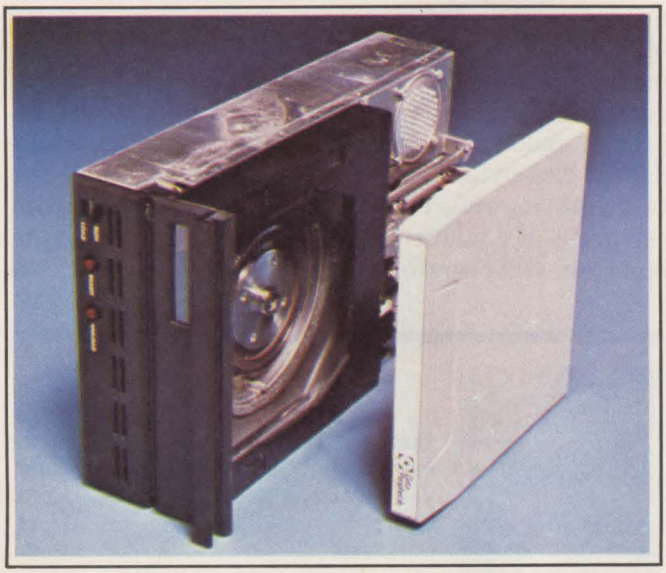

Fig. 1. Removable cartridge *sits next to the Lynx drive.*

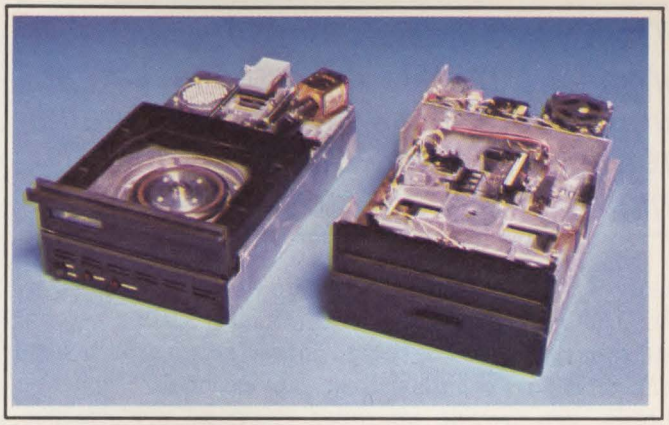

Fig. 2. Lynx drive, *at left, is the same size as a standard 8-in. floppy-disk drive, right.*

Because the Lynx uses a single disk platter, dedicating one side to servo signals would reduce the data storage capacity by half. To overcome this, Data Peripherals designed a servo system that has servo information embedded at specific intervals on each track; 48 servo signals are prerecorded on each track of the disk in the removable cartridge. The result is that only 10 percent of the disk surface is used for servo signals, leaving 90 percent for data storage. This approach requires that a 48-sector format be used with the Lynx.

Because the embedded servo system provides direct feedback, temperature differentials between drive and cartridge are compensated for and head-alignment adjustment is not required. This, in turn, eliminates the need for an alignment cartridge.

The microprocessor's role

In conjunction with the actuator and embedded servo, Data Peripherals has designed an Intel 8049 microprocessor into the Lynx to control the direction, speed and final track position of the voice-coil actuator. Through the feedback servo system, the microprocessor "samples" the embedded servo signals and computes the seek trajectory for the actuator. With several velocities available, the microprocessor computes the optimum speed during seeks to a new track position. Average access time of the Lynx is 60 msec.

Until now, microprocessors have been used in larger, high-performance drives mainly for internal diagnostics, such as fault identification and failure analysis. The Lynx's use of the microprocessor may be the first as an integral part of servo loop operation. Other functions the microprocessor performs include interface control, spindle-speed monitoring and sequencing control for operations such as cartridge-door interlocking.

Higher-flying heads

The Lynx uses Winchester recording techniques with certain key enhancements in line with the removability

The Lynx's design innovations include a built-in microprocessor, an embedded track-following servo and retractable read/write heads that fly higher than standard heads.

feature. The head is a composite design developed by Information Magnetics Corp., Goleta, Calif., another subsidiary of CCT. The design characteristics of the head enable it to fly higher than conventional Winchester heads, yet provide improved electrical performance. The higher flying height results in less sensitivity to contamination, and the material used in the air bearing slider of the head results in improved wear characteristics over conventional Winchester monolithic ferrite heads.

With the original IBM 3340 drive, the removable data module had a head and disk assembly in which the heads and disks were designed to be inseparable. Data Peripherals is the first to develop a removable

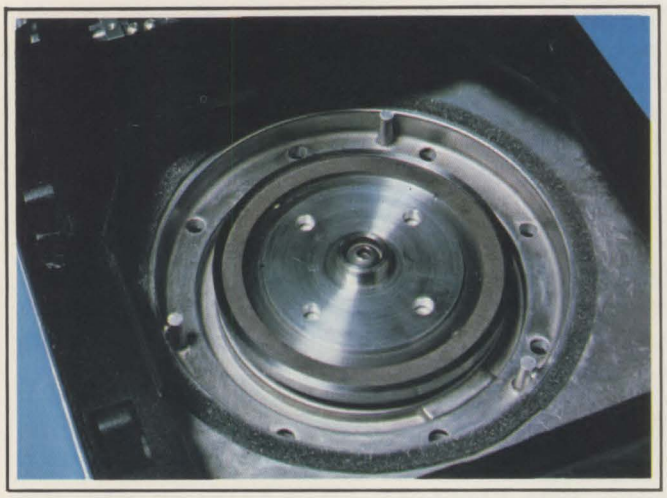

Fig. 3. Close-up of spindle *and magnetic chuck. Cartridge's contact with the chuck frees the disk to rotate.*

Winchester cartridge with the heads designed to stay in the drive. The load-unload mechanism built into the drive causes the heads to land on the disk surface and remain there, in standard Winchester fashion, when the disk stops—at the end of a transaction or at the end of a day. But removal of the cartridge activates a proprietary electromechanical mechanism that unloads the heads from the surface to facilitate cartridge removal.

Data Peripherals designed the Lynx cartridge to be removable, but it is completely sealed and does not open until it is properly seated in the drive. Inserting the cartridge through the drive's door automatically opens the cartridge door. When the operator closes the drive's door, the cartridge is seated on a magnetic chuck and on the spindle. The magnetic coupling thus established opens another seal, allowing filtered air to enter and purge the cartridge of any contaminants that may have entered when it was momentarily opened.

Fig. 4. Removable cartridge *sits atop the Lynx drive.*

The magnetic coupling also frees the disk to rotate inside the cartridge. The primary manufacturer of the cartridge will be Dysan Corp., Santa Clara; Data Peripherals will also manufacture it.

Loading, power requirements and redundancy

After the disk cartridge has been loaded into the Lynx drive, the heads are lightly loaded onto the disk surface. The Lynx provides greater protection than other Winchester drives against foreign particles coming in contact with the head by flying the heads at approximately 22 microinches, instead of 18.

All-DC power operation is another capability of the Lynx. It uses a direct-drive brushless DC spindle motor, which contributes to small size, ease of integration and reliable operation. Another advantage to an all-DC-powered drive is that it can be used worldwide without power or motor modifications. The Lynx requires three DC voltages (+24V, +5V and −12V). Total power requirements are less than 100.

The Lynx provides inherent system-redundancy features when used in a dual- or multidrive system. Multiple floppy disks are the common configuration for most small computer systems, whether they're word-processing or business systems. Two Lynx drives, provide redundant, independent drives that together deliver 22M bytes of unformatted storage. One can be taken off line while the other is still operating. Also, in the event of a failure or malfunction of one drive, the other can still operate. ■

Tazz Pettebone is vice president for marketing of Data Peripherals, Sunnyvale, Calif., a subsidiary of CCT Corp.

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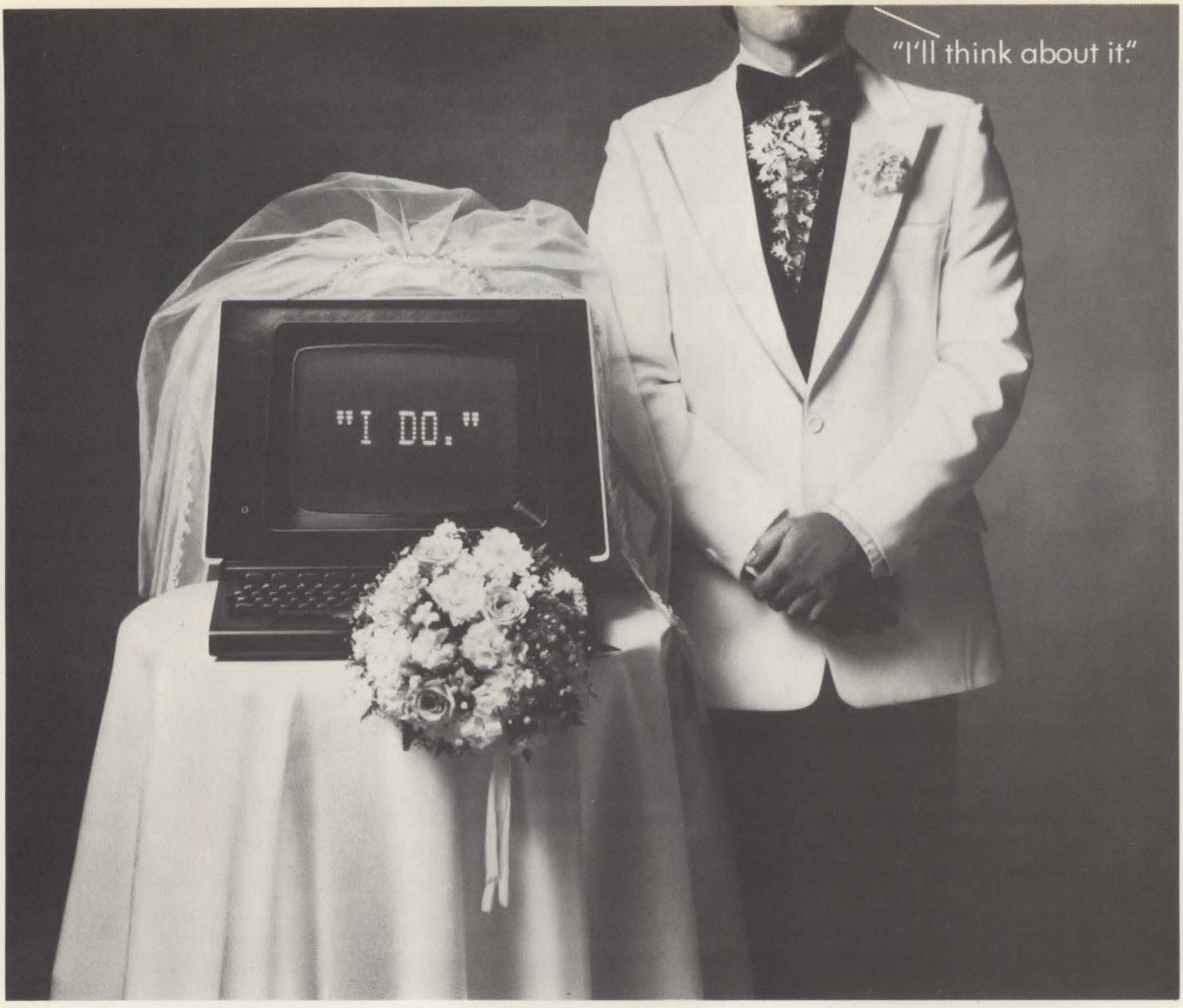

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CIRCLE NO. 92 ON INQUIRY CARD

A transportable SEED

HARVEY M. WEISS,
Weiss & Associates

Data base management system's strongest feature is its ability to be transported from microcomputer to minicomputers and mainframes

This is the second in a series of reports on data base management systems for minicomputers. The first, on the ORACLE system, appeared in the August, 1980, issue, beginning on p. 111. These reports are intended to provide sufficient information about the subject DBMS to allow potential users to determine if they should consider installing the system. Each article surveys the features of a single DBMS, and evaluates it against a standard set of criteria. If there is a particular system you would like to see reviewed, please send its name and supplier, along with a brief summary of the reasons for your interest, to: Editor, Mini-Micro Systems, *221 Columbus Ave., Boston, Mass 02116.*

A full-function data base management system called SEED is the only such system for minicomputers to date that is CODASYL-compatible in its design and contains both COBOL and FORTRAN interfaces. Developed by International Database Systems, Inc., Philadelphia, SEED offers a powerful query/report-writer option, and scores 287 of a possible 400 points (see "The Evaluation Matrix," p. 137).

SEED's most powerful feature is its transportability. Because it's written in a high-level language (FORTRAN), IDBS has been able to move SEED from minicomputers to mainframes from IBM, Digital Equipment Corp., Hewlett-Packard Co. and Prime Computer, Inc., and into certain microcomputers, as well. SEED can be used in a variety of application environments, including distributed data processing, and in a local/central or timesharing environment, which means that its selection results in a single source for software, assisting the user in cost reduction for training, design, maintenance and implementation in a multiprocessor environment.

On the negative side, SEED does not score well in data integrity, in its ability to provide format modifications or in its provision of redundancy and consolidation controls.

EXPLAINING THE EVALUATION MATRIX

The evaluation matrix is the chief tool used in evaluating SEED. In a competitive evaluation, the matrix would list the criteria used, the vendors being considered and the ratings each vendor receives. (Not all criteria are used each time.) The first step is to establish an importance weight factor for each criteria. 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 specific criteria, establishing the vendor's requirement score. Multiplying the importance weight factor by the vendor's requirement score produces an effective score for the vendor for that criteria.

For example, if one of the selection criteria, a data base 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 criteria might be 1. The resulting effective score for this criteria for this vendor is 10 ($1 \times 10=10$). However, vendor #2 might provide such a product, receiving a rating of 10. That vendor's effective score would then be 100.

Once all criteria used in the selection process have been weighted, and all vendors' responses have been given a rating, their effective scores can be calculated.

The criteria listed in the matrix comprise a standard list that could be used to define system requirements for a data base. Details of their meaning can be found in any document describing DBMS capabilities, or are available from Weiss & Associates.

The evaluation matrix is used here only to establish a rating for SEED and its ability to meet all the criteria as if all had an importance weight of 10. If a criteria receives a score greater than 7, it indicates that SEED could effectively meet that system requirement. A score of 4 to 6 indicates it is marginally satisfied, and a score lower than 3 is unsatisfactory.

SEED's most powerful feature is its transportability. It is written in FORTRAN and has been moved from minicomputers to mainframes and into certain microcomputers, as well.

But IDBS provides the data base designer with support in other areas. A package entitled DESIGNER is intended to assist in the optimal logical design effort of CODASYL network data structures. A second package, APG, is an automatic program generator of the data manipulation language (DML) and related access code for SEED.

What SEED is

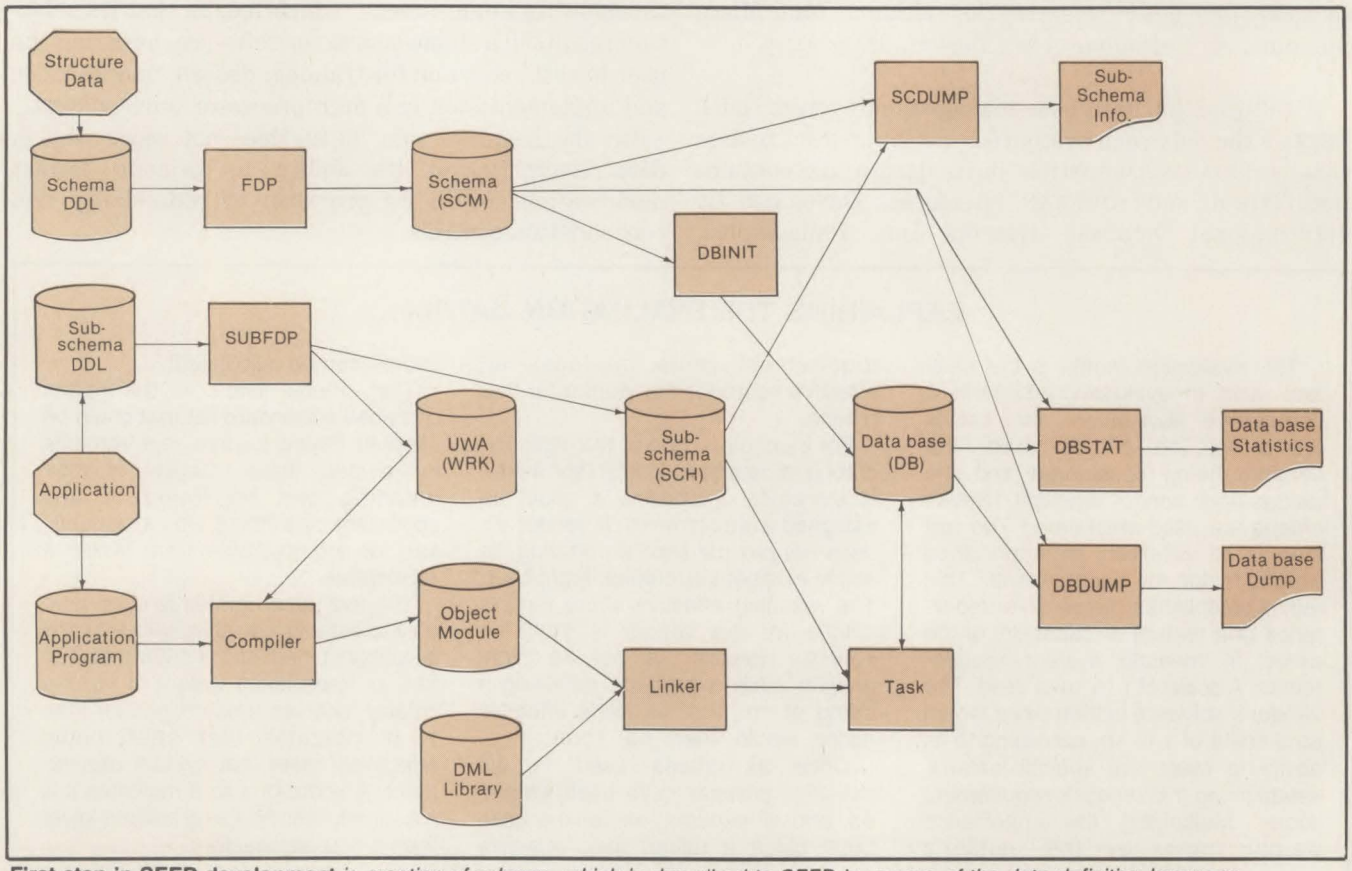
SEED is an implementation of the 1971 federal CODASYL-data base task group standard. It employs a network structure and can operate in as little as 50K bytes of main memory. The system is highly structured and modular, and is sold to users of minicomputers and microcomputers, as well as to mainframe computer users. SEED supports hierarchical, confluent and recursive data structures in any mixture, with *no limit* on the number of levels. Moreover, SEED permits a record to participate in as many as 35 hierarchies as a "member" of a set, and simultaneously in as many as 35 hierarchies as an "owner" of a set. This provides considerable flexibility in representing the concepts of one-to-many, many-to-many, and exploding relationships among record types.

The total offering of IDBS includes the SEED kernel, a query language/report writer system entitled HARVEST, an interactive data-manipulation language called GARDEN and a system for processing transactions into and out of the data base called SPROUT.

SEED has been implemented in the following computer systems: IBM 370, 303X, 43XX; CDC 6000 and Cyber systems; DEC 10, 20 and VAX systems; and the HP 3000. It will also run on Prime and Modcomp systems, and a micro-SEED version is available on the INTEL 8080, 8086, Zilog Z80 and Z8000 microcomputers.

SEED can be run in batch, on-line, or batch and on-line simultaneously. The system supports FORTRAN, COBOL and Pascal. Not supported by IDBS, but developed by customers, are interfaces to PL/1, and Lisp. SEED supports data communications in a multi-threaded environment at all levels for retrieval processing and multithread to the area level for update processing. Security/privacy processing is taken to the field level, but not to the field value level. Checkpoint processing can be automatic if the option is selected by the user, and it involves both a roll-back or roll-forward facility. In addition, the user can execute a request for checkpoint processing within his own code at his own logic point.

The system allows dynamic reorganizing of files by deleting and recovering disk space in the data base as it is required. It protects the chain structure by not physically deleting records when the chain relationship is still required. Data-base extensibility—the ability to combine or extend current records into a new data base—cannot be performed dynamically.



First step in SEED development *is creation of schema, which is described to SEED by means of the data-definition language.*

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SEED lacks an in-line or tightly associated data dictionary, causing it to lose some significance in its ability to provide security and integrity.

SEED consists of four major components. The first, SEED, is considered the DBMS kernel. It, in turn, is composed of the data-definition language (DDL) as defined in the CODASYL recommendations, the data manipulation language (DML), also defined in the data base DBTG standard, and the basic processing components that retrieve data from and update the data base. As is true with most CODASYL systems, the application programmer must be familiar with the host language that processes the data.

The second component, GARDEN, is a software product that provides an interactive data-manipulation language (DML); any DML command established in SEED and found in the application code can be given to GARDEN directly. GARDEN also provides relational data about the sets, records and items in a data base, such as the names of areas, items, records and sets. In addition, a HELP facility is offered to instruct the novice in the use of GARDEN in the DML program development effort.

HARVEST, the third component of SEED, is a significant piece of software in that it is a useful tool for the data-base administrator (DBA). It allows the DBA to query the system about the structure and components of selected data bases installed in the system; it is useful to the programmer for the same reasons. The programmer can use it to edit a data base, to verify that programs are running correctly, to correct minor errors or even to create a test data base.

The final component is SPROUT, a subsystem designed to process transactions into and out of a SEED data base. Transactions are defined here as "utility" transactions, not user application transactions. Thus, SPROUT is *NOT* considered a transaction processor of the type that provides the ability to handle user-generated transactions. Rather, it is a software utility designed to manipulate the data base. SPROUT can be used to: convert existing external data files to SEED data bases, create a SEED data base, maintain an existing SEED data base, restructure a SEED data base, convert a SEED data base to external data files, maintain data base archives and support parallel operations during conversion. SPROUT can define as many as 50 transaction types through the use of a transaction library.

EVALUATION MATRIX VENDOR RATING: SEED

SELECTION CRITERIA	VENDOR SCORE
1. Data-manipulation capabilities:	
1.1 Data-manipulation processes	8
1.2 Privacy, security techniques used	5
1.3 Error recovery procedures employed	7
1.4 Data integrity controls	2
1.5 Format modifications ability	4
1.6 Redundancy/consolidation controls	4
1.7 File growth	10
Possible: 70	40
2. Query capabilities:	
2.1 Availability of feature	10
2.2 Ease of use of feature	10
2.3 Capability of feature	10
Possible: 30	30
3. Application-programming complexities:	
3.1 Program data independence levels	10
3.2 Methods used to define manipulation and retrieval operations	7
3.3 Subsystem view development	10
3.4 Data base schema description process	7
3.5 Programmer skill required	6
Possible: 50	40
4. Physical file design:	
4.1 Physical file organization(s) used	6
4.2 Record types supported	10
4.3 Record change capability	7
4.4 Ability to combine records	7
4.5 File space management method used	8
4.6 Indexing methods used	7
4.7 Logical record definition process	8
4.8 Logical structures used	8
Possible: 80	61
5. Datacom interface capability:	10
Possible: 10	10
6. System installation:	
6.1 Physical file distributing control	10
6.2 Data base loading facility available	10
6.3 Hardware configuration requirements for DBMS	5
Possible: 30	25
7. DBMS utilities:	
7.1 Performance statistics gathering	5
7.2 Minimum reorganization	9
7.3 Simulation facility	4
7.4 Data dictionary facility	1
Possible: 40	19
8. Secondary features:	
8.1 System performance	7
8.2 DBMS maintenance policy	7
8.3 Systems design and development time	8
8.4 System desginer training time	8
8.5 Ease of installation of DBMS	9
8.6 Documentation available	7
8.7 Vendor support provided	5
8.8 Vendor responsiveness to hardware/ software changes	5
8.9 Customer experience	6
Possible: 90	62
Total Possible: 400 SEED:287	

The physical file design environment leaves something to be desired, but the systems installation capability is strong.

There is no limit to the number of transaction libraries that can be created, and any transaction type definition can be included in multiple libraries. SPROUT provides the DBA with a strong tool to ensure the integrity and completeness of a data base, an easy way to initialize a data base and can be used for backup and archival processing.

Using the data base

The SEED development process is shown in the accompanying diagram. The initial effort required is to create the schema, which is described to SEED via the data-definition language. Once the files have been initialized, SPROUT can be used as the loader to create the actual data base files. The SPROUT transaction will have been defined in the transaction library, and is used along with the schema to load the data base. Once the schemas/subschemas are defined and loaded, application code can be written, which, when compiled and established as a task, will then access the data base. If general statistics are desired, they can be obtained by using the SCDUMP, DBSTAT, and DBDUMP utilities. SCDUMP prints the contents of the schema/subschema files; DBSTAT shows usage general statistics, and DBDUMP prints page contents.

GARDEN can be used to interact with the data base. One of its most powerful features is the FIND command, which can locate records whether through the CACL or VIA options. GARDEN can be used to generate X-Y plots of data, create histograms and manipulate the data in the data base.

HARVEST, the query language/report writer system also available with SEED, contains only six basic commands: display, exit, let, report, set and show. Through these commands, the user can examine data base contents and perform analysis and arithmetic operations on the contents of fields in the data base as well as through variables introduced by the commands.

Security/integrity features

SEED lacks an in-line or tightly associated data dictionary, causing it to lose some significance in its ability to provide security and integrity over the data base. However, it provides the ability to audit the data base via the transaction processor system. Security and privacy are carried to the field level within the data base, which can be a significant factor in a minicomputer DBMS environment.

Customer reviews

In reviewing the names of more than 20 SEED users provided by IDBS, it appears that many of them are universities, service bureaus, timesharing or governmental organizations and hardware vendors. Their comments, as well as those of commercial users, are summarized here:

- "SEED was the only package we could find that was a CODASYL standard, and which would provide us with source code."
- "SEED provides the ability to install a DBMS on several different kinds of computer hardware."
- "We found SEED to be the software package easiest to implement in our environment and to offer to our timesharing users."
- "IDBS's personnel were most willing to help us evaluate the package, to provide education and design support and to continue support after the package was delivered."
- "SEED was the only CODASYL system available in a minicomputer environment."

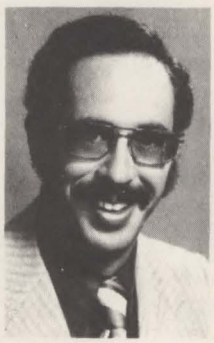
Besides the strengths and weaknesses cited earlier, these others should be carefully considered. The physical file design environment leaves something to be desired, as it does with all DBMSs of the CODASYL type. The system installation capability, however, is very strong. The lack of any utilities in the area of detailed statistics gathering, simulation and a data dictionary are most disappointing. Most of the secondary figures were adequate.

The score in no way indicates the success a user might have with the DBMS; it is a subjective evaluation based on SEED's ability to satisfy all system requirements. ■

COMPANY PROFILE: INTERNATIONAL DATABASE SYSTEMS, INC.

International Database Systems, Inc., is located at 2300 Walnut St., Suite 701, Philadelphia, Pa. 19103. The company was formed in 1977 to develop and sell a data base management system. SEED's first installation was made in 1977, and more than 45 customers now use the package. IDBS has more than 20 employees; the Phildelphia location is headquarters, the sole source of IDBS personnel and support.

IDBS's product can be purchased or licensed, and the company sells the SEED source code. The company provides maintenance either on a paid-up or a monthly rental basis, and offers discounts for educational institutions and multiple-CPU environments. The package can be leased initially and converted to purchase at a later time, if desired.



Harvey M. Weiss, president and principal consultant of Weiss & Associates, Denver, Colo., has had more than 20 years of experience in data processing. His firm's activities include development of data base plans and designs and evaluation and selection of data base management systems for clients in industry, education and government.

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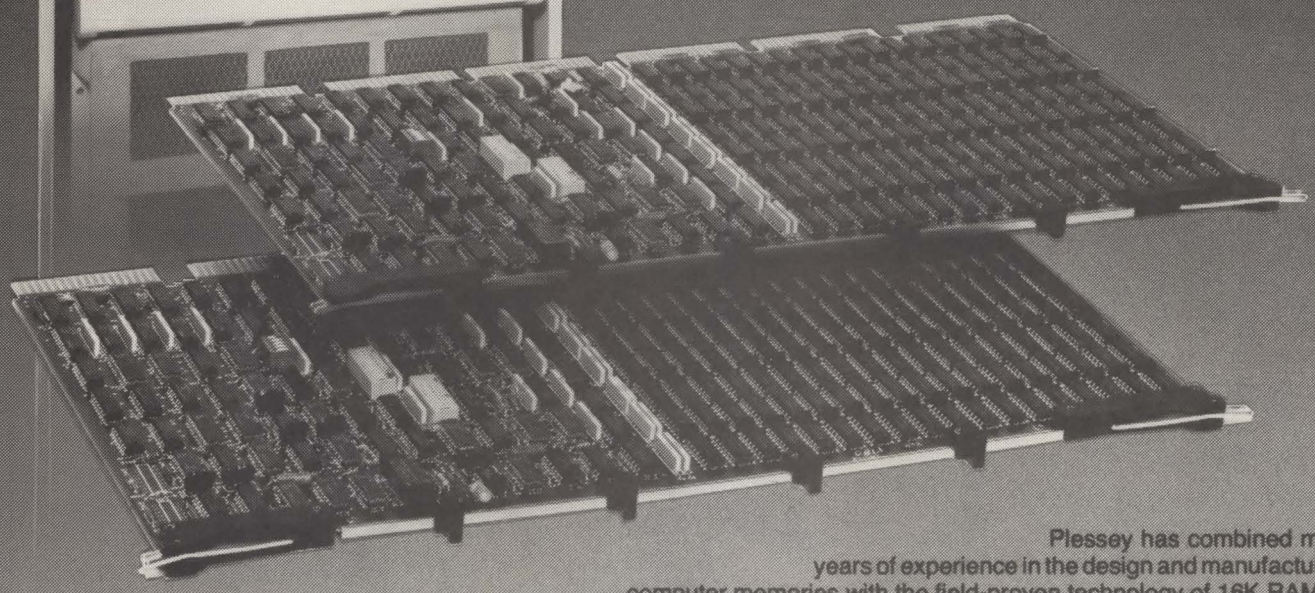

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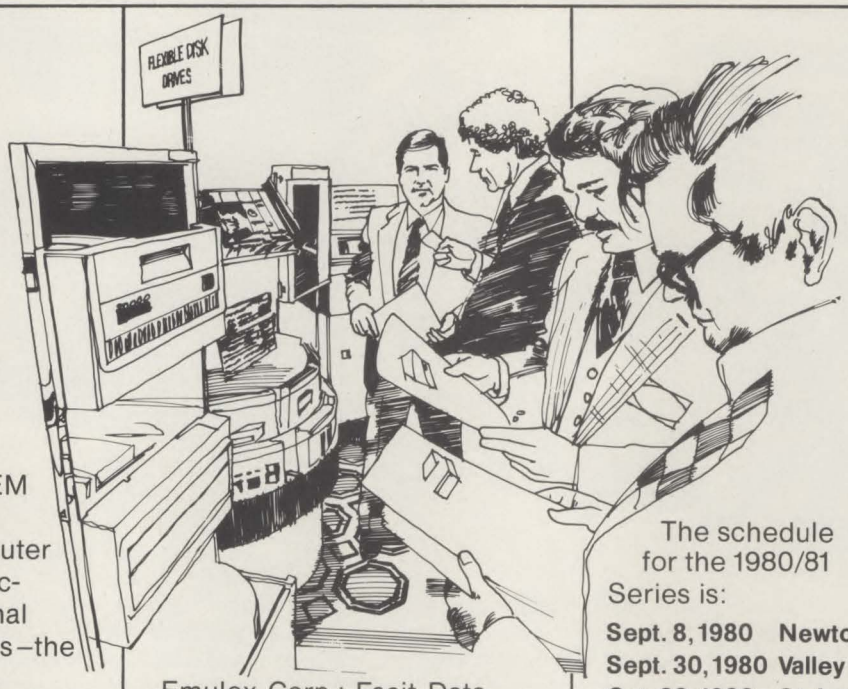

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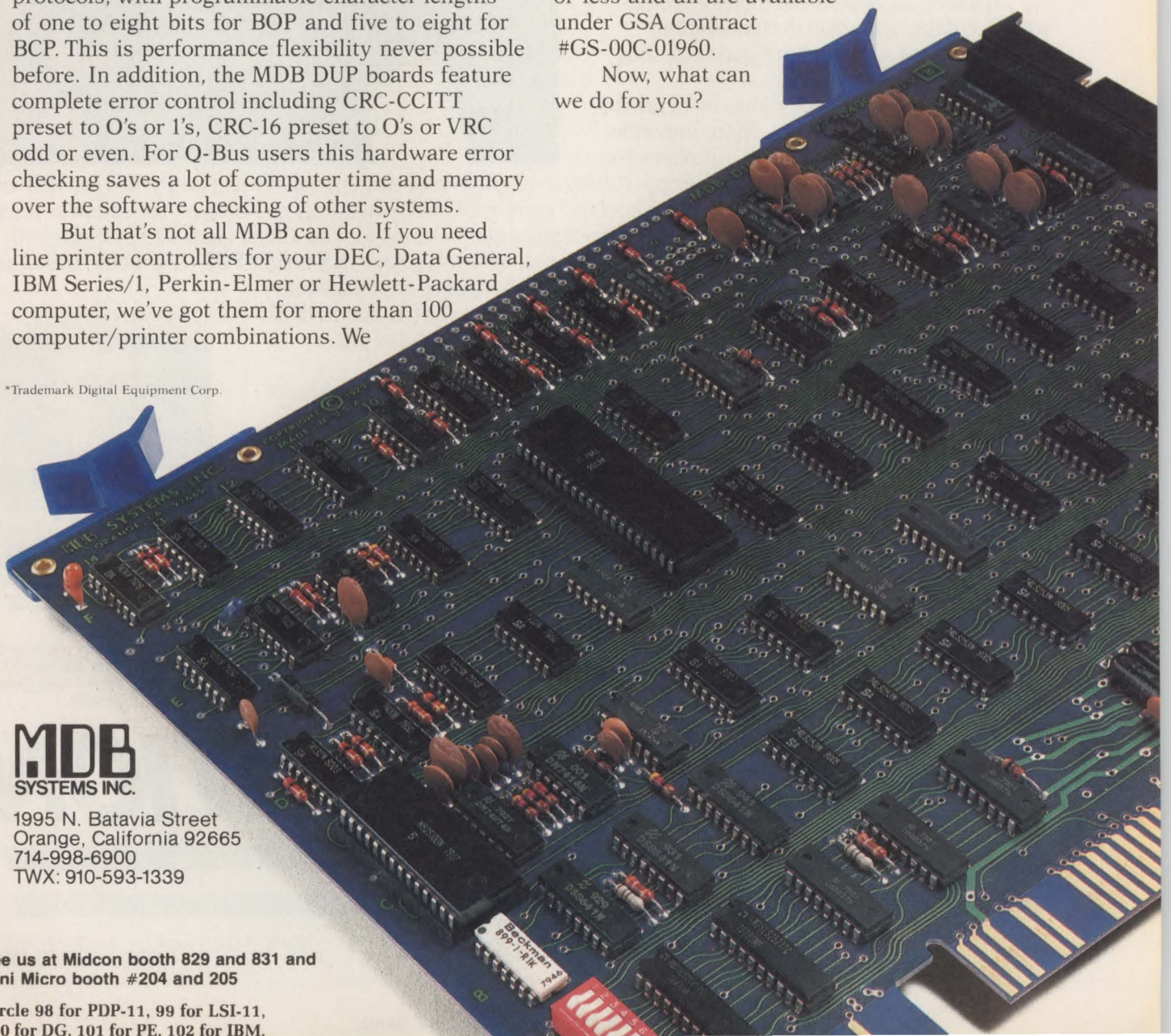

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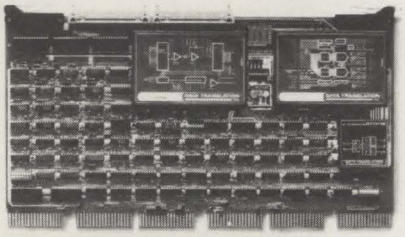

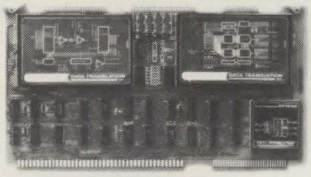

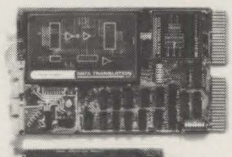

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CIRCLE NO. 103 ON INQUIRY CARD

DATA COMMUNICATIONS

Microcomputers are supplanting front-end processors

CAROL ANNE OGDIN, Software Technique, Inc.

Microcomputer-based communications handlers are no more complicated to deal with than a disk drive

One of the most secure niches for sophisticated microcomputers is at the ends of data communications lines. Complex special-purpose communications front-end computers traditionally have been used to relieve the central computing system. Now microcomputers dominate that application. Properly designed and programmed, these microcomputer-based communications handlers are no more complicated to deal with than are disk drives.

The microcomputer can be assigned the total communications responsibility. In effect, the host computer that carries out the work of the application says, "Here are some output buffers; keep them empty. Here are some input buffers; keep them full." The microcomputer coordinates the communications medium, competing for the channel resources as required and allocating the resources to several different message streams. The data to be transmitted is formatted into a standard kind of message so that the received data can be checked for accuracy and either automatically corrected or corrected through retransmission.

Between the microcomputer and the channel are the communications-related input/output components. Some of these merely match the computer's electrical characteristics to those of the channel. Others relieve the microcomputer of the need to carry out simple conversion of bytes into serial bit streams, while still others automatically adhere to communication channel rules.

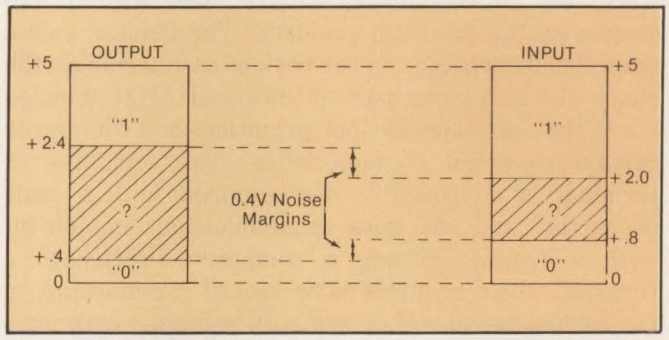

Fig. 1. TTL *voltage levels.*

The simplest means of communication between a computer and its terminal, another computer or a communications channel is by direct wire connection. Virtually all microcomputers have input/output circuitry that conforms to the rules imposed by transistor-transistor logic (TTL) (Fig. 1). The computer represents one logical state (say, one) with a voltage more positive than +2.4V and the other (zero) with a voltage lower than +0.4V—nominally, +5V and ground (0V), respectively. On the receiving side, any voltage below +0.8V is assumed to be equivalent to ground, and any voltage above +2.0V is assumed to be logically the same at +5V. TTL is often used to send data to a printer, CRT or disk drive.

Because the voltages (ideally) are never negative, they are called unipolar (one polarity). A simple TTL signal produced by a microcomputer can easily be transmitted over 1000 ft. of copper wire. If longer

The most widely recognized standard, the EIA RS232C document, enables agreement on how computers and terminals connect to modems.

distances are to be covered, special line drivers and receivers are used to provide greater immunity to any electrical noise that might be picked up by the wire; typical TTL parts for this kind of buffering are the 75121 (driver) and 75122 (receiver).

TTL rules are not established by any standards body. The data may be transmitted and received serially on a single wire, or eight parallel wires can be used to send a byte at a time. Speeds are limited only by the cable medium and the ability of the two computers to keep up. The "rules of the road" are entirely the responsibility of the designer, although sometimes other standards are invoked to prevent misunderstandings.

Physical standards

The first level of standardization deals with what the wires represent logically, how they are arranged on a connector and their electrical properties. The most popular and widely recognized standard is the Electronic Industry Association's EIA RS232C document, which was conceived to enable computer vendors and communications vendors to agree on how computers and terminals connect to modems. Later, as terminals were tied to computers, RS232C was drafted into service as the interface standard. The familiar 25-pin trapezoidal connector on the back of each terminal (the shape of which is not part of the standard) terminates wires that have specific interpretations and conform to certain electrical characteristics. The computer or terminal is supposed to be equipped with a male connector, and the data communications equipment with a female. Mating a computer directly to a terminal, then, requires some special consideration in the cabling because they are both equipped with male connectors. There is no standard that covers the precise method of circumventing the communications channel's absence, so designers and installers resort to "null modem" cables available from such vendors as Inmac Corp., Santa Clara, Calif., to simulate the nonexistent communications channel.

Electrically, RS232C signals are bipolar. A positive voltage represents logical zero, and negative represents logical one (Table 1). Proper voltage magnitudes lie from 5V to 15V. Bipolar voltages are still transmitted on a single wire. Clearly, for a TTL-compatible microcomputer to produce electrical signals that conform to RS232, some signal modification is required. A level shifter handles this modification. The 75188 is an appropriate bipolar line driver, and the 75189 is the compatible receiver. The driver and receiver perform a logical inversion because the polarity of the voltage in RS232C is opposite that of TTL.

RS232C voltages, speeds and distances were specified before the growth of data communications, so these parameters may seem anachronistic. The new standards are RS422A and RS423A. The characteristics of RS423A are similar to RS232C, but with different voltage levels, speeds and recommended maximum distances. The RS422A standard is different in that it uses two wires for each logical signal. As a result, any induced noise is algebraically added to both signals. At the receiving end, only the differential voltage on the two wires is detected, effectively canceling out any induced noise.

If operation is restricted to 5V to 6V, RS232C can be made compatible with RS422A and RS423A, but other restrictions may make total compatibility impossible.

A new standard

Because the RS232C standard emerged before much information had been gathered about data communications, it contains several deficiencies. To cope with these, another standard—along with RS422A and RS423A—has been designed to replace it. This standard—RS449 (MMS, November, 1979, p. 67)—specifies two connectors. The main connector, which is trapezoidal in shape, has 37 contacts; an auxiliary trapezoidal connector with nine contacts is required in some installations. RS449 is not compatible with RS232C, but there is a document available on constructing adaptors for RS232C-compatible devices.*

The RS449 standard is intended for transmission

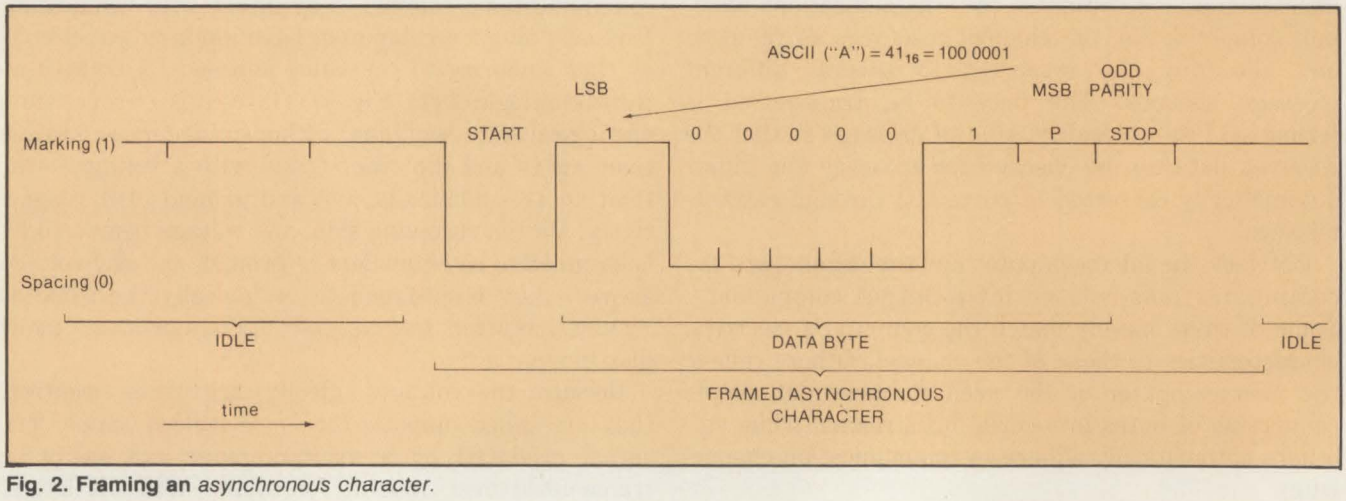

Fig. 2. Framing an *asynchronous character.*

		TTL	RS232C	RS422A	RS423A	
Representation	1 (High; Marking)	≥ +2.0	−5 to −15	−2 to −6	−4 to −6	volts (DC)
	0 (Low; Spacing)	≤ +0.8	+5 to +15	+2 to +6	+4 to +6	volts (DC)
Components	Transmitter	any TTL	75188 or 1488	75151 or 26LS31	75188 or 1488	Product type
	Receiver	any TTL	75189 or 1489	3486	3486	
Conditions	Max. Speed	25×10^6 (est.)	20,000	10×10^6	100,000	bits/sec.
	Recommended Max. Distance	10 (30) (est.)	15 (50)	15 (50) @ 10M bps 120 (3900) @ 100,000 bps	1200 (3900)	meters (ft.)

Table 1. *Standards parameters.*

speeds as high as 2M bits per sec. For speeds higher than 20,000 bps, the RS422A (balanced circuit) electrical characteristics are recommended; for speeds lower than that, RS423A can be used if it is more convenient. The RS232C set contains 10 new logical functions and related signal lines. Only a few of the older standard's seldom-used lines have been dropped, although several have been moved to a separate nine-pin connector that is required only if those capabilities are used.

The federal government already is starting to require RS449 in some of its installations, although the industry will probably stick with RS232C for some time. The adaptor cables operate only under certain circumstances, and a cheap, universal RS449/RS232C converter hasn't been developed.

Speeds

When bits are sent over wires, the sender and the receiver must agree on what constitutes one bit-interval. Without this agreement, several successive identical bits might be received as just a single, slower bit. One way to assure agreement is for the sender to produce a clock signal that changes during the time the next data bit is stable. This requires another wire. In a local mode, between a CPU and a disk drive, for example, this is practical. But in a telephone channel, in which all the bandwidth is used for data, the receiving end synthesizes a clock that operates at nearly the same speed as the sender's clock.

To simplify matters, the data communications industry has standardized some data-signaling rates ranging from 75 bps to 1.544 million bps. Common speeds are 300, 1200, 2400, 4800 and 9600 bps. These timing pulses can be generated by the microcomputer under software control, but critical programming is required to assure that all program path lengths have the same execution times. A better approach is to use an oscillator with a frequency of 153,600 pulses per sec., which is 16 times the 9600-bps data rate of some video display terminals. The higher frequency is used to count pulses from a reference point to find the midpoint of each data bit. From the leading edge of the first bit, eight clock pulses are ignored before the logical state of that bit is read. Thereafter, every 16th clock pulse samples the incoming data at the center-point, where the data is likely to be most stable.

Programmable interval timers, such as Intel's 8253, can be set to issue a square wave at the appropriate

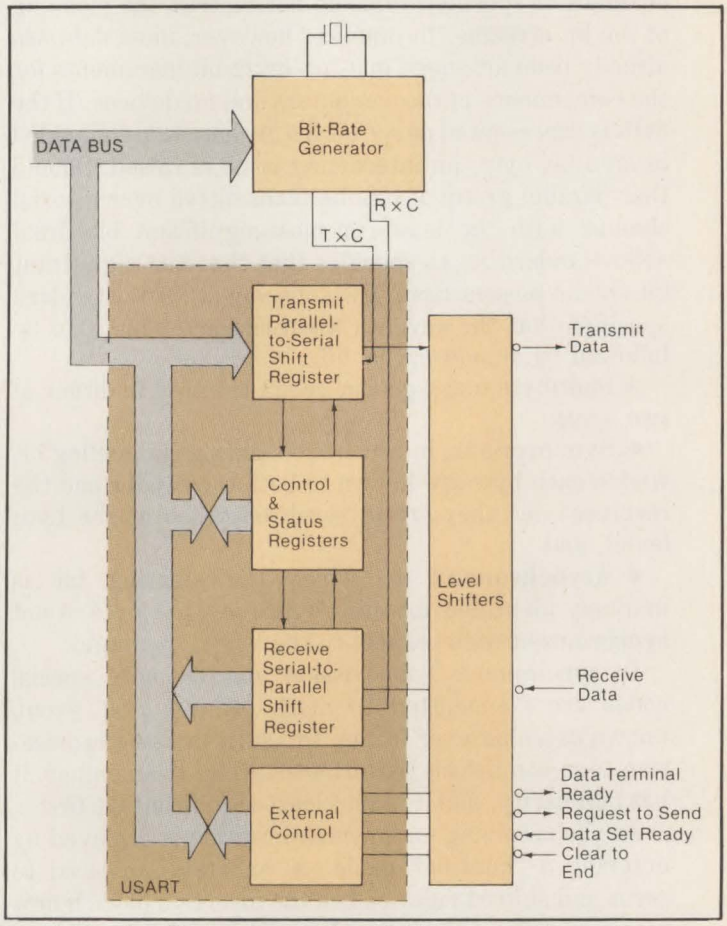

Fig. 3. Physical I/O *is moved to the USART to ease software load.*

The most recent trend is to implement both synchronous and asynchronous ability in one IC, leading to the USART.

frequency. The 8253 is fed from a fixed frequency source, and a counter is primed to count down once per clock pulse. With an external crystal-controlled frequency source of 2.544 MHz (typically from the CPU's clock generator), programming the interval timer with 165 results in 153,600 pulses per sec. (2.544 MHz ÷ 165), the 16 × 9600 frequency determined above. The same strategy can be used to approximate nearly any interval.

There are special counter/oscillator combination designed to produce the periods specified in the standards. The Western Digital BR1941L dual baud rate generator (BRG) is an 18-pin IC with two identical sections operating from the same internal oscillator. An external crystal sets the oscillator to 4.9152 MHz, and each half can be set to operate at standard bit rates from 75 to 9600 bps, plus a top speed of 19,200 bps and intermediates of 50 bps (for international circuits), 110 bps (for teletypewriters) and 134.5 bps (for Selectric-typewriter-based terminals). The sixteen frequencies are selected by two four-bit inputs.

Parallel-to-serial

The standards for bits sent over communications channels at specified rates do not restrict the meaning of the bit streams. In practice, however, most data has already been arranged in 8- 16- or 32-bit increments for the convenience of the computers and I/O devices. If the data is represented as a 7-bit ASCII character embedded in an 8-bit byte, an interesting issue is raised: Should that parallel group of bits be transmitted over a serial channel with the least- or most-significant bit first? ANSI standard X3.15 specifies that the least-significant bit should be sent first. The subsequent X3.16 standard specifies that the seventh ASCII-character bit is to be followed by an odd-parity bit.

A multibyte message can be transmitted in either of two ways:

- **Synchronous,** in which the starting and ending bit within each byte are known to both the sender and the receiver (i.e., they are in synchronization at the byte level), and
- **Asynchronous,** in which the starting bit is uniquely identified for each byte (i.e., the byte is not synchronized with respect to the larger message).

In synchronous transmission, one or more special codes are transmitted to mark off the 8-bit group known as a character frame. In ASCII, the SYNchronization code has the bit pattern 0001 0110. (Remember, it has odd parity, and it is sent least-significant bit first.)

At the receiving end, synchronization is achieved by entering a "hunting" mode. A register is cleared to zeros and shifted right before the insertion of each new incoming bit in the high-order position of the register.

Vendor	Part	Name
Fairchild	F6856	Protocol Controller
Intel	i8273	Programmable HDLC/SDLC Protocol Controller
Motorola	MC6854	Advanced Data Link Controller
Signetics	2652	Multiprotocol Communications Controller
Texas Instruments	TMS9903	Synchronous Communications Controller
Western Digital	SD1933	Synchronous Data Link Controller
Zilog	Z80 SIO	Serial Input/Output Controller

Table 2. *ICs with ADCCP/HDLC/SDLC control logic.*

As each new bit is inserted, the pattern is compared to the SYN code until a match is detected. Thereafter, each 8-bit group is taken as a unique character.

In asynchronous transmission, no transmitted character bears any relationship to any predecessor or successor. Since the end of one character does not implicitly mark the starting point of the next, it is important to mark differently the start of each new character. Typically, the idle communications channel is left in the marking (negative voltage) state that corresponds to a logical one. The obvious way to mark the start of a character is to issue a single bit-period ("start bit") of the opposite logical sense. One or more "stop bits" are issued to define an interval between characters, because the receiver is looking for the change from idle (marking, or 1) to active (spacing, or 0) to start the succeeding character (Fig. 4).

Clearly, asynchronous transmission is hard to foil. If the receiver gets out of sync with the sender, then one character, at most, is lost. However, if the start- and stop-bits are each one bit interval long, throughput is reduced by 25 percent. Synchronous transmission is more efficient, but it requires more logic.

Some years ago semiconductor firms developed single ICs for communication serial data between byte-orietned sources. The first models of these universal receiver/transmitters concentrated on asynchronous data because of the large number of teletypewriters in service and were called universal asynchronous receiver/transmitters (UARTs). For higher speed applications, receiver/transmitters for synchronous transmission (USRTs) were introduced. The most recent trend is to implement both synchronous and asynchronous ability in one IC, leading to the USART (universal synchronous/asynchronous receiver/transmitter). There are dozens of different models available, the most popular being Intel's 8251A (Fig. 3). Other such products include the Zilog Z80 DART, which includes two UARTs, and the Motorola 6850 for asynchronous data and 6852 for synchronous.

These products require suitably programmed bit-rate generators to set transmitter and receiver clock speeds (T × C and R × C in Fig. 3). The Signetics 2651

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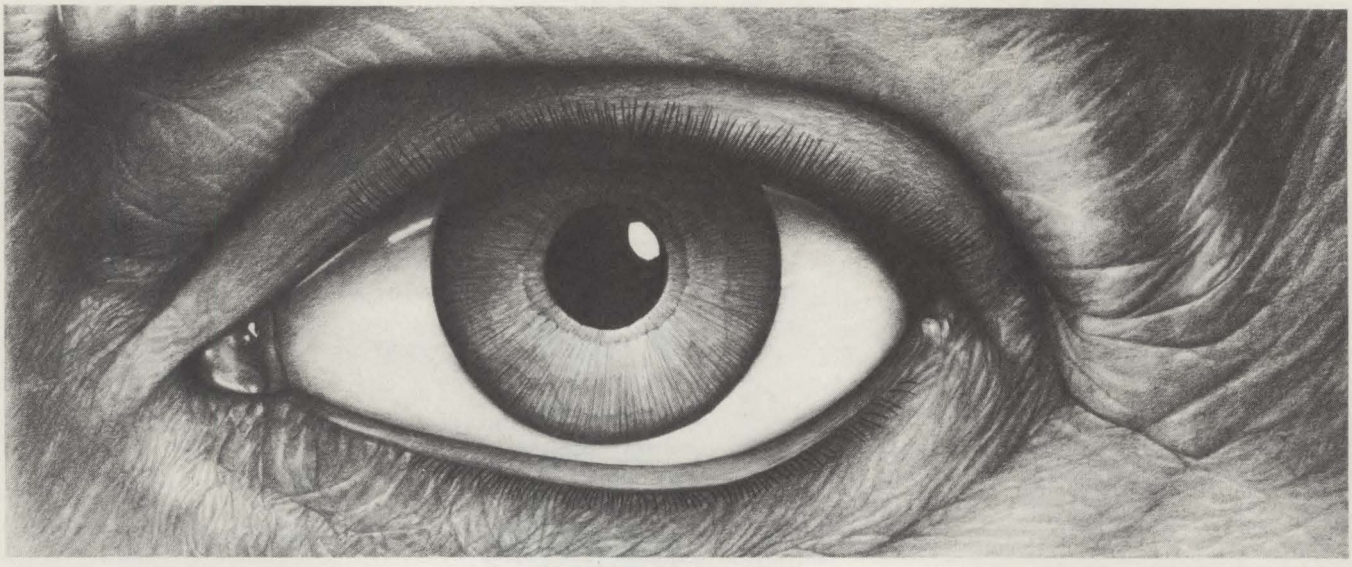

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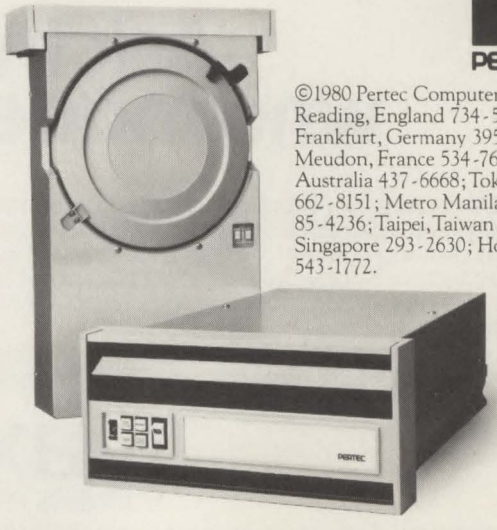

CIRCLE NO. 105 ON INQUIRY CARD

Although installing a USART and BRG raises a system's price, it significantly eases a programmer's work load.

has a programmable BRG on-board and some added logic that looks for certain character sequences.

All UARTs, USRTs and USARTs can conform to RS232. The four major control signals can be controlled by programming the communications IC. A different set of level shifters and a different-sized connector can be adapted to conform to RS449, although the added input and output signals must be interfaced to software through an auxiliary parallel I/O port.

Once the BRG and USART are programmed, data is transmitted by writing it across the data bus. The transmitter is double-buffered so that the computer can prepare a second byte while the first is transmitted. If the USART is in a synchronous mode and the transmitter's second-byte buffer is empty, the SYNC code is automatically sent.

On reception, a similar double-buffering occurs. (The Z80 DART offers quadruple buffering.) Bits are clocked into the receive serial-to-parallel shift register. When all bits are collected, the character is copied to a holding register, and the CPU is notified. To prevent the buffer from becoming overrun with data, the CPU must fetch the complete character from the USART before the next character is completed.

A novel asynchronous receiver/transmitter recently has been introduced by Motorola. The MC14469 is an addressable CMOS transponder with its own 7-bit code wired on seven pins of the IC. Data is transmitted on one wire to as many as 128 of these devices, but only the one that recognizes the address carried in the message will respond. Because transmission and reception occur at different times, data can be sent both ways on a single wire. The MC14469 can issue seven outputs and sense seven inputs.

Although installing a USART and BRG raises the price of a system, it significantly eases a programmer's work load. With complete control over the USART, the resident software is typically 120 bytes long. Imple-

RELEVANT COMMUNICATIONS STANDARDS

ANSI X3.1-1976	Synchronous signaling rates	$3
ANSI X3.15-1976	Bit sequence, serial data transmission	$3
ANSI X3.16-1976	Character structure and parity, serial transmission	$3
ANSI X3.24-1968	See EIA RS334	
ANSI X3.28-1976	Communications control with ASCII	$10.50
ANSI X3.4-1978	American standard code for information interchange (ASCII)	$4.50
ANSI X3.36-1975	High-speed signaling rates	$3
ANSI X3.57-1977	Structure for message-heading formats	$5.25
ANSI X3.64-1979	Additional controls for use with ASCII	$13.50
ANSI X3.66-1979	Advanced data communications control procedures (ADCCP)	$15
CCITT X.25-1978	Provisional recommendations X.3, X.25, X.28 and X.29 on packet-switched data transmission services (NTIS # PB 283257)	$8
EIA RS232C	Interface between DTE and DCE employing serial binary data interchange	$6.90
EIA RS269B	See ANSI X3.1	
EIA RS334	Signal quality at interface between data-processing terminal equipment and synchronous data communication equipment	$3.90
EIA RS363	Signal quality for transmitting and receiving at the interface with nonsynchronous data communication equipment	$5.80
EIA RS366A	Interface between DTE and automatic calling equipment	$14
EIA RS404	Start-stop signal quality between DTE and nonsynchronous data-communication equipment	$5.40
EIA RS422A	Electrical characteristics of balanced voltage digital interface circuits	$8
EIA RS423A	Electrical characteristics of unbalanced voltage digital interface circuits	$8
EIA RS449	General-purpose interface for DTE and data circuit terminating equipment, employing serial binary data interchange	$13
EIA RS449-1	Addendum #1 to RS449	$2

Standards Sources

ANSI: American National Standards Institute
1430 Broadway
New York, N.Y. 10018

CCITT: Documents are available in U.S. from
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EIA: Electronic Industries Association
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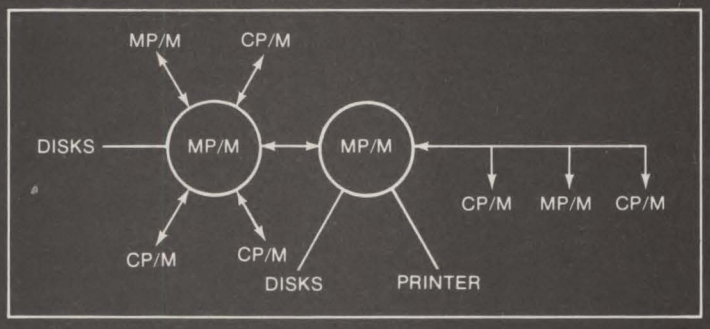

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CIRCLE NO. 106 ON INQUIRY CARD

A semiconductor vendor risks being sued when it states conformance to a standard in a data sheet.

menting the USART's functions in software requires 400 bytes or more. In very high-production volumes—in the thousands, for example—the low cost of memory may suggest replacing the USART with software, but the CPU time required to execute that real-time code must also be considered.

Data format

Each level of the various communications standards and circuits has become progressively more cognizant of the data. The level shifter circuits work on electrical levels independent of time. Serial transmission according to RS232 or RS449 requires timing information generally independent of the number of bits per character. At the serialization level, the number of bits per character becomes important, but the sequence of bytes is not.

Messages are the mainstay of data structures conveyed in data communications networks. The rules by which sender and receiver agree how to interpret bits and bytes comprise the communications protocol. As protocols have become more widely used, semiconductor firms have offered special ICs to implement them.

One of the first protocols was IBM's binary synchronous communications (BISYNC) method. In BISYNC, each group of bytes that comprises a message is preceded by synchronization codes and followed by a 2-byte checkword. The protocol also includes some specific procedures for managing the communications process between two BISYNC-compatible nodes. Ultimately, 8-bit bytes are sent over a serial pathway that can be managed by a USRT.

Some communications control chips, such as Zilog's SIO (Serial I/O, a dual-channel USRT), have BISYNC-related capabilities that can aid this process. The Z80 SIO computes a 16-bit cyclic redundancy checkword (CRC) that can be appended to the block during transmission and can flag detected errors during reception. Another chip, the Signetics 2651, contains logic for a transparent mode used to send and receive purely binary BISYNC data that might appear to be control codes. The Z80 SIO does not include this mode, and the Signetics 2651 does not have built-in CRC ability. In the case of BISYNC, the designer has to mate the USRT's capabilities with available software (or software talent) to construct a complete protocol.

The situation is simpler with IBM's replacement for BISYNC, the synchronous data link control (SDLC, which has subsequently been called HDLC; the ANSI standard X3.66 calls it advanced data communications control procedures ADCCP). Several manufacturers of ICs support this standard, which has several data-dependent functions that require careful control (Table 2). With the standards document in hand, a competent designer can program any one-chip microcomputer to use a USRT for these functions. It is easier, however, to adopt a USRT that includes the protocol.

Standard adherence

A semiconductor vendor risks a lot when it states conformance to a standard in a data sheet. If the component does not conform to the standard, the vendor could be sued as a result of misrepresentation, misunderstanding or honest error. Thus, semiconductor makers are careful to meet all the ramifications of the standard—probably more than a designer of a one-of-a-kind product.

There are definite risks in adopting off-the-shelf logic for level shifting, communications control and protocol management. As protocols become more complex (such as the CCITT X.25 for packet switching, or the MIL-STD 1553B for time-division multiplexed multistation communications), it becomes less likely that an IC will work precisely according to the standard at the outset. It may take several months before the design completely conforms.

This does not provide an argument for a designer to implement his own logic. If a new controller IC has a subtle bug, the thousands of designers working with it are likely to detect it, where if the protocol is implemented through software, the latent bug might not be discovered for years.

Designers should leave adherence to standards to the vendors. If you are buying complete systems, the vendor should assure you that he has conformed. If you are buying components, the component vendor should worry about the standard. However, to evaluate a vendor's adherence to a standard requires that you know the standard's scope, intent and function. The complete designer always keeps relevant standard copies on hand. ■

* EIA: *Application Notes on Interconnection between Interface Circuits Using RS449 and RS232C;* Industrial Electronics Bulletin, No. 12, Nov. 1977.

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CBEMA: *Status of Standards Documents,* X3.

Carol Anne Ogdin, a regular contributor to *Mini-Micro Systems,* is technical director of Software Technique, Inc., a consulting firm in Alexandria, Va.

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This is the new Epson MX-80 dot matrix printer. It does just about everything you could ask a printer to do. Quickly. Quietly. Reliably. In fact, for OEM installations, the MX-80 may be the single best, all-round printer you can buy. But that's not the best reason to buy it.

The MX-80 prints bidirectionally at 80 CPS in a user-defined choice of 40, 80, 66 or 132 columns. And if that's not fast enough, its logical seeking function minimizes print head travel time. The MX-80 prints 96 ASCII, 64 graphic and eight international characters with a tack-sharp 9x9 matrix. For a long time. Epson printers are known for reliability and the MX-80 is no exception. But that's not the best reason to buy it either.

The print head has a life expectancy of up to 100×10^6 characters, and when it wears out, just throw it away. A new one costs less than $30 and the only tool you need to change it is attached to the end of your arm. The MX-80 is compact, weighs only 12 lbs., and the whole unit, including the two stepper motors controlling carriage and paper feeding functions, is precisely controlled by an internal microprocessor. But even that isn't why you should specify the MX-80.

The best reason is this: because Epson makes more printers than anyone else in the world, we can afford to sell each one for a little less. So you can get one Epson MX-80 Printer for less than $650. And more than one for even less than that.

That's what we call a small price to pay for a printer that does everything well.

The world's first disposable print head. When it wears out, just throw it away. A new one costs less than $30, yet it's so simple, you can change it with one hand.

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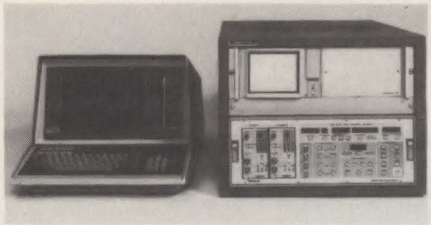
CIRCLE NO. 107 ON INQUIRY CARD

HOSPITAL SYSTEM. This hospital financial system, designed for remote problem diagnosing and programming, provides on-line financial data and updates files in real time. The minicomputer-based system includes software for patient registration; patient accounting; and material, labor and financial management. **Spectra Medical Systems,** Evanston, Ill. **Circle No 241**

TURNKEY INSPECTION SYSTEM. The Autovision vision-based system for manufactured parts inspection includes a solid state camera, a video processor, a dedicated 32-bit control processor, 120K bytes of memory, a cartridge tape drive, Pascal software, an interactive terminal, industrial-grade system packaging and optoisolated industrial I/O. The system can be instructed to detect and identify parts and to measure characteristics, such as orientation, area, perimeter, number of holes and hole areas. The system can compute statistical analyses, sort objects or provide information for robotic part-handling under control of standard or user-supplied software. **Automatix, Inc.,** Burlington, Mass. **Circle No 242**

FACTORY DATA-COLLECTION SYSTEM. The model 5000 interactive factory data-collection system collects production, material and labor data from the shop floor, enabling management to reduce work queues, make better use of productive facilities and simplify labor and material tracking and monitoring. Using a series of 16-bit processors and from 32K to 256K bytes of main memory, the model 5000 can accommodate as many as 128 9600-baud terminals on multidropped lines as much as 10,000 ft. long. The network, which uses the SDLC protocol, supports both batch and on-line communications to most makes of computers through either EIA serial asynchronous or synchronous interface channels. **Infolink Corp.,** Northbrook, Ill. **Circle No 243**



SIGNAL-PROCESSING SYSTEMS. These three signal-processing systems, designed to provide quick, complete waveform characterizations, are based on the vendor's 7612D programmable digitizer. Applications include production and calibration of avionics, missiles, computer and complex electronic systems; development of high-technology equipment; and equipment test and analysis. The WP3110 signal-processing system consists of a 7612D digitizer and a 4052 graphic computing system and uses extended BASIC. The WP3200 substitutes the vendor's CP4165 DEC-compatible minicomputer with 34K words of memory. And the WP3201 uses a DEC PDP-11/34A minicomputer with 64K words of memory. The WP3200 costs $63,100, the WP3201 $78,700, and the WP3110 $45,100. **Tektronix, Inc.,** Beaverton, Ore. **Circle No 244**

DESK-TOP COMPUTER. The SD-700 table-top computer system includes a 32M-byte fixed-removable disk (expandable to 96M bytes) with an average access time of 30 msec. The system can support as many as five users with 48K-byte partitions and a 16K-byte CP/M-compatible operating system called COSMOS (communications-oriented multi-user operating system), which supports COBOL, MBASIC, CBASIC and other compilers and individual and shared files for multi-user applications. The standard configuration has two Z80 central microprocessors operating at 4 MHz and two I/O ports. Price is $16,500. **SD Systems,** Dallas, Texas. **Circle No 245**

VIRTUAL-MEMORY FORTRAN ENGINE. The superset PGM computer, which combines a 48-bit FORTRAN processor with a virtual-memory operating system (VMOS) and compiler, functions as a stand-alone graphics-oriented system or as a distributed processor. Designed to execute megabyte-sized high-level language programs, the system has no programmer-addressable registers, no assembly language and no I/O instructions to operate channels. I/O is handled by a front-end 8080 microprocessor using an asynchronous RS232 protocol. The PGM weighs about 85 lb. and includes 300K bytes of RAM, a 29M-byte disk drive and an extended version of the DISSPLA graphics package. Prices start at $49,000. **Integrated Software Systems Corp.,**San Diego, Calif. **Circle No 246**

COMMERCIAL SYSTEMS. The CS/10 single-station microcomputer system can expand to support as many as four terminals and as much as 50M bytes of disk storage. The CS/70 supports as many as 17 display terminals and as much as 760M bytes of disk storage. Both systems run an interactive version of ANSI '74 COBOL. In a distributed environment, both can run 2780/3780 emulation software, and the CS/70 can run HASP II communications software. Applications include order-entry processing, inventory control and general accounting. Prices for the CS/70 start at $40,000. **Data General Corp.,** Westboro, Mass. **Circle No 247**

NETWORK DIAGNOSTIC & MANAGEMENT SYSTEM. The CMS 1000 diagnostic and management system serves medium-scale data-communications networks using as many as 32 lines. It provides monitoring and test-generating abilities and single-operator directed automated monitoring, testing, control, restoration and configuration. The system includes a color CRT terminal, a logging printer and a 10M-byte hard-disk drive that retains information about modems and other devices, their physical locations in a network and their relationships to each other. Prices start at $39,500. **Racal-Milgo, Inc.,** Miami, Fla. **Circle No 248**

COLOR GRAPHICS COMPUTER. Based on an LSI-11/23 CPU, the VISACOM/23 is said to perform graphic and true color, monochrome or pseudo-color image processing twice as fast as other available systems. It can also be used for process-control, LANDSAT analysis, military and other command-and-control applications. The system supports as many as four terminals and includes as much as 512K bytes of image memory. Other features include independent zoom and scroll on image or graphic overlay, four independent graphic overlay channels, as many as four alphanumeric character generators, four intensity-transformation units and four independent cursor overlays. Price including a color monitor, dual floppy-disk drives, a terminal and an interactive joystick is approximately $39,000. **DeAnza Systems,** San Jose, Calif. **Circle No 249**

PRACTICE-MANAGEMENT SYSTEM. This medical/dental office computer system includes proprietary computer hardware, an IRIS time-sharing operating system and the vendor's STATUS software. STATUS is a patient-management, patient-billing and practice-management system designed to improve cash flow by providing production reports, receivable aging, collection reports and outstanding insurance claim lists. The system can be expanded to a maximum of 32 video display terminals and 1.2 billion characters of on-line memory storage. Price is $24,500. **MicroTech Business Systems,** Costa Mesa, Calif. **Circle No 250**

New Products

design aids

S2150 EMULATOR. The SES 2150 emulator board for the vendor's S2150 single-chip microcomputer plugs directly into the microcomputer socket in an engineering prototype, enabling functional system checks of software designs. The module includes 2K bytes of 2716 EPROM for program storage and can be powered from a separate supply to prevent distortion of the prototype system's characteristics. Price is $625 in single-unit quantities. **American Microsystems, Inc.,** Santa Clara, Calif. **Circle No 251**

8080 DEVELOPMENT SYSTEM. Designed for development of 8080-based STD-BUS systems, the MMD-2 has a buffered system bus brought out to solderless breadboarding sockets for ease in designing interfaces. Included in the 11- × 15-in. cabinet are high-current power supplies, 4K to 8K bytes of EPROM, 4K bytes of RAM, a programmer for 2708 and 2716 EPROMs and a hexadecimal or an octal keyboard input and display. I/O facilities include RS232, 20-mA current loop and audio cassette interfaces with variable baud rates, three 8-bit parallel output ports and one 8-bit parallel input port. Other features include a real-time clock, RAM write-protect, a variable system clock, an editor-debugger, user-variable breakpoints, single step and register examine and modify. Price is $1250. **E&L Instruments, Inc.,** Derby, Conn. **Circle No 252**

PROM PROGRAMMER CARD FOR AIM 65. The A65-901 PROM-programmer and code-editor module plugs directly into the expansion connector of an AIM 65 printing microcomputer. Features include PROM check, read and verify functions; data load, verify and dump, each with offset; and an object code-editor (CO-ED). CO-ED controls the editor program pointer and can search, disassemble and modify R6500 object-code programs. The module includes 1K byte of R2114 static RAM, which, when used with an AIM 65 with 4K of RAM, enables single-pass programming of 4K × 8 PROMs, and internal logic to select PROM programming characteristics for the Intel 2756, 2716 or 2732 or the TI TMS 2508, 2516 or 2532 without switch or jumper changes. Price is $265 in single-unit quantities. **Rockwell International,** Anaheim, Calif. **Circle No 253**

DIAGNOSTIC EMULATOR. The EM-188 provides real-time or single-step emulation for 8080A, 8080A-1, 8085A and 8085A-2 microprocessors, as well as many logic-state analyzer functions and automatic test capabilities. The unit supports regional and relational breakpoints and includes a 250-word by 32-bit trace memory. Automatic test functions include RAM data or address test and continuous address increment for signature analysis stimulus. A user can copy a PROM to target-system memory or verify target memory against the PROM inserted in the front panel. The EM-188's RS232 interface supports data rates as high as 19.2K baud. Price is $2895. **Applied Microsystems Corp.,** Kirkland, Wash. **Circle No 254**

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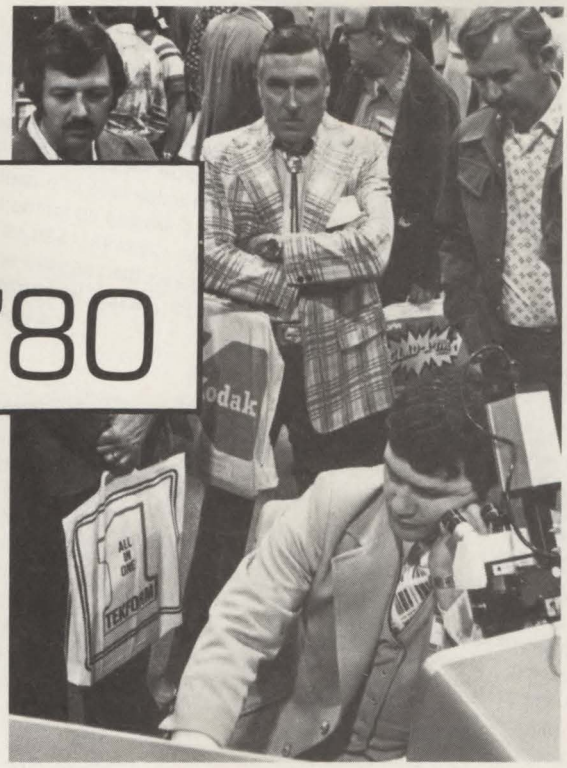

...a NEW exposition serving the Pacific Northwest electronics manufacturing industry

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More than 450 suppliers of production equipment will show their products at NEPCON NORTHWEST '80. This is the first time that the famous NEPCON Show will be held in the Pacific Northwest — affording a rare opportunity to see the most extensive displays of electronic production equipment for printed circuits and microelectronics.

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Covering major phases of manufacturing from artwork generation, through fabrication, assembly and production, to QC/QA/Testing, this wide-ranging Conference Program is designed to meet specific needs of the growing Pacific Northwest electronics industry.

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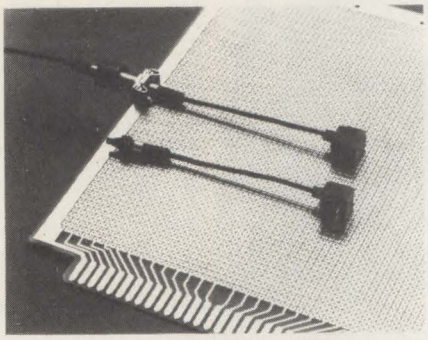


OPTICAL SOURCE AND DETECTOR. Texas Instruments' TXES482, TXES483, TXES492, TXES493 and TXED457 assemblies consist of an optical source or detector mounted in a low-profile, six-lead, plastic DIP for printed circuit board mounting and an integral 0.37-mm. Dupont PIR-140 fiber-optic cable. Available in 5,- 10- and 25-cm. lengths, the cable is terminated in a ferrule compatible with the AMP Optimate. The TXES482 and TXES483 source assemblies incorporate gallium aluminum arsenide emitters with a 20-nsec. rise time and a peak emission wavelength of 790 nanometers for optimum transmission through the plastic fiber-optic cable. The TXES492 and TXES493 source assemblies incorporate GaAlAs emitters with a peak emission wavelength of 850 nanometers and a rise time of 8 nsec. Prices in quantities of 10 are $33.59 for the TXES482, $50.39 for the TXES483, $33.59 for the TXES492, $50.39 for the TXES493 and $28.89 for the TXED457. **Texas Instruments Inc.,** Dallas, Texas. **Circle No 255**

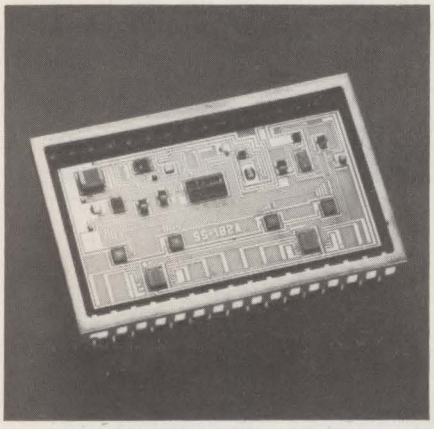
PROM AND SPROM. The 29681ADC is a tri-state 2048 × 8 PROM with a maximum access time of 50 nsec. and an enable access time of 35 nsec. over the full commercial temperature range. The 29683ADC is a tri-state 2048 × 8 SPROM with a maximum access time of 50 nsec. and an enable time of 65 nsec. The devices come in 24-pin ceramic DIPs and cost $243.75 in 100-unit quantities. **Raytheon Semiconductor,** Mountain View, Calif. **Circle No 256**

MULTIBUS CHASSIS. The IMC-400 chassis for industrial applications mounts on the backplate of NEMA-type industrial enclosures and accepts as many as eight Multibus boards. The standard chassis includes dual 110-CFM fans; a four-slot Multibus card cage; a linear power supply with outputs of +5V at 14A, +12V at 2A, −12V at 0.8A and −5V at 0.9A; a line-frequency clock, which can be used to generate a real-time clock interrupt; and a user-programmable front-panel switch and LED. The removable front panel can be modified to hold displays, cassette drives, 5¼-in. floppy-disk drives or other custom equipment. A standard IMC-400 chassis costs $1295. **Rela Systems, Inc.,** Boulder, Colo. **Circle No 257**

A/D CONVERTER. The ICL7126 is a low-power version of the ICL7106 3½-digit A/D converter used in many hand-held DMMs, DVMs and digital thermometers. The CMOS device, which runs on a single 9V battery, includes seven-segment decoders, display drivers, reference and clock on a single chip. It is designed to interface directly with a liquid crystal display (LCD) and includes a backplane drive. The ICL7126 is available in 40-pin plastic or ceramic DIPs. Price for the epoxy-package version is $11.30 in quantities of 100. **Intersil, Inc.,** Cupertino, Calif. **Circle No 258**

16K-BIT STATIC RAM. The MSM 2128-1 VLSI static RAM has a maximum access time of 200 nsec. and maximum power dissipation of 600 mw. Organized as 2048 × 8 bits, the device uses fully static circuitry requiring no clocks or refreshing operation. The MSM 2128-1 is TTL-compatible, operates from a single +5V power supply and comes in a 24-pin ceramic DIP package that is pin-compatible with the vendor's MSM 2716 16K-bit EPROM. The MSM 2128-1 costs $105.60 in single-unit quantities. **OKI Semiconductor,** Santa Clara, Calif. **Circle No 259**

Q-BUS-COMPATIBLE CHASSIS. The MCC-2 Microchassis enclosure for DEC Q-Bus-compatible microcomputer, memory and I/O cards accommodates four dual-height circuit boards. The enclosure comes with a built-in power supply, front-panel logic controls and cooling fans. Price is $690 in single-unit quantities. **North Atlantic Industries, Inc.,** Hauppauge, N.Y. **Circle No 260**



16-BIT A/D CONVERTER. The MN5282 is a 16-bit successive-approximation A/D converter in a 32-pin DIP. Features include an internal clock and reference, six user-selectable input ranges, short-cycling capability and optional offset and gain adjustments. Conversion time is 50 μsec., and power consumption is 1400 mw. Price is $245 in quantities of one to 24. **Micro Networks Co.,** Worcester, Mass. **Circle No 261**

WIDE-BAND ISOLATION AMPLIFIER. The model 289 three-port isolation amplifier provides 12-bit linearity, DC to 20 kHz small-signal (−3-dB) bandwidth and DC to 5 kHz full-power bandwidth, maximum offset voltage drift of ±10 μV/°C, maximum gain temperature coefficient of 50 ppm/°C and an auxiliary isolated power output. The 289L costs $99 in single-unit quantities; J and K versions are available for $59 and $69, respectively. **Analog Devices, Inc.,** Norwood, Mass. **Circle No 262**

WIRE-WRAP PANEL. The model 347 high-density universal wire-wrap panel can hold as many as 469 devices on a 15.85- × 14.90-in. area. The panel, which can accommodate almost all available DIPs, has two voltage planes, plus ground, and provides high-density I/O via five 108-pin connectors. In single-unit quantities price is $1193.83 with gold-plated pins, $984.61 with tin-plated pins. **Mupac Corp.,** Brockton, Mass. **Circle No 263**

4K-BIT STATIC RAM. The MM2147-3 4096 × 1 static RAM has a 55-nsec. cycle time and requires no clock or refresh. All data is read out nondestructively, with the same polarity as the input data. When deselected, the device automatically switches to a low-power standby mode, which reduces current drain by 85 percent. Packaged in an 18-pin DIP, the MM2147-3 costs $29 in quantities of 100. **National Semiconductor Corp.,** Santa Clara, Calif. **Circle No 264**

New Products

minis

PDP-8 ALTERNATIVE. The LSI-8 microcomputer is designed for medium- and high-volume general-purpose applications in which a PDP-8 could be used. Typical system boards contain a CPU with dual serial I/O, 32K bytes of RAM, 4K bytes of battery-backed-up CMOS RAM and a DMA floppy-disk-drive controller. A number of other chassis, power-supply, cabinet and disk-drive options are also available, along with operating systems, special handlers, utilities and cross assemblers. A complete 32K-byte system with a rack-mount chassis and power supply costs $1500. **Intersil, Inc.,** Cupertino, Calif. **Circle No 265**

MINICOMPUTER. The TCP-16/5 16-bit minicomputer, which emulates Lockheed's LEC-16 (formerly the MAC-16), provides access and memory size protection, memory parity and extended memory addressing to 1M word. The TCP-16/5 is said to be 30 to 40 percent faster than the LEC-16 and supports as many as six DMA channels, compared to two for the LEC-16. It has 32 levels of priority interrupts, bootstraps as many as 412 words and can handle as much as 300M bytes per spindle of disk storage. Prices start at $19,884 for a single unit with 32K words of main memory. **Telefile Manufacturing Co.,** Irvine, Calif. **Circle No 266**

ARRAY PROCESSOR. The APS array processor subsystem increases the speed of floating-point arithmetic operations, eliminating data-transfer bottlenecks between a host computer and special scientific processor elements. The system operates at a maximum execution burst rate of 120M floating-point operations per sec. and at a sustainable rate, for suitable algorithms, of 80M floating-point operations per sec. Maximum system performance of 245M floating-point operations per sec. can be realized when two APSs are attached to a 1100/84 system. Purchase prices start at $950,000. **Sperry Univac Co.,** Blue Bell, Pa. **Circle No 267**

HIGH-END NAKED MINI. The LSI 2/40 Super 2 minicomputer has a 100-nsec. cycle time. Other features include lined microinstructions, pre-fetch routines, on-board diagnostics and a memory management unit (MMU) providing as much as 8M bytes of addressing memory and a 2K-byte on-board cache memory. The LSI 2/40 can use the vendor's 128K- and 256K-byte RAM cards with error correction and control (ECC). The Super 2 can accommodate as much as 1M bytes of this memory on a nine-card, "split" chassis. In single-unit quantities, prices start at $5650 with 64K bytes of RAM and at $11,400 with an MMU, a cache and 256K bytes of ECC RAM. **Computer Automation, Inc.,** Irvine, Calif. **Circle No 268**

32-BIT MINICOMPUTER. The Concept/32, said to be the first 32-bit minicomputer based on a single-slot CPU, includes a 16M-byte mapped memory management system, instruction look-ahead and floating-point arithmetic instructions. Also incorporated in the unit are a single-slot integrated memory module that combines 256 bytes of ECC MOS memory with refresh logic and memory controller functions and a single-slot I/O processor that can handle 16 device controller subchannels and four external priority interrupts. The Concept/32 comes in a 15-in.-high package and costs $25,000. **Systems Engineering Laboratories,** Ft. Lauderdale, Fla. **Circle No 269**

HOW FINDEX WON!

$6,980.
Delivery: 30 days

FINDEX—No need for peripherals

Not a toy!

FINDEX is a fully portable, inexpensive, feature-packed business computer designed for the professional. FINDEX uses the latest technology: bubble memory, flat gas plasma display, built-in 80-132 column, plain paper printer.

This terminal sized computer can have up to 2 million characters of non-volatile solid state bubble memory mass storage, or up to 400,000 characters on an inexpensive built-in mini-floppy diskette drive; random access memory from 64 kilobytes to 2 megabytes. It interfaces to a variety of peripherals, such as fast printers, or hard disk drives (up to 195 megabytes).

It has I/O expandability: serial, parallel and S-100 Bus interface is standard. Audio-cassette recorder jacks and acoustic coupler are optional.

No sorting!

FINDEX is programmable in easy to use Business BASIC. It supports also a full ANSI FORTRAN, COBOL 74 or a BASIC compiler, as well as a MACRO assembler. APL and PASCAL can be used too. The 26k BASIC includes a comprehensive file management capability. There is no loss of time for data to be sorted. As data is typed in, it is immediately entered in its proper place in the desired order: alphabetical, zip code, price, quantity, etc. There is no loss of time for retrieving data either. The computer will access the requested data directly without going through any lengthy search.

Powerful!

The FINDEX BASIC is the most extensive Z-80 BASIC language available.

- Direct access to CPU I/O ports (INP,OUT);
- Ability to read or write any memory location (PEEK,POKE);
- Matrices with up to 255 dimensions;
- Error trapping;
- Fully formatted print output (tab, asterisk fill, floating $ sign, scientific notation, trailing sign, comma insertion, etc.);
- Extensive string functions as well as complete mathematical functions; 16 digit precision;
- Sequential files with variable length record;
- Random files (record I/O).
- Linked keys (any string) indexed sequential files —no need for sorting!
- Dynamically written variable length records and fields;
- Programs merging;
- Multiple statements on one line;
- Ability to call up to 10 assembly language subroutines.

Fully portable!

FINDEX weighs 31 pounds (14 kg.) and can be taken along in its carrying case on airplanes or in cars. Wherever you go FINDEX goes with you. Its battery back-up (optional) and built-in printer grant you independence from heavy peripherals. FINDEX has the programming power of an expensive mini computer for a fraction of its cost.

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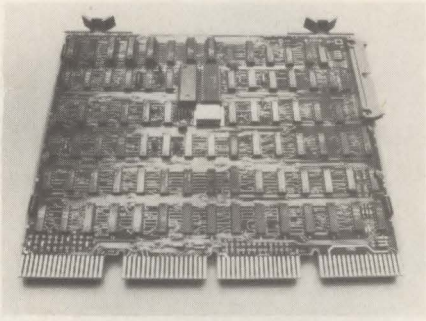
CIRCLE NO. 113 ON INQUIRY CARD

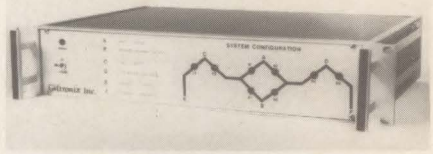
interfaces and controllers

SERIES/1 PRINTER CONTROLLER. The DLP-3300 line-printer controller for the Series/1 minicomputer emulates the IBM 4973 attachment. It will operate in any single Series/1 I/O slot and is compatible with IBM's RPS, EDX and CPS operating systems. The unit will support any printer using Centronics or Dataproducts interface standards. Price is $1950 in single-unit quantities. **Datasystems Corp.,** San Diego, Calif. **Circle No 270**

DX11-B REPLACEMENT. The model 8911 channel-speed IBM interface for Digital Equipment Corp. Q-Bus and Unibus computers is a functional replacement for the DEC DX11-B. Using an internal LSI-11 CPU instead of the external PDP-11 required by the DX11, the 8911 can emulate any standard IBM controller and respond to all 256 possible subchannel addresses. It can provide 1M-byte-per-sec. channel-speed communication between any IBM selector, byte-mux or block-mux channel and multiple Q-Bus and Unibus devices at distances as great as 1200 ft. Price is $17,500 for the Q-bus interface, $18,400 for the Unibus model. **Austron Data Systems,** Austin, Texas. **Circle No 271**

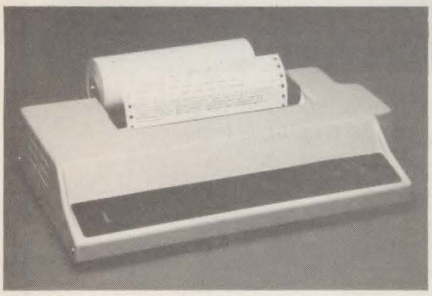


BYTE-ORIENTED DMA CONTROLLER. The PDI-11 controller for DEC Unibus computers performs DMA data transfers to and from byte-oriented peripherals, such as printers, plotters, graphic terminals and plasma displays, at rates of 80K to 100K bytes per sec. The quad-size board can also run in a PIO mode, which enables peripheral devices to look to the computer like DEC DL serial line units. DMA operation is half-duplex, bidirectional; PIO is full-duplex. The PDI-11 uses RS422 receivers and drivers and can operate over distances as great as 3000 ft. at full speed. Price is $2150 in single-unit quantities. **MDB Systems, Inc.,** Orange, Calif. **Circle No 272**



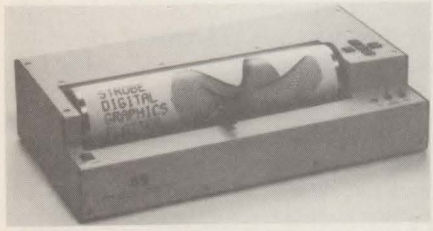
AUTOMATIC INTERFACE CONTROLLER. The GA6S8, the most powerful member of a family of software-controlled automatic interface controllers, can interconnect as many as six devices, such as CPUs, modems and terminals. As many as five of its six ports can be masters; data rate is switch-selectable from 110 to 9600 baud for master ports and unlimited for slaves. The 8085-based unit, which complies with RS232 and IEEE-488 specifications, can switch as many as eight pins on the 25-pin EIA connector. A status-verification features enables remote operation. The GA6S8 costs $2099 in single-unit quantities. **Giltronix, Inc.,** Palo Alto, Calif. **Circle No 273**

printers



DOT-MATRIX PRINTER. Designed for continous duty in small-business, educational, professional data-processing, industrial, laboratory and personal-computing applications, the DIP-81 impact printer generates an upper- and lower-case character set in a 7 × 7 or expanded 14 × 7 dot matrix. Other features include 100-cps bidirectional printing, clean ribbon-cartridge loading and a low profile. The 80-column unit uses bond paper in sheet, roll or fanfold form and includes a Centronics-compatible parallel interface. Price is $499 in single-unit quantities. **DIP, Inc.,** Boston, Mass. **Circle No 274**

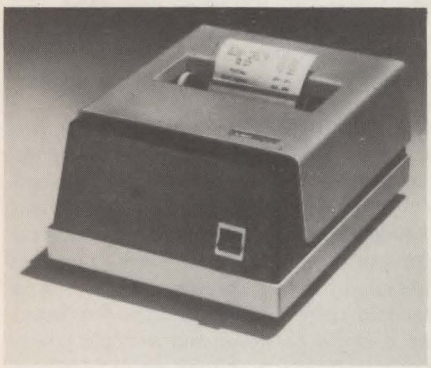
SMALL PRINTER. Designed for portable and compact instrumentation readouts, the MP-2000 is said to be one of the smallest impact printers, measuring 1½ × 2¾ × 3 15/16 in. and weighing 9 oz. The unit prints two 12-column lines per sec. and uses a 4-bit BCD parallel interface. Price is $175, with quantity discounts available. **International Technology Resource Corp.,** New York, N.Y. **Circle No 275**



GRAPHICS PLOTTER. The model 100 graphics plotter uses four-phase stepping motors for drum rotation and linear pen motion. The drum accepts 8½- × 11-in. paper, and the pen holder accommodates a variety of pens. Minimum line length is 0.004 in. An interactive digitizing mode enables direct entry of X-Y coordinate data corresponding to pen location into a computer. Also included is assembly language vector software support for 8080/8085, Z80 and 6502 microprocessors. The model 100 can be interfaced to any computer through two parallel 8-bit output ports and an 8-bit input port. Price is $680 in single-unit quantities. **STROBE, Inc.,** Mountain View, Calif. **Circle No 276**

54-IN. PLOTTER. The model 5400 54-in. drum plotter, which plots at 35 ips, accelerates at 4G and has a resolution of 0.0125 mm, is intended for high-throughput CAD/CAM applications, such as automobile body design. The plotter's servo-motor drive system and dual 16-bit microprocessors enable an operator to define a window so that only the portion of a plot between specified X and Y limits is plotted. Plot time is indicated on an LCD display, which also reports the results of an automatic self-diagnosis sequence. Ballpoint, liquid-ink, nylon-tip and liquid-roller pens can be used. An RS232 interface provides for both local and remote operation with terminals and modems. The model 5400 costs $33,900. **Nicolet Zeta Corp.,** Concord, Calif. **Circle No 277**

printers



THERMAL GRAPHIC PRINTER. This 44-column thermal graphic printer for microprocessor-based systems incorporates a fixed head using thick-film linear dot arrays. MICROPLOT 44 is available in both desk-top and panel-mount versions that accept and plot analytical and computational data, print grids and scales, annotate the data with alphanumerics and print alphanumeric text both horizontally and vertically. Other features include individual dot addressing, enhanced vector plotting, 256-dot resolution, manual and programmable mode selection, a full 96-character ASCII set, double-height and double-density characters, IEEE-488, RS232C and parallel interfaces and internal self-test. Price in single-unit quantities is less than $1000. **Gulton Industries, Inc.,** East Greenwich, R.I. **Circle No 278**

IBM-COMPATIBLE IMPACT PRINTER. The Telex 287C printer, which is plug-compatible with the IBM 3287/2, uses a Diablo 7 × 9 dot-matrix printer mechanism to produce copy at 180 cps. It can function as one of as many as eight devices attached to an IBM 3276 controller or a Telex 276 plug-compatible replacement or as one of as many as 32 devices attached to an IBM 3274 controller. The 287C supports dynamic choice of either ASCII-B or EBCDIC input from two distinct sources. Internal buffer memory capacity ranges from 960 to 3556 characters. The 287C performs microprocessor-controlled diagnostic routines. Price is $4395, with lease plans available. **Telex Computer Products, Inc.,** Tulsa, Okla. **Circle No 279**

QUIET BAND PRINTER. The model 6080 band printer, intended for applications such as word processing, office information distribution and mainframe data processing, is enclosed in an acoustically padded cabinet that reduces operational noise to less than 60 dB. The printer, which is compatible with the Centronics 6000 series, runs at 600 lpm. It is available with 48-, 64-, 96- and 128-character bands in a variety of easily changeable character sets. Price is $7695, with OEM discounts available. **Centronics Data Computer Corp.,** Hudson, N.H. **Circle No 280**

DOT-MATRIX IMPACT PRINTER. The model 7000+, a dot-matrix impact printer designed for small business and home computer systems, operates unidirectionally at 1.25 lines per sec. It accepts single- or multi-ply paper rolls from ¾ to 3⅞ in. wide and prints a 3⅓-in. line. Capacity is 40 columns at 12 cpi. The 7000+ prints the full ASCII character set and can print both single- and double-width fonts. Options include a 120-character buffer and a version that prints 64, 40, 32 or 20 characters per line, selectable under software control. **Eaton LRC,** Riverton, Wyo. **Circle No 281**

disk/tape

HARD-DISK SUBSYSTEM. The model 16 hard-disk subsystem provides 16M to 80M bytes of Winchester and 16M bytes of SMD bulk storage for the vendor's Series 5000 and 8000 microcomputer systems. The drive also includes a controller that supports either direct memory access (DMA) or programmed I/O (PIO) data transfer at maximum data rates of 1.2M bytes per sec. Prices start at $10,000. **Industrial Micro Systems,** Orange, Calif. **Circle No** 282

UNIVERSAL RECORDER. The model 4000 universal recorder has RS232, TTY and 8-bit parallel interfaces; an interface for Hewlett-Packard's 98XX series computers is optional. Serial data rates are selectable to 9600 bps. The unit is available in desk-top, rack-mountable or ruggedized configurations. Prices start at $2500 in quantities of 100. **Saylor Electronics International,** Anaheim, Calif. **Circle No** 283

FOUR-TRACK CASSETTE RECORDER. The model 4240-320 four-track cassette recorder has a transfer rate of 100K bps per track, with an unformatted tape capacity as great as 8.6M bytes. The unit is available in an OEM configuration or with an intelligent 8085-based controller to speed system integration. Prices start at $1250 in quantities of 100. **Saylor Electronics International,** Anaheim, Calif. **Circle No** 284

RS232 DATA RECORDER. The model 7000 Datatape is a microprocessor-based recording device that provides nonvolatile mass storage for data associated with the RS232C and CCITT V.24 communications interfaces. Data and control signals can be recorded and later replayed at any of 16 data rates to facilitate analysis of communications link problems. Operation is independent of data code, line protocol, code level and parity for both synchronous and asynchronous data links. Prices start at $5000. **International Data Sciences, Inc.,** Lincoln, R.I. **Circle No** 285

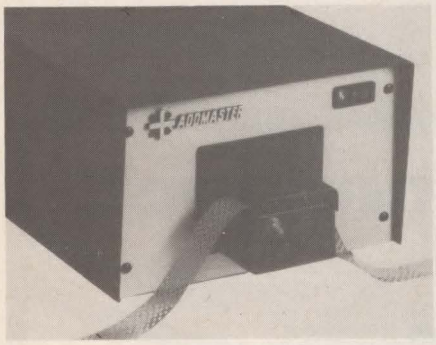
40M-BYTE WINCHESTER. The model 6173 8-in. Winchester-disk drive provides a data-transfer rate of 800K bytes per sec. and a data-access time of 50 msec. Other features of the 40M-byte, three-disk system include an MTBF of 10,000 hr., a brushless DC motor directly driving the disk spindle and an SMD interface. ANSI-type and host bus interfaces will also be available. Prices start at $3600 in single-unit quantities. **BASF Systems,** Bedford, Mass. **Circle No** 286

8-IN. WINCHESTER SUBSYSTEM. The MSC-8100 disk-storage subsystem combines 19M bytes of 8-in. Winchester mass storage with a 1M-byte floppy-disk drive backup, an intelligent controller-formatter and a universal IEEE-488 or LSI-11 interface. The 7-in.-high subsystem, which can be mounted in a standard 19-in. rack, is said to be the first to use a single controller and a single power supply for both drives to reduce size and cost and increase reliability. The MSC-8100 costs $9250 in single-unit quantities. **Microcomputer Systems Corp.,** Sunnyvale, Calif. **Circle No** 287

DISK SYSTEMS FOR DG MINIS. The 3100 Series disk-storage systems for Data General Nova and Eclipse minicomputers use a microprocessor-based, single-board controller to emulate DG's 6057, 6060 and 6061 disk systems. The controller, which mounts in a single I/O slot in the computer's backplane,

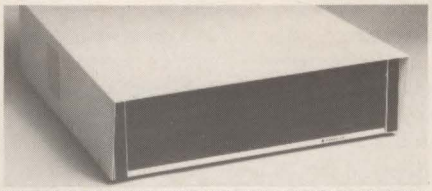
enables a user to daisy-chain as many as four CDC Storage Module Drives—either 80M, 300M or 675M bytes each—for a total capacity of as much as 2700M bytes per system. Other features include an external multiplexor and multiplexor panel. Prices start at $20,500 for a 300M-byte system and $13,000 for an 80M-byte system. **System Industries,** Sunnyvale, Calif. **Circle No 288**

TAPE-CARTRIDGE SYSTEM. The model 4000A ¼-in. magnetic-tape cartridge system provides a formatted data capacity of more than 24M bytes and an average data throughout of 20K bytes per sec. Other features of the one- or two-drive system include average data-transfer rates greater than 20,000 bps (150,000 bps maximum) and 6400- or 1600-cpi ANSI compatibility with Hewlett-Packard, Tektronix and other IEEE-488 desk-top computers. The 4000A is available in either free-standing cabinets or 19-in. rack mounts. Prices start at $3995. **Dylon Corp.,** San Diego, Calif. **Circle No 289**



PAPER TAPE READER/TRANSMITTER. The model 612 can read five- to eight-level paper tape and transmit seven to 11 frames per character at 50 to 9600 bps. Other features include starting and stopping on character at all speeds; choice of manual control or X-on, X-off; 90V to 260V, 50- to 60-Hz power; and even, odd or no parity. The model 612 is available in desk-top and rack-mount enclosures. Prices start at $656 to $779 in single-unit quantities. **Addmaster Corp.,** San Gabriel, Calif. **Circle No 290**

MICRO-BASED DATALOGGER. The model DL-42 microprocessor-controlled data logger records digital information on a Phillips-type cassette in ASCII, BCD, alphanumeric and binary formats. Weighing 5 lb. and measuring 8½ × 9 × 6 in., the unit can record as many as 10,000 ASCII characters. Options include an RS232 output with selectable data rates of 110, 300, 1200, 2400, 4800 and 9600 baud. If required, the device can output data directly to a terminal or printer. Prices start at $1195. **A. D. Data Systems, Inc.,** Rochester, N.Y. **Circle No 291**



INTELLIGENT DISKETTE SUBSYSTEM. The model 48 intelligent floppy-disk system stores as much as 3.2M bytes of data in IBM-compatible 26-,15- or 8- sector-per-track schemes. Other features include an RFS 4810 dual-head master drive, providing 1.6M bytes of unformatted data per drive, an on-board microprocessor-based controller-formatter, diskette-to-diskette copy and an access time of 3 msec. track-to-track. The rack-mountable device costs $1197 in small OEM quantities. **Remex Division, Ex-Cell-O Corp.,** Irvine, Calif. **Circle No 292**

New Software

DATA ENTRY. Designed to replace key-to-disk systems, the LOBOL data-entry program is compiled on an HP3000 and downloaded to an HP2645 or HP2649 terminal via a procedure call in the user's application program. The data-entry program then runs entirely in the terminal, providing validation, calculation, table look-up and file manipulation without accessing the host CPU. When a batch of data is ready, it is transferred to the host program through another procedure call. LOBOL also includes the TNET communications system, a protocol that is claimed to reduce the communications overhead of the host HP3000. The one-time license fee is $7500. **Pantechnic,** Oakland, Calif.

Circle No 293

GENERAL LEDGER. The GL general-ledger system, which uses a double-accounting method, requires a TRS-80 model II microcomputer running under the TRSDOS 1.2 operating system, a 132-column printer, dual disk drives and 64K bytes of RAM. The chart of accounts contains five-digit account numbers, account descriptions and current, year-to-date and budget balances. The user specifies account type, master/sub-account code and balance-sheet column code. Outputs include trial balances, balance sheets, income statements and department income statements. Departmental and summary income statements show current and year-to-date amounts, percentages by category and year-to-year comparative data. Price is $129, including a manual, an installation guide and an 8-in. diskette. **Micro Architect Inc.,** Arlington, Mass.

Circle No 294

DATA BASE MANAGEMENT. The Business Data Base System for the TRS-80 computer enables users to define and build data bases for inventory control, general ledger accounting, accounts receivable and accounts payable. Fields can be manipulated to format hard-copy reports and present status displays; report formats can be filed for later use. Data can also be searched and sorted. The system, which has a built-in file catalog, is compatible with the TRSDOS, NEWDOS and 3.0 DOS operating systems. It requires 32K bytes of RAM and a single disk drive and can support multiple-disk systems. Price is $89.95. **Charles Mann & Associates,** Yucca Valley, Calif.

Circle No 295

JOB ACCOUNTING. Written in RPG-II, the Job Accounting/34 System for the IBM System/34 tracks job and print time by procedure, user ID, device, date and time. Users generate management reports by defining report contents, sort order and control breaks. Applications include client and department billing, scheduling and installation management. One-time license fee is $435. **Calvin P. Allyn & Associates,** Boston, Mass. **Circle No 296**

PROJECT SCHEDULING. Critical Path Method (CPM), an interactive project-management program that can produce graphics diagrams of the sequence of tasks governing a project on a line printer or terminal, runs on DEC PDP-11, DEC-10, DEC-20 and Honeywell Series 60 Level 66 computers. Written in FORTRAN, the system tracks multitask projects comprising as many as 3000 activities and generates 12 reports, including a list of activities that are on or behind schedule, a summary of activities to be worked on during a given period, a tally of available resources and a running account of costs. Reports can be modified interactively to suit a user's need. A user can obtain separate reports for critical, targeted or milestone activities, receive separate reports for each department, sort reports on any 14 fields and specify time windows to select subsets of activities. Purchase price is $10,500. **Technical Economics, Inc.,** Berkeley, Calif. **Circle No 297**

NETWORK OPERATING SYSTEM. The NOS.2 disk-based operating system includes a networking module, which enables several microcomputers to share disks and a printer. The system provides a command language, error-checking-and-recovery facilities, public and private files, help files, printer spooling, disk paging and a desk calculator facility. Procedure files can call other procedure files and can call themselves recursively. NOS.2 runs on Z80 and 8080 microprocessors and is said to be upwardly compatible with the CP/M operating systems. **Cambridge Development Laboratory,** Watertown, Mass. **Circle No 298**

APL INTERPRETERS. The APL/LW and APL/LWSF APL interpreters for Prime 50 computers provide as much as 31M bytes of work space per user. All APL operators, system variables, system commands and I-Beam and system functions are included. The APL/LWSF file system provides component files, as well as binary sequential and ASCII sequential files. Files created by other language processors, such as FORTRAN, COBOL, RPG, BASIC, PL/1 and Pascal, can be read from APL/LWSF, using the sequential file access functions, and files designed to be processed by non-APL languages can be created. **MIPS Software Development, Inc.,** Pontiac, Mich. **Circle No 299**

SCREEN MANAGEMENT. The E-CODE language, which runs on a PDP-11/03 computer under the RT-11 operating system, provides screen management for the DEC VT-100 terminal. Designed to support four VT-100s and an LA-120 printer, E-CODE supports concurrent key-to-disk, data-entry, data-edit and record-managment functions. Features include structured programming, virtual memory of as much as 6M bytes and provisions for validating operator input in character or block mode. Multifile capabilities enable independent data file manipulation from each attached terminal. Price is $850 in single-unit quantities. **MCPC Systems,** Minneapolis, Minn. **Circle No 300**

New Software

FILE MANAGEMENT. PFAS, running in 6K bytes of memory on I.5 or II.0 UCSD Pascal systems, enables programs to access data with user-defined keys. Functions include file creation, opening of existing files, addition of records to a file randomly or sequentially by key, retrieval of records randomly or sequentially by key, sequential reading beginning with any record and changing of records already in a file. On-line record and key deletion and retrieval of records by partial key are options. PFAS routines, contained in a Pascal code unit, are linked to the user program using the system linker. A single-site license costs $100 for the standard version and $150 for the version with options. **C.J. Wigglesworth Software,** Cardiff, Calif. **Circle No 301**

FORTRAN-CALLABLE GRAPHICS. GP-10, a package of FORTRAN-callable graphics subroutines that provide basic plotting capabilities, runs on DEC PDP-11 computers and works with Tektronix-compatible graphics peripherals. MOVE, DRAW and POINT routines are available in device and virtual (user-defined) coordinates and in absolute and relative modes. Utilities are included for displaying text at any point, defining dashed lines and for doing interactive graphics. Hard copies of images produced on a graphics terminal can be obtained via graphics memory readback routines. **Syscon Design Inc.,** Manhattan Beach, Calif. **Circle No 302**

MULTI-USER APL. AlphaAPL, a multi-user APL for the Alpha Micro computer, is intended for financial and scientific work. Running under the Alpha Micro operating system, the language can be used with ASCII or APL terminals. Assembler subroutines can be called directly from an APL program. The package, including the APL language, a user's manual and assembler subroutine development aids, costs $500. **Softworks Ltd.,** Chicago, Ill. **Circle No 303**

REPORT GENERATOR. REX/3000, a report generator program and language for the HP 3000 Series computer, is designed to facilitate application system development. The package performs housekeeping functions, such as opening and closing data bases and files or testing for end-of-file conditions, without user intervention. Users can access combinations of data bases, data sets and files during report preparation and produce multiple reports on a single pass through the data. A single-machine license costs $8500, and an annual maintenance and enhancement costs $850. A 45-day trial is available for $150. **Gentry, Inc.,** Oakland Calif. **Circle No 304**

Mini-Micro Systems receives dozens of news releases each week about new software products that may not warrant the detail included in the foregoing New Software section. Nevertheless, we don't want to deny readers the opportunity to get more information about the latest software developments. Toward that end, we offer the following brief entries, compiled and edited by Malcolm L. Stiefel, contributing editor.

OPERATING SYSTEMS. Microcobol, Inc., Longwood, Fla., offers an operating system for the DEC PDP-11 computer. **Circle No 412 . . . Lifeboat Associates,** New York, N.Y., provides a CP/M operating system for

the Durango F-85 computer. **Circle No 413 . . . Harris Corp.,** Fort Lauderdale, Fla., unveils a new version of its Vulcan operating system for its Series 100, 500 and 800 computers. **Circle No 414 . . . American Microsystems, Inc.,** Santa Clara, Calif., introduces an operating system for Intel, Motorola, Texas Instruments and Tektronix microprocessor development systems. **Circle No 415**

DEVELOPMENT AIDS. Computer Applications Research, London, England, releases a COBOL compiler for the Alpha Microsystems microcomputer. **Circle No 416 . . . Modcomp,** Fort Lauderdale, Fla., adds a FORTRAN compiler for its Classic Series computer. **Circle No 417 . . . Ampersand Corp., York, Pa.,** announces an IBM-1130 to IBM Series/1 FORTRAN-conversion program. **Circle No 418 . . . Hewlett-Packard,** Palo Alto, Calif., brings out a Pascal compiler for its model 64000 microprocessor development system. **Circle No 419 . . . Motorola Semiconductor Products, Inc.,** Phoenix, Ariz., introduces a BASIC compiler for its M6809 microprocessor. **Circle No 420 . . . Datapoint Corp.,** San Antonio, Texas, offers a BASIC interpreter and Teletype emulator for its model 1500 business computer. **Circle No 421 . . . Ruben Engineering Corp.,** Cambridge, Mass., announces a cross-assembler and linker for the M68000 that runs on the DEC PDP-11S. **Circle No 422 . . . Stoneware Microcomputer Products,** San Rafael, Calif., offers a macro library that works with Microsoft, Digital Research and Computer Design Labs macro assemblers running on Z80 or 8080 microprocessors. **Circle No 423 . . . Corion International,** Newport Beach, Calif., unveils a series of development tools for System Engineering Labs 32 Series computers. **Circle No 424**

UTILITIES. Raxco Inc., Palm Beach, Fla., announces enhancements for its RABBIT computer time-accounting package, which runs on DEC PDP-11 and VAX computers. **Circle No 425 . . . Signal Technology, Inc.,** Santa Barbara, Calif., offers a computer time-accounting system for the VAX-11/780. **Circle No 426 . . . Logicaid Ltd.,** Nepean, Ontario, provides a sort package for the DEC PDP-11 running under the RT-11 operating system. **Circle No 427 . . . Computhink,** Sunnyvale, Calif., adds asynchronous communications software to its Minimax small business system. **Circle No 428 . . . Computer Systems Consultants,** Tuscon, Ariz., brings out a routine to create display formats on HP 264X terminals attached to HP 1000 series computers. **Circle No 429 . . . FD Systems, Inc.,** Houston, Texas, offers memory diagnostics and disk-file repair software for Altos computers running under the CP/M operating systems. **Circle No 430**

WORD-PROCESSING AND DATA MANAGEMENT. EEC Systems, Sudbury, Mass., announces a word-processing and record-management system for DEC PDP-11 and VAX computers. **Circle No 431 . . . Lifeboat Associates,** New York, N.Y., introduces a word-processing and report-generating package for 8080- and Z80-based microcomputers running under CP/M. **Circle No 432 . . . Data Processing Design,** Placentia, Calif., adds new features to its Word-II word-processing program for the DEC PDP-11 computer. **Circle No 433 . . . NBI,** Boulder, Colo., extends its word-processing software to run on its System 8 and System 64 computers. **Circle No 434 . . . Micro Data Base Systems, Inc.,** Lafayette, Ind., upgrades its MDBS data base management system with a query system and report writer, **Circle No 435 . . .** and a transaction-logging and crash-recovery rou-

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CIRCLE NO. 144 ON INQUIRY CARD

tine **Circle No 436 . . . Berman Associates,** Sterling, Va., offers a demonstration package for its Omnidata data management system that runs on the PDP-11 under the RT-11 and TSX operating systems. **Circle No 437**

BUSINESS APPLICATIONS. Logical Design Corp., Southfield, Mich., announces an accounts-receivable system for Burroughs CMS computers. **Circle No 438 . . . Hewlett-Packard Co.,** Palo Alto, Calif., offers an accounting package for its model 250 small business computer. **Circle No 439 . . . Retail Sciences,** Atlanta, Ga., introduces an accounting and inventory system for the Apple II computer, **Circle No 440 . . .** and a general ledger system for accountants and service bureaus that runs on 8080-, 8085- and Z80-based microcomputers. **Circle No 441 . . . Sperry Univac** releases an order-processing and inventory-control package for distribution centers and public warehouses that runs on its V77 minicomputers. **Circle No 442 . . . J. Baker & Associates, Inc.,** Wheeling, Ill, updates its warehouse-distribution application package. **Circle No 443 . . . Desk Top Financial Solutions, Inc.,** Spotswood, N.J., brings out a financial-planning system for the Canon BX-1 computer. **Circle No 444 . . . Custom Tailored Software, Inc.,** Wayne, N.J., unveils three packages for the Radio Shack TRS-80 computer: one for a business school, **Circle No 445 . . .** another for a chiropractor's office, **Circle No 446 . . .** and a third for large apartment complexes, **Circle No 447 . . . Transcomm Data Systems, Inc.,** Pittsburgh, Pa., provides a package for catalog showroom management that runs on the DEC PDP-11 and VAX-11/780 computers. **Circle No 448 . . . SDS,** Venice, Calif., has a billing, word-processing and financial-applications package for law offices that runs on its model 420 small business system. **Circle No 449 . . . Sarig Business Systems, Inc.,** Reading, Pa., offers a stockholder accounting package for the IBM System 34 computer. **Circle No 450**

OTHER APPLICATIONS. Tektronix, Inc., Beaverton, Ore., introduces a statistical package for its 4050 series computers. **Circle No 451 . . . Management Science Associates, Inc.,** Pittsburgh, Pa., offers statistical routines for the DEC VAX-11/780 computer. **Circle No 452 . . . Integrated Software Systems Corp.,** San Diego, Calif., offers a program that interfaces its Dissppla and Tell-A-Graf graphics-manipulation software with the APS-5 and APS-Micro 5 phototypesetters. **Circle No 453 . . . Perkin-Elmer Computer Systems Division,** Oceanport, N.J., provides a mechanical design and drafting package for its model 3220 and 3240 minicomputers. **Circle No 454 . . . Plessy Microsystems,** Gaithersburg, Md., unveils a signal-processing routine for its Miproc-16 computer. **Circle No 455 . . . California Computer Products,** Anaheim, Calif., brings out a package that converts data from line-printer output format to microfiche output format, for use on its model 930 controller. **Circle No 455 . . . Com Dev, Inc.,** Sarasota, Fla., announces a PARX traffic-analysis package for its Callquest SMDR processor. **Circle No 457 . . . NCR Comten, Inc.,** St. Paul, Minn., offers an X.25 interface for its model 3600 communications processing system. **Circle No 458 . . . Memorex Corp.,** Santa Clara, Calif., adds terminal-handling software and an updated operating system for its model 1380 communications controller. **Circle No 459 . . . Structural Dynamics Research Corp.,** Milford, Ohio, introduces machine-tool tape-conversion routines and NC part-programming systems for its HI-PRO manufacturing system. **Circle No 460**

New Literature

DISK STORAGE SYSTEM. The DD 40/50 series disk storage system for PDP-11 unibus processors is described in a brochure. The four-page publication details interface and software compatibility. The catalog also includes a diagram of a typical configuration, and a table of specifications and comparisons of the seven systems in the series. **DIVA, Inc.,** Eatontown, N.J. **Circle No** 305

INTEGRATED CIRCUIT PRODUCTS. A line of analog, digital, horological and microprocessor integrated circuit products is described in a product guide. The 30-page catalog, which lists applications and specifications, includes information on data acquisition components and systems; memories, microprocessors and development systems; multiplexors and switches; and discrete MOS and bipolar transistors. **Intersil, Inc.,** Cupertino, Calif. **Circle No** 306

DATA ACQUISITION SYSTEMS. A line of data acquisition systems is detailed in a catalog. The 12-page publication describes subsystems and computer interfaces and includes specifications, charts and ordering information. **Phoenix Data, Inc.,** Phoenix, Ariz. **Circle No** 307

BUTTERFLY ARITHMETIC ARCHITECTURE. An FFT (fast Fourier transform) butterfly arithmetic architecture is detailed in an application note. The 14-page publication explains the DAU (data arithmetic unit) architecture and presents the four cycles of the butterfly sequence in a color-coded computational diagram. The text also includes block diagrams, a flowchart and a timing diagram. **TRW LSI Products,** El Segundo, Calif. **Circle No** 308

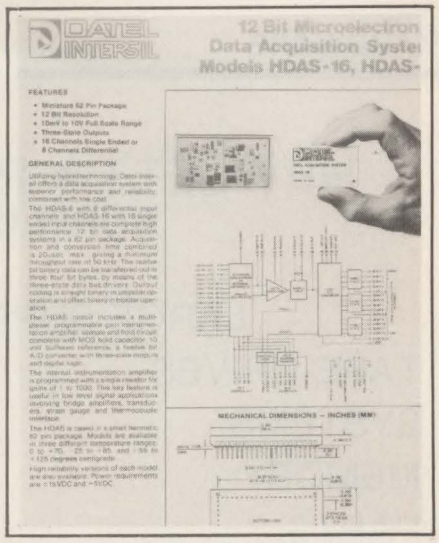
MICROCOMPUTER INTERFACES AND DATA ACQUISITION MODULES. A line of microcomputer interfaces, data acquisition modules and accessories is described in a catalog. The 20-page brochure covers A/D converters, remote controller computer interfaces, addressable PET printer adaptors, simultaneous multiple-input connectors, temperature probes and connectors. The catalog also includes an order form and a dealer listing. **Connecticut MicroComputer, Inc.,** Brookfield, Conn. **Circle No** 309

IC SOCKETS. A line of dual-in-line sockets, including the solder-tab low profile series 703-42XX and 703-43XX, is detailed in an engineering guide. The 16-page guide includes outline drawings, charts, isometric illustrations and diagrams. It also lists configurations and plating options. **CAMBION,** Cambridge, Mass.
Circle No 315

TAPE SUBSYSTEM. The 6200 series tape subsystem, including a tri-density tape drive and formatter, is described in a brochure. The six-page publication explains capstan technology, patented tape path and maintenance, operation and diagnostic capabilities. **Telex Computer Products, Inc.,** Tulsa, Okla. **Circle No 316**

PC BOARDS. A line of PC boards is described in a brochure. The eight-page booklet details multilayer boards, double- and single-sided boards and computer backpanels. **Fabri-Tek Circuits, Inc.,** Baldwin, Wis. **Circle No 317**

COIL ASSEMBLIES. The use of coil in transformers, solenoids and vibrator assemblies is detailed in a brochure. The 12-page booklet, which includes photos and diagrams, describes winding, insulating, fabricating, molding and sonic welding techniques. **Endicott Coil Co., Inc.,** Binghamton, N.Y. **Circle No 318**



DATA ACQUISITION SYSTEMS. The models HDAS-16 and HDAS-8 miniature data acquisition systems are described in a technical brochure. The eight-page publication lists the electrical and mechanical specifications of the 12-bit, 62-pin systems and includes block diagrams, technical notes and applications. **Datel-Intersil,** Mansfield, Mass. **Circle No 319**

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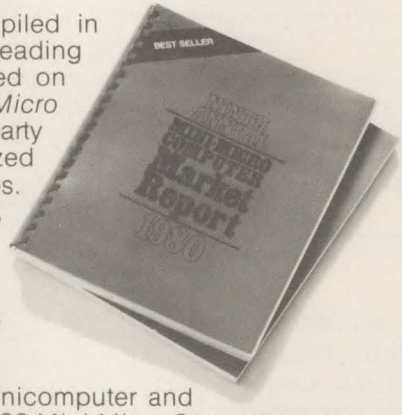

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