

Mini-Micro Systems

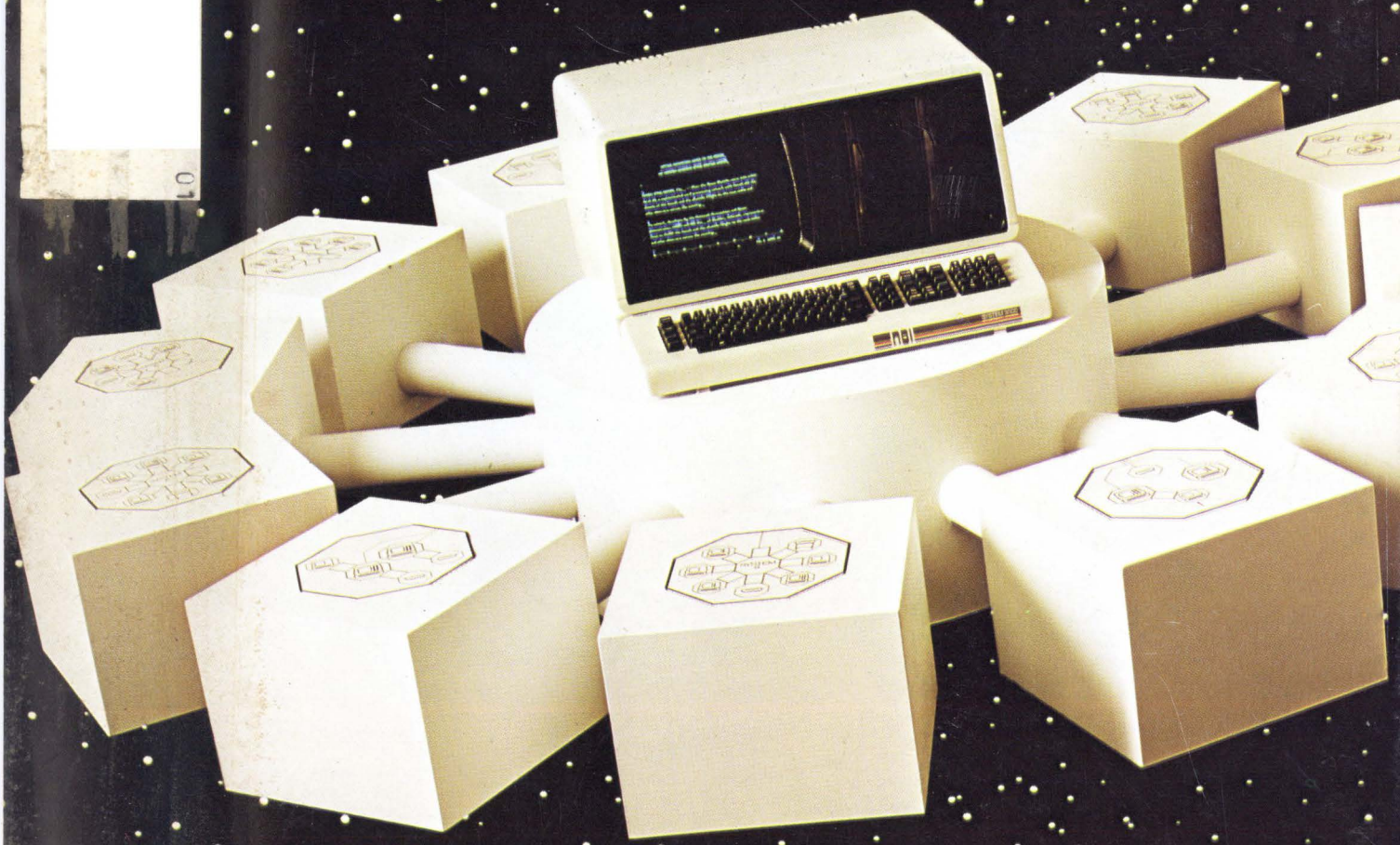
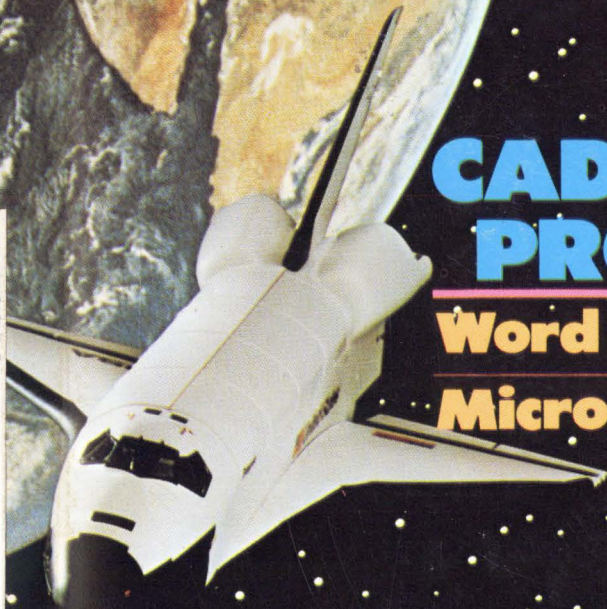
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JULY 1981

CAD/CAM SPELLS PRODUCTIVITY

Word processing at NASA

Microcomputer data base
management



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

And for good reason. Ask any other supplier of peripheral products for system backup, and you'll find that some can supply a disk, some can supply a cartridge recorder, others a streaming transport. But none can supply the choice which Kennedy can offer.

Kennedy is the only company that can offer an SMD compatible, 8" 40 MByte disk drive (Model 7300) and an 80 MByte 14" Winchester disk drive (Model 5380). To back them up, Kennedy has a 1/4" cartridge recorder (Model 6450), and Model 6809, 1/2" Data Streamer Tape Transport.

KENNEDY INTERNATIONAL INC.

U.K. and Scandinavia
McGraw-Hill House
Shoppenhangers Road
Maidenhead
Berkshire SL6 2QL England
Tel: (0628) 73939
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KENNEDY INTERNATIONAL

Koningin Elisabethplein, 8
B-2700 Sint-Niklaas
Belgium
Tel: (031) 771962
Telex: 71870 KEN CO

Kennedy was the first to utilize the 1/4" 3M cartridge for disk backup; Kennedy was the pioneer in Winchester disk technology, and was a leader in developing a low cost streaming tape drive.

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

Kennedy has always backed its products. That's why we're No. 1. Call or write us about your problem.

We won't back off.

KENNEDY

Subsidiary, Magnetics & Electronics Inc.

1600 Shamrock Ave., Monrovia, CA. 91016
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CIRCLE NO. 1 ON INQUIRY CARD

KENNEDY • QUALITY • COUNT ON IT

Rapid Transmit Authorities.

TI's Portable Models
785 and 787 Data
Terminals are experts
on interactive
communications.

With TI's *Silent 700** Models 785 and 787 Portable Data Terminals, you can put state-of-the-art technology right at the heart of your business. Featuring TI's unique dual-matrix thermal printhead, these innovative data terminals can minimize your communications costs with speedy 120 characters-per-second printing. Weighing only 17 pounds each, the portable 785 and 787 can improve your application efficiency, wherever your work takes you.

The Model 785 Portable Data Terminal combines speed with remote access capabilities. With the 785's built-in 300/1200-bps acoustic coupler, users are able to transmit and receive data using a standard phone and electrical outlet. Other standard features include automatic modem selection and com-



patible speed selection to let you optimize your on-line communication time.

The Model 787 Portable Communications Data Terminal can handle your application needs with its cost-saving, built-in standard features. The 300/1200-bps direct-connect internal modem allows users to plug directly into a standard telephone data jack for greater communications flexibility. The 787 also features memory dialing and originate/automatic answer operations for additional time and cost savings.

For information retrieval, remote sales order entry, and a variety of other interactive applications, the Models 785 and 787 speed your communications from coast to coast.

TI is dedicated to producing quality, innovative products like the

Models 785 and 787 Portable Data Terminals. And TI's hundreds of thousands of data terminals shipped worldwide are backed by the technology and reliability that come from 50 years of experience.

Supporting TI's data terminals is the technical expertise of our worldwide organization of factory-trained sales and service representatives, and TI-CARE[†], our nationwide automated service dispatching and field service management information system.

If you would like more information on the Models 785 and 787 Portable Data Terminals, contact the TI sales office nearest you or write Texas Instruments Incorporated, P.O. Box 202145, Dallas, Texas 75220, or phone (713) 373-1050.



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CIRCLE NO. 2 ON INQUIRY CARD



The DSD 880 can integrate with a VT103 Intelligent Terminal containing an LSI-11/23 to form a complete, powerful table-top microcomputer.

You deserve better disk storage than you get from DEC.

For your LSI-11 or PDP®-11, bigger isn't better when it comes to disk storage.

DEC® designs great CPUs. But if you want 7.8 megabytes of disk storage, they give it to you in two ungainly boxes 21 inches high. Data Systems Design gives you one compact package 5¼ inches high, with an ultra-reliable 7.8 megabyte winchester drive and a 0.5 megabyte single-sided (or 1 megabyte double-sided) floppy for I/O and integral backup, plus on-board diagnostics and lots of extras.

A superb buy—the DSD 880 DEC-compatible Winchester/Floppy Disk System.

Offering far better value than RX02 and RL01 combos or dual-RL01 or -RL02 disk drives, the DSD 880 provides more megabytes per buck than any DEC alternative. And you save in other ways.

Less rack space means lower cabinetry costs.

The DSD 880 interfaces require 70% less backplane space than similar DEC configurations.

The HyperDiagnostics™ panel and comprehensive library of microprogrammed routines, in conjunction with Data Systems Design's Rapid Module Exchange™ program and HyperService™ service contracts, deliver more uptime for less than half the cost of a DEC service contract.

Fully compatible three ways.

DSD 880 is hardware compatible. And it integrates with any DEC LSI-11 or PDP-11 computer-based system.

It's software compatible. You can use RT-11 or RSX-11 operating systems with RL01 (winchester) and RX02 (floppy) handlers without modification. The DSD 880 runs all applicable DEC diagnostics and utilities.

And it's media compatible. Its floppies utilize DEC double-density or IBM single-density formats.

Want to know more? For full technical details, write Data Systems Design, 2241 Lundy Avenue, San Jose, CA 95131, or call the sales office nearest you.



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The Intelligent Alternative to DEC Disk Systems

United States: Western Region (408) 727-3163; Eastern Region (617) 769-7620. **International Sales:** Australia: Melbourne 03/543-2077, Sydney 02/848-8533; Canada 416/625-1907; Denmark 01/83 34 00; Finland 90/88 50 11; France 03/956 81 42; Israel 03/298783; Italy 02/4047648; Japan: Osaka 06/323-1707; Netherlands 020/45 87 55; New Zealand 4/693-008; Norway 02/78 94 60; Sweden 08/38 03 70; Switzerland 01/730 48 48; United Kingdom 01/207-1717; West Germany and Austria 089/1204-0.

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CIRCLE NO. 101 ON INQUIRY CARD

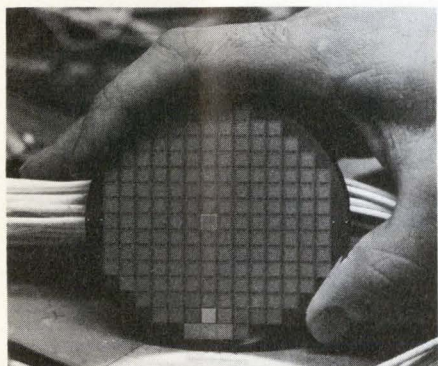
Mini-Micro Systems

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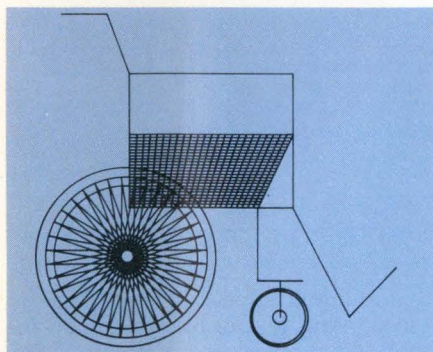
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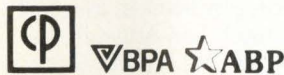
NBI, Inc., helped NASA upgrade its existing data-processing computer by tying in 18 of its System 3000 word processors (see p. 157). Cover art by Glenn Herbert, photography by Bill Braley, courtesy of NBI.



Page 49 IBM's digital logic circuit



Page 147 CAD/CAM rehabilitation



MINI-MICRO SYSTEMS (USPS 059-470) is published monthly by Cahners Publishing Company, Division of Reed Holdings, Inc., 221 Columbus Avenue, Boston, MA 02116. Norman L. Cahners, Chairman; Saul Goldweitz, President; William M. Platt, President, Boston Division. Second class postage paid at Long Prairie, MN 56347. Postmaster: Send Form 3579 to MINI-MICRO SYSTEMS, 270 St. Paul St., Denver, CO 80206. MINI-MICRO SYSTEMS is circulated without charge by name and title to U.S. and Western Europe based corporate and technical management, systems engineers, and other personnel who meet qualification procedures. Available to others at the rate of \$30.00 per year in the U.S.; \$35.00 in Canada; \$65.00 in all other countries (12 issues). Single issues \$3.00 in the U.S.; \$4.00 in Canada; \$6.00 in all other countries.

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C. ITOH ELECTRONICS, INC.

FOR IMMEDIATE RELEASE

C. ITOH ADDS TWO

DAISY WHEEL PRINTERS

LOS ANGELES - C. Itoh Electronics, Inc. has added two new daisy wheel impact printers to its line of computer peripherals for systems integrators and the OEM market.

Starwriter and Starwriter II employ an industry-standard 96 character print wheel - an easy-to-change format that readily accommodates multi-lingual applications. They both produce letter-quality printing on three sheet codes with either 136 columns in plus pitch or 163 columns in close pitch. The Starwriter also offers the highest degree of vertical and horizontal placement, resulting in high resolution than competitive models.

Both models are compatible with daisy-wheel and dot-matrix fonts up to 32 point size. They also feature 147-line resolution, 100% duty cycle, 100% vertical blanking and 100% horizontal blanking.

LETTER PERFECT.

You can actually see the superior print quality when you use C. Itoh's new daisy wheel impact printers. Besides clear and crisp print characters, you also get the throughput performance you're looking for, at prices never before available to quantity buyers of Daisy Wheel printers.

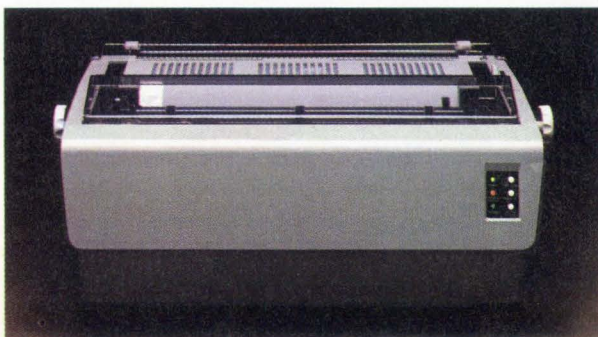
C. Itoh's Starwriter offers you a print speed of 25 cps while the Starwriter II operates at 45 cps. Both machines incorporate the latest LSI technology and utilize an easy-to-change industry standard 96-character wheel. Starwriter printers are the perfect choice for multilingual and multi-discipline applications.

The two Starwriter models also feature self-test capabilities and a programmable VFU. You'll be

able to print up to 163 columns on multiple copies and you can process paper widths to 381 mm (15"). Both models are equipped with front panel indicator lamps and switches.

You can put our printers to work the minute they're delivered. They're plug-compatible and meet either the industry standard parallel interface specifications or serial RS 232 C with voltage or current mode capacity.

So if you're looking for perfection in printing, let our Starwriters do the job. All printers are backed by C. Itoh's warranty and nationwide service organization. For more information, contact C. Itoh Electronics, Inc., 5301 Beethoven Street, Los Angeles, CA 90066; Tel. (213) 306-6700. Chicago Office: 240 E. Lake Street, Suite 301-A, Addison, IL 60101; Tel. (312) 941-1310. New York Office: 666 Third Ave., New York, NY 10017; Tel. (212) 682-0420. Dallas Office: 17060 Dallas Pwky., No. 108, Dallas, TX 75248; Tel. (214) 931-0177.



**C. ITOH
ELECTRONICS, INC.**

One World of Quality

CIRCLE NO. 3 ON INQUIRY CARD

DEC FORMS OFFICE-SYSTEMS GROUP

Digital Equipment Corp. has formed a strategic marketing and product-planning organization dedicated to overseeing the company's assault on the office-automation market. That assault is expected to be mounted over the next 18 months. Headed by DEC's telecommunications-industry group systems manager Arthur F. Laramee, the Office Information Systems operation falls under the aegis of Julius Marcus's Commercial Products Group, which in DEC parlance is a "super group" with various sub-groups reporting to it. Laramee, program manager for Office Information Systems, reports to Commercial Group marketing director David R. Fernald. Laramee will attempt to coordinate the activities of the company's office-related sub-groups, such as word processing and retail products, into a cohesive attack on the office market in which DEC has been perceived to be weak.

IBM, DG FOLLOW XEROX INTO PERSONAL COMPUTER MARKET

A battle is brewing on the sandlot as large companies, including Xerox Corp., IBM Corp., Data General Corp. and Digital Equipment Corp., move in on the small business/personal-computer market now dominated by Apple Computer and Radio Shack. IBM was expected to introduce its entry, code-named Acorn, late last month. Using an Intel 8088, the 16-bit-based μ c includes two 5¼-in. dual-sided, double-density diskettes with 256K bytes of mass storage. A source says the 8-bit 8088 was incorporated to enable IBM to run CP/M programs eventually. The system includes 64K bytes of internal memory and the PC/DOS operating system, which was developed by Microsoft. The system will come out of the General Systems Division's Boca Raton, Fla., facility, but it is being built in Japan by Matsushita. IBM is rumored to be actively pursuing Sears and J.C. Penney stores as outlets, and is considering Computerland as well. Acorn's 600- x 400-pixel screen is available in four or eight colors, and is expected to include graphics. Price is \$6000, including word-processing software, and is competitive with Xerox's new 820 Worm. IBM declines comment on the system.

DG announced the first member of a small-business computer family in June. The Enterprise 1000, code-named Tiny Business System, a 16-bit microNova-based μ c, includes an MP/OS-like operating system, two 5¼-in., dual-sided, double-density floppy disks with 358K bytes each, Business BASIC, 64K bytes of dynamic RAM internal memory and a printer. Price is \$7195.

DEC reportedly will not have its entry ready until next year, with pricing expected to be \$4000 to \$7000. The project, formerly called K.O. (MMS, January, p. 5), has been absorbed into central engineering, and a special team is going full-speed ahead on development efforts. The new system will depart from DEC's reliance on the PDP-8 and will incorporate an LSI-11 on a chip, called Tiny-11. Tiny-11 is being used in other products as well, but is not in full-volume production yet at the company's Hudson, Mass., semiconductor facility.

H-P IS READYING \$7000 CP/M-BASED SYSTEM

Details of a Hewlett-Packard Co. CP/M-based small-business system are coming to light. The system is called the HP-125, says one source, and is based on the company's HP2621A intelligent terminal. HP has added a Z80 CPU board, about 64K bytes of RAM and data-communications capabilities to the Z80-based 2621A to enable it to handle all CP/M-compatible software. The source says the system will include an optional integral thermal printer. The company had planned an introduction in April, but indecision about how to position the system in the market forced the firm to postpone the unveiling until June, says the source. Further marketing strategy concerns have pushed the announcement into August or later, he adds. The HP-125, with floppy-disk drives, is expected to be priced at about \$7000.

SKY PLANS ARRAY-PROCESSOR UNVEILING

A plug-in array processor that can provide 32-bit single-precision and 48-bit extended capabilities for an LSI-11 μ c is expected to be the first in a line of μ c number crunchers from

Breakpoints

recently formed Sky Computers Inc., Lowell, Mass. Sky's chairman, Howard Klemmer, formerly an engineering manager for Digital Equipment Corp.'s commercial products, claims that the company has an array processor with floating-point capabilities all contained on two quad-size PC boards that can be plugged directly into the LSI-11 Q-bus. Prices start at \$6000 for one unit and fall to less than \$4000 for quantities of 100 to 150. Klemmer sees a big market for the μ c array processors, especially in the burgeoning robotics market in which array processors will help perform the computations to power robots' eyes and arms. Klemmer, who left DEC last October, has been joined by Gerald Shapiro, who was the technical director of array-processor development at Analogic Corp. and is Sky's president.

RANDOM DISK FILES

Look for **Tandon Corp.** to unveil a super-low-cost 5¼-in. floppy-disk drive during the first quarter of 1982. The 125K- to 250K-byte single-sided drive will use a conventional medium, and will be as wide and as deep, but only one-half as high, as 5¼-in. floppies based on the dimensions of Shugart Associates' SA450. Tandon reportedly has customers for the drive and will help with controller development. The as-yet-unnamed drive is being built at Tandon's Santa Clara, Calif., R & D facility (MMS, January, p. 6), and could be priced as low as \$60 to \$75 in quantities of 5000.

Meanwhile, don't be surprised if **Shugart Associates** releases a redesigned version of its SA200 low-cost single-sided floppy-disk drive (MMS, February 1980, p. 20) later this year. Called the SA210, the 125K-byte drive will be built by Matsushita Communication Industrial Co., Ltd., and may also be used internally by that Yokohama-based electronics complex in a small-business system. According to one report, part of the SA200 redesign includes a low-cost stepper-motor head actuator instead of the noisy ratchet-solenoid design initially used in the SA200. The SA210 will be media-compatible with other 5¼-in. floppy-disk drives and reportedly will be priced at less than \$90 in quantity.

Frank Gibeau, former head of Verbatim's defunct Winchester-media program, is preparing prototypes of a high-performance, 5¼-in. Winchester-disk drive, said to have access times in the 20- to 30-msec. range and initial capacities exceeding 20M bytes. Gibeau's new company is headquartered in Los Gatos, Calif., and is reportedly called **Atasi Corp.** after a Creek Indian war club.

Watch for **Datapoint Corp.'s** Sunnyvale, Calif., disk-drive operation to unveil a five-platter, 5¼-in., 20M-byte Winchester for use in an upcoming small stand-alone business system due later this year. The drive will use manganese-zinc ferrite heads developed in-house along with a proprietary non-lubricated, thin-film medium coated with a layer of carbon 0.1- to 0.15- μ m. thick. The drive is designed to operate at 8240 flux changes per in., 530 tracks per side, says one source, and has been operated experimentally at the 12,000- to 16,000-bpi range.

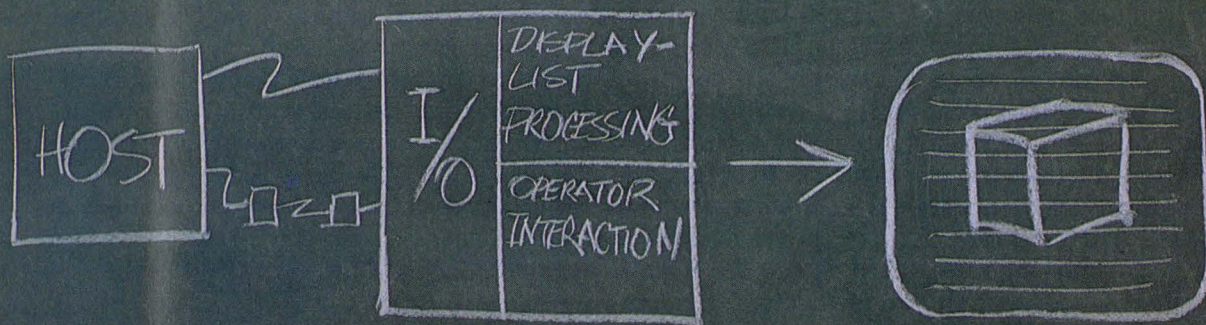
Data Peripherals, Sunnyvale, Calif., is expected to debut a fixed 8-in. Winchester dubbed the DP-400 Puma at the Comdex show this fall. The Puma will be I/O-compatible with the company's first Winchester offering, the removable-only 10M-byte DP-100 Lynx drive, and will have four times the mapped capacity of the earlier device—a ratio Data Peripherals executives feel is optimal for backup applications, and one that will most likely be maintained as the company boosts Puma capacities beyond 40M-bytes. Price is less than \$2000 in 100-unit quantities, with evaluation hardware scheduled for the first quarter of 1982.

—John Trifari

IBM WILL ANNOUNCE 5100 ADDITION

Following an in-house announcement in late June of an addition to IBM's 5100 family, the company is expected to make an imminent public announcement of the system, dubbed the 5130. The 5130 is believed to be a multiterminal, hard-disk version of the 5120. The public's first view of the system will probably be a four-terminal system priced from \$7000 to \$35,000 in various configurations. The system will handle as much as 27M bytes of hard-disk storage

THE MEGATEK DIFFERENCE: REMOTE WORKSTATIONS



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

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

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

Swiftly interacting with the host computer at the "action" end of the communication line is an intelligent Whizzard 6200 memory-management

SEE US AT SIGGRAPH, BOOTH NO. 607

I/O interface which maps subroutines, segments, and attribute information into a 64K-byte display-list memory (expandable to 128K bytes).

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

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



The more you know about graphics, the more you lean toward Megatek.

There is a Megatek difference. See it, believe it. Call or write: Megatek Corporation, 3931 Sorrento Valley Blvd., San Diego, CA 92121. 714/455-5590. TWX 910-337-1270.

MEGATEK
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CIRCLE NO. 4 ON INQUIRY CARD

Breakpoints

and will have increased main memory. Greg R. Leveille, a research director with the Gartner Group, Inc., Greenwich, Conn., says the internal announcement was made on June 22, and the public will learn about the system this month.

DG STREAMLINES SUPERMINI EFFORTS BEHIND MV/8000

After straining engineering and financial resources across two competing supermini projects over the past four years, Data General Corp. now appears to be focusing its efforts behind only one—the one-year-old MV/8000. Efforts to get FHP (MMS, Feb., p. 5), an advanced multiprocessor computer under development in the company's North Carolina R & D facility, to market have dwindled, sources close to DG say. Additionally, FHP project head Ron Gruner recently was recalled to Westboro, Mass., to become director of development for the Information Systems Division, which handles the MV/8000. DG is faced with rebuilding the Westboro team. More than a dozen top engineers from the two projects left in the past nine months, many after a massive corporate reorganization. The most notable losses are supermini engineers Carl Alsing, Ed Rasala, Richard Belgard, Gary Funk and Barry Tannenbaum, all of whom now work for Tandem Computers, Cupertino, Calif., and are reportedly working on that company's first 32-bit minicomputer.

In addition, Steve Wallach, a chief MV/8000 architect, joined Rolm Corp.; software engineer Robert Downes is at SOLVation; software vice president Steve Gaal is on a one-year leave of absence; and former vice president of engineering Jeff Kalb is at Digital Equipment Corp.'s Hudson, Mass., semiconductor plant. A DG spokesman says the attrition is not unusual at a big company, and that it will not hamper 32-bit product programs.

CP/M USE ON WORD PROCESSORS INCREASES

Following the example of Xerox Corp. and CPT Corp., Lanier Business Products, Inc., Atlanta, was expected to include CP/M on an enhanced version of its "No Problem" word-processing work station, introduced late last month. The new "Super No Problem" system increases internal memory from 32K bytes to 96K bytes, and almost triples mass storage with 5¼-in. floppy-disk drives. Business packages will include general ledger, accounts payable and accounts receivable. Lanier will bundle the software for the Super No Problem, says a source close to the company. Price for the Super No Problem was not known at press time. CPT Corp. added CP/M to its CPT 8000 word processor for \$900 a year ago, but only recently added eight separately priced business packages. Xerox Corp.'s 820 personal computer system, introduced in June, includes CP/M to enable some of the more than 2000 independent software packages to be used on the system.

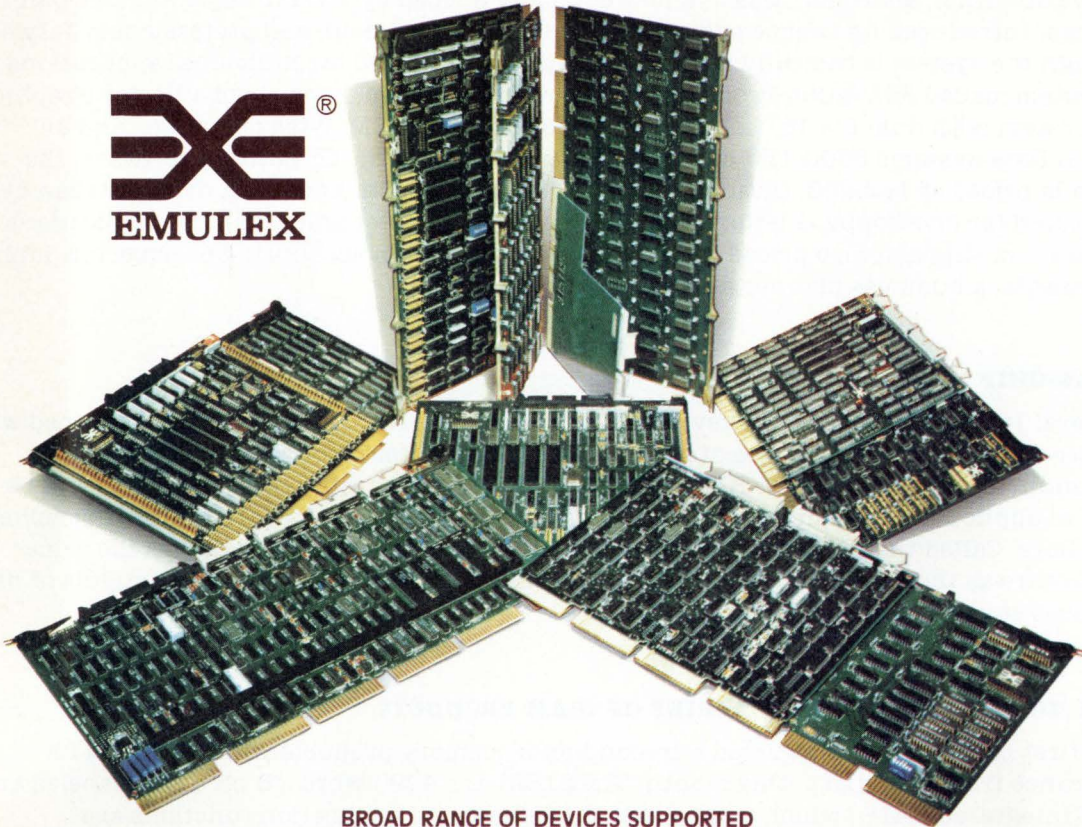
ICL MULTIPROCESSOR SYSTEM IS UNDER DEVELOPMENT

London-based International Computers, Ltd., which has twice attempted to gain a share in the U.S. computer market, is developing a new product line at its Utica, N.Y., facility, industry sources say. The new multiprocessor, multitasking system, designed for small- to medium-sized businesses, incorporates as many as 15 Intel 8085 8-bit μ ps, each with 64K bytes of memory housed in one unit. As many as 15 slave terminals can be attached to the CPU. An entry-level system includes two 8-in. double-density floppy-disk drives. The product, one of ICL's few low-end entries, is also one of its first U.S.-developed computers.

EXCALIBUR UNVEILS EASY-TO-USE EXECUTIVE WORK STATION

One-year-old Excalibur Technologies Corp., Albuquerque, N.M., will introduce a stand-alone work station for executives in August. The company claims the system is "as easy to use as driving a sportscar." Dubbed the Powerstation, the work station includes three Z80 μ ps, an S-100 bus, RS232 communications, a 64K-byte RAM internal memory, 10M bytes of hard-disk storage and a proprietary Excalibur operating system. Priced at \$8000 to \$12,000, it includes application software, but no printer.

PDP-11[®] and LSI-11[®] TAPE and DISK CONTROLLERS



AUTHORIZED EMULEX DISTRIBUTOR

First Computer Corporation, the world's leading DEC computer system integrator now distributes the complete spectrum of EMULEX Tape and Disk controllers for the PDP-11 and LSI-11 family of computers.

HARDWARE/SOFTWARE TRANSPARENCY

These microprogrammed, emulating Tape and Disk Controllers are fully software transparent to both the PDP-11 hardware and software. The use of these controllers protects you from the impact of future versions of the operating system software. They are so compatible you can plug them into your system and be up and running the standard DEC diagnostics and operating systems in minutes.

ADDED FEATURES

These controllers provide you with added features such as automatic self-testing, onboard pack formatting, and programmable bandwidth control at no additional cost.

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Houston, TX (713) 960-1050

BROAD RANGE OF DEVICES SUPPORTED

It makes no difference which of the DEC PDP-11 or LSI-11 family you are using or which type of storage device is required for your application. We can support 59 different drives from 13 different manufacturers.

HIGHEST QUALITY AND SUPER RELIABILITY

You can be assured of the quality and reliability of these Tape and Disk Controllers because First Computer Corporation specializes in PDP-11 and LSI-11 computer systems, components, and peripherals. Over the years our reputation was built on the quality and reliability of the products we sell. We continue to protect this reputation by selling only the very best.

SUPER FAST SERVICE

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CIRCLE NO. 5 ON INQUIRY CARD

Breakpoints

SOLVATION WILL CUSTOMIZE ACCOUNTING SYSTEM SOFTWARE

SOLVation, Inc., Waltham, Mass., a new company formed by Exxon's Qyx founder Dan Matthias, introduced its first μ c system for first-time-user accounting professionals July 4. Although the system is basically turnkey, it can be customized for individual applications. The system, called SOLVation Professional Accountant System, consists of a Vector Graphics 2600 system with dual 5¼-in. floppy-disk drives housing 1.2M bytes of storage, and an Integral Data Systems 560G 150-cps matrix printer. With basic accounting software, the system is priced at \$12,500. Options include a 5M-byte, 5¼-in. hard-disk drive that can be substituted for one floppy, a letter-quality, 55-cps NEC printer and graphics. Applications software and support, also priced at \$12,500, include a client accounting package for public accountants, a business planner and word processing.

SINGLE-CHIP μ C HAS EEPROM

General Instrument Corp., Hicksville, N.Y., is readying a single-chip 8-bit μ c equipped with 48 bytes of EEPROM and 1K byte of ROM. Andrew Sass, director of research for the semiconductor maker, says the EEPROM will be dynamically reprogrammable and will be suited to applications requiring nonvolatile data storage and easy updating. One is peripheral controllers. Called the PIC16E70, the μ c is part of GI's 8-bit PIC family, and has the same architecture as the EEPROM-less PIC1670. The chip should be available by the middle of next year, Sass says.

INTEL TO RELEASE FIRST IN SERIES OF iRAM PRODUCTS

The first in a series of integrated semiconductor memory products will be making its appearance from Intel Corp. this month. The 21821 is a 4096-word \times 8-bit device labeled an iRAM (integrated RAM), which means that the refresh and arbitration functions are integrated on the memory chip. The 21821 is a byte-wide memory device intended for use with μ ps, and is expected to be priced at \$19.95 in quantities of 10,000. Sampling will begin in the third quarter, with volume production in the fourth. At least one iRAM, and perhaps as many as four others, is expected from Intel within the next year.

DIRECT \$1790 VIDEO TERMINAL EMULATES HP-2622A

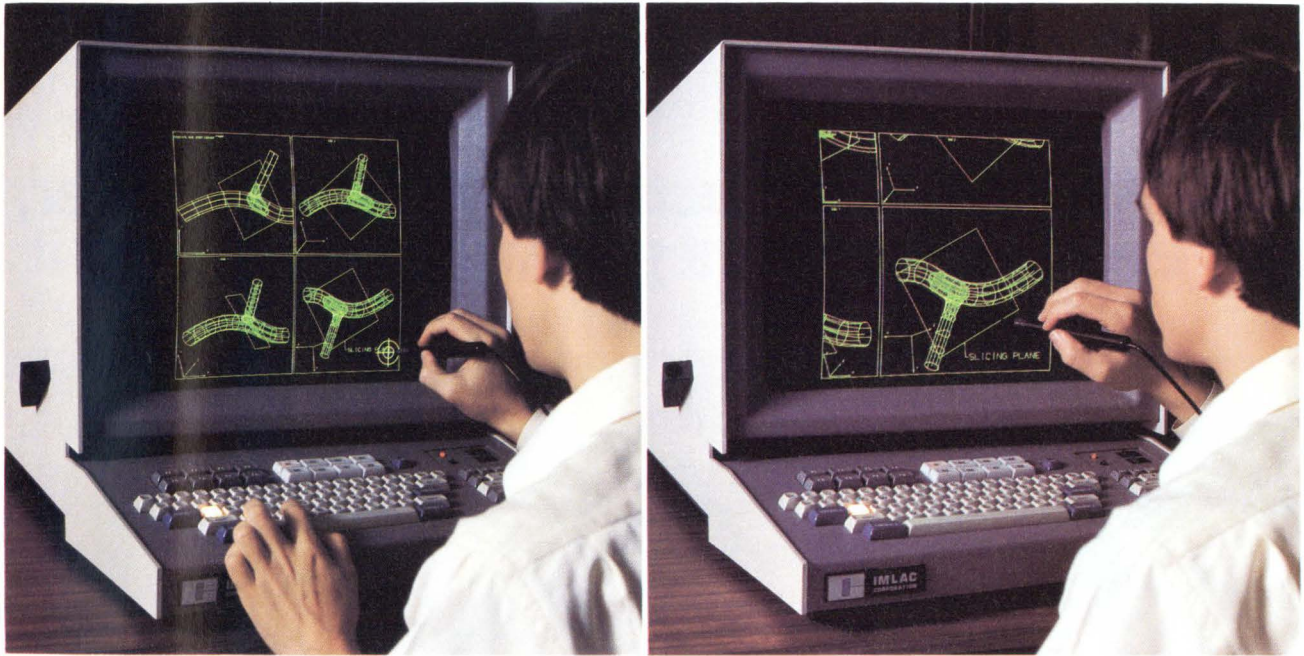
Direct, Inc., Sunnyvale, Calif., has begun shipping a video terminal said to be the first that is software-compatible with Hewlett-Packard's HP-2622A. Called the VP825, the terminal is based on Direct's first product, the 800A, a DEC VT-100-compatible display. A spokesman says the VP825, like the 800A, uses a Z80A and is available with as much as 32K bytes of RAM. The 132-column display sells for \$1790, some \$300 less than the H-P device. Direct introduced its first H-P-compatible hardware, an HP2645A emulator, about two months ago, and plans on an HP2624A-compatible device in the near future, says the spokesman.

VOICE-MAIL MARKET INTENSIFIES

Voice-mail systems were once the province of a few companies such as Dallas-based ECS Telecommunications, but there are increasing indications that the field is going to get crowded this summer. Wang Laboratories has already announced its base-priced \$125,000 digital voice exchange system, which can be expanded from a 200- to an 800-user system. While Wang can be a potent competitor, the company that has been creating the strongest rumblings among the voice-mail companies is IBM Corp. Some competitors are betting that a basic version of IBM's Speechfile message-store-and-forward system will be on the market before fall.

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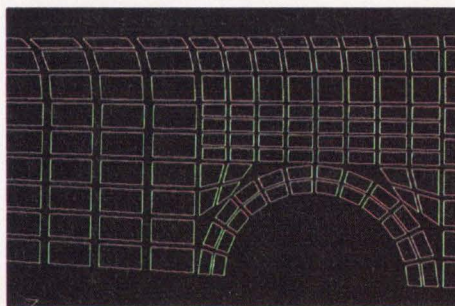
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CIRCLE NO. 6 ON INQUIRY CARD

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Like the B-300 and B-600 models, it has Dataproducts' patented Mark V hammer system at its very heart. The system is virtually friction-free. The result is a remarkable level of reliability.

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the operator in mind. The long lasting ribbon cartridges are easy to load. The bands can be changed in less than a minute. Sophisticated self diagnostics let the operator identify problems and often correct them without a service call.

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With fully sound-insulated cabinets, the printers operate at only 60 dbA— even less than the noise level of a

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GREAT MOMENTS



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CIRCLE NO. 7 ON INQUIRY CARD



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is overdrawn.*

*Help. Alert!
Fire in building 3!
Send assistance.*

*Wake up, sleepyhead,
it's now 7 a.m.!*

*Your computer
is down . . .*



SEL introduces speedy scientific supermini

Well-known for its scientific superminicomputers, Systems Engineering Laboratories, Inc., introduced in May a powerful 32-bit minicomputer with performance exceeding 3.6 million instructions per sec. (MIPS). The Concept 32/87 is the first product introduced by SEL since its acquisition by Gould, Inc., late last year.

To some industry observers, the high-end product verifies what some see as an excellent acquisition for Gould, in that SEL's products complement those of Gould's other subsidiaries (MMS, November, 1980, p. 51). "This is the crowning piece in the hierarchy of Gould's product lines," says Charles Hill, vice president of Kidder Peabody & Co., Boston, Mass. He says Gould now has a variety of industrial products ranging from the Modicon Corp. subsidiary's low-end industrial controllers to the 32/87.

A basic system with 1M byte of MOS main memory, 16K bytes of

bipolar cache memory, integral single- and double-precision floating-point processor, diagnostic processor, I/O processor, two floppy-disk drives, CRT terminal, firmware and diagnostics and documentation is priced at \$235,000. A similar configuration with 32K bytes of cache memory is priced at \$265,000. A 40 percent discount will be available to large OEM customers.

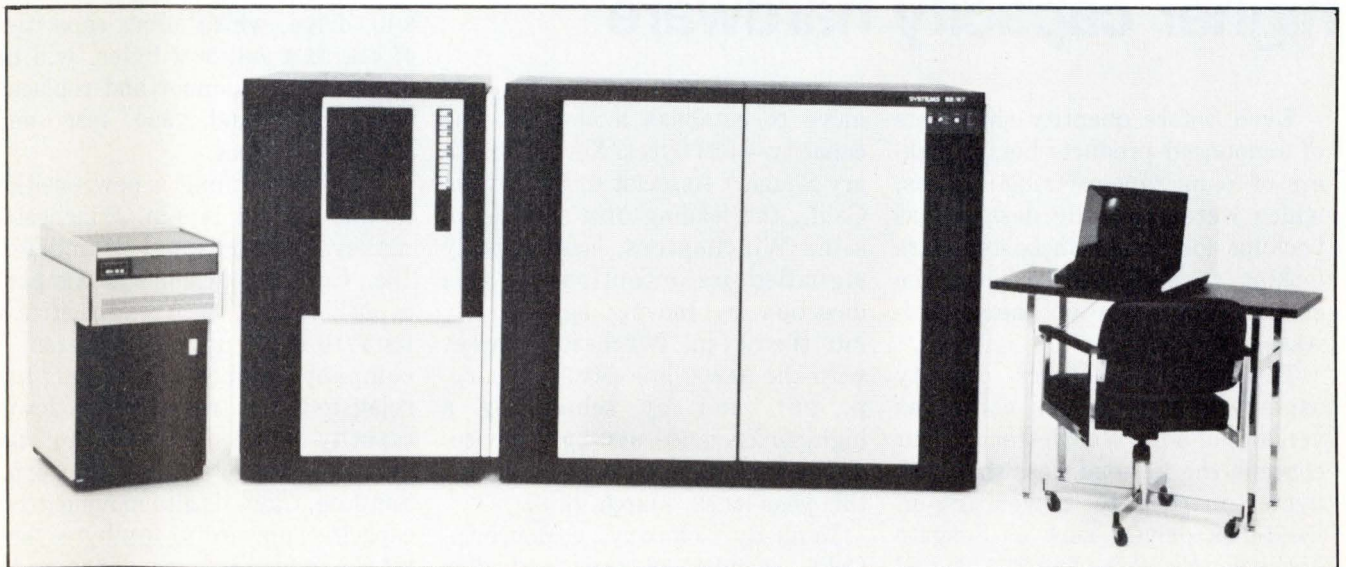
The system achieves its high performance by using emitter-coupled logic in the CPU cache memory and floating-point processor. The CPU achieves 75-nsec. bus cycle times. Control Data Corp. and IBM also use ECL in their superminis to enable extremely fast gate-switching times.

The system also includes a four-way set-associative cache memory, a hierarchical memory system, alterable control storage and a four-stage instruction pipeline. The 32/87 runs on the company's MPX-32 real-time operat-

ing system, which makes the system upwardly compatible with I/O, memory controllers and software of earlier Concept products. A new version of the MPX operating system with a file system will be introduced this summer.

Both new processors have a single-precision FORTRAN Whetstone I performance rate of 3604 thousand instructions per sec. (KIPS). By comparison, Data General Corp.'s MV8000 supermini performs at 1166 KIPS, Digital Equipment Corp.'s VAX-11/780 performs at about 1133 KIPS, and Perkin-Elmer's 3240 performs at 1300 KIPS. (P-E points out, however, that the 3240's price—\$100,000—coincides with this relatively low KIPS rate.)

The 32/87's performance can be enhanced even further by using an I/O processor attached to an I/O asynchronous multipurpose bus. The I/O processor off-loads most I/O functions performed by the CPU, to enable the CPU to handle more



SEL claims its Concept 32/87 is the world's fastest supermini with performance exceeding 3.6 million instructions per sec.

Mini-Micro World

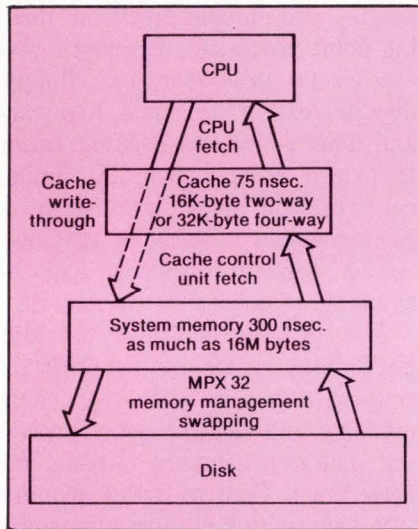
computational functions. Under control of the I/O processors, the multipurpose bus transfers data at rates as high as 1.5M bytes per sec. An I/O processor on a multipurpose bus can handle as many as 16 device controllers supporting as many as 124 devices.

The 32/87 is built around a high-speed synchronous SelBUS, with a 26.67M-byte-per-sec. transfer rate. The I/O processor, I/O devices and main memory reside in the 17-slot SelBUS. The CPU chassis that accommodates the SelBUS contains 38 slots.

The ECL-based single- and double-precision floating-point processor has 64-bit-wide buses. Addition and multiplication are performed in approximately 225 nsec. and 900 nsec., respectively. Floating-point instructions include add, subtract, multiply and divide of words and double words, and float and fix words and double words. A diagnostic processor loads CPU microdiagnostics from a dedicated floppy-disk drive to the control-store RAM.

The memory is built hierarchical-ly; each level is faster than the

preceding one. The CPU exchanges data with the system cache, which brings frequently used data to the forefront. The company claims the cache has a hit ratio better than 90 percent. Combined with main memory, the cache can deliver words from main memory to the CPU in $94\frac{1}{2}$ to 153 nsec. The CPU measures $55\frac{1}{2} \times 68\frac{1}{2} \times 36\frac{1}{2}$ in.



System memory in the Concept 32/87 is hierarchical, with each level faster than the one below. Cache and main memory deliver words from main memory to the CPU in $94\frac{1}{2}$ to 153 nsec.

“We took mainframe concepts and incorporated them with minicomputer packaging using ECL,” says William Ward, senior director of advanced hardware development at SEL. He explains that a 19-in. rack unit holds relatively large PC boards measuring 15×18 in.

Ward expects that SEL customers who want to expand numerical processing-intensive applications, such as seismic data processing and laboratory computations, will buy the 32/87. The company also hopes to enter new markets, such as CAD/CAM and factory automation, by working with other Gould subsidiaries.

Kidder Peabody's Hill says large factories might need a powerful machine like the 32/87 in the future, and Gould is a very strong competitor. He says the 32/87's primary use is in fast, real-time response, and the system may be more efficient than mainframes in that application.

SEL has booked five orders amounting to \$1.5 million, and the product is available for delivery.

—L. Valigra

Cartridge-drive vendors plan higher capacity hardware

Even before quantity shipments of announced products begin, makers of $\frac{1}{4}$ -in. tape-cartridge drives, which were originally designed as backups for 8-in. Winchester, are looking to significantly boost the storage capacities of their hardware.

The move to higher capacity tape-cartridge drives comes as vendors of 8-in. Winchester all but concede the low-end (less than 20M bytes) market to newer $\frac{5}{4}$ -in. fixed-disk drives, such as Seagate Technology's pioneering ST-506, and

move to establish a new baseline capacity—40M bytes. Xerox subsidiary Shugart Associates, Sunnyvale, Calif., the leading OEM supplier of 8-in. Winchester, has already signalled its intentions in this direction by moving aggressively into the $\frac{5}{4}$ -in. Winchester market with the SA600 line (MMS, January, p. 20), and by scheduling a high-performance 34M-byte device, dubbed the SA1100, for introduction this year (MMS, March, p. 8).

Kennedy Company, a Monrovia, Calif., vendor of tape and disk

drives, will also move out of the low-end 8-in. Winchester business by year-end. The firm's model 7000 8-in. drive, which offers capacities of 4M, 12M and 20M bytes, will be dropped this summer and replaced with the model 7300 40M- and 80M-byte devices.

Also establishing a new position in this market is 8-in. Winchester maker International Memories, Inc., Cupertino, Calif. The company is pushing the 10M-byte capacities of its 7710 drive up to 40M bytes. A company source says IMI has relegated the market for lower capacity 8-in. hardware to the vestigial category. Quantum Corp., San Jose, Calif., is also moving drive capacities upward to 40M bytes, and 3M Co., which recently announced a

line of 8-in. Winchesters (MMS, June, p. 8), concedes that its low-end 10M- and 20M-byte 8400-series drives are "learning-curve" devices, says a company executive, meaning they aren't regarded as growth products.

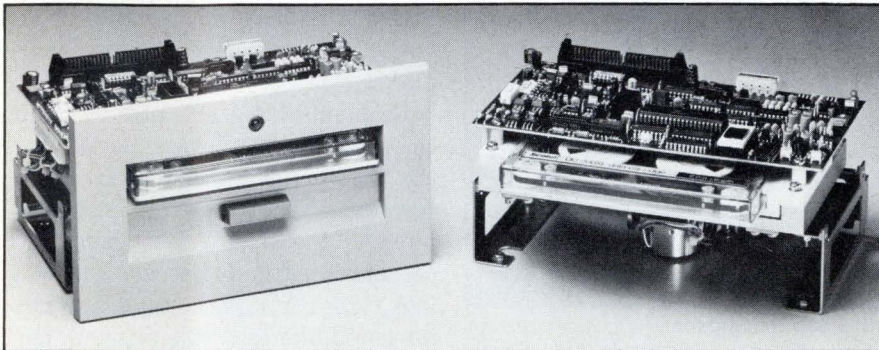
The trend toward higher capacity 8-in. Winchesters has not been lost

on vendors of tape-cartridge drives. "The low-end of the market is finished as far as 8-in. hardware is concerned," says Wes Theriault, marketing vice president and co-founder of Archive, Inc., a Costa Mesa, Calif., hardware house that started a little more than a year ago to sell streaming, tape-cartridge

drives. "Anyone planning to stay in this segment of the market is heading for trouble."

Theriault says Archive plans to boost the 20M-byte capacities of its Sidewinder tape-cartridge drive to 40M bytes with a product ready to be shipped around this time next year. How the increased capacity will be accomplished, says Theriault, has not been decided, but several alternatives exist, including the use of stepper-motor-driven read/write heads tied to a track-following servo system for higher track densities.

Archive is also considering increasing the Sidewinder's recording densities from 6400 flux changes per in. to 10,000 fcpi. "40M to 50M bytes can be accomplished without a major redesign of the drive," Theriault says, "and we could go as



TEAC's MT-20 1/4-in. tape-cartridge drives are designed to be compatible with Data Electronics, Inc., hardware. Now specified at 10M and 20M bytes, TEAC's new drives may be available in higher capacity versions later this year.

BACKUP FOR 5 1/4-INCH WINCHESTERS ALSO PLANNED

Increased storage capacity is not the only problem being thrust onto the shoulders of tape-cartridge drive vendors. Some vendors are considering what it will take to fit their hardware into the smaller form factor specified by new 5 1/4-in. Winchester-disk drives. The National Computer Conference demonstrated that this problem can't be ignored. Many small-business systems on display featured Seagate Technology's 6M-byte ST-506 5 1/4-in. Winchester tied to a double-sided 5 1/4-in. floppy-disk drive for backup.

A tape-cartridge drive that will match the envelope dimensions of these small Winchesters has not yet been announced. Many drive manufacturers feel, however, that despite moves to increase the storage capacities of 5 1/4-in. floppy-disk drives, tape will remain the most viable method of handling the backup chore—especially considering that 5 1/4-in. Winchesters show every sign of increasing in storage capacity. Seagate, for example, has announced a 12M-byte drive with thin-film read/write heads (MMS, April, p. 134). Computer Memories Inc.'s first product offering is a 16M-byte device, and both Rotating Memories, Inc. and

International Memories, Inc., might have 40M-byte drives in the works.

Use of the standard DC-300 1/4-in. tape cartridge can present a problem to vendors contemplating using it as backup for 5 1/4-in. Winchesters. While more than able to fit the cut-out dimensions required for larger 8-in. drives, the DC-300 is too wide for the cut-out dimensions specified by smaller 5 1/4 devices. One solution is to alter the way the cartridge is inserted. Data Electronic Inc.'s marketing vice president Sam Thompson says his company is redesigning its "Streaker" drive in conjunction with Olivetti Peripheral Equipment so that the cartridge can be inserted end-first. This hardware could be available this year, Thompson says.

Tandberg Data A/S Oslo, Norway, which markets its line of start/stop tape cartridge drives in the U.S. through Innovative Data Technology, is also reportedly considering an end-loading 1/4-in. tape-cartridge drive.

Vendors are also examining other forms of tape media. Irwin International, Inc., whose first 5 1/4-in. Winchester offering includes an integral tape-cartridge backup using a 0.15-in. DC-100 cartridge is planning to push

both drive and cartridge capacities into the 20M-byte range this year (MMS, June, p. 8). Raymond Engineering, Inc., Middletown, Conn. is looking into cassette backup for lower capacity 5 1/4-in. Winchesters. Company vice president Robert Duffy, says cassette media could be pushed to the 6400-fcpi level, a move that would yield a total per-cassette storage capacity of 5M bytes. "Use of these cassettes gives us the smaller form factor needed for 5 1/4-in. Winchesters," he says, adding that Raymond may have such a drive available by NCC '82 in Houston.

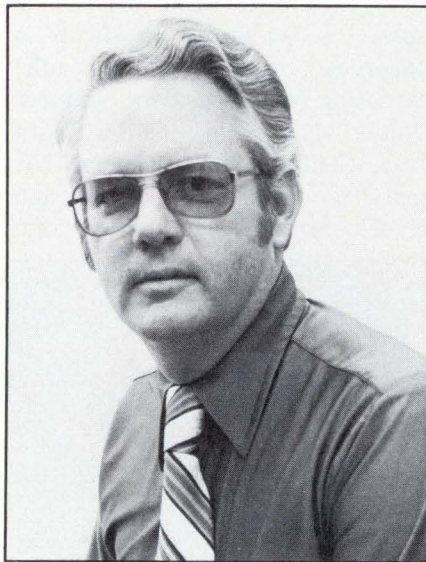
Kennedy Co., which is pushing capacities in response to changing 8-in. Winchester specifications, is also thinking in terms of tape backup for small fixed-disk drives. But tape product manager Darell Meyer says the company will cast its lot with 1/4-in. tape cartridges. "This is the only way to address the question of tape backup for these drives," he says. Meyer does not specify when hardware for this application will appear, but he leaves little doubt that it will. "This is an untapped market for us," he explains. "Floppy-disk drives won't suffice for the higher capacity 5 1/4-in. drives on the drawing boards."

Mini-Micro World

high as 150M bytes without any controller redesign." Tape-cartridge drives of that capacity would require some "fine tuning, however," Theriault says, in the way the media is handled within the drive, and could require some form of media registration.

Data Electronics, Inc., San Diego, Calif., the leading supplier of tape-cartridge hardware, also plans to respond to the upward migration of 8-in. Winchester capacities, says marketing vice president Sam Thompson. The company expects a 40M- to 60M-byte version of the company's 10M- and 20M-byte Streaker streaming tape-cartridge drives to be unveiled this year.

Thompson notes that DEI's hardware includes read/write electronics able to handle flux densities in the 10,000-fcpi range. As a result, he says, additional storage capacities will also come through the use of stepper-motor-driven read/write heads. "We see no reason why 1/4-in. tape cartridges can't store more than 100M bytes of data," he says.



DEI's Sam Thompson: "We see no reason why 1/4-in. tape cartridges, in their present form, can't store in excess of 100M bytes of data."

Executives at Innovative Data Technology, San Diego, are planning to increase capacities through higher bit densities. To this end, the company is awaiting widespread availability of tape-cartridges with high coercivity, 70- μ m. media. IDT

president Dale Spencer says media performance is the limiting factor in tape-cartridge-drive capacities. With the arrival of 500-Oersted tape from 3M Co., St. Paul, Minn. (compared to the 330 Oe specified for the media in 3M's cartridge line), however, 50M-byte capacities can be easily obtained in cartridges no larger than the ones now commonplace.

Problems have cropped up with the evaluation cartridges containing the thinner media, however, Spencer says. "The oxide came off and jammed the read/write heads," he explains. "After 10 passes, we could look right through the tape." 3M has informed him that this problem has been solved and Spencer anticipates that IDT drives using the new media could be available by the first quarter of next year.

Two other entrants in the 1/4-in. tape-cartridge drive market—TEAC Corp., Montebello, Calif., and Electronic Processors, Inc., Englewood, Colo.—are also considering higher capacity drives. TEAC's 10M- and 20M-byte MT-20 DEI-compatible streaming-tape drive will probably have increased storage later this year, says national sales manager Al Astor. First production versions of the device are not scheduled until the third quarter, however. Price for the drives is set at \$1395 in single-unit quantities and \$915 in 500-lot orders, including formatter.

A 17M-byte start/stop cartridge drive from Electronic Processors, Inc., Englewood, Colo., is also expected during the third quarter. Called the Star-Stream, the new device was first shown at this year's National Computer Conference, and operates at 6400 fcpi. Storage capacities might be boosted later this year by increasing flux densities to 10,000 fcpi, says product manager Vince Stinton. "We're in the process of assessing this now," he says.

Kennedy Co. might also unveil



Archive's Wes Theriault (right): "The low end of the market is finished as far as 8-in. hardware is concerned." At left is Archive president Howard Lewis.

The Supermux 480 Is Smarter Than Your DEC or Data General



Your minicomputer does a good job of computing. But it's not nearly as smart as the Supermux 480 Statistical Multiplexer when it comes to talking to remote terminals. No matter which brand you're using, the Supermux 480 can cut your communications costs, make your dumb terminals appear smart and help diagnose system problems.

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CIRCLE NO. 9 ON INQUIRY CARD

Mini-Micro World

higher capacity 1/4-in. tape-cart-ridge drives early next year. Darell Meyer, tape product manager, says the 20M-byte hardware being shipped will be increased to

40M-byte capacity. Shortly thereafter, he says, these start/stop drives might be followed by a high-capacity streaming device. "The pressure is on," he adds,

summing up the attitude of many other tape-cartridge-drive vendors. "The upward migration of 8-in. Winchester is forcing us to follow suit."
—John Trifari

Zilog's new Z800 is plug-compatible with Z80

Providing a growth path for Z80 users and hoping to head off 16-bit μ p design-ins are the two goals of Zilog, Inc., as it readies an 8-bit processor, compatible with the company's popular Z80. The company says the new processor offers three to five times the performance of its predecessor.

Called the Z800 and aimed primarily at the process-control and small-business-systems markets, the part is binary-compatible with the Z80. That means, says Bill Carrico, director of marketing for Zilog's components division, that the "two processors can run exactly the same code." This prevents users from having to redo their operating systems or applications software, he says.

An instruction-buffering technique, says Carrico, allows the Z800 to store upcoming instructions, eliminating the need to go off the chip for the next command. Carrico won't say how many instructions can be stored, but he indicates that buffering contributes significantly to the Z800's increased speed.

Unlike the Z80, the new device features memory mapping and can address as much as 4M bytes of memory, compared to 64K bytes for the Z80.

The device will operate with Zilog's Z-Bus, allowing the Z800 to act as a peripheral to the firm's 16-bit Z8000. While the Z800's internal clock rate is 12 MHz, Carrico says, the part will run at 6

MHZ because of Z-Bus speed limitations.

The Z800 will be available in 40- and 64-pin packages. There may also be "other options," Carrico says, but the company has not yet disclosed them.

The Z800 has a 16-bit internal architecture, Carrico explains. Versions with 8- and 16-bit data paths will be available, he says, adding that the "processor is similar in concept to Intel's 8088 processor." Intel's 8088 is a 16-bit machine with an 8-bit external data path.

"We see the Z800 competing with the 8088 and Motorola's 6809," says Carrico. He claims the part will not hamper future Z80 designs, rather it will stimulate them. "The software compatibility between the two processors is very attractive to many people," he points out. Some customers, however, are rethinking 16-bit designs, including those using Zilog's Z8000. "It will nibble at the low end of the 16-bit market," Carrico concedes.

One industry source believes that the Z800 is a smart move for Zilog, especially because the processor preserves users' investments in Z80 software. Given the slow progress of the firm's Z8000, he adds, the new device should attract Zilog customers looking for an alternative to the Z80.

But a source at systems maker Onyx Systems, Inc., San Jose, Calif., doesn't see the Z800 affecting his company's plans for its Z8000-based hardware. It is interesting, he says, that Zilog has opted for a strategy of producing "transition chips." The Z800 will perhaps be a harbinger of transitional peripheral chips, of which there is a shortage for 16-bit processors, including the Z8000, he says.

Development support for the Z800 is planned for Zilog's recently announced Z-LAB-8000 (MMS, March, p. 5). A new emulator will be developed also, says Carrico.

He expects the Z800 to be available soon after the second quarter of next year. When volume production begins, Carrico says, a Z800 will cost about \$10 for purchases of more than 25,000 a year.
—Larry Lettieri

Pascal development tools gain in popularity

With the increasing power and applicability of 16-bit μ ps comes the need for reusable, transportable software. Several companies, including Intel Corp., Intermetrics,

Inc., and Boston Systems Office, are meeting that need by offering high-level Pascal compilers or cross-compilers for the Intel 8086.

While Intel, a supplier of 16-bit

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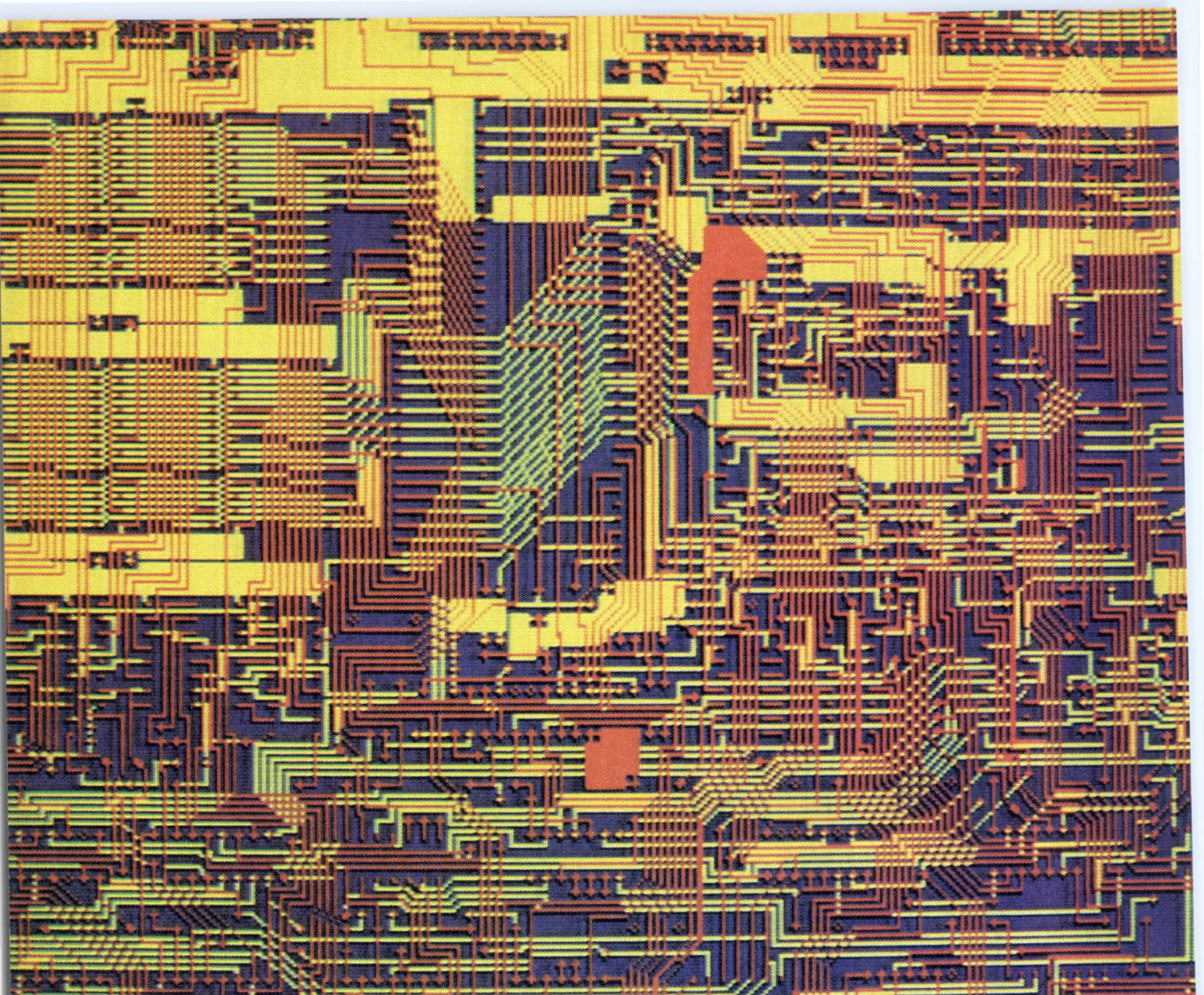
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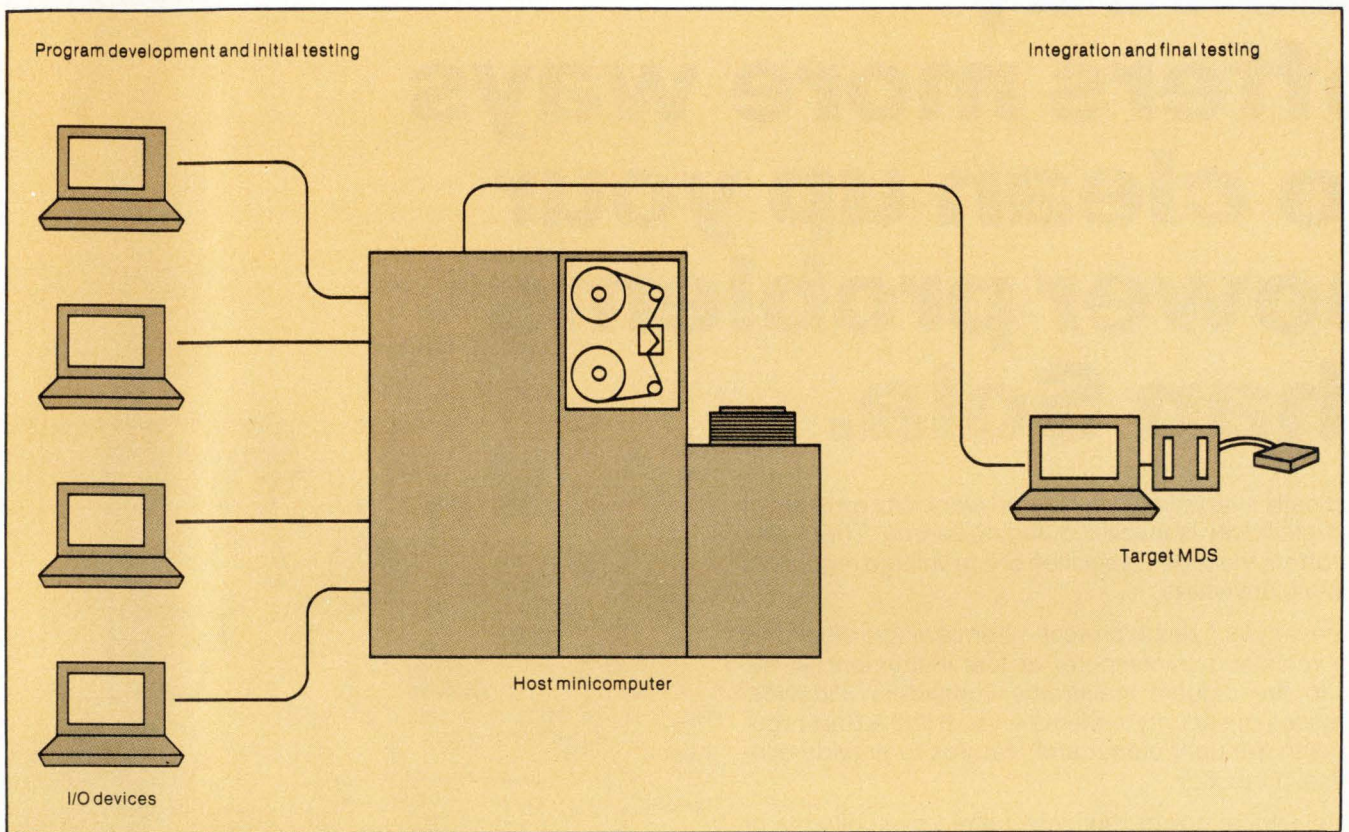
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MINI-MICRO SYSTEMS/July 1981



Intermetrics' PasPort Pascal cross-compiler allows several programmers to develop and pre-test software for Intel 8086 μ ps on a time-shared DEC PDP-11 minicomputer host.

μ ps, is offering a Pascal compiler on a single-user μ p development system, Intermetrics and BSO have opted for a different approach. Each offers cross-compilers that enable μ p software to be developed by multiple programmers on a minicomputer or mainframe host. A compiler takes source language and produces code to run on the same machine; a cross-compiler executes on one machine, such as a PDP-11, and produces code for another, such as a μ p.

Intermetrics, Cambridge, Mass., previously sold custom software to the government, and is entering the commercial market with its recently introduced PasPort 8086 Pascal cross-compiler. The company's best known recent efforts include the design of a software translator and compiler system for the Ada language under contract to the Defense Department, and develop-

ment of the HAL/S programming language used for the National Aeronautics and Space Administration's Space Shuttle.

The company is touting cost-effectiveness in its time-sharing approach for programming the 8086 (see "PasPort spots most errors on minicomputer," p. 26). A Pascal program is compiled into an intermediate language on a Digital Equipment Corp. PDP-11 minicomputer running under Bell Laboratories' UNIX or DEC's RSX-11M operating system. The program is tested on the minicomputer, and then down-loaded into a development system for final software checks. Single license price for PasPort, which is available now, is \$15,000. Intermetrics does not supply the hardware.

The company claims PasPort minimizes the number of development systems and programmers

needed for a project, maximizes productivity and makes software development cycles more efficient and predictable. "Most manufacturers of products that incorporate a μ p typically develop software in machine-level assembly language on one or more μ p development systems. But the general availability of 16-bit μ ps, with their larger address spaces, significantly reduces the viability of the μ p development systems approach to software development," says Ron Kole, director of the company's compiler products division. He adds that most development systems are single-user tools designed for hardware and software debugging, and do not include the program-development facilities available on minicomputers. The company claims that larger programs and correspondingly larger programming staffs put a strain on traditional

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Mini-Micro World

development-system techniques.

Kole says the company will expand product offerings to support more μ ps in a given family, to include other manufacturers' μ ps and to use more hosts. Intermetrics will support the 8088 and 8087 μ ps. It will also support the Motorola 68000 by year-end and probably the Zilog Z8000 by mid-1982. Intermetrics plans to broaden the number of hosts as well, with the next offering most likely on DEC's VAX. The company has no immediate plans to support Ada, but would like to capitalize on the results of Ada development efforts, Kole says.

The promise of providing less expensive programming tools also lured Boston Systems Office into that market a year ago. The company, which produces many μ p products, offers a Pascal cross-compiler to develop 6800 software on a VAX. The company also hopes to support the 8086 and to add a PDP-11 with Pascal by year-end.

Price for the 6800 cross-compiler is \$20,000, including a generator, with quantity discounts available.

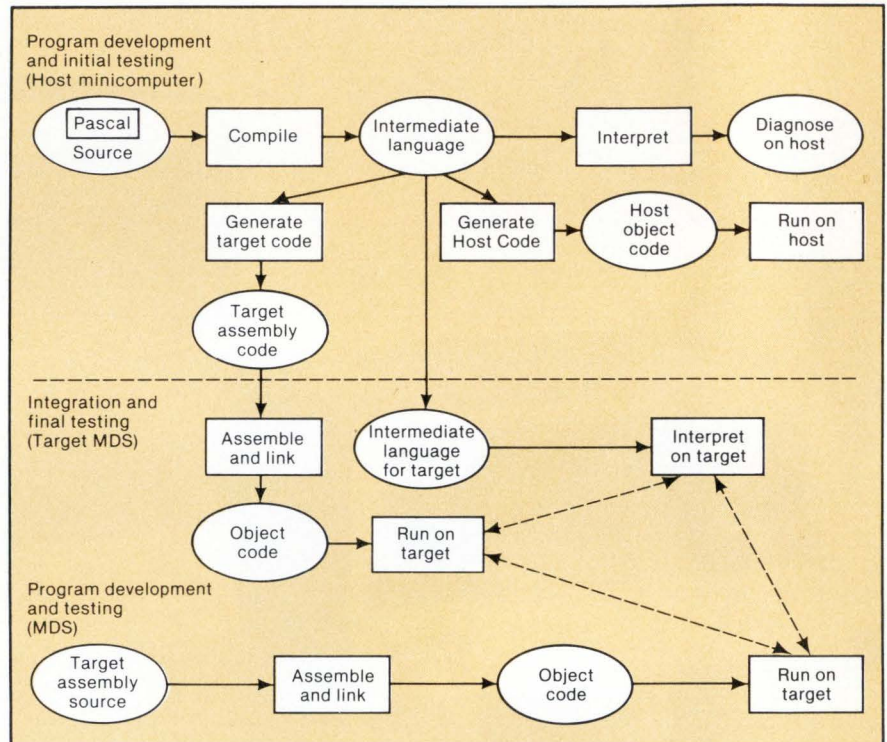
Simon Wieczner, marketing manager at BSO, says multi-user equipment is very cost-effective,

and claims that his company has had to keep initial prices high to limit demand. The total development-system market is worth more than \$200 million, he says.

As many as 20 users can program on a BSO system. To support one

programmer, a company must buy both hardware and software, which could sell for as much as \$35,000.

Wieczner recognizes one risk in using the time-shared programming approach: If a host computer fails, it could idle as many as 20 program-



Steps in software development for the Intel 8086 identify most errors on the minicomputer before the program reaches the μ p development system for final test.

PASPORT SPOTS MOST ERRORS ON MINICOMPUTERS

The most important feature of Intermetrics, Inc.'s new Pascal cross-compiler is that most errors can be identified using the PDP-11 minicomputer host, the company says. The μ p development system is used only for final software integration and testing. Tools available on the host, such as file management, source-control systems, archives, large disks and high-speed printers, can be used in the development process. Many programmers can share files and procedures to develop software.

The PasPort system is divided into compilation, host run-time support and target run-time support tasks. Source preparation is performed by using any editors available on the minicomputer.

- All compilation is done on a

PDP-11 minicomputer host. About 4 sec. of PDP-11 CPU time is required to compile the program, the company says, and as much as 11 sec. is needed for multiple users. A front-end compiler translates a user's Pascal program into an intermediate form similar to P-code. That code can be executed by an interpreter, or further translated by a code generator into machine code.

- The Pascal program is executed and tested on the PDP-11 via an interpreter that accepts the intermediate code as input. The interpreter supplies the run-time environment required by the Pascal program, and performs dynamic checking. Error messages are related to the program's source line. If the host minicomputer runs on UNIX, users can

generate PDP-11 instructions from the Pascal program.

- After the programmer checks the Pascal program, it is transferred over an RS232 serial line to the target development system for loading and execution on the 8086. The program can be transferred in the intermediate code, or as an 8086 assembly source produced by further program compilation. To execute programs on the 8086, PasPort includes an 8086-resident run-time system for compiled Pascal programs, an 8086-resident interpreter for direct execution of the intermediate code and the ability to mix interpreted and direct-execution modes. Direct execution can be chosen over generation of 8086 machine code for large, non-time-critical applications.



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mers. "That's why we use vendors such as DEC," Weiczner says. "Down-time is infrequent, and service is very good."

Another problem of time-shared systems posed by some development-system proponents is that a user must first own a minicomputer. Buying a minicomputer can be an expensive solution to programming, and some industry participants advocate development systems for that reason, while others support distributed development on communicating systems.

"The way people are going with software development is to have their own machines," says Jack Hemenway, president of Hemenway Associates, Inc., Boston. Hemenway questions the need for time-shared systems, because Intel offers a resident Pascal compiler on the 8086.

That compiler, which produces machine code with both the 8086 and the 8088 8-bit-compatible family member, has been shipped since March. Price is \$3900, not including hardware. The compiler works on Intel's MDS 286 development system, with prices starting at \$16,000.

Intel claims that because hardware CPU costs have decreased so much over the years, it is not as necessary to share a CPU. "The 8086 costs a few dollars. If people need more performance, they can add another CPU in the system," says Suneel Kelkar, software product marketing manager at Intel.

Kelkar cites another disadvantage of using a time-shared system: many customers use more than one type of CPU, such as an 8085, an 8086 and an 8051. "One cross-compiler on one time-sharing system does not solve all problems," he says.

Intel provides support that allows networking of multiple development systems with the NDS-1 network development system, which can

connect as many as eight MDS 286 systems. Kelkar explains that in networking four systems, the user would have to install the software on one development system that will serve as a file manager, and add a cable and a board to the other systems. He claims that there is a trend toward this type of distributed development system.

Yet, he says, there is room for the time-shared approach, which addresses a different market segment. Intel plans to provide a similar solution for users who have made the minicomputer hardware invest-

ment. The first move came in January, when Intel introduced three programs modified to run on VAX machines: a PLM 86 compiler, an 8086 assembler and a linker. Kelkar says large users will employ the VAX for computation and linking.

Intel eventually will stretch its distributed approach to include development on any system that supports the Ethernet protocol. Kelkar says Ethernet-based software to support such communications will be available next year on Intel systems. —L. Valigra

Panafax unveils intelligent facsimile machine

With the introduction by Panafax Corp. of the MV-3000 transverter, facsimile-equipment market leaders, including Xerox Corp., Quip, Burroughs Corp. and 3M Co., face

an unprecedented challenge. The Panafax unit, unveiled in late May, is the first machine of its kind equipped with intelligence to handle facsimile as well as computer-



Panafax president Denis Krusos (left) and vice president Robert Siegler with the MV-3000, which receives a 500-word document in 3 sec. and prints a full page in 15 sec.

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generated communications. Industry observers expect the machine to be used in data-communications applications in which the limitations of thermal printing are acceptable.

"We wanted to come out with a product with which we could penetrate the facsimile market," says Robert Siegler, vice president of sales for Panafax, which is rated one of the top five facsimile suppliers. "We decided the best way to boost our market share would be to offer a unit with broad applications at an affordable price—one that could handle data as well as facsimile communications". Siegler terms the MV-3000 a "universal communicator," with applications in the office-automation and electronic-mail markets.

Siegler will not project how many units Panafax hopes to sell this year but he says the attention the MV-3000 has received thus far in the industry has been encouraging.

The software-controlled AMD-2901 μ c-based unit is programmed in PROM to receive messages in synchronous or asynchronous form using BISYNC, HDLC, SDLC, Telex and TWX protocols. Resident RAM buffers the unit so that it can accept data from a computer or word processor at rates as high as 9600 bps. A 500-word document can be received and stored in 3 sec., and a full page printed in 15 sec. The buffer holds two to three pages of data and will be expandable within a year to store as many as 50 pages, Siegler says.

In the facsimile mode, the MV-3000 can communicate with any machine that transmits in 3 min. or less (Group II and III) and automatically adjusts itself to the speed of the corresponding unit without operator intervention. An expansion option allows the transverter to interact with machines that transmit in 4 to 6 min. (Group I). The unit contains modified Huffman and modified Read encod-

ing and handles modem speeds as high as 9600 bps. If a phone line cannot accommodate higher rates, the MV-3000 selects a lower speed that is suitable for the line.

The unit transmits documents as wide as 11¼ in. and automatically reduces documents it receives that are wider than 8¼ in. A thermal printer produces copy with resolutions as fine as 200 × 200 lpi, and a single font provides single-sized characters.

Prices start at \$6995, and the MV-3000 is also available for a monthly rental charge of \$170 and a maximum usage charge of \$105.

Manufactured in Japan, the transverter will be sold directly to end users through Panafax sales representatives located in 30 cities nationwide. Deliveries will start in late October.

"The thing that's really exciting about this machine is that it's inexpensive for what it does," says H. Paris Burstyn of the Yankee Group, a Boston, Mass., market-research team. "Prior to this announcement, a facsimile machine was basically a remote copier used for sending mail fast. Now you can also hook up to a computer or a word processor and receive messages directly."

Burstyn says that the only product comparable with the MV-3000 is the top-of-the-line model of the Xerox 495, which was

introduced three weeks before the Panafax unit and sells for \$15,395, more than double the price of the MV-3000. The 495 does not include computer-communication capabilities except through a Xerox service bureau. Furthermore, it is not buffered to store messages it transmits or receives and, consequently, does not operate as fast as the MV-3000.

Melody Johnson, an analyst with Kidder-Peabody Co., New York, says the Panafax announcement is significant but adds that the product's limiting factor is its thermal printer.

"When you're talking about printing from word processors and computers," she says, "most of the time you're looking for high-quality impact or laser printers." Johnson says, however, that many users will be willing to sacrifice print quality to have a fax and a remote data printer combined in one unit.

The MV-3000 includes ID code printing at the bottom of each document transmitted or received, remote- and self-diagnostic capabilities and a daily-activity report or log of transactions.

Panafax Corp., with U.S. headquarters in Woodbury, N.Y. is a private company held jointly by Matsushita Electric Industrial Co., Matsushita Graphic Communications Systems, Inc., and Visual Sciences, Inc. —Frank Catalano

Personal-computer makers enter software publishing

The lack of quality application software for personal computers is leading many personal-computer manufacturers to publish third-party software for their systems, using a variety of techniques to attract potential authors. These techniques include running soft-

ware contests and promoting programs from small, third-party developers.

Apple Computer Corp., Cupertino, Calif., has opted to promote the developers. Last fall, Apple introduced Special Delivery Software, a line of programs developed



A few years ago, you bought DEC controllers or you took chances.

Time was you couldn't trust anyone. Price was often lower. Delivery was sometimes faster. But let's just say quality, reliability and service left lots to be desired (if the product even worked at all).

Times change. Enter Emulex.

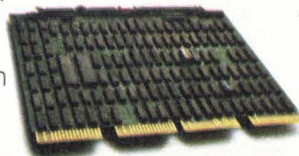
First we decided that price shouldn't be the only reason to buy our controllers even though they cost less. The design goal of every tape, disk and communications controller we make is to go DEC one better. Emulex controllers actually optimize the DEC systems in which they're installed.

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of controllers that improve DEC performance across the board. If we did anything wrong, it was in setting a new standard. Competitors stopped imitating DEC and started trying to imitate us.

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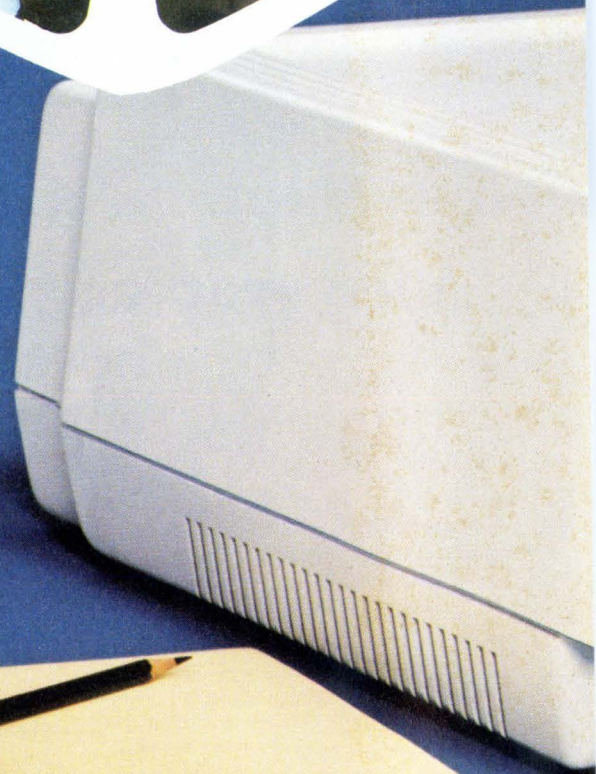
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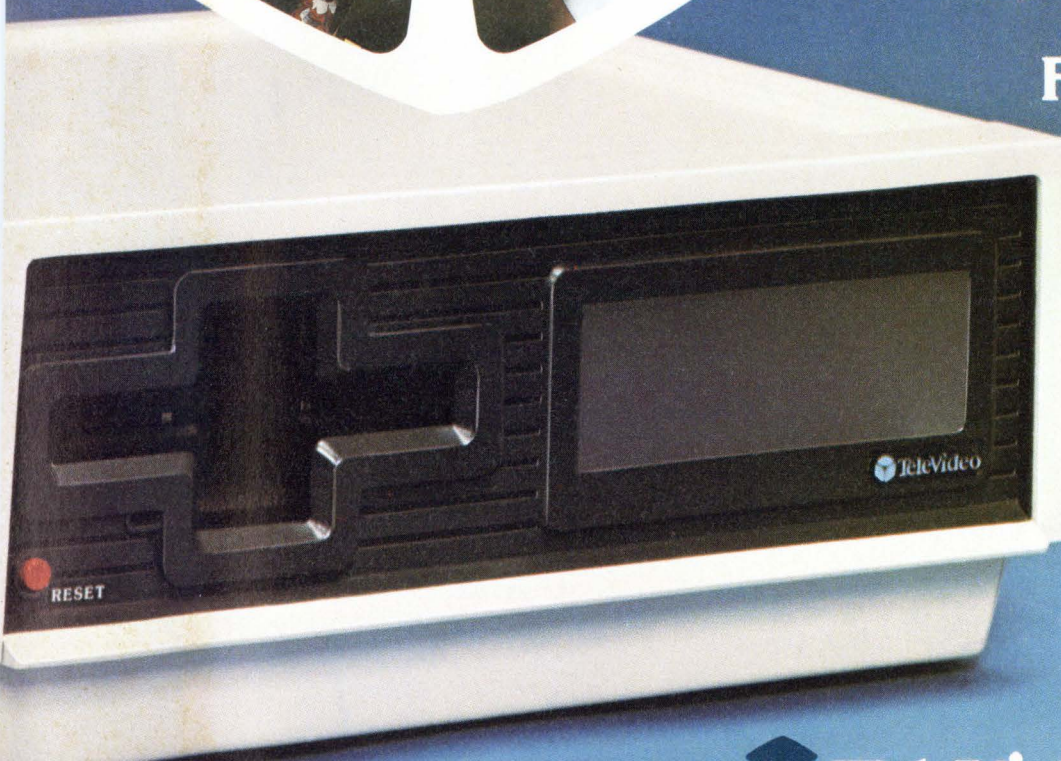
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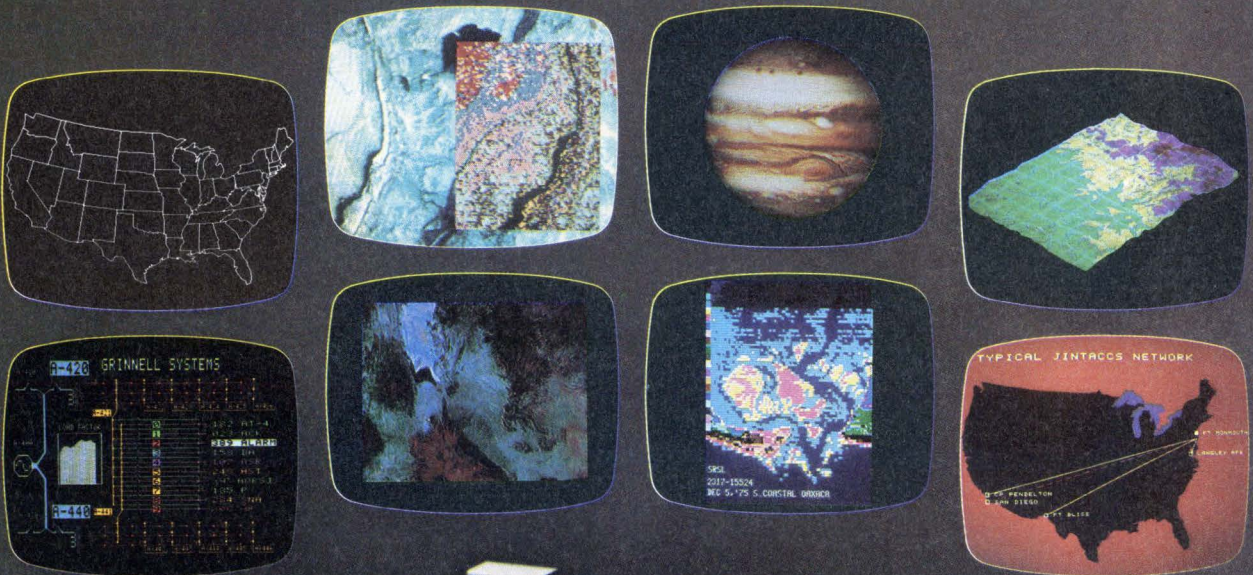
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CIRCLE NO. 19 ON INQUIRY CARD

by third-party authors. Tupper Snook, product manager for Special Delivery, says the new line will coincide with initiating a "New Deal," which puts the thrust of selling software with Apple's dealers. In addition, the company provides a software catalog. Authors are paid a royalty, and, although the developers own the software, Apple has the exclusive rights to market and distribute it.

"There's no way Apple could fulfill the needs of every user," says Snook. "We know there are a lot of talented people out there who write software, and Special Delivery is a vehicle for them to sell that software."

Apple looks at finished programs and those that need a "touch-up" to be marketable, Snook says. "We have our feelers out, and the catalog promotes that." He feels that, in the future, Apple may have to go even further in advertising and promotion to attract more high-quality software.

Running a contest is the route Texas Instruments Inc. took last fall as an incentive to attract more authors. TI advertised the contest in several personal-computing publications. With a \$3000 first prize, the contest generated about 400 entries, including several from small, third-party software writers. TI also ran an in-house contest at the same time.

"Games were excluded from the contest," the spokesman says, "because there's a lot of them around already." The first-prize-winning entry was an easy-to-use household-inventory system. Other winning programs included ones for science and education, planetary-motion prediction, a metric-system tutor, business, stock-chart timing, loan analysis, astrology, chemistry, automobile-cost analysis and several others covering a wide spectrum of applications.

Winners retained the right to

market the software themselves, if they chose to, as did the first-prize winner. The spokesman says, however, that several contestants entered into agreements with TI.

Another means TI used to attract high-quality software was to announce, also last fall, the availability of two development systems—one for UCSD Pascal and one for TI Extended BASIC—which were made available to potential authors. In addition, the spokesman says, the company actively solicits educational software from large publishers, including Scott Foresman, Chicago, Creative Computing, Moorestown, N.J., and Micro-Ed, Minneapolis, as

well as Hayden, McGraw-Hill and Milton Bradley.

Unlike TI, Radio Shack, Fort Worth, Texas, does not solicit software from developers because "so many people come to us," says Ed Juge, director of computer merchandising. "Out of 200 programs we receive in the mail, maybe one is really suitable for sale by Radio Shack." He says that the problem with software from outside sources is that Radio Shack doesn't know whether it will run, and the company does not have the time to test every program. "The company," he says, "must support any programs it offers for sale—for

MINIBITS

XEROX DROPS XTEN NETWORK

Citing a lengthening payback period, an uncertain economic environment and recent regulatory changes that could potentially increase the number of network competitors, Xerox Corp. announced that it will halt all work on its XTEN telecommunications network. After investing approximately \$30 million in the project, Xerox had overcome various technological barriers inherent in its broadband digital scheme. "But even with a modest rate of investment—which still would have been a substantial amount—we couldn't expect the payback to begin until late in the 1980s," says a company spokesman. He also indicates that other Xerox projects, particularly the Ethernet local-area network and its associated products, have placed increasing demands upon the company's resources. The folding of the XTEN program comes just after the Federal Communications Commission had allocated a portion of the radio-frequency spectrum for such non-voice networks. When Xerox first approached the FCC in November of 1978 for such a ruling, the regulatory situation was such that XTEN was imperative to meet Xerox objectives, the spokesman says. Since then, as the communications industry became increasingly open to competition, the attractiveness of XTEN has diminished in the eyes of its developer.

PERKIN-ELMER DROPS OEM TERMINALS

Low profit margins and low volume sales have forced Perkin-Elmer out of the OEM terminals business. From 50 to 60 percent of the units produced by the firm's now defunct Terminals division had been bought internally for configuration on the company's 32-bit computer systems or for use by Perkin-Elmer's Instrument group. By folding the Flanders, N.J., Terminals operations, Perkin-Elmer believes it can redirect development money once slated for low-end OEM products into the more profitable business of producing terminals specifically for its computer systems. Affected in the restructuring are the 550 series and the 1250 series, used primarily by the Computer group, and the 3500 terminals, used by the Instrument group. One source close to the company suggests Perkin-Elmer may capitalize on the graphics expertise it has gained with the 3500 products eventually to produce terminals directed at CAD/CAM or business graphics markets. Of the 250 people previously employed by the Terminals division, most will be integrated into other sections of the company, according to a company spokesman, who predicts that very few layoffs will occur because of the firm's exit from the OEM terminals arena.

Mini-Micro World

better or for worse, and this is very difficult with programs that come in the mail."

Some of the company's software is developed in Japan to Radio Shack's specifications, and the company also uses a few free-lance authors. Juge says these free-lancers may make as much as \$100,000 a year just writing programs for Radio Shack.

Juge strongly disagrees with the idea of running a contest to attract software. "That's like digging up the whole state of Florida to find a buried treasure," he says.

Another personal computer maker, Atari, Sunnyvale, Calif., is initiating several incentive programs for software developers, says a company spokesman. "There is no one company in the world that can come up with the software to fill every application and need," he says. As a result, the company needs good authors and hopes to attract them by publishing a quarterly catalog, called the *Program Exchange*. It lists contributed programs and, thus, gives broad public exposure to third-party software authors.

The company is also sponsoring contests. Authors who have had software listed in the catalog will be eligible for prizes consisting of \$75,000 worth of Atari products and \$25,000 cash. The company will run the contests every three months—to coincide with the quarterly updates of the catalog—in each of four categories: consumer (games, personal development and hobby), business, education and systems software.

In addition, Atari will open acquisition centers, the first of which opened in the Sunnyvale area in mid-May. At these centers, developers can use Atari computers, peripherals, reference materials and technical manuals to develop software, the spokesman says. Technical personnel will be available

to answer questions and to review the programs. The company will either market the finished programs under Atari's name or list them in the *Exchange*. However, authors can also market their programs themselves, if they choose.

Another company that is publishing a catalog of externally developed software is Commodore Computer Corp., Norristown, Pa. The catalog, called the *Software Encyclopedia*, will be sold by dealers and will include two designations of software—Commodore-sold and

NEC'S PERSONAL COMPUTER 'FOR PROFESSIONALS'

With prices starting at less than \$1600, a Z80-compatible personal computer from NEC Information Systems, Inc., provides as much as 64K bytes of dynamic RAM and as much as 32K bytes of optional ROM. The PC-8000's integral package also includes a monochromatic or optional eight-color display/keyboard, a 320K-byte minifloppy diskette drive and various I/O interfaces.

"The PC-8000 will compete initially in two markets," says Jack A. Dutzy, NECIS PC-8000 program manager: "the very small computer market, where it will be used for both data and word processing by professionals and managers in small businesses and professional practices; and in large corporations, where it will be used

both as a remote terminal and as a stand-alone, desk-top decision-support system."

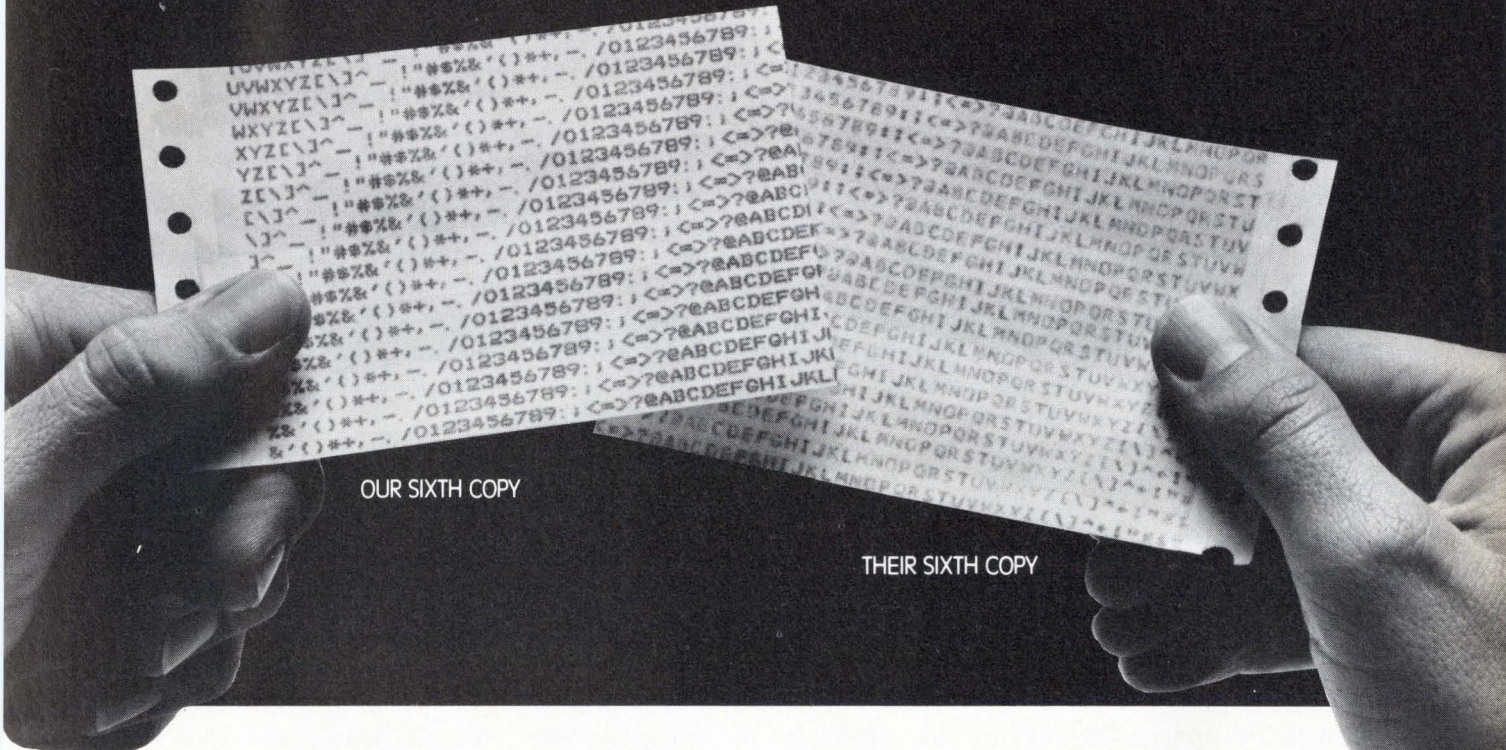
With the unit's 12-in. CRT terminal, users can select variable screen widths, variable-sized upper- and lower-case characters, static paging, scrolling, split screen, graphics and blinking and inverse video. The 82-key keyboard array includes a standard typewriter layout, a numeric pad and five function keys.

The system will operate under several operating systems, including CP/M. Various application packages are also available from NECIS, such as business analysis and planning, inventory control, word processing, mailing-list maintenance and most common accounting programs.



A typical PC-8000 configuration with 64K-byte RAM, 32K-byte ROM, a 320K-byte dual diskette drive, three serial communication ports operating at speeds as high as 4800 bps, a parallel printer adapter, an IEEE interface and a 2000-character CRT terminal sells for approximately \$3700.

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CIRCLE NO. 20 ON INQUIRY CARD

Commodore-approved. Commodore develops no software in-house, choosing instead to use independent authors, says Rick Lamb, technical support manager at the company.

"The catalog is necessary to give users an up-to-date listing of the known software for Commodore equipment," Lamb says. The *Encyclopedia* includes a number of programs from software-developer firms as well as from private authors.

Lamb does not think a contest is necessary to attract software authors. Like Radio Shack, Commodore receives so many programs in the mail that Lamb feels it must be "fairly obvious that Commodore is interested." He adds, "The attraction for an author is lots of money. We may put money up front against a royalty, or we may make an outright purchase of a program." He feels that Commodore is helping to legitimize a cottage industry and will be able to continue acquiring its software in this manner for at least the next 10 years.

The reaction of software publishers to the trend of personal-computer makers entering publishing territory has been surprisingly favorable. Many think the trend will help, rather than hurt, their business. For example, Roland Joffe, marketing director at Lifeboat Associates says, "I welcome the opportunity of competing with people like that." Lifeboat, he says, provides authors something that personal-computer makers can't—the ability to sell products on the equipment of 65 manufacturers. "We offer the authors a wider distribution. Apple's programs can be sold only to Apple customers, Radio Shack's to Radio Shack customers," Joffe says.

Joffe believes, however, that it is good idea for an author to "get his feet wet (dealing with a personal-computer manufacturer), learn the pitfalls and learn how to deal with a

company before coming to Lifeboat." Lifeboat does two to three months of testing before signing an author, after which a contract is negotiated. "I see no migration (from publishers to manufacturers)," he says. "If there were a dearth of quality programs, we might feel otherwise."

Dan Fylstra, president of Personal Software, Sunnyvale, Calif., agrees: "We see it as a welcome trend," he says, adding, "We feel no impact at all. It's expanding the market, and customers are getting a wider selection."

One reason the company feels no

impact, he says, may be that Personal Software does not deal with individuals. "We work very closely with a small number of development firms that employ five to 25 people. We have never offered our software any other way or tried to lure individual authors.

Russell Gee, associate publisher at Access Communications Corp., Wellesley, Mass., (MMS, February, p. 51) says that his company also feels no impact from the trend. "It proves we're in the right business and underlines the necessity for more, good software," he says.

—Fran Granville

DEC starts marketing third-party software

Companies looking to cash in on the market for publishing application packages developed by independent software vendors were recently greeted by a formidable competitor when Digital Equipment Corp. joined the fray.

The Maynard, Mass., minicomputer giant recently unveiled a project named the External Applications Software (EAS) Library that is offering four DEC-tested, but non-DEC-warranted, application packages written by outside vendors.

More software is on the way, says EAS marketing manager Kurt Lynn. The EAS program is aimed at packages that should sell about 1000 units yearly, says Lynn. The initial offerings have heavy commercial word-processing orientation, but Lynn says the EAS offerings eventually will span the firm's product lines.

The EAS program offers a customer a software package that has been thoroughly tested by DEC. The customer doesn't get an

opportunity to purchase a DEC software-service and maintenance contract.

Lynn claims that a potential EAS package receives testing as rigid as that given to a DEC software product before it hits the market. DEC officials talk to users, run a sample test and check the program's documentation before the company can sell the product. "We'll encourage third-party software suppliers to offer maintenance contracts directly," Lynn says. To date, three of the four suppliers offer the contract.

He also claims that the EAS program won't incur the ire of the firm's OEMs for marketing applications that may fall within the OEMs' turf. "We were very sensitive to that (possible conflict)," Lynn says. He expects the company's OEMs will become contributors to, as well as customers of, the EAS program. As customers, OEMs can use EAS products as a "baseline" to add future applications, Lynn says. The EAS program offers DEC a unique

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Allen Kluchman, president of third-party software publisher Access Communications Inc., Wellesley, Mass., isn't worried about DEC's entry (MMS, February, p. 51). "The main thrust of the minicomputer manufacturers is to sell machines; our main thrust is to offer additional application programs to the installed base," Kluchman says. In any case, Kluchman adds, the application-software market is large enough to accept DEC or other newcomers willing to offer tested, well-documented software.

While DEC does not offer maintenance contracts, it does monitor customers' problems and acts as a "clearinghouse" between customers and outside vendors. "Our intent with the program is to provide products of reasonable quality," says Lynn. So far, the EAS program has rejected as many packages as it has accepted. The company will discontinue packages that encounter undue problems in the field.

The EAS marketing effort is located in DEC's central engineering organization, but potential EAS candidates are nominated by the company's product groups. Beyond some basic marketing efforts by the company's central organization, the main burden of selling EAS-approved packages returns to the product group.

Each product group must hammer out a contract with the third party involved, and royalty and exclusivity issues are decided in those contract negotiations. Lynn expects DEC to receive royalties equal to 25 to 50 percent of the selling price.

EAS's marketing services include listing the application in an external software-product document that will be distributed nationwide. In the future, EAS may print a catalog.

The four packages include:

- A text-editing package developed by Unilogic Ltd., Pittsburgh, Pa., that supports DEC's color-graphics terminal and is designed to run on VAX and DECsystem-20 computers. Single-user licenses with documentation are priced at \$10,000 for educational and \$25,000 for non-educational institutions. Additional licenses at the same sites without documentation are priced at \$2000 and \$5000, respectively.

- A financial-modeling system priced at \$140 from American Business Systems, in Littleton, Mass., that will run on DEC's WS-78 word-processing systems and was sponsored by the retail products group.

- A math/sort utility priced at \$300, from Symbolic Systems, Summit, N.J., that was sponsored by DEC's word-processing group and runs on DEC's word-processing systems.

- A document-transfer utility to move documents running under DEC operating systems to systems running under the UNIX operating system developed by Bell Laboratories. The sponsoring group was DEC's telephone industry group, and the package is priced at \$1500. Lynn will not identify the developer of the document-transfer package, which is the only EAS package without a maintenance contract.

—Eric Lundquist

Only half the vendors now shipping Winchester

Of the 50 Winchester vendors that have announced intentions to manufacture disk drives, only 25 are shipping hardware, says Andy Roman in a report entitled "Winchester-Disk Drives: How Difficult to Manufacture?" The Newark, Calif., consultant and publisher of the *Random Access International* newsletter, adds that of the 25 vendors delivering hardware, only 10 are selling into the OEM or plug-compatible markets. The remaining 15 are captive suppliers, such as IBM or ISS/Univac, or are headquartered in Japan. And of this latter category, only one supplier—Hokushin Electric Works, Ltd.—is shipping Winchester in volume, he adds.

Of the other 10 manufacturers of Winchester-disk drives, Roman continues, six build 14-in. devices, seven build 8-in. versions, and three supply 5¼-in. hardware. Roman says 25 manufacturers, including Japanese suppliers, have announced

14-in. Winchester, 26 have announced 8-in. drives, and 16 have unveiled 5¼-in. hardware.

Six- to 24-month delays have occurred between announcements of Winchester-disk drives and the start of volume deliveries. One vendor unveiled a Winchester line more than two years ago, and is only now beginning to ship hardware. Roman also indicates that many Winchester-disk drives have been returned to the vendors for repairs, or have been rejected by end users and third-party OEMs. "In one case, 100 percent of the first year's production was returned," Roman claims. He will not identify the companies involved, although he does point out two of the prime culprits. "In many cases, lubricants on the disks were coming off when the heads landed, causing media contamination," he says. "In other cases, the lubricants were too thick and the read/write heads became fouled."

—John Trifari

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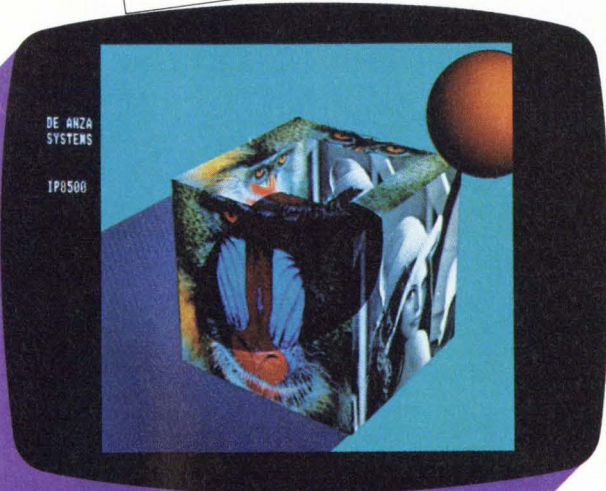
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CIRCLE NO. 23 ON INQUIRY CARD

Hard-disk controller will have standard interface

Two-month-old Adaptek, Inc., Campbell, Calif., will develop a low-cost, device-independent, hard-disk controller based on a standard interface. Although details are not yet available, co-founder Larry Boucher says the controller will be

based on a concept similar to that proposed by Data Technology Corp., Santa Clara, Calif.

To be implemented with LSI components, the Adaptek product will be centered on a standard, device-independent core, around

which will be added components to customize the device for various disk drives. Boucher says the controller will be "priced lower than anything available, but will have extra capabilities, such as error correction."

Boucher and co-founders Wayne Higashi and Bernie Nieman, all former Shugart employees, expect the controller to be in production by late next year. —Larry Lettieri

Personal, small-business market is segmenting

Relief is on the way for confused buyers faced with choosing from a myriad of personal and small-business computers. Two systems with the same price tag can vary widely in capabilities, upgradeability, software, entry-level price and configuration. The market for those systems appears to be segmenting into price and performance categories based on the minimum investment required for a user's application.

Personal computer manufacturers, such as Commodore International, Ltd., Apple Computer Inc. and Tandy Corp. are selling low-end models priced at less than \$5000 and typically 8-bit μ p-based systems. Minicomputer manufacturers, such as Digital Equipment Corp. and Data General Corp., will sell high-end products priced at \$5000 to \$15,000 and typically built around 16-bit μ ps. In some cases, low-end models can be configured at prices comparable with high-end systems.

Demand in each price category is growing equally fast, according to figures from Dataquest, Inc., a Cupertino, Calif., market-research firm. Worldwide end-user sales for personal-computer systems priced lower than \$5000 totaled \$730

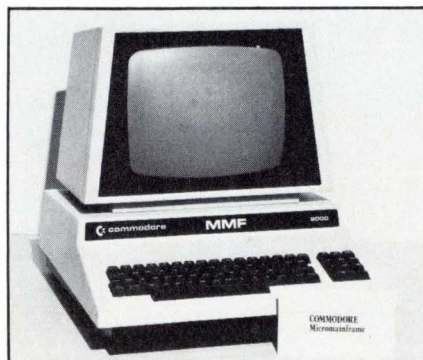
million in 1980, and will grow to about \$3 billion by 1985. Similarly, the \$5000-to-\$15,000 very small-business-computer market was valued at \$800 million in 1980 and will grow to \$3.6 billion by 1985. In 1985, the combined market will exceed \$6 billion. Most personal computers are used for business applications.

"Most people want to get in (to buying a computer) with a minimum amount of commitment and then upgrade or migrate," says Ralph Gilman, senior analyst at Dataquest. Entry price varies depending on the amount of mass storage and level of performance. Users who want good response time, large disk

files and fast access to disks can start with a \$2000 system and add Winchester-disk drives, peripherals and more terminals until they reach the \$8000 range, he explains. Although an \$8000 system is not as powerful as a typical high-end system, it is appealing because it represents a minimal initial investment. The same strategy holds true for those who want to migrate from a high-end \$8000 system to a \$40,000 computer.

Manufacturers' decisions on whether to take a top-down or bottom-up system-development approach is based on marketing—current products and distribution channels—rather than technology, Gilman says. "DEC and other minicomputer vendors must consider their installed base of equipment and pricing strategies that might obsolete other existing products. Apple, Commodore and Vector Graphic do not have to consider that. But minicomputer companies also have a lot of software and an installed base, and they can offer upward compatibility," he says.

Yet, minicomputer manufacturers may be at a disadvantage in achieving low prices. "Companies with higher technology equipment and with large R & D centers amortize (the cost) into the machine. They find it hard to take money out of the machine or its mechanism of delivery (to the



Commodore intends to compete with both low- and high-end personal/small business computers with its new micromainframe system.

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CIRCLE NO. 24 ON INQUIRY CARD

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user)," says James Finke, president of Commodore Business Machines.

Commodore, which develops its equipment from the bottom up, aspires to compete across both market segments. It is targeting its new super Pet micromainframe at its low-end competitors, and later at forthcoming high-end products, as systems houses add to the 134K-byte memory.

The super Pet, priced at \$1995, upgrades the Pet 8032 computer by adding a \$995 board. The super Pet is based on an 8-bit Motorola 6809 μ p with 36K bytes of ROM, 96K bytes of RAM and 2K bytes of screen RAM. Four software language interpreters, developed by the University of Waterloo, Waterloo, Canada, are available, plus a Waterloo microEditor for creating and maintaining program and source data files. Software can be developed on a super Pet to be up-loaded to a mainframe system.

With software and peripherals, the super Pet will sell for more than \$5000. A 2M-byte dual floppy-disk drive is priced at \$1795, and a tractor-feed printer sells for \$795. Prices have not been set for an 8-in.-Winchester-disk drive and the languages.

Finke hopes the super Pet will not have to be re-designed if it is upgraded for more power. He says that internal memory could be added to prevent a re-design. Some memory can be off-loaded onto intelligent peripherals, thus distributing the intelligence.

DG uses a top-down approach to system development. "We're used to solving more difficult problems," says Larry Seligman, general manager of the company's Small Business Systems Division. The company introduced its high-end market entry, Tiny Business System, late last month.

Applications software is an important factor in purchasing equipment. Low-end computer manufac-

turers typically rely on third-party software vendors for applications, but high-end manufacturers often develop software in-house, Dataquest's Gilman says.

"There is a tendency of manufacturers in the \$10,000-to-\$15,000 price range to distinguish themselves in getting a market niche via applications software. The end user is demanding more sophisticated,

solid packages. It takes a lot of money and effort to develop these," he says. A trend toward development software is also emerging, Gilman says. This enables a user to modify applications packages. Gilman does not expect low-end companies to provide such support, although he says they may pick up independently-developed software.

—L. Valigra

IBM's digital logic circuit boosts processing power

A digital logic circuit developed by two IBM Corp. engineers could dramatically increase the performance of small computer systems. The new circuit could also significantly reduce the size and cost of high-performance mainframe systems, says Richard R. Konian, co-inventor of the circuit along with James L. Walsh.

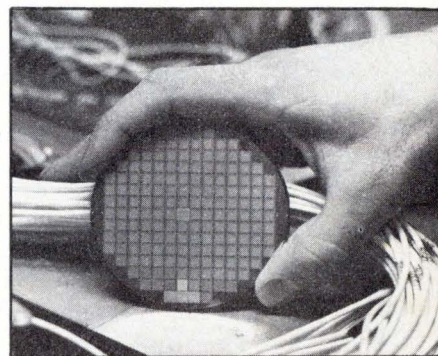
Low-voltage inverter (LVI) logic, as the new circuit has been dubbed, is expected to have this double impact because it combines high speed with small size and low power consumption. For example, the circuit is twice as fast as emitter-coupled logic (ECL), which forms the basis of high-performance mainframe computers, such as the IBM 3033 and the Amdahl 570. Yet, it has roughly the same size and power consumption as transistor-transistor logic (TTL), which underlies most minicomputers and mainframe computers.

Because of these characteristics, Konian sees the versatile new circuit replacing TTL in minicomputers to boost processing power. Conversely, he says, LVI could replace ECL to lower the cost and size of high-performance mainframe systems. This is because the low power consumption and small size of

the LVI circuit would allow more circuits to be integrated on a silicon chip than can be done with the ECL structure. For example, the highest density ECL circuits now in use in mainframe computers contain 400 circuits. LVI promises to achieve densities comparable to TTL, which in production volume has attained densities as high as 1000 circuits per chip.

Konian says the LVI circuit looks doubly attractive because it not only outperforms competitive circuits in their own power and performance ranges, but also spans a performance gap between TTL and ECL, where there is no natural competitor. "It sweeps across all circuit technologies," he says.

The LVI circuit uses bipolar



A wafer consisting of 159 chips made up of experimental Konian-Walsh circuits is framed by cables leading to an LSI tester.

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transistors as its active elements. Bipolar circuits have higher performance than logic circuits based on field-effect transistors (FETs), but they usually consume more power, and their density per chip is lower. Konian says that an FET group at IBM has begun to study the feasibility of applying the LVI configuration to FET circuits, which are used in very high-density, low-cost integrated circuits.

If LVI performs as advertised, it would represent a rare phenomenon in the computer industry—a price/performance breakthrough resulting from an innovation in circuit design rather than in fabrication. In contrast, the stunning advances in the performance and price of computers over the last decade have come mainly as a result of advances in integrated circuit fabrication techniques.

The LVI circuit was developed at IBM's East Fishkill, N.Y., semiconductor facility, part of IBM's general technology division. The circuit was first announced in a paper delivered by Konian and Walsh at the Comcon '81 show in February.

The LVI circuit is a two-input logic gate whose output is "on" only when both of its inputs are "off." This is an electronics equivalent of the elementary logic function called NOR (negative OR). Such elementary logic circuits form the basis of all digital computers—from μ cs to super mainframe computers such as Cray Research's Cray 1 machine.

An LVI circuit occupies about 10,000 sq. microns of semiconductor real estate when fabricated with 2.5-micron design rules, Konian and Walsh reported. This compares to about 9500 sq. microns for TTL and 12,000 sq. microns for ECL when fabricated using the same design rules. With these design rules, the narrowest line width achievable for metal interconnect paths between active devices is 2.5 microns.

The LVI circuit has a 300-psec.

gate delay at power consumptions lower than 2 mW. This is twice as fast as an ECL circuit operating at 10 mW, according to data supplied by Konian and Walsh.

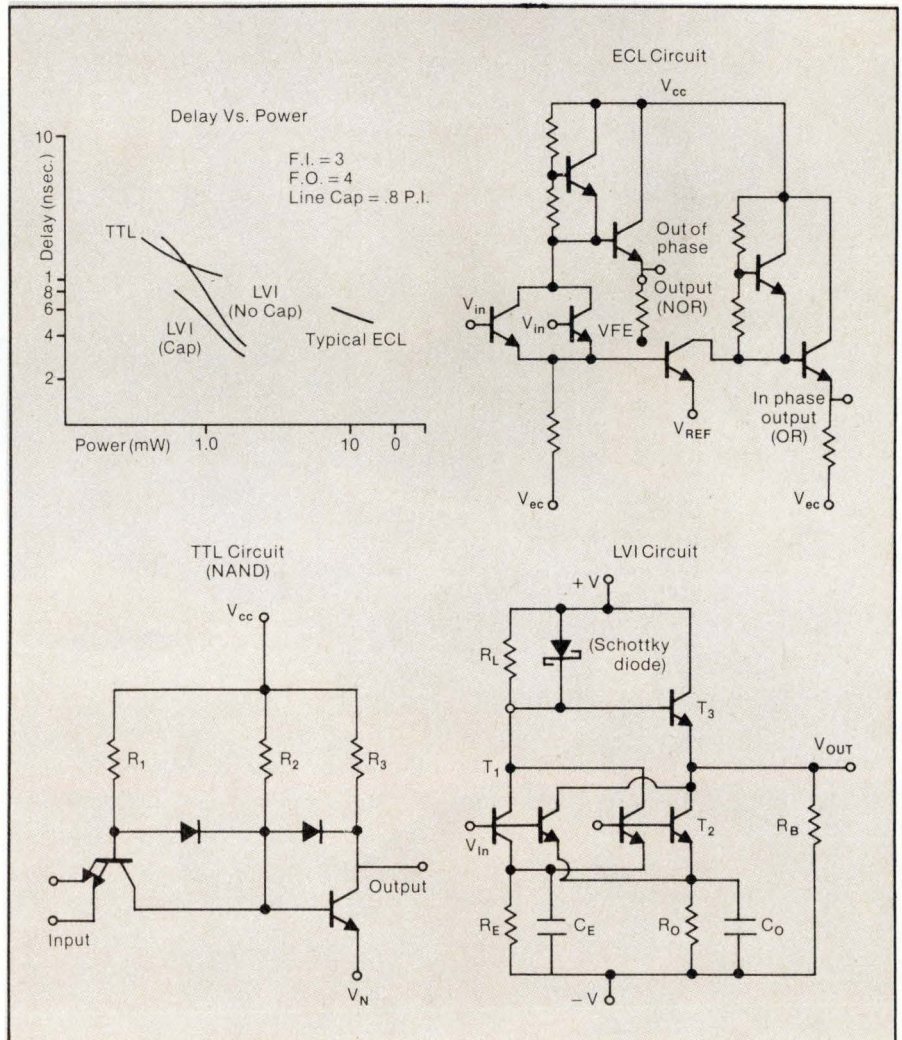
The LVI circuit derives its high speed from a unique configuration of circuit elements (transistors, resistors, capacitors and diodes) that minimizes intra-circuit delay—the time between the appearance of a signal at a logic gate's inputs and the resulting output. With the LVI circuit, the bases of the switching transistors are connected in parallel. As a result, a signal passes through only one transistor to reach the output. With other logic circuits, a signal must pass through two or more transistors to reach the

output, introducing additional delay.

(Logic circuits usually combine a switching function to set the voltage levels that represent logic states with an amplifier stage to provide the necessary power to drive following logic circuits.)

LVI gets its low power consumption, Konian says, from a combination of factors—low power-supply voltage (less than 2V), fewer circuit branches (two versus ECL's four) to consume power and a lower steady-state current caused by the use of active elements.

Like other logic circuits, LVI's speed depends on the amount of power fed to it; the more power applied, the greater the speed.



How LVI stacks up against the competition.

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The circuit is undergoing tests by IBM to assure that it lives up to its performance claims and to assure its manufacturability in volume.

IBM has created a test chip based on the circuit that contains 49 NOR gates arranged in a ring configuration. So far, the test chip has confirmed earlier computer simulations from which initial LVI performance specifications were derived.

It's uncertain when LVI will appear in a commercial product from IBM, assuming that no unanticipated problems arise with the circuit.

Before the LVI circuit could come into widespread use, it would also have to be adopted by independent semiconductor makers because IBM manufactures logic circuits only for internal consumption. One semiconductor manufacturer—Motorola Inc., which is regarded as a leader in ECL chips—is known to be looking at the LVI circuit.

Although IBM has applied for a patent on the circuit, most observers believe the company would encourage its adoption by independent IC makers through licensing arrangements to assure a plentiful supply of LVI chips. An IBM spokesman would say only that "It's IBM's practice to make licenses available on reasonable and nondiscriminatory terms."

A factor that might hinder the widespread use of LVI is its use of a 2V power supply, instead of TTL's +5V and -12V, warns L.J. Reed, design manager for bipolar products at Motorola Semiconductor. "You could not turn the world around to a new power-supply voltage," he says. However, Konian believes this problem could easily be circumvented by using LVI circuits internally in a chip and surrounding the circuits with a TTL-compatible interface to the outside world.

Semiconductor makers and other computer manufacturers are adopting a wait-and-see attitude toward

the IBM development. "It (LVI) looks attractive," says Motorola's Reed, "but we've seen other circuit design innovations come and go without making a significant impact." He adds, "Most semiconductor makers will wait and see what IBM does with the circuit before committing themselves."

A spokesman for IBM competitor Amdahl Corp. views the IBM

announcement as a ploy to offset the negative publicity that resulted from IBM's inability or unwillingness to use ECL circuits in its recently introduced 3081 mainframe computer. "Our response (to LVI) is, 'The proof is in the pudding,'" says the spokesman for Amdahl, which regards itself as ahead of IBM in the application of ECL circuits to mainframe computers. -Paul Kinnucan

LPI enters systems-software arena

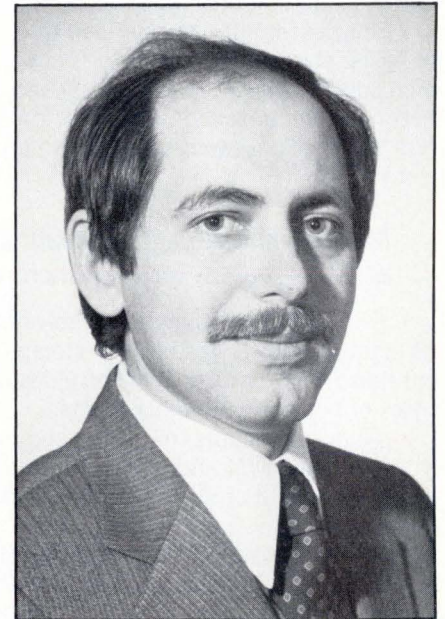
Computer manufacturers and system integrators planning to implement several software languages on their equipment often face the expensive and lengthy process of developing distinct compilers for each target language. Language Processors Inc. (LPI), a newcomer to the systems-software arena, hopes to ease this development burden, and at the same time establish itself at the forefront of sophisticated compiler vendors.

To achieve these goals, the Belmont, Mass., firm has introduced a family of seven machine-independent compilers that incorporate a common intermediate language and a common optimizer, and that also permit the development of a common code generator and run-time library for any computer. LPI's compiler family consists of ANSI-74 Low-Intermediate Level COBOL, ANSI-74 High-Intermediate Level COBOL, Draft ANSI Pascal, ANSI-78 FORTRAN, ANSI Full PL-I, ANSI Subset-G PL/I and IBM System3-compatible RPG-II. The company plans eventually to add compatible BASIC and C language compilers to the family.

Written in PL/I Subset G, all the compilers optimize on the level of Language Processors' Standard

Intermediate (LPSI) language. A host machine must support 16-bit or larger integers and provide 64K bytes or more of directly addressable memory for each compiler.

Licensing fees for the seven products range from \$50,000 for Pascal to \$190,000 for Full PL/I, and include a one-year maintenance warranty. Additional yearly maintenance can be obtained for approxi-



LPI president and founder Michael Schwartzman says he offers computer manufacturers and OEMs an inexpensive and low-risk route for implementing several high-level compilers.

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- The PDQ-3 benchmark comparisons are available in print on request. They include tests for Transitive Relations, Floating Point Add/Subtract and Multiply/Divide, Transcendental Functions, Task Switching and many more.



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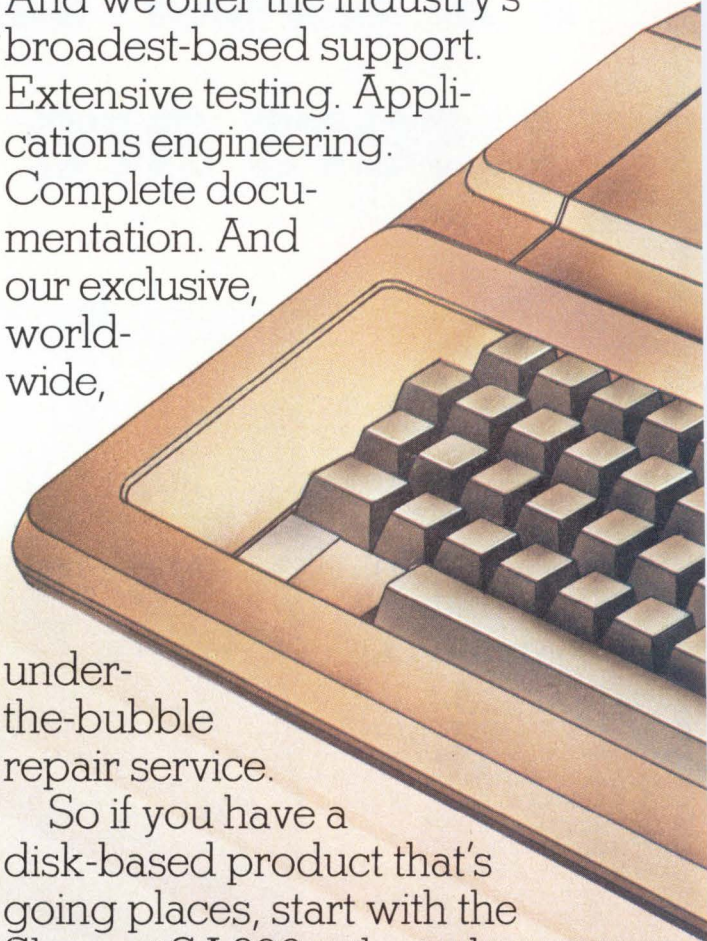
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Mini-Micro World

mately 15 percent of the price of each compiler. Royalty arrangements are also available for distributors of the compilers.

The PL/I and FORTRAN compilers were originally developed by Translation Systems, Inc., which has licensed Language Processors as a distributor for these products. LPI later developed the COBOL, Pascal and RPG-II compilers under contracts to various computer manufacturers, retaining the right to sell the finished products on the open market.

Thanks to the development history of the compilers, LPI could boast of having more than a dozen large customers, each with average yearly sales of about \$650 million, at the time it announced its compiler family. But this blessing is also something of a curse for the young firm. Because LPI's customers don't want it generally known that they acquired some of their software externally rather than in-house, the manufacturers won't allow the software vendor to publicize its impressive list of accounts.

"If we have a hard prospect who won't buy unless he can contact some of our existing customers, then we can use our discretion and release some of the names," explains Michael I. Schwartzman, co-founder and president of Language Processors. Schwartzman, who admits the restrictions he works under complicate his job, says it is the uneducated customers of the computer manufacturers who pose potential problems. "The educated customers care about the quality of the product they get, not where it came from," he says.

One computer manufacturer using the PL/I Subset-G and FORTRAN-77 compilers was willing to evaluate those products anonymously. The customer had initially obtained the machine-independent front-end portion of each compiler from Translation Systems, choosing to develop the code generator for its

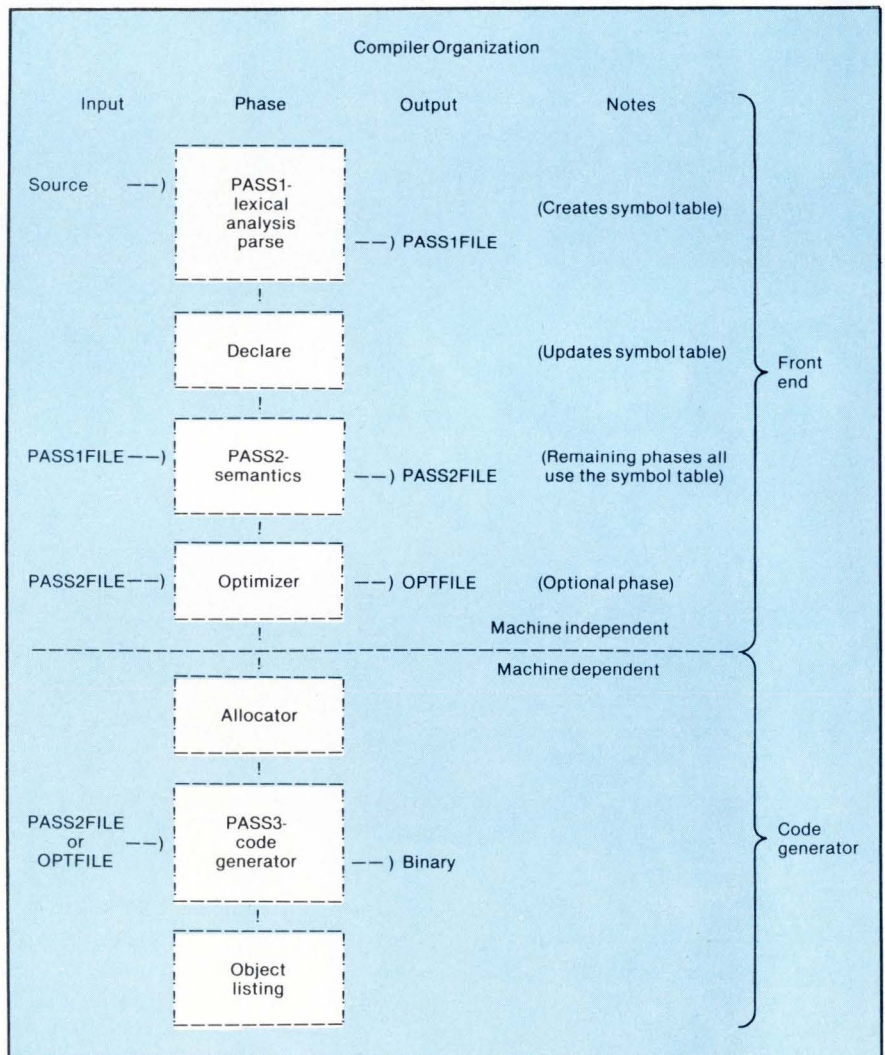
computers in-house. (Customers can opt to develop the common code generator from scratch, with the aid of an LPI prototype code generator or by contracting with LPI to develop the required product.)

Buying compilers through an independent vendor provides several benefits that outweigh end-user concerns about the manufacturer's technical expertise and its ability to provide long-term support, says the customer. "Buying the product off-the-shelf costs only about 5 to 10 percent as much as it would cost us to develop it ourselves," he estimates. "It also lowers the risk to our company and allows us to get

the product to market much faster."

The customer gave high ratings to the PL/I and FORTRAN-77 compilers' reliability, adding, "The overall approach of using a common design and a common intermediate language is an excellent architectural method." He notes that few computer manufacturers use such an approach, claiming, for example, "If DEC has X (number of) compilers, they've probably got about X-2 code generators."

Compile time for both products was slow, the customer says, but he admits his in-house development effort could be as much to blame for that as the software vendor. He also



All major phases of Language Processors' compilers are table-driven, and each compiler manages its own virtual memory for the symbol table. While the front-end portion of the compilers is machine independent, a single code generator must be developed for each machine or computer series.

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MMS-7

LPI PRESIDENT CAPITALIZES ON USSR TRAINING

It's probably safe to assume that a decade ago, the concept of founding Language Processors Inc. was far from the mind of Michael Schwartzman, the firm's president. At the time, Schwartzman, a native of the mountainous Caucasus region in the Soviet Union, had just graduated from the Novo Sibirsk University where he studied math and computer science. In 1970, he had graduated from the university and joined a research group at the Computer Center of the Siberian branch of the USSR Academy of Science.

"Our research team consisted of about 16 people," he says, "and our project was to work on the development of a universal compiler." Schwartzman, who was in charge of the development of intermediate languages, describes the universal compiler as still "a very distant ideal," but says the experience at the

Academy was a valuable one. "Although we didn't produce a universal compiler, I gained lots of insight into intermediate languages and into the structure of programming languages."

In 1974, Schwartzman emigrated to the United States, where he became a staff researcher at Columbia University's Computer Center. A year later he went to the Chase Manhattan Bank as a data-base management systems staff consultant, and moved from there to Digital Equipment Corp. in 1976. At DEC, Schwartzman was manager of software development for the first shipment of the VAX 11/780 32-bit computer.

Two years later, he travelled to Prime Computer Corp., where he served as the manager of translator development. Then, in 1979, "I realized the market was mature enough to accept off-the-shelf compil-

ers and also that the technology to make such compilers was available." At that point, he left Prime and, with co-founder John C. Ankcorn (now vice-president) started Language Processors.

Schwartzman says, "It's harder to run your own business than many people think," but he prefers working for himself rather than for another company. He claims LPI's four-person staff tries to limit its work to "normal working hours," but admits the announcement of the compiler family and contacts made at the National Computer Conference have placed some additional pressure on the firm.

Schwartzman likes to think he has continued the work he began 10 years ago with the products offered by Language Processors. "Our family of compilers is one step on the road toward the realization of a universal compiler," he says.

mentions that the level of documentation could be improved and that the compilers—designed by one man—had to be modified to make them more consistent with a multi-person development effort.

Mike Parrella, vice president and general manager of Informatics and an LPI's Pascal compiler end user disagrees, saying he prefers a small team that can provide consistency of thought during development. He obtained the compiler from a computer manufacturer and used it to develop the TAPS system software for use on Prime Computer's 50 Series of 32-bit machines.

"We had to go through lots of lines of code to develop TAPS, which is a communications manager, a transaction manager, a relational data base, a query language and an ad hoc report writer," Parrella says. Informatics found few bugs in the compiler during the TAPS development. "The compiler is an excellent product that I would recommend to anyone," says Parrella.

He notes that compile time is not as important as run time, because

LPI products produce optimized code. The documentation was a problem, however, only because the Informatics team had to learn the data structure to develop TAPS. For most users, who need only to understand the compiler's logical operation, the documentation should be adequate, Parrella says.

Despite such reports, LPI's Schwartzman knows it will be an uphill battle to convince potential customers that the small, four-employee company warrants serious consideration. He plans to approach smaller computer and system manufacturers—those with sales of \$50 million or less—because such companies "have fewer resources than

large manufacturers and are willing to take more risks."

Schwartzman says LPI will make less than \$750,000 in revenues this year, but he expects a 60 percent annual growth rate. For now, he's mainly concerned with building the company's reputation.

"We won't take orders if we can't handle them properly," he says, noting that the delivery schedule would suffer if LPI strains its capacity. "We just want manufacturers and integrators of less expensive computer systems to realize that they can implement the same sophisticated languages found on many higher level machines."

—Dwight B. Davis

TI-COMPATIBLE PRINT HEADS AVAILABLE FROM GULTON

Texas Instruments' March decision to discontinue sales of its thermal-print head devices has prompted Gulton Industries Inc. to announce a low-end thermal print head compatible with TI's model EPN 9120. Gulton has manufactured thermal printing elements since 1977, but its model AP-9120 will be the first 20-column device the firm has produced. John Olobri, product marketing manager at Gulton, says the company chose to manufacture a low-end print head because its potential for large volume sales. Expected to cost 10 to 15 percent more than the EPN 9120, the AP-9/20 will be identical in print head addressing, mounting-hole location and motor-drive connectors. Production volumes should be available during the fourth quarter.

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—David A. Brown, VP-Engineering, Quantum Corporation

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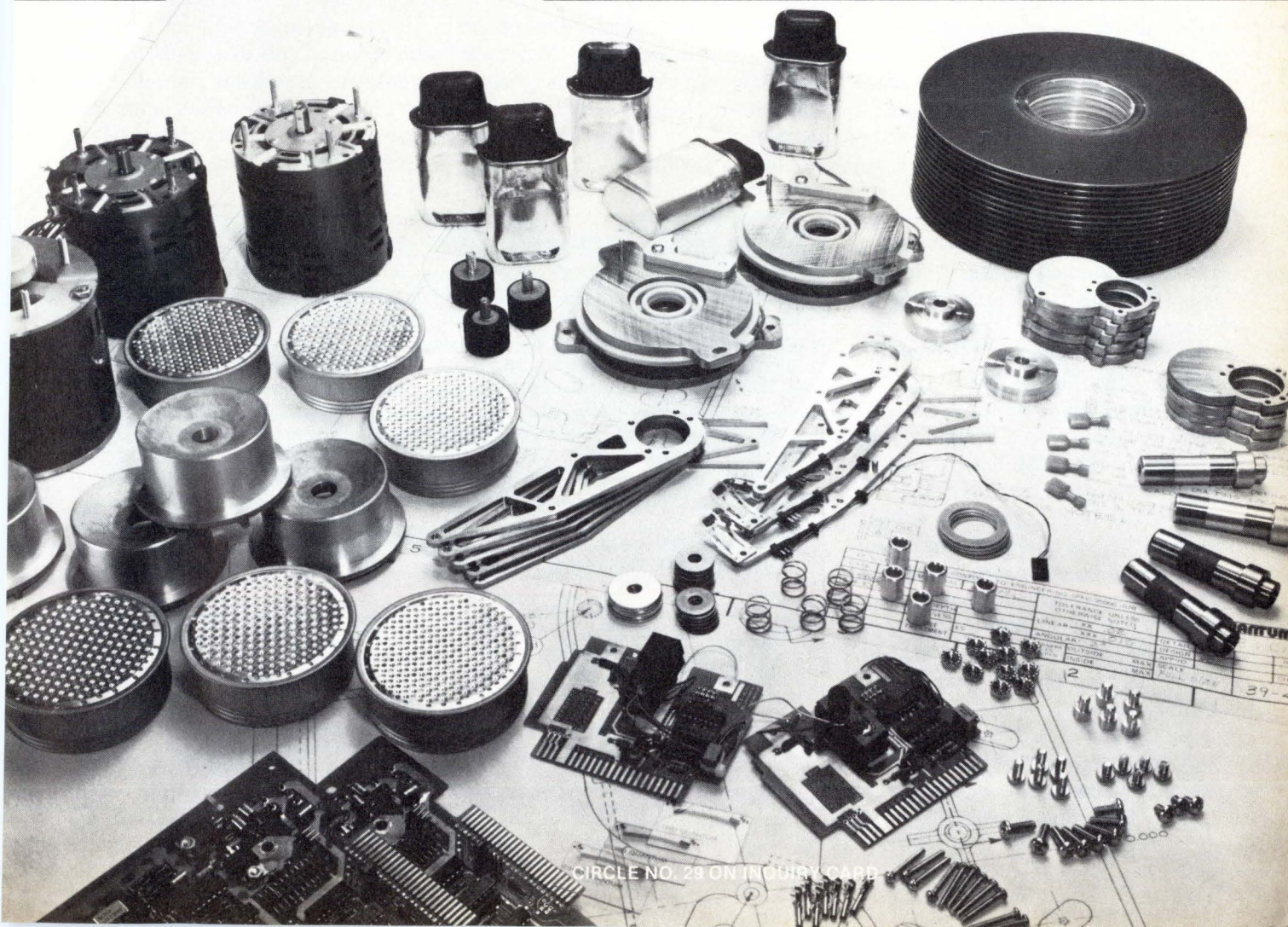
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CIRCLE NO. 29 ON INQUIRY CARD

Computer use expands in industrial purchasing

Evidence of the pervasiveness of computers abounds in periodic studies aimed at establishing how extensively U.S. industry uses computers. One of the latest is a nationwide survey of its readers by *Purchasing* magazine, another Cahners publication. In an article planned for the June 25 issue, news editor Thomas R. Temin reports that 59 percent of the survey respondents in purchasing departments use a computer daily, and nearly all of them plan to expand their computer use. Of the respondents who report not using a computer, about 50 percent say they plan to do so.

All but a handful of purchasing departments use remote CRT terminals linked to a company's central processor, as opposed to having a computer for their exclusive use.

The longer a company has had a purchasing computer, the more use the purchasing department makes of it, the survey shows. United Technologies' Hamilton-Standard Division, Windsor Locks, Conn., for example, has had purchasing on computer for 25 years, says purchasing manager Richard P. Quintin. At the diverse aircraft-components manufacturer, procurement is folded into a company-wide materials-requirements planning (MRP) system. The computer aids everything from routine paperwork to quality inspection and vendor and purchasing performance evaluation. Quintin says that MRP purchases—and evaluation of MRP buyers—will soon be computer-aided as raw materials are now. After that, the company plans to investigate tie-ins with suppliers' own data bases.

At the other end of the spectrum are companies such as the Evans Railcar Divisions, Alsop, Ill., which

has used a computer in its purchasing department for a year. Because of growth through acquisition, the purchasing department is scattered among three states and buying for 12 plant locations, explains purchasing director Donald Schmall. Having vendor and order information stored in the computer helps the three offices coordinate and avoid duplication. It also indicates which office gets the best deal on common items. When the computer was installed last June—primarily as a manufacturing-control tool—buyers worked through a set of self-training exercises to learn how to use the machine for purchasing.

Overall, the sophistication of the uses to which purchasers put their computer programs is increasing, the survey shows. By now, 83 percent of the departments with computer hookups use electronic data processing for inventory man-

agement, and 78 percent use it for tracking the movement of supplies from receiving docks to production floors. Fifty-seven percent track prices with the aid of a computer, 26 percent have electronic assistance with quality inspection, 22 percent have help with vendor evaluation, and about 17 percent use a computer to predict prices.

Frank B. Bryan, purchasing manager for Rexnord Mechanical Power Division's coupling plant, Warren, Pa., notes that he can better evaluate vendors thanks to the accurate information of daily production needs—compared with raw materials on hand—that a computer provides. "I can be lenient," Bryan says. "I judge (a vendor's delivery performance) according to our needs, not to the schedule. If a vendor is late, but I don't really need the items now, then he doesn't get a black mark."

Real-time knowledge of production requirements also allows Bryan to ease the expediting burden. "We don't expedite an order until we have a true need. I've been successful (with that approach)," says Bryan.

INTEL BEGINS OEM SOFTWARE SALES

To encourage the development and use of applications programs that run under the System 2000/80 data-base management system, Intel's Commercial Software Systems Operations will offer the DBMS under an OEM sales plan. Under the plan, Intel customers who develop or acquire such applications programs will be allowed to sub-license the integrated DBMS application package directly to end users. Up to now, the end users were required to license the full System 2000/80 from Intel if they obtained a related application package. Intel's OEM customers will pay the company a royalty fee for each DBMS installation they sub-license. This royalty will be a small percentage of the System 2000/80's list price, which ranges from about \$45,000 to \$105,000.

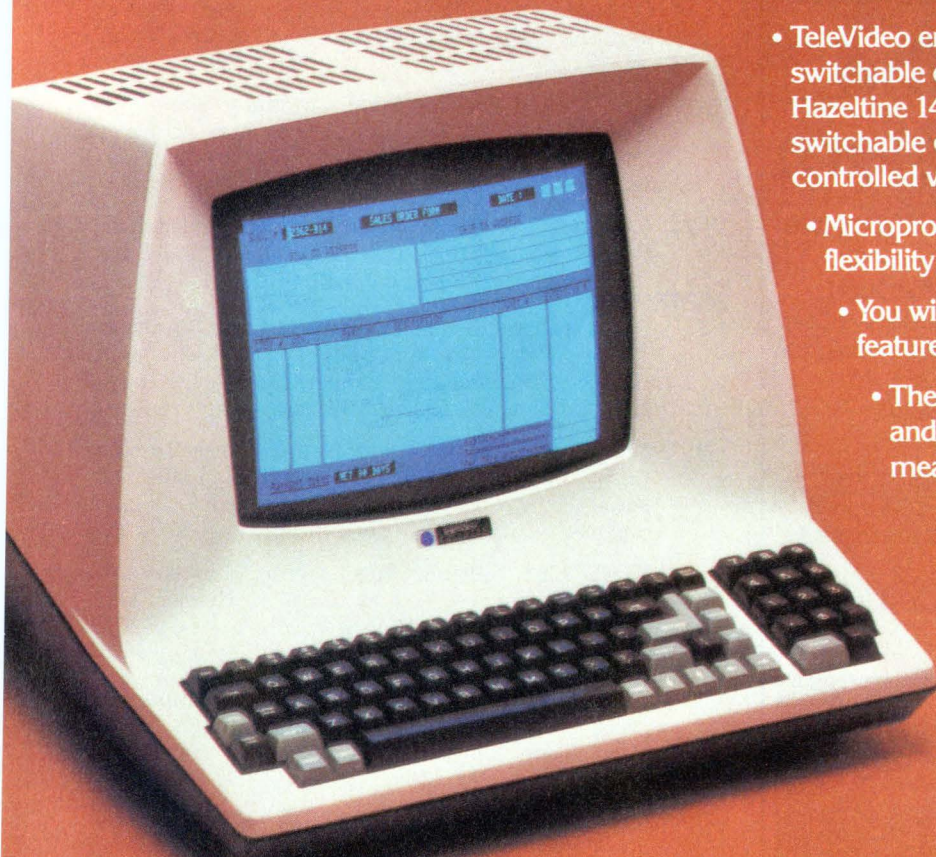
NEW HONEYWELL BULL PRESENCE IN U.S.

CI Honeywell Bull is reorganizing its U.S. small computer peripherals sales and support activities around a newly incorporated North American marketing company to be headquartered in the San Francisco Bay area, with additional offices in Atlanta, Chicago and Boston. The new firm will consolidate and extend the present activities of Bull Corp. of America's marketing and repair centers in Waltham, Mass., and Burlingame, Calif., respectively. These locations are credited with deliveries of more than 3000 small disk drives in the U.S. in the past nine months, most of them to Datapoint. Francois Peleyras, director of OEM and licensing activities for CI Honeywell Bull, says the new 25-man organization is expected to generate revenues of \$15 million in its first year.

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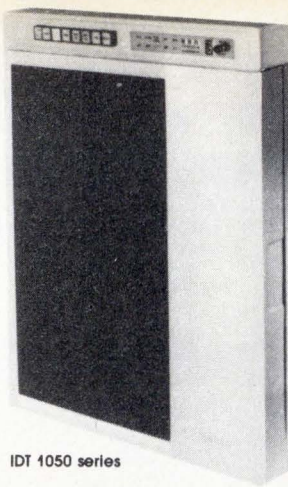
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CIRCLE NO. 31 ON INQUIRY CARD

Calendar

SHOWS & CONFERENCES

JULY

29-31 1981 Microcomputer Show, London, England. Contact: Jeff Wolf, TMAC, 680 Beach St., Suite 428, San Francisco, Calif. 94109, (415) 474-3000 or (800) 277-3477.

AUGUST

10-19 The 20th General Assembly of the International Union of Radio Science, Washington. Contact: Richard Y. Dow, Executive Secretary, National Academy of Sciences, 2101 Constitution Ave., N.W., Washington, D.C. 20418, (202) 389-6478.

12-15 New York Computer Expo (NYCE), New York, sponsored by H.A. Bruno, Inc. Contact: NYCE, 110 Charlotte Place, Englewood Cliffs, N.J. 07632, (201) 569-8542.

18-20 1981 IEEE International Symposium on Electromagnetic Compatibility, Boulder, Colo. Contact: Charlotte Tyson, Registration Chairwoman EMC '81, IBM, 59Z/025-1, P.O. Box 1900, Boulder, Colo. 80302, (303) 447-5072.

26-29 Fifth Annual National Small Computer Show, New York. Contact: National Small Computer Show, 110 Charlotte Place, Englewood Cliffs, N.J. 07632, (201) 569-8542.

28-30 Personal Computer Arts Festival, Philadelphia. Contact: PCAF-81, Box 1954, Philadelphia, Pa. 19105.

SEPTEMBER

1-3 Computerized Office Equipment Expo/Southeast, Atlanta, organized by Cahners Exposition Group. Contact: Janet Schafer, Cahners Exposition Group, 222 W. Adams St., Chicago, Ill. 60606, (312) 263-4866.

1-3 Computer Marketing Expo, New York, sponsored by Computer Dealer Magazine. Contact: Computer Marketing Expo, c/o Conference Management Corp., 500 Summer St., Stamford, Conn. 06901, (203) 356-1900.

9 NCOM '81, Newton, Mass., sponsored by Norm De Nardi Enterprises. Contact: Carol L. Reimer, Show Administrator, Norm De Nardi Enterprises, 95 Main St., Los Altos, Calif. 94022, (415) 941-8440.

9-11 Second Annual Office Automation Symposium, Chicago. Contact: Symposium Manager, U.S. Professional Development Institute, 12611 Davan Drive, Silver Spring, Md. 20904, (301) 622-0066.

9-12 Internecon/Semiconductor International Taiwan '81 Exhibition and Conference, Taipei, Taiwan. Contact: Industrial & Scientific Conference Management, Inc., 222 W. Adams St., Chicago, Ill. 60606, (312) 263-4866.

10-13 Second Annual Mid-West Computer Show & Office Equipment Exposition, Chicago. Contact: National Computer Shows, 824 Boylston St., Chestnut Hill, Mass. 02167, (617) 739-2000.

14 Invitational Computer Conference, Newton, Mass. Contact: B.J. Johnson & Associates, Inc., 2503 Eastbluff Drive, Suite 203, Newport Beach, Calif. 92660, (714) 644-6037. Other dates and locations available.

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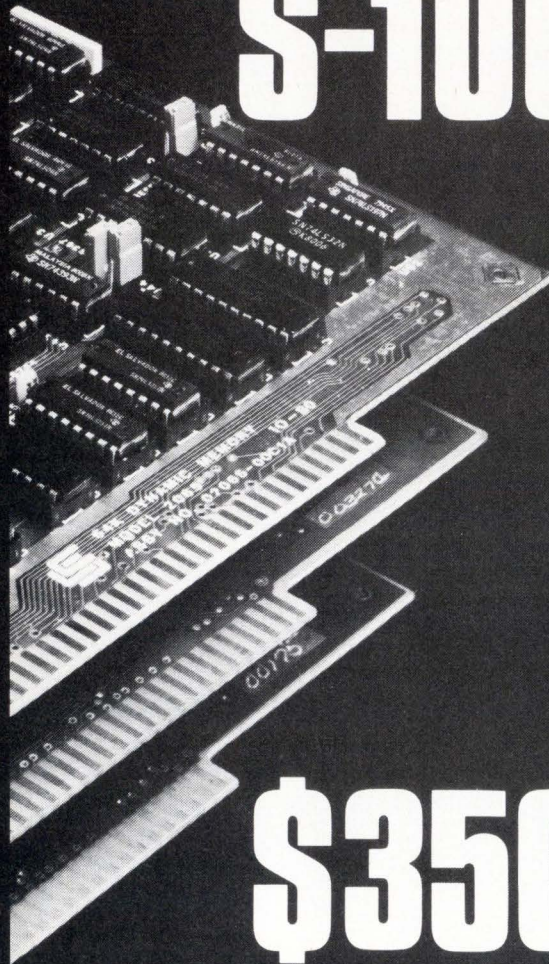
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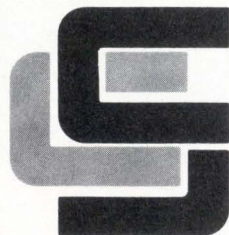


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Calendar

- 14-18 The Impact of Computerization on Social Research: Data Bases and Technological Development Conference**, Grenoble, France. Contact: Alice Robbin, IASSIST President, Data & Program Library Service, 4452 Social Science Building, University of Wisconsin, Madison, Wis. 53706.
- 15-17 Wescon/81 Show and Convention**, San Francisco, sponsored by the Los Angeles and San Francisco Bay Area Councils of IEEE and Southern and Northern California Chapters of ERA. Contact: Dale Litherland, Educational Activities Manager, Wescon/81 Professional Program Committee, Suite 410, 999 N. Sepulveda Blvd., El Segundo, Calif. 90245, (213) 772-2965 or (800) 421-6816.
- 15-24 EMO Machine Tool Trade Fair**, Hanover, Germany. Contact: Joachim Schafer, Hanover Fairs Information Center, P.O. Box 338, Whitehouse, N.J. 08888, (201) 534-9044.
- 21-23 Federal Computer Conference**, Washington, sponsored by Federal Education Programs. Contact: Federal Education Programs, P.O. Box 368, Wayland, Mass. 01778, (617) 358-5181.
- 21-25 International Switching Symposium**, Montreal, Canada. Contact: John M. Benet, Chairman, Publicity Program, ISS '81 CIC, P.O. Box 56, Station "Ile des Soeurs," Verdun, Quebec, Canada H3E 1J8, (514) 761-5831.
- 22-24 Electrical Overstress Electrostatic Discharge Symposium**, Las Vegas, sponsored by the IITRI Reliability Analysis Center. Contact: Reliability Analysis Center, RADC/RBRAC, Graffiss AFB, N.Y. 13441, (315) 330-4151.
- 22-24 NEPCON/ Central '81 (National Electronics Packaging & Production Conference)**, Rosemont, Ill. Contact: Cahners Exposition Group, 222 W. Adams St., Chicago, Ill. 60606, (312) 263-4866.
- 24-27 Second Annual Mid-Atlantic Computer Show & Office Equipment Exposition**, Washington. Contact: National Computer Shows, 824 Boylston St., Chestnut Hill, Mass. 02167, (617) 739-2000.

OCTOBER

- 5-7 International Electrical, Electronics Conference & Exposition**, Toronto, Canada, sponsored by the Canadian Region of the IEEE. Contact: Southex Exhibitions, 1450 Don Mills Rd., Don Mills, Ontario, Canada M3B 2X7, (416) 445-6641.
- 6-7 Word-Processing Systems Expo**, Washington, produced by National Trade Productions, Inc. Contact: Joseph P. Rubel, Exhibits Chairman, National Trade Productions, Inc., 9301 Annapolis Rd., Suite 300, Lanham, Md. 20801, (301) 459-1815.
- 7-21 1981 Far East Computer/Electronics Tour**, Japan, South Korea and Taiwan. Contact: Terry Butler, Commerce Tours International, 870 Market St., Suite 742, San Francisco, Calif. 94102, (415) 433-3072.
- 12-15 Information Management Exposition & Conference: INFO 81**, New York. Contact: Clapp & Poliak, Inc., 245 Park Ave., New York, N.Y. 10167, (213) 661-8410.

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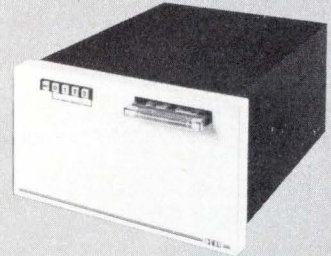
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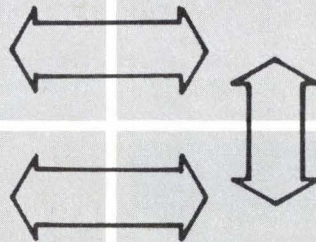
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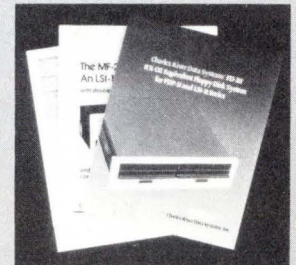
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CIRCLE NO. 37 ON INQUIRY CARD

Calendar

13-15 Word Processing & Office/Business Equipment Trade Show & Conference, San Jose, Calif. Contact: Carlidge & Associates, Inc. 491 Macara Ave., Suite 1014, Sunnyvale, Calif. 94086, (408) 245-6870.

15-18 Third Annual Northeast Computer Show & Office Equipment Exposition, Boston. Contact: National Computer Shows, 824 Boylston St., Chestnut Hill, Mass. 02176, (617) 739-2000.

19-23 Systems 81-Computer Systems and Their Applications, Munich, Germany. Contact: Kallman Associates, 30 Journal Sq., Jersey City, N.J. 07306, (201) 653-3304.

20-22 Computerized Office Equipment Expo/Southwest, Houston. Contact: Industrial & Scientific Conference Management, Inc., 222 W. Adams St., Chicago, Ill. 60606, (312) 263-4866.

21-24 COMPUTA '81-Second International Computer Technology Exhibition, Singapore, sponsored by the Singapore Computer Society. Contact: Gerald G. Kallman, U.S. Representative, 30 Journal Sq., Jersey City, N.J. 07306, (201) 653-3304.

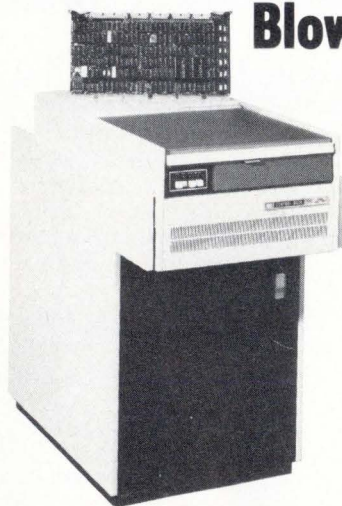
25-28 1981 Conference on Electrical Insulation and Dielectric Phenomena, Whitehaven, Pa. Contact: Dr. Chathan M. Cooke, Program Chairman, Bldg. N-10, High-Voltage Research Laboratory, Massachusetts Institute of Technology, 155 Massachusetts Ave., Cambridge, Mass. 02139.

25-30 44th Annual Meeting of the American Society for Information Science, Washington. Contact: ASIS, 1010 16th St., N.W., Washington, D.C. 20036, (202) 659-3644.

26-28 Computers in Aerospace Conference III, San Diego, Calif., sponsored by the AIAA Technical Committee on Computer Systems, IEEE and ACM. Contact: Thomas V. McTigue, McDonnell Aircraft Co., Box 516, St. Louis, Mo. 63166, (314) 232-0232.

27-29 Computer Graphics '81, London, England, sponsored by Computer Graphics World and Online Conferences Ltd. Contact: Jerry Borrell, Library of Congress, CRS-SPR LM 413, Washington, D.C. 20540, (202) 287-7062.

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CIRCLE NO. 38 ON INQUIRY CARD

THE REST OF THE YEAR IN MMS

The remainder of 1981 in Mini-Micro Systems promised a wealth of information in major survey articles that detail available hardware, plus technology and market trend in four categories.

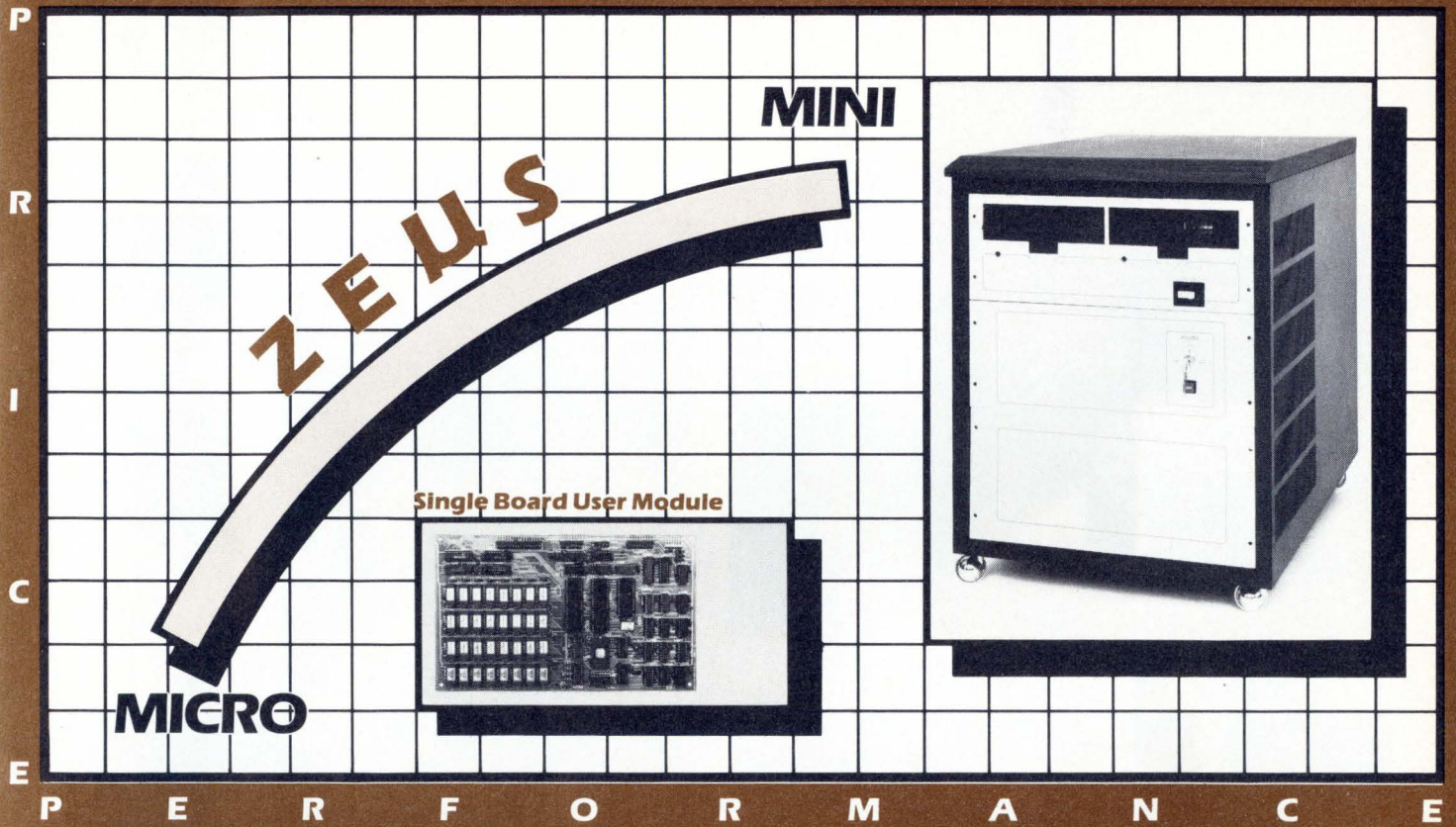
SEPTEMBER will bring an ambitious survey covering single-board μ c products and the various operating systems that make them work.

OCTOBER's main topic will be data base management system software.

NOVEMBER will focus on both add-on and add-in memory systems, and also explore the system implications of semiconductor RAM technology.

DECEMBER will offer Mini-Micro Systems' third annual special report on computer graphics.

ZEUS SPANS THE MICRO-MINI GAP.



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ZEμS is expandable from 1 to 64 users simply by adding the OSM-1080 single board user module for each user. Each module consists of a Z80A, 64K RAM, two serial and parallel I/O. A master processor module supervises all user requests for common storage and/or shared peripherals. Each user module communicates with the master module via a high speed, parallel, synchronous, interprocessor data channel. Response time remains fast even as more users are added. And each user remains autonomous from each other. A unique reset feature through the console break key eliminates the need for operator attendance at the main computer. Should a user "crash," he simply resets himself and loads in a fresh copy of the operating system. Consider the advantages for remote and timeshare applications.

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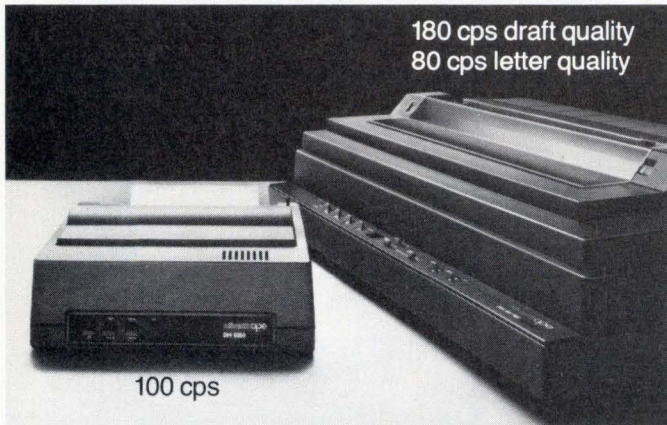
ZEμS single user systems are competitively priced with single processor microcomputer systems, and ZEμS' multi-user systems are priced thousands of dollars less than comparably performing larger systems. For example, the ZEμS 5+ system is a five user configuration including 6-Z80A processors, 384K RAM, 12 serial and 11 parallel I/O, 34MB of hard disk storage, .6MB of floppy storage, and 20MB of tape backup. Also included with every system is the MUSE operating system—all for just \$19,900.

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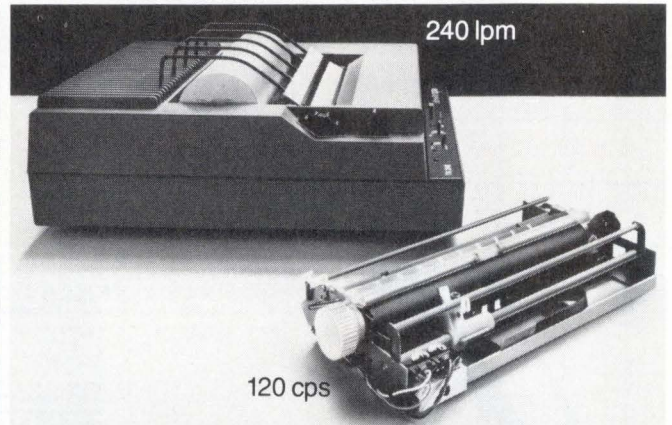
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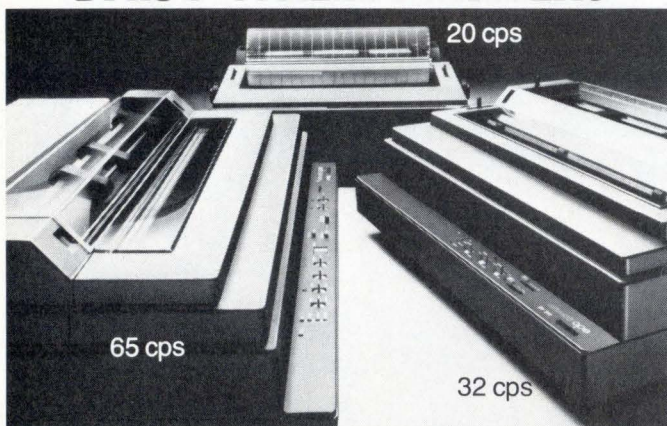
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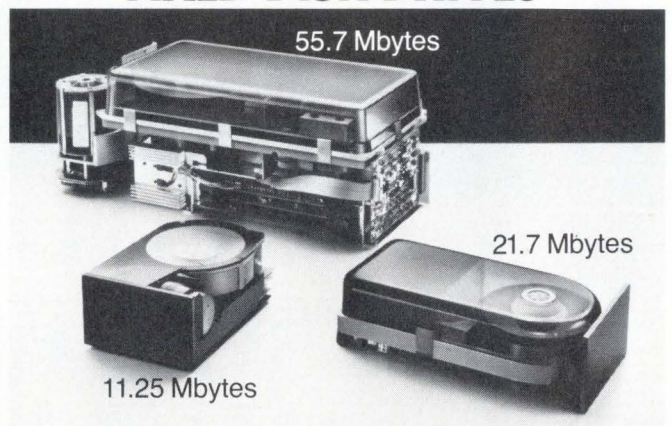
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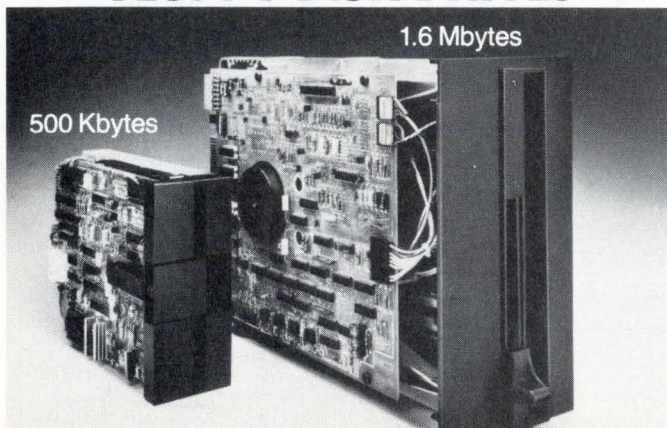
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European service firms prepare for market growth

European sales of computer systems selling for \$2000 to \$200,000 are expected to expand to nearly \$8 billion a year by 1984. Shipments of μ cs alone will experience an annual growth rate of more than 50 percent to account for \$1.5 billion of the 1984 total. Most of this hardware will be supplied by manufacturers based in the U.S. and Japan, but considerable value could be added by European-based computer-service companies.

Facing up to the dangers and opportunities presented by this dramatic change in the information-technology business, many leading computing-service companies in Europe—bureaus, systems integrators and software houses—met in Paris in May to exchange views on how to survive and prosper in the new environment. Appropriately, the conference was called "Minis and Micros—Strategy for Profit."

The service companies represented at the Paris meeting varied considerably in size and the nature of their business, but they all shared one common feature—membership in the European Computer Services Association (ECSA). A consortium of "local" computing-service associations from most West European countries, ECSA could be regarded as the equivalent of the Association of Data Processing Service Organizations in the U.S. In fact, just to underline their common interests, the two associations meet once every two years for the World Computing Services Congress, the venue alternating between the U.S. and Europe. The Paris show was strictly a Europeans-only meeting, although many of the issues discussed would have been of interest to a U.S. delegation.

Bearing in mind that France dominates the European comput-

ing-services industry, Paris was an appropriate location for the conference. No less than seven out of the top 10 European service-bureau groups are French-owned, and Paris is the headquarters of the European software-house giant, Cap Gemini Sogeti. In marked contrast to the hardware market, in which U.S.-based companies are predominant, the service business in Europe is largely controlled by European firms. U.S.-owned service companies are relatively weak, controlling only 23 percent of the industry in the United Kingdom, and a mere 10 percent of each of the two biggest markets—France and West Germany.

But in a keynote address to the conference, the head of the French government's Information Technology Ministry, Philippe Sahut D'Izarn, warned that U.S.-based minicomputer manufacturers were

WHO CONTROLS HARDWARE PRICES?

The theme of rapidly falling hardware prices was taken up dramatically at the recent ECSA conference by one of Europe's best-known software-industry entrepreneurs, Alex D'Agepeyeff, former chairman of the big U.K. software house, CAP-CPP. D'Agepeyeff asserted that established computer manufacturers, such as Digital Equipment Corp. and IBM, no longer control computer-technology development and that their market shares are "dropping like a stone." They had made the fundamental mistake of thinking the μ c would be bought only by small users, failing to realize that multiple μ cs can be chained. Coming up fast were the semiconductor manufacturers, such as Intel, whose

iAPX 32-bit chip offered the same performance as an IBM 370/158 and that would have a "horrendous" effect on vendors of 32-bit minicomputers employing bit-slice technology. Alongside the processor developments, peripheral technology was developing at such a pace, D'Agepeyeff said, that Winchester-disk drives were becoming "staggeringly" less expensive than earlier disk units. Optical-disk technology would offer even less expensive mass storage—billions of bytes per platter.

D'Agepeyeff asked the conference participants to consider the impact on the service industry of a hand-held file-processing machine based on a powerful μ c with 256K bytes of main memory, a built-in flat-screen display,

power from miniature rechargeable batteries and 2M to 4M bytes of mass storage held in bubble-memory modules and/or 3-in.-diameter diskettes. D'Agepeyeff asserted that such a machine was likely to be the "computing product of the decade" and would take the use of computers from the era of the professional "priest scribes" to the age of universal computer literacy. The hand-held file machine will cost only a few hundred dollars, D'Agepeyeff said. He predicted that 50 million of them would be sold in 1986. The need for these machines to be provided with reliable user-friendly software was clear and one that presented the computer-services industry with an interesting challenge.

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moving increasingly towards end-user sales in direct competition with the European-based systems integrators that had helped them establish a user base in Europe in the first place. D'Izarn also underlined the growing trend among manufacturers to sell separately priced software products as hardware prices fall.

Philippe Dreyfus, vice president of Cap Gemini Sogeti, found favor among the other software-house participants when he urged them to stay out of the systems business and to retain their manufacturer independence regardless of any move by manufacturers into applications-software development. The best way to survive, Dreyfus asserted, was for software houses to stop their customers thinking that total systems costs were bound to come down because of the big drop in hardware prices. "Otherwise," Dreyfus proclaimed, "we are digging our own tombs."

In a discussion on the possible threat to systems integrators from their hardware suppliers, the feeling was that established firms, such as Digital Equipment Corp., which supply minicomputers on an OEM basis, were not likely to erode their OEM clients' market share seriously. More likely, systems integrators would harm themselves by failing to adapt to the special requirements of the burgeoning μ c market. They were in danger of pricing themselves out of that business by developing applications software that was far too complex, facility-rich and expensive. The new breed of μ c customers were prepared to get by without much of the complex data-validation coding demanded by customers purchasing minicomputer systems.

But the structure of the small-systems market in much of Europe differs substantially from that in the U.S. While DEC, Data General Corp. and several other U.S.-based mini-

computer manufacturers are as predominant in the United Kingdom as they are in the U.S., a large slice of the market in continental Europe, West Germany in particular, is accounted for by suppliers of complete packaged systems. They include Olivetti, Philips, Triumph-Adler and Nixdorf, the latter being the European manufacturer with the most substantial presence in the U.S. computer market. Nixdorf alone employs 3000 in-house software-development personnel out of its total work force of 14,000. That fact, coupled with its packaged approach to hardware, explains its opposition to OEM-type agreements with systems integrators. Instead, it favors looser accords with software houses.

One of the biggest strengths of Nixdorf and similar suppliers of complete systems is their concentration on vertical marketing, offering packaged hardware and software to customers in specific sectors of industry and commerce. There was general agreement among the Paris conference delegates that a similar approach had to be adopted by independent systems integrators.

The same move towards vertical marketing is faced by many European service bureaus as they are forced to diversify into the systems-integration business because many of their customers are opting for in-house data processing. Total vertical marketing is the ultimate goal, for example, of Geest Minicomputer Systems Ltd., a U.K. systems integrator specializing in Texas Instruments machines. It was set up in 1976 as a means of sustaining revenue growth by Geest Computer Services, a mainframe-bureau operation owned by the Geest organization.

An even more urgently needed change was described by the managing director of Geest Minicomputer Systems, Graham Gough,

who revealed that Geest was currently having to re-think its approach to selling, which currently involves two largely autonomous organizations—the Bureau and the Mini divisions. The reason was the emergence of the μ c as an effective alternative to the minicomputer. The problem for Geest and other turnkey suppliers was that customers still expected the same level of support and service despite the drop in hardware prices. Gough said the solution chosen by Geest to counter the growth of the μ c retailer was to merge its bureau and turnkey operations and create regional centers selling all the company's services in the hope of preventing all its customers from going over to μ cs. In addition, Geest's engineering team would be expanded to take over all support of its minicomputer customer base and to step up Geest's activities in profitable areas, including selling and interfacing add-on peripherals for minicomputers.

Looking at applications software, another area where profits could still be made, Gough noted that Texas Instruments had little expertise in the European commercial sector and revealed that Geest was aiming for margins of 10 percent from its software-development activities. But he viewed the future with great uncertainty, mainly because of the continuing fall in hardware prices and the margins that could be derived from hardware. Gough visited Texas Instruments earlier this year and was shaken by the advances being made by the company in bringing hardware prices down even further. Restrained by his signing of a nondisclosure agreement with TI, he still felt safe in commenting ominously, "When I see what TI is bringing out 18 months from now, I wonder how we are going to make any money."

—Keith Jones

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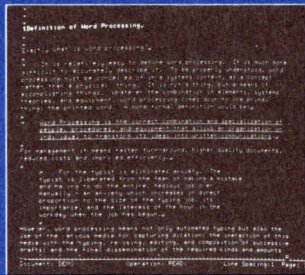
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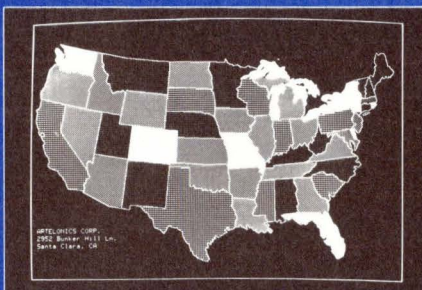
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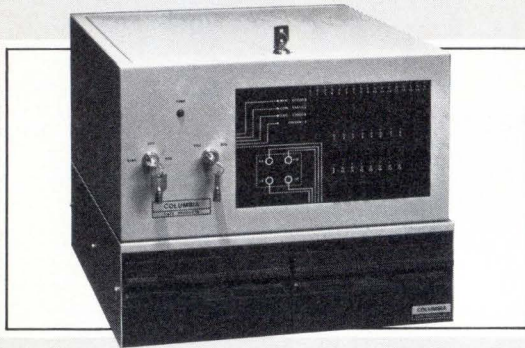
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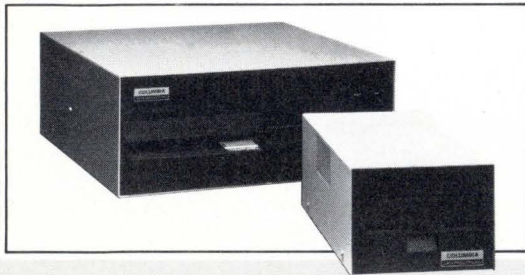
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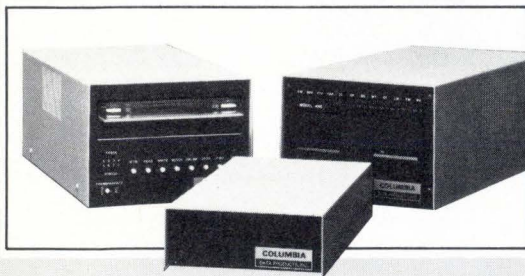
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Hawaii moves to lure California computer firms

Government officials in Hawaii, concerned about declining agricultural and tourism industries and reduced federal spending, are planning a major effort to lure expansion-minded Bay-Area computer and semiconductor firms to the islands.

The decision to expand the state's economic base with an infusion of California electronics firms has been occasioned by what some see as trouble in paradise. According to a report completed earlier this year for the state's Department of Planning and Economic Development (DPED), prospects are slim for Hawaiian agriculture expansion, while expenditures by the federal government—the island state's big-

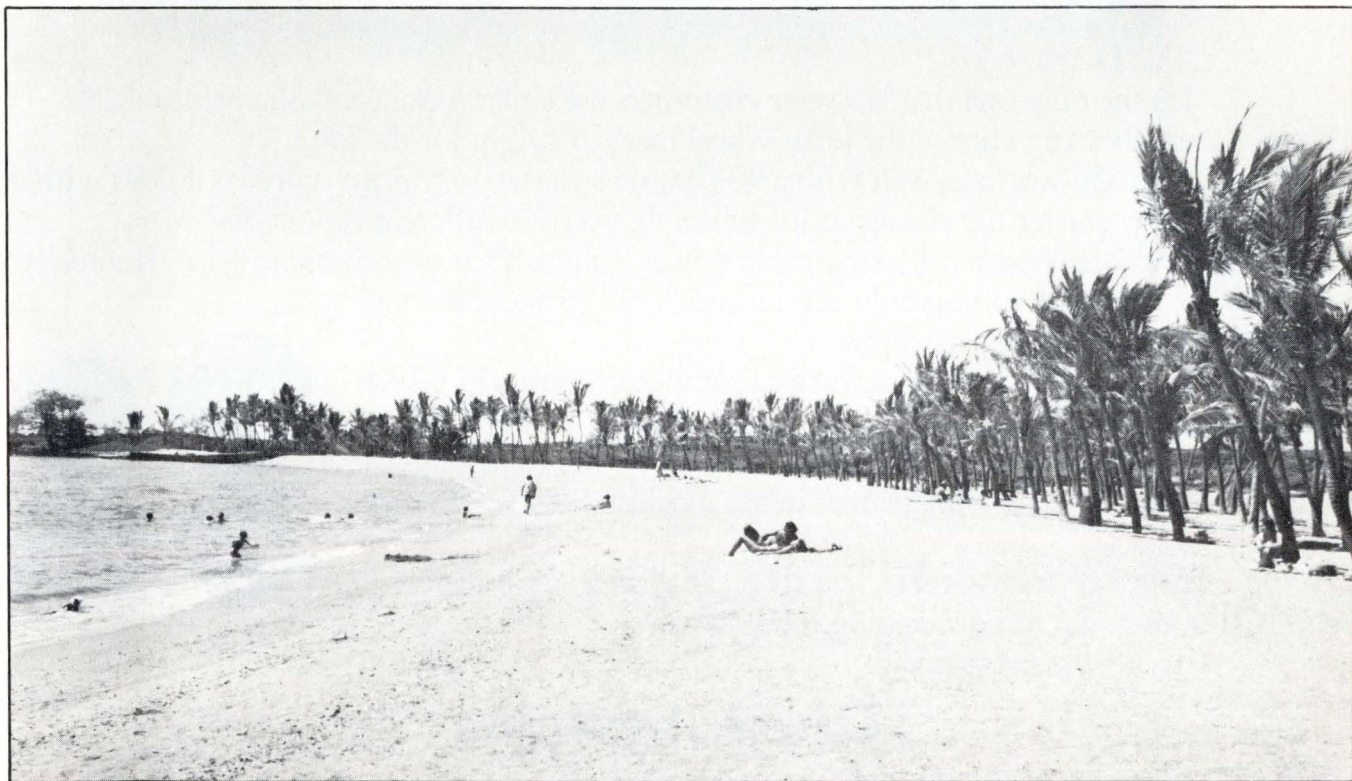
gest spender—will continue to decline.

More ominous to Hawaiian officials, however, is a downturn in the state's largest private industry—tourism—with some estimating that the decline this year could be as much as ten percent compared to last. "The general state of the U.S. economy has hurt us," says Hawaii Sen. Richard Henderson (R-Hilo), chairman of the State Senate's Economic Development Committee.

The state could get a much-needed economic shot in the arm, however, if California electronic companies can be persuaded to include Hawaii in their expansion plans, says the DPED report. "It is conservatively estimated that 1000

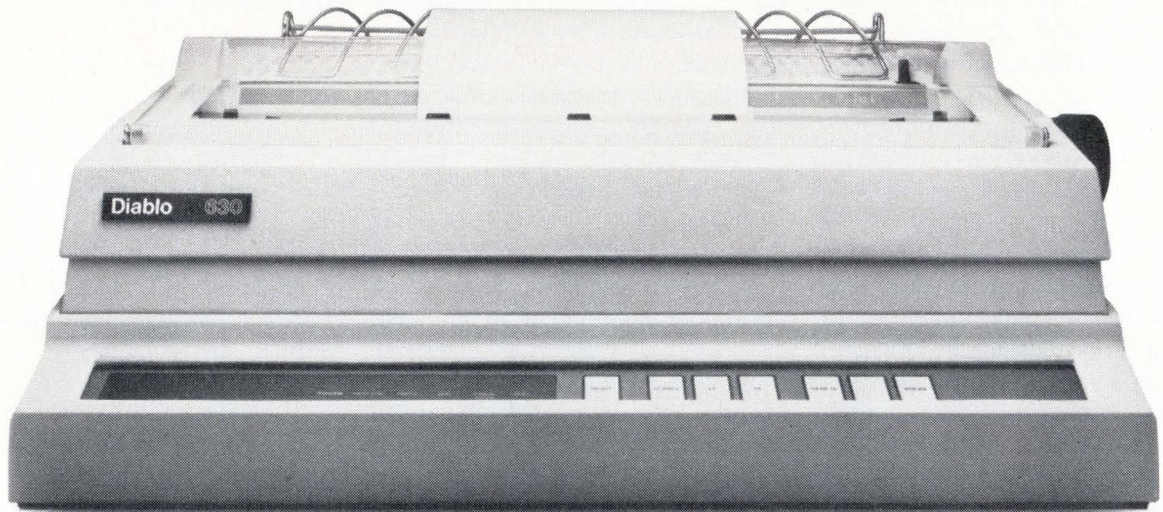
jobs and \$50 million in annual sales revenue could be generated in the next five years," as a result of introducing the industry to Hawaii, the report states. "Of these 1000 jobs, approximately 700 would be for skilled assemblers and technicians." Work would also be provided for the 70-some electrical engineers graduating each year from the University of Hawaii. According to the report, these graduates must leave the states and get to the "mainland" to seek jobs. The report further contends that many would return to Hawaii if jobs were available for them.

The DPED study contends that getting California-based firms to go along with the idea of setting up



Hawaii's efforts to lure computer and semiconductor companies looking to expand their operations will be helped, officials feel, by the state's natural attractions. Above is the Anaehoomalu Bay beach on the island of Hawaii.

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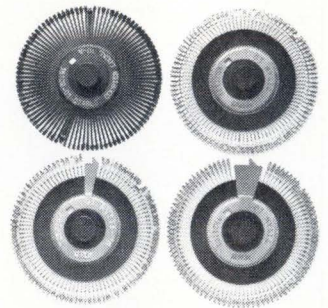
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shop in Hawaii is not in the "mission-impossible" category. For starters, the state feels that its halfway position between North America and Asia makes it the ideal spot for companies interested in doing business in the Far East, and vice versa, although minimal effort is placed in the DPED report on attracting Japanese electronics firms to the islands. Second, the report continues, there is the obvious appeal that the state offers as a place to live.

Of more interest to expansion-conscious electronics firms is what the report says is an abundance of local labor. "(The electronics industry) is fast growing...and it must move somewhere. Those companies wanting to expand must move due to labor shortages in their traditional areas."

As a result, the computer and semiconductor industries "are vulnerable to what Hawaii has to offer—a stable, productive, available labor force," which includes a high percentage of working women.

Other advantages to doing business in the state: Hawaii has ample power-generating capabilities to meet the demands of industries that might re-locate on the islands. The state has never had a power brown-out or black-out, says the DPED report. A second advantage: the report states that Hawaii's transportation and import/export industries "have become among the most sophisticated in the world."

But before Hawaii can switch from growing pineapples to manufacturing semiconductor RAMS, the state must alleviate a few business deterrents. And, the lessons being learned by island officials may serve as guidelines for those local-government entities looking for a piece of the computer and semiconductor industries. For starters, the report rightly concedes that the state—like some others—is perceived as being "anti-growth." Businessmen, the

report continues, "are always concerned with the climate in which they operate." As a result, the study calls for a strong program of tax incentives to lure businesses from the mainland.

One of the Hawaiian taxes, that is viewed as falling into the anti-growth category is a 4 percent "use" tax, levied on purchases made outside the state. The apparent motivation for this tax is to protect local industries serving inter-island markets from the obvious advantages enjoyed by larger mainland firms. The DPED report recommends that this tax be eliminated for the electronics industry.

Similarly, the report calls for the suspension for high-technology firms of the state's 0.5 percent "manufacturing" tax, noting that

"Hawaii's competitors for the location of these companies do not impose such a tax." Recommendations to sweeten the relocation pot include tax exceptions, attractive industrial bond issues and the establishment of a state-run venture-capital fund.

Other problems addressed by the report: A lack of suitable industrial space, a situation that Sen. Henderson feels will be remedied if abandoned pineapple acreage north of Honolulu can be re-zoned for industrial purposes, and a conflict over who has priority over the state's limited water resources—the state's nascent electronics industry, or established agricultural concerns.

There are two problems, however, that won't go away, and Santa

BOOM PREDICTED FOR TELEPRINTER MARKET

Total shipments of teleprinters are expected to boom over the next five years, at almost 40 percent a year, according to a report by Venture Development Corp., a Wellesley, Mass., research firm. The report, "The Teleprinter Terminal Industry: A Strategic Analysis," maintains that the growing use of word-processing applications is the reason for the rapid growth, and that by 1985, more than 85 percent of all teleprinter shipments will be used for word processing.

As a result, intelligence will be in demand, says the report, and many

letter-quality teleprinter manufacturers plan to step up their products' intelligence, while others will compete by offering teleprinter enhancement kits to add intelligence to dumb terminals.

The report defines dumb teleprinters as those that depend on a host computer for instructions. Smart teleprinters are defined as those with editing features such as inserting and storing data and marking corrections. Intelligent is defined as those with editing features, plus the ability to drive auxiliary devices.

LEXICON OFFERS POSTABLE PRINTER

Measuring about one-third the size of Texas Instruments Inc's 745 portable terminal, a printing communications unit from Lexicon Corp., Miami, Fla., includes a built-in modem, 2K-byte memory for text composition and editing and a 1K-byte line buffer.

Called the LEX-21, the terminal has a full-function keyboard that is approximately the same as that of Hewlett-Packard Co.'s printing calculator, says Michael Levy, Lexicon's president. The small size shouldn't prove a detriment, he says because most business and professional users probably won't have typing skills.

Incorporating a thermal printer and

a 4-in.-wide paper roll, the LEX-21 can transmit data at 10 or 30 cps, using the same asynchronous communications protocol as the one used in industry-standard Teletype 43 terminal. Users can buy an optional numeric keypad, an acoustic coupler for non-modular phones that won't accept the standard jack and a leather carrying case.

The LEX-21 will be marketed initially through distributors, but, Levy says, his firm will eventually sell directly to large Fortune 500-type companies. Production shipments will begin this month, and Levy predicts production volumes for the \$1195 unit will reach 1000 units per month by year-end.

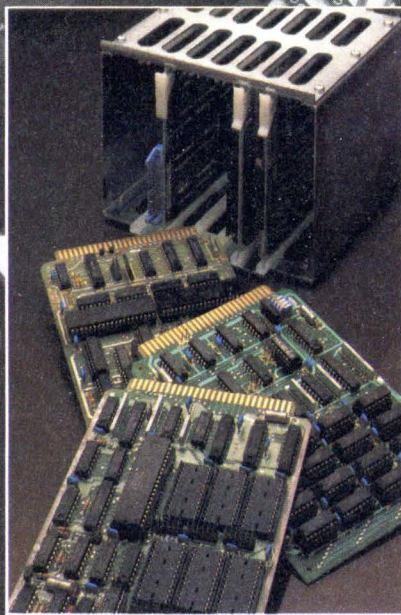
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Mini-Micro World

Clara County site-selection managers point to them whenever the subject of expansion to Hawaii is brought up: the first is distance. "It's a great place to send people to," says Klaus Kramer, director of corporate construction at Santa Clara-based Rolm Corp. "But everything else has to be brought in, and then brought out." Kraemer's counterpart at Ampex Corp. in Redwood City agrees. "There's no question about the availability of labor there," he says, "but if you're going to start something up off-shore, you might as well go to Hong Kong or Taiwan."

The second obstacle is housing. "This is critical," says Kraemer. "The only engineers we could get to work there are the ones that already live there." Henderson concedes that housing prices in Oahu, where the development plans are focused, are "ungodly," but notes that a large-scale building project is under construction that could add 10,000 single-family dwellings to Oahu's housing inventory. Aside from noting the existence of these plans, however, the DPED report makes no other mention of the housing situation on Oahu, nor does it make any recommendations as to how the state should help finance the sale of these homes.

Exactly what steps Hawaii will take to implement any of the recommendations contained in the DPED report will not be known until next year. According to Henderson, the report did not get into state legislators' hands until just before the closing of the 1980 session in May. As a result, the recommendations contained in the report, including those relating to the implementation of tax breaks for electronics firms interested in considering Hawaii as an expansion site will have to wait until the legislature is open for business again early next year. —John Trifari

BOX SCORE OF EARNINGS

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

Company	Period	Revenues	Earnings	Eps
Adage	12 mos. 3/28/81	15,904,000	835,000	.71
	12 mos. 3/28/80	10,279,000	612,000	.54
Astrocom	3 mos. 3/31/81	1,062,684	(8,590)	(.01)
	3 mos. 3/31/80	823,701	(123,405)	(.10)
Atlantic Research	3 mos. 3/31/81	21,633,000	751,000	.41
	3 mos. 3/31/80	17,077,000	585,000	.39
Burroughs	3 mos. 3/31/81	756,485,000	22,250,000	.54
	3 mos. 3/31/80	673,624,000	47,630,000	1.16
Computervision	3 mos. 3/31/81	60,615,000	5,123,000	.37
	3 mos. 3/31/80	37,820,000	4,178,000	.33
Comsat	3 mos. 3/31/81	77,934,000	20,109,000	2.51
	3 mos. 3/31/80	70,030,000	9,889,000	1.24
Data General	24 wks. 3/14/81	318,101,000	27,314,000	2.57
	24 wks. 3/15/80	283,821,000	24,631,000	2.36
Datapoint	9 mos. 4/30/81	292,306,000	35,312,000	1.80
	9 mos. 4/30/80	228,127,000	24,250,000	1.38
Data Terminal Systems	3 mos. 5/3/81	24,172,000	(2,363,000)	(.46)
	3 mos. 5/4/80	30,364,000	1,432,000	.28
Datatron	9 mos. 3/31/81	4,926,382	(291,446)	(.08)
	9 mos. 3/31/80	4,522,717	531,837	.24
EG&G	13 wks. 3/29/81	162,470,000	6,420,000	.46
	13 wks. 3/30/80	142,168,000	5,477,000	.40
Emulex	9 mos. 3/29/81	7,242,703	902,881	.54
	9 mos. 3/31/80	2,997,917	373,421	.32
Fabri-Tek	12 mos. 4/3/81	38,121,000	3,813,000	.97
	12 mos. 3/28/80	33,663,000	2,076,000	.56
Floating Point Systems	6 mos. 4/30/81	26,692,000	2,747,000	.74
	6 mos. 4/30/80	19,190,000	1,770,000	.47
General Automation	9 mos. 5/2/81	94,478,000	(807,000)	(.32)
	9 mos. 4/26/80	95,476,000	(9,448,000)	(3.73)
GenRad	3 mos. 4/4/81	41,787,000	362,000	.05
	3 mos. 3/29/80	33,373,000	2,578,000	.38
Honeywell	3 mos. 3/29/81	1,210,800,000	52,300,000	2.31
	3 mos. 3/30/80	1,130,700,000	44,900,000	2.02
Logicon	12 mos. 3/31/81	56,380,000	1,795,000	1.84
	12 mos. 3/31/80	49,287,000	1,955,000	2.12
Magnuson Computer Systems	3 mos. 3/31/81	7,918,000	304,000	.06
	3 mos. 3/31/80	5,613,000	741,000	.29
Management Assistance	6 mos. 3/31/81	157,741,000	5,447,000	.66
	6 mos. 3/31/80	145,696,000	6,638,000	.82
MSI Data	12 mos. 3/28/81	55,613,000	3,473,000	1.49
	12 mos. 3/29/80	45,427,000	1,046,000	.46
Network Systems	3 mos. 3/31/81	3,689,000	317,000	.03
	3 mos. 3/31/80	2,273,000	128,000	.01
Perkin-Elmer	9 mos. 4/30/81	819,209,000	55,483,000	1.29
	9 mos. 4/30/80	715,195,000	48,221,000	1.20
Printronic	12 mos. 3/27/81	52,428,000	4,639,000	1.24
	12 mos. 3/28/80	36,976,000	3,137,000	.95
System Industries	3 mos. 3/29/81	12,024,000	1,441,000	.89
	3 mos. 3/30/80	8,009,000	94,000	.22
Tandy	12 mos. 3/31/81	1,612,460,000	145,659,000	2.86
	12 mos. 3/31/80	1,355,067,000	101,824,000	2.00

Centronics, DG managers named to stabilize operations

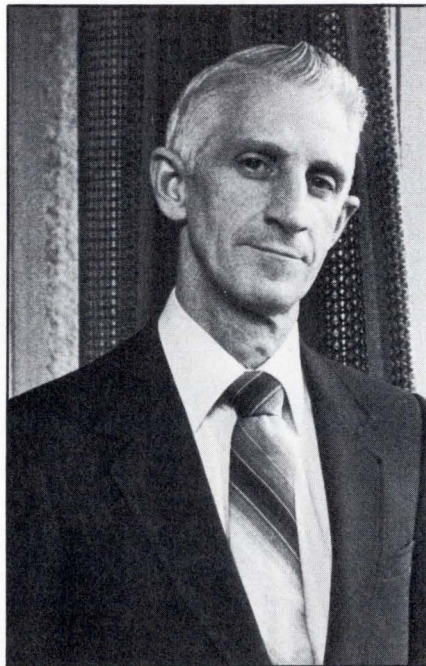
In companies that quickly outpace the pack to become industry leaders, strategies to channel growth may take a back seat to the fruits of growth, especially when the president is a strong-willed entrepreneur.

Two companies that fit that profile, Centronics Data Computer Corp. and Data General Corp.—seem willing to face reorganization aimed at controlling growth as they continue to round out and strengthen management teams. Both recently added top-level managers, each with more than 20 years of large-company experience, to help solidify their respective managements and marketing.

Centronics appointed its third president in less than two years (MMS, June, p. 69). He is 48-year-old John L. Tincler, a 24-year Raytheon Co. veteran, who has been promoted twice since joining Centronics last August. DG added 52-year-old Frank P. Silkman, a 24-year IBM veteran, to run DG's three new business divisions (MMS, April, p. 141).

Although becoming a company president is an enviable goal for many aspiring managers, Centronics's Tincler faces some tough challenges. He will head a company that over the past year has had a high turnover rate among top management, and manufacturing and marketing problems that led to decreased profit. Among Tincler's duties will be to bring in line some of the company's excessive manufacturing facilities, bring new products to market, help soothe some skeptical large OEM customers and generate teamwork among 14 vice presidents.

His most important task, perhaps, is to assert himself as a strong president. Founder and former company president Robert Howard has been criticized for retaining too much control. Yet Howard claims he will not assume operations responsibilities. "It has always been my intention to let the president run



Centronics's new president, John Tincler, has strong operations experience, and will bring inventories and manufacturing capacities into line.

the company. (My) stepping away is not abandonment; it is assuming a nonoperational role," he says. Howard adds that the "office of the president," used most recently to dilute some of former president Michael Kaufman's responsibilities in mid-March, "is not a vehicle for me to take over when I want to."

Tincler, who formerly served as executive vice president at Centron-

ics, had the following responsibilities at Raytheon: vice president of engineering, manufacturing, service, marketing, and sales at Raytheon Data Systems, with responsibilities for the PTS-100 terminal and the minicomputer lines. His tenure at Raytheon company includes work in various divisions that produce military equipment.

Even though he has a strong background at a large company, Tincler says he understands the needs of a smaller organization, which is one deficiency that Centronics watchers cited in Kaufman. "I have the disciplines of being a big company manager, and I understand the needs of small companies," he says. Tincler points to his experience at RDS, which was one of Centronics's largest customers and which increased its revenues to \$200 million while he worked there. He also cites his experience in dealing with similar large customers.

Howard is confident about Tincler's abilities, as are former colleagues of Tincler's. Tincler is respected at Centronics, according to former vice president of field service Kendrick Estey, who is now at Applicon Corp. Estey, who departed in January after 10 years at Centronics, says he would not have left had Tincler been president then.

Tincler's attention to detail seems to be his strongest attribute. "He recognizes what it takes to bring products to market, in terms of manufacturing capacity, inventory levels and cost of sales," says Estey. "Howard will let him get into the details of the organization, which is

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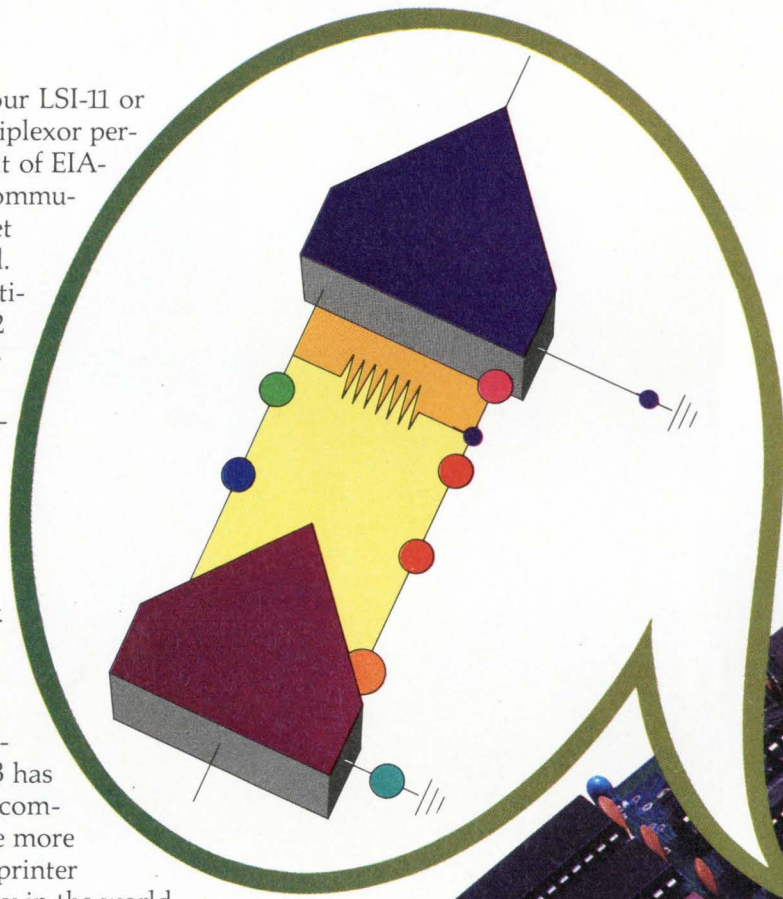
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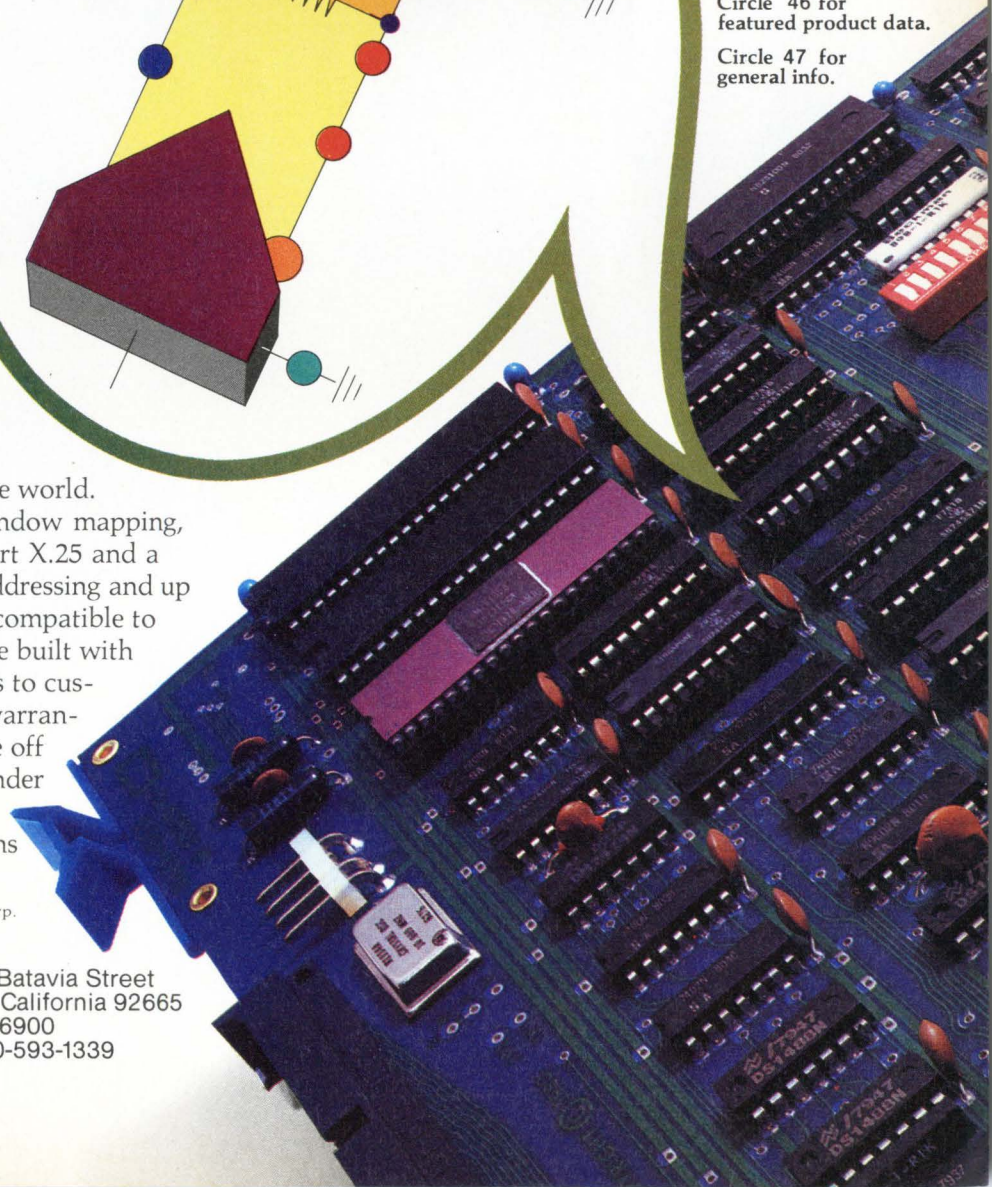
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what Centronics needs.”

J. Thomas Markley, former RDS president and Tincler's boss, agrees that Tincler is fanatic about details and will complete an assignment, no matter what. That fanaticism is also a weakness, says Markley. "If he has a weakness, it's that he works 30 hours a day and doesn't smell the roses."

Tincler's knowledge of operations will be put to good use at Centronics. One of his most pressing needs will be allocating company resources. Centronics has excessive inventories and manufacturing capacities, which Tincler will bring into line. "This does not necessarily mean layoffs, but maybe redeployment of resources and moving activities in rental space back into headquarters," he says.

He also will have to propel enhanced and follow-on products out the door. Many product lines were not developed over the past year when company resources were channeled into remedying problems with low-end printers. Tincler will also respond to the needs of Centronics's salesmen and major customers by making calls himself and developing personal relationships. "We used to do a great deal of (this)," although the activity was not very intense over the last year," Howard says.

Customer satisfaction is also on the mind of DG's new senior vice president, Frank Silkman, who will focus on those needs to help the company reach its next revenue plateau of \$1 billion. Silkman is responsible for the performance of the newly formed business divisions, and will report to Herbert J. Richman, executive vice president. The three divisional vice presidents and general managers will report to Silkman.

Previously, Silkman held various positions at IBM, most recently as assistant to the president of the company's Information Systems Division, White Plains, N.Y. Earli-



Data General Corp.'s new senior president, Frank Silkman, will run the three business divisions and begin to measure revenues. "The corporation needs discipline. That's not easy, but it's necessary," he says.

er, he was vice president and general manager of the Office Products Division in Boulder, Colo., where he was responsible for product planning, engineering and manufacturing. He also served as director of manufacturing for the General Business Group International and as general manager of the General Systems Division's development and manufacturing activities in Rochester, Minn. Silkman's

IBM product portfolio includes development and manufacture of the 1401, 360, Series 3, 32, 34 and 38 and the 5100 desk-top computer.

Silkman may experience some déjà vu at DG: his former experience is very similar to the job at hand. He had handled development, manufacturing, and market planning at IBM. Additionally, he was at GSD when it started in 1969 and until it grew to the \$2-billion level in 1980. He'd like to be similarly instrumental in DG's move from fiscal 1981 revenues of \$654 million to the billion club.

Silkman believes his primary challenges will be to implement a much-needed organizational structure and to create a measurement system for revenues generated in the three profit centers. He will also add a support staff, including technical and financial staff members.

DG has had a situation similar to that of Centronics, in that its entrepreneurial founder, DG president Edson D. deCastro, has had difficulty relinquishing control. But Silkman is assured he'll have free rein to manage the divisions. He adds that de Castro has faced the fact that he can't control the entire company. "It's a big hurdle he'll get over," Silkman says. "The corporation needs discipline. That's not easy, but it's necessary."—L. Valigra

PRINTER BUYERS CONSIDER QUALITY FIRST

Computer printer users are opting for quality over price and speed in selecting printers, according to a report by Venture Development Corp., a Wellesley, Mass., research firm. The report, "The high-quality computer printer industry: A strategic analysis," includes a survey of more than 4000 printer users. When these users compared price, quality and speed, approximately 46 percent looked for quality, 31 percent for price and 22 percent for speed before they made their selection, the report says.

The report also predicts that high-speed, high-resolution dot-matrix printers will show the largest growth by 1985, because of the integration of word- and data-processing systems. Moreover, the report contends that within the next five years, many new entries in the dot-matrix printer market will step up competition not only among themselves, but also with vendors of daisy-wheel and ink-jet printers. Page printers, which are expected to become less expensive, will also become a source of competition within the market, the report says.

—Nancy Love

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Durango desk-top incorporates letter-quality matrix printer

After three relatively quiet years, Durango Systems, Inc., is intensifying its push into the desk-top business-systems market. Leading the way for the San Jose, Calif., company is a system that incorporates a high-resolution, letter-quality, dot-matrix printer, capable of both high-speed printing and word-processing output.

Dubbed the 800XR, the system combines an 8085 central processor, two double-sided, double-density 5¼-in. floppy-disk drives—providing 2M bytes of storage, 64K bytes of RAM, expandable to 128K bytes—a 9-in. 1920-character video display, a keyboard and printer into a desk-top unit. Company officials say the 800XR will sell for \$18,000 to \$23,000, depending on memory size, processor speed and software packages. The system runs Durango's own DX85M multi-tasking operating system or Digital Research's CP/M.

Durango's 9 × 9 matrix printer uses friction-feed techniques to position the paper for letter-quality output. The device can handle fan-folded, sprocket-fed paper too.

Program manager Brian Verstegean says "During high-resolution printing, we can position the paper within 3.5 mils for a two-pass matrix character." He compares this vertical-spacing figure and Durango's 2-mil horizontal space with typical matrix-printer positionings of 8 mils vertical and 21 mils horizontal.

To attain these tolerances, Verstegean explains that Durango uses a standard stepper motor to advance the paper. However, the company reduced the gearing of the

motor by a factor of three. The result is a half-stepping stepper motor, he says.

The printer is capable of speeds of 165 characters per sec. in its standard print mode. That speed is reduced to about 38 cps for letter-quality printing. A separate 8085 processor controls the printer.

Durango also uses a customized ribbon cartridge; one cartridge can accommodate either a mylar-based, carbon-film multistrike ribbon for high-resolution printing, or a cloth ribbon for standard output. The cloth ribbon, says Verstegean, will

print about 10 million characters, while the mylar-based ribbon will print about 250,000 characters.

Fonts are loaded from the system's floppy-disk drives, which Verstegean says is unique to Durango. This eliminates the need for ROM to handle that chore, common with other multi-font matrix devices.

An external 14-in. Winchester disk is also available. Plans call for replacing at least one floppy-disk drive with a 5¼-in. Winchester drive soon, says the company.

—Larry Lettieri



Durango's 800XR desk-top business system incorporates a high-resolution, letter-quality, dot-matrix printer, capable of both high-speed printing and word-processing output.

10M-byte disk cartridge uses flexible media

As file backup emerged as a major issue following the announcement two years ago of a number of 8-in. Winchester, some drive vendors selling into the OEM market began to explore the possibilities offered by high-capacity removable rigid-disk cartridges based on technology found in fixed-disk hardware.

Already, several 8-in. drives that incorporate disk cartridges in conjunction with fixed media have appeared, and one disk-cartridge-only Winchester, Data Peripherals' DP-100 Lynx drive (MMS, October, 1980, p. 132) is shipping in evaluation quantities. Several fixed/removable 5¼-in. Winchesters have also been announced, and it is rumored that industry pioneer Seagate Technology will announce a removable-only disk-cartridge device with thin-film read/write heads later this year.

One start-up vendor feels, however, that high-capacity disk-cartridge drives can be built without resorting to the rigid media associated with Winchester hardware, and has announced a 10M-byte device using a single Mylar-based 8-in. diskette. Called the Alpha 10, the new drive is the first offering from Ogden, Utah-based Iomega Corp. and according to company sources, it combines the best of two worlds. On the one hand, it offers the removability of a disk-cartridge drive without the need to seal the cartridge when it is not in use or maintain a clean environment after the cartridge is inserted into the drive. On the other hand, the drive offers storage capacities and performance specifications comparable to those found in many Winchesters on the market.

Key to the performance claims

put forth for the Alpha 10 is a concept that essentially converts a diskette into a piece of rigid media. As the cartridge is inserted into the drive, it is slipped over a fixed plate lying in a plane parallel to that of the diskette in the cartridge, and through which the heads read and write data. The plate does not come in contact with the diskette. Rather, it serves to stabilize the media when it has been brought up to rotational speed—1500 rpm, or roughly five times faster than that of a floppy-disk drive.

Once the diskette attains rotational speed, a pressure differential is created on one side that flattens the media out. This, in turn, permits Iomega to fly the heads off the disk surface, eliminating media wear and simplifying head design, say company sources.

Flying the heads in conjunction with a track-following servo system and a rotary actuator based on a printed-circuit motor also pushes track and bit densities in the new device. Compared to the 96-tpi maximum typical of higher capacity floppy-disk drives, the Alpha 10 operates at 300 tpi. Compared to the 6800-bpi density of Shugart Associates' 1M-byte 8-in. floppy-disk drive, the Alpha 10 operates at

18,000 flux reversals per in. (24,000 bpi using a run-length limited-encoding scheme) in a package approximately the same size as the lower capacity device.

This performance level has impressed many industry observers. But it has also led to some expressions of caution concerning Iomega's decision to introduce a new technology to a market that tends to value considerations such as tradition, IBM acceptance and the ready availability of second-sourced hardware and media. "The performance specs and recording densities of the drive will make it attractive to the market," says Santa Barbara, Calif., consultant Raymond Freeman, Jr. "I reserve opinion, however, as to whether or not the market will accept the unique media involved."

Newark, Calif., consultant Andrew Roman also counsels caution: "The Alpha 10 is a great concept if Iomega can make the media work. Running a flexible disk at 300 tpi and 18,000 fepi hasn't been done before, and getting long-term repeatability could be a problem."

Evaluation versions of the 10M-byte Alpha 10 start shipping by the third quarter of this year, with production units set to go by the second quarter of 1982. Price in 500-lot quantities is set at \$2300 and includes an integrated controller that can operate as many as four drives. —John Trifari

Voice synthesis moves to terminals via controller

The idea of a machine performing actions typically performed by a human terminal operator has been put into practice in an innovative way by Digital Pathways, Inc. The Mountain View, Calif., company has combined a μ p and synthesized

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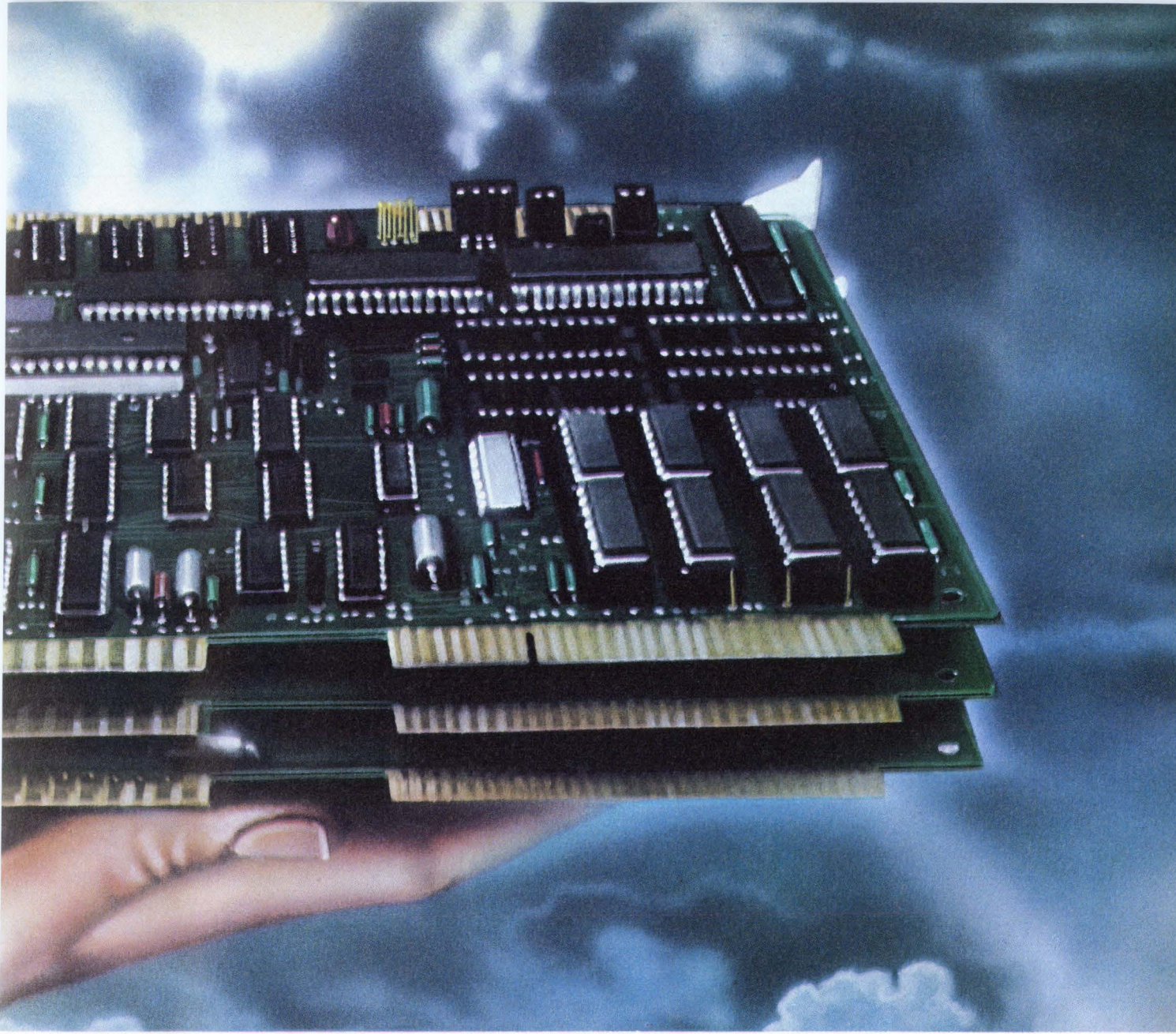
The in-circuit automatic test equipment is the trouble-shooting tool for the previous burn-in. It's also used to verify shipping configuration for functionality. The process is

then finished with a final configuration test, providing a last pre-ship reliability check-out. Boards that make up a system receive an extra 8-hour error free ambient run.

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MMS 7/81

Mini-Micro World



The SLC-II voice-synthesis device connects between any computer and terminal without the need to change the host's operating system, and has a 300-word vocabulary.

and CPU to monitor incoming messages, says company president Mel Schwartz. When a message is received, the SLC-II performs a specific action, such as dialing a certain telephone number and leaving a message, or making an announcement over a public-address system.

Schwartz says the SLC-II is the first application of speech synthesis at the terminal level. "Our intention was to build a device smart enough to recognize questions from a computer and answer the way an operator would," he says. It was an effort to remove the operator from "a situation of just sitting, listening and watching," he adds.

The SLC-II uses a 6502 μ p. A basic system has 16K bytes of RAM, expandable to 80K bytes. A total of 4K bytes of CMOS battery-backed RAM stores as many as 16 messages. Speech is synthesized by a Texas Instruments Inc. LPC chip set.

The system has a 300-word vocabulary and is capable of as much as 300 sec. of speech. It spells words that it cannot say, Schwartz says.

Custom vocabularies must be prepared through TI's speech-development facilities, a process

that takes about one month, and costs nearly \$30,000 for 300 sec., Schwartz says. Digital Pathways is working on an agreement to license the TI speech software. This arrangement might reduce the development time, but Schwartz says he is not certain that the \$30,000 price would be cut, as well.

Digital Pathways will begin

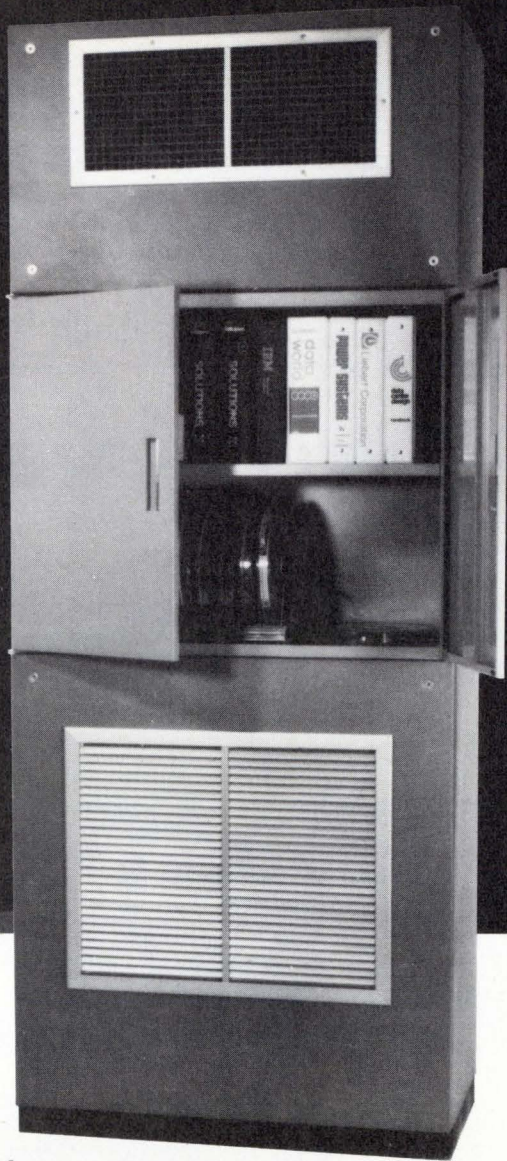
shipping units in June. A standard SLC-II with 16K bytes of RAM sells for \$1975. Later versions, Schwartz says, will be shipped with a Microsoft BASIC compiler that will permit OEMs to tailor the actions, though not speech, to their markets. The SLC-II connects to CPU and terminal via an RS232C or a 20-mA loop interface.

—Larry Lettieri



Philips Information Systems, Inc., Dallas, recently added a new member to its MICOM word-processor family—the MICOM 2002. The 2002 can be expanded from one work station and printer to four work stations and two printers. Standard storage capacity can be increased from 254 pages to more than 12,000 pages using hard disks. A base system including printer, work station and controller is priced at \$13,900. The 2002 is compatible with the earlier 2000 and 2001 systems.

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 environment I need?
 ...In the space I have?



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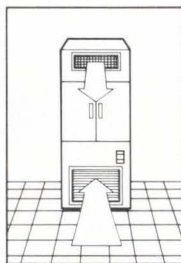
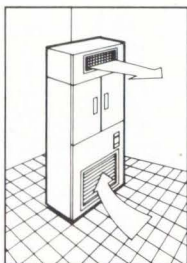
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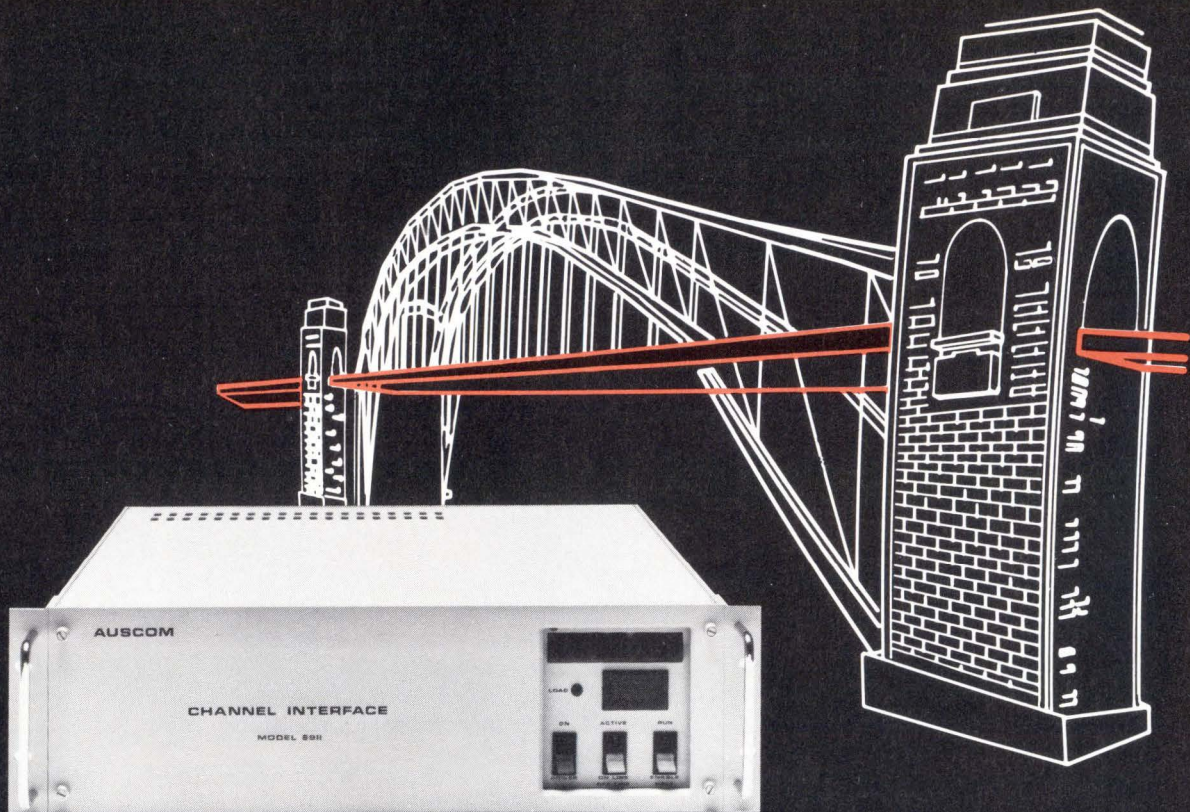
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An editorial commitment

Just two months ago, I reported to you in this column that we had hired three new editors since February (MMS, April, p. 83). Since then, another three editors have joined our ranks, and we're looking for more. Why do we risk boring you with this steady stream of information about people who work on the editorial staff of *Mini-Micro Systems*? It's because we're committed to editorial leadership among computer publications, and we think our editorial staffing demonstrates that commitment.

So bear with me again so that I may introduce the new editors in our Boston headquarters.

Associate editor Eric Lundquist will be reporting on industry developments and trends for the magazine's Mini-Micro World section. Eric comes to us from *Electronic News*, where for the past two years he served as a regional correspondent covering New England's computer and electronics firms. Before his experience with *Electronic News*, Eric was a reporter for a daily newspaper and a correspondent for United Press International. He has a master's degree in journalism from Boston University and a bachelor's degree in history from the University of Massachusetts.

Associate editor Dwight Davis comes to us from *Computer Times*, where he was a senior editor covering the New England region. He will also be reporting on the minicomputer and μ c industry in Mini-Micro World. Dwight previously served on the staff of *Minicomputer News* for three years, including one year as managing editor. His editing experience includes a year-long position as the editor at Harvard University's *Museum of Comparative Zoology*, plus assignments as a free-lance book manuscript editor for John Wiley & Sons, Inc. Dwight has a B.A. in biology from Macalester College and an M.S. in science journalism from Boston University.

Assistant editor Mary Anne Weeks will be working on the magazine's copy desk, assisting chief copy editor Frances Granville, and will be writing and editing the magazine's new products section. Mary Anne's background includes teaching seminars on computer use, developing emergency backup systems and writing technical manuals at Children's Hospital Medical Center, Boston, where she was information-systems coordinator. She holds a B.A. degree in English and government from Emmanuel College and an M.S.W. degree from Boston University.

Their initial efforts are embodied in this issue, and you'll be hearing from them frequently in the future.



Lundquist



Davis



Weeks

S. Henry Sacks
Vice president/Publisher

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The Z89: a subcompact microcomputer that needs about as much space on a desk as a portable TV set.

And needs about as much technical training to operate. Because the Z89 uses the industry-standard CP/M™ operating system, it accepts a vast variety of existing software. Most microcomputer programmers already know it, and anyone trained on larger systems adapts to CP/M* in a flash. The Z89 also uses standard, currently available software on both 5¼" and 8" floppy disks, yet is capable of more sophisticated operation using extended languages such as Microsoft BASIC, COBOL, FORTRAN, and PASCAL.

The keyboard follows the standard typewriter format, with every touch of a key confirmed by an audible click. Numbers are duplicated in calculator format, with up to 18 decimal-place accuracy. And the large-capacity non-glare video display is easy on the eyes.

The Z89 is a sub-compact desktop unit with a memory of up to 64K bytes of RAM—more than enough for word processing, accounts payable,

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Revisiting the quality race

(Sixteen months ago in this column, we cautioned that U.S. computer and peripheral equipment makers had yet to face the full force of competition from Japanese vendors [MMS, January, 1980, p. 11]. Our view then was that product quality would be a pivotal element in the competition between U.S. and Japanese manufacturers. That view hasn't changed, and it was recently reinforced by remarks made by James S. Campbell, president of Shugart Associates, the Sunnyvale, Calif., manufacturer of disk drives. The occasion was a meeting of Palo Alto purchasing managers. Campbell added that customer service, as well as quality, will help U.S. vendors of OEM hardware compete effectively with Japanese suppliers. We think his comments deserve wider exposure, and have excerpted from them here.—L. J. Curran)



The leading question today is whether U.S.-made products will be of sufficient quality to allow our customers to continue buying from U.S. manufacturers. The answer depends entirely on how well we—the vendors—design and build reliability into our products, and service into the whole product package.

The issue at stake here is simply: Will a product perform to its specification levels when the customer opens the box at his receiving inspection? In the case of floppy-disk drives, for example, there should be a 95 percent "plug-and-play" rate.

U.S. vendors are in a position to do more than the Japanese have typically done—deliver a high-quality piece of merchandise. We have the common language, the corporate infrastructures and the market understanding to provide much better overall service as well.

We can take a lesson from what the semiconductor manufacturers did when they first introduced μ ps. They were forced to make a tremendous amount of applications-support material available because very few people at the time knew how to use these powerful new devices.

Making it easier for customers to do business with us is essential no matter what the short-term costs. The resulting quality and service improvements will be seen in increased long-term profitability for both ourselves and our customers. After all, you only make a real profit on a product that's shipped only once. And that product's good quality is the key to repeat sales for the OEM vendor.



BUMPER CROP

8-inch Winchester Multi-User Systems. Now In Volume- \$8,500.

Altos is delivering the cream of the crop with their new 8-inch multi-user Winchester disk systems. They're freshly packed with the quality features you expect from Altos, and at a price you expect from Altos, too—just \$8,500.

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either 8-inch, single or double-sided floppy drives (ACS8000-10 and -10D) or a 1/4-inch magnetic tape drive (ACS8000-10/MTU). And for powerful performance, all of these Z80A*based systems come complete with 208K of RAM and 6 programmable serial ports, ready to support four users.

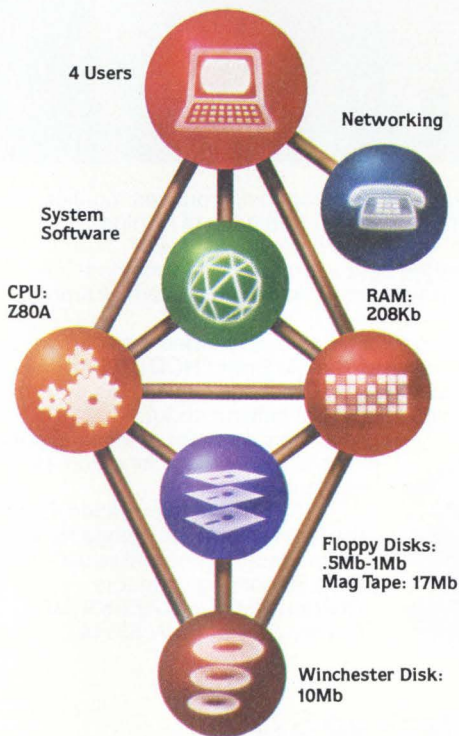
Here's the most bountiful selection of systems and capacities in the field from the company that knows how to deliver quality systems in the volumes that OEMs need to stay competitive.

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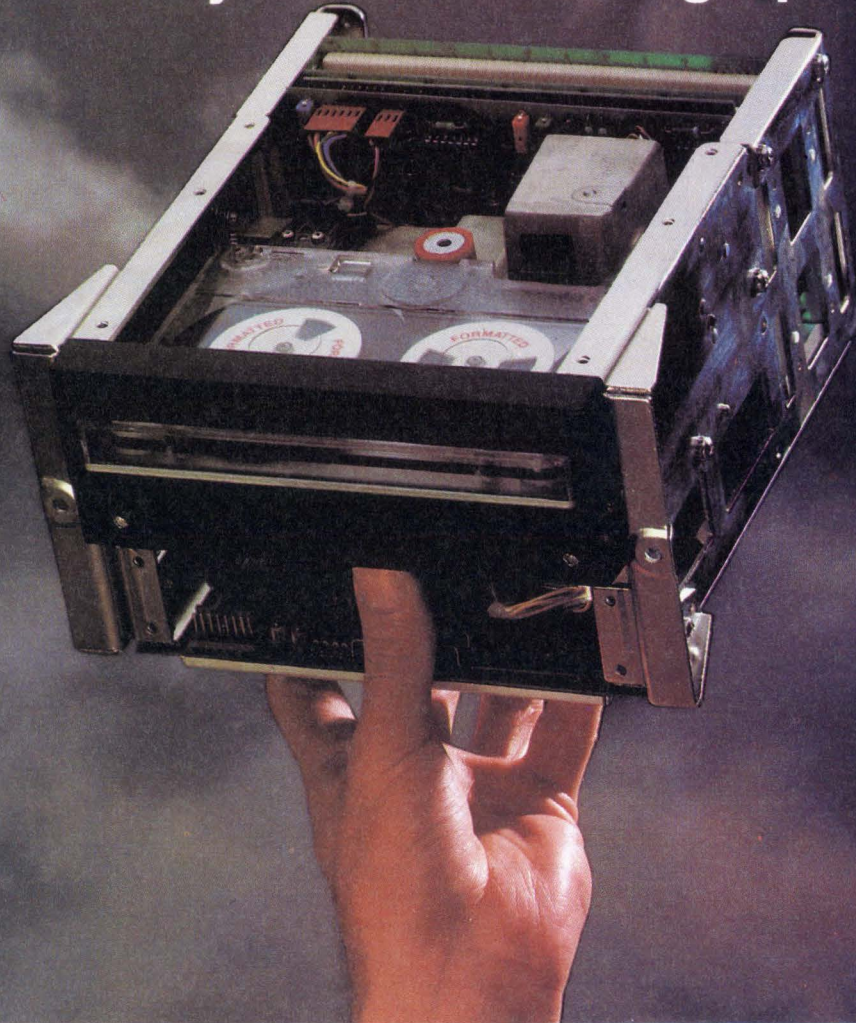


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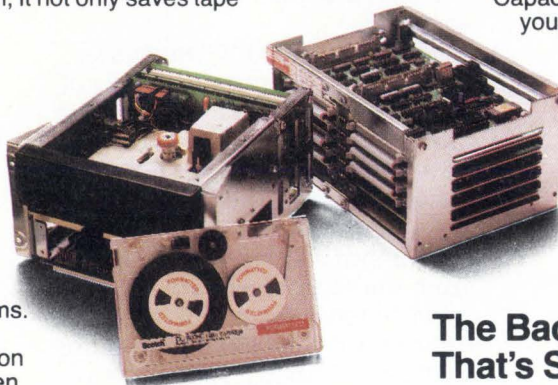
What's more, the HCD-75 features state-of-the-art error detection and correction capabilities. Even when

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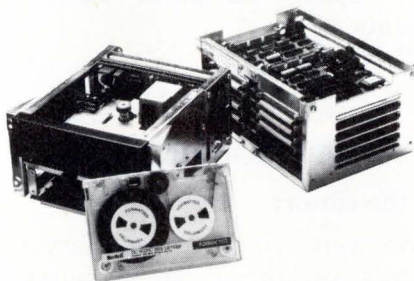
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SELLING GRAPHICS

To the editor:

I would like to comment on "Selling computer graphics in retail stores" (MMS, April, p. 23). In their discussions of readily accessible computer graphics services, Phil Cooper of Computer Pictures and Alex Ferdinand of Genographics failed to note the growing number of firms involved in retail computer graphics services.

In his paper on computer graphics service bureaus at the 1980 Harvard Laboratory for Computer Graphics Summer Conference, conference director Eric Teicholz described no fewer than 57 operating color-graphics service bureaus. They include, among others, AUI Datagraphics (Washington, D.C.), Iconics (Cupertino, Calif.), Compu-serve (Ann Arbor, Mich.) and Design and Systems Research, Inc. (Cambridge, Mass.). All of those mentioned provide from simple plotting service to advanced data analysis and design.

The computer-graphics service industry is seeing a tremendous growth phase with the advent of service firms dedicated to graphic-design quality graphics backed by integrated data sources and applications personnel.

Daniel S. Raker
President
Design & Systems Research, Inc.
Cambridge, Mass.

PERSONAL PREFERENCE

To the editor:

Yours is an excellent publication, but we feel obliged to forward the following constructive criticism of Mr. Cherry's article "Evaluating word-processing software," (MMS, April, p. 123).

The article's bias toward WordStar is understandable but unfortunate. WordStar is the most popular

package in the home market, but this doesn't mean that it is the best, the most efficient or the one that allows the most productivity. Its popularity stems from the fact that the home market is composed of consumers with no previous experience with computers. As a result, they simply don't know what to ask for or expect.

Our own research since switching from large systems to the μ c (home) market indicates that the personal computer can provide a very attractive and serious alternative to traditional system solutions involving smart terminals, distributed processing, networking and office automation. And there are some configurations that provide many times the level of performance improvement available from the NBI/Micom/Wang systems.

But the evaluation of word-processing packages must not proceed according to the home-computer evaluation technique used by Mr. Cherry. Instead, a professional cost/benefit analysis based upon final human effectiveness will tell a given client which WP package is best for him.

The methods involved in such an analysis involve the learning curve, the speed of text entry and modification, the versatility of print formatting for many weighted functions, etc. The job description of the user must be considered—both what he is doing and what he could be doing.

Our experience has shown that, in a typical installation, a good WP package may increase user produc-

CORRECTION

In the article "The double-sided floppy is reborn" (May, p. 159), MMS published a photograph of the SA410, Shugart's single-sided minifloppy-disk drive. The photo should have shown the SA850, an 8-in. double-sided drive.

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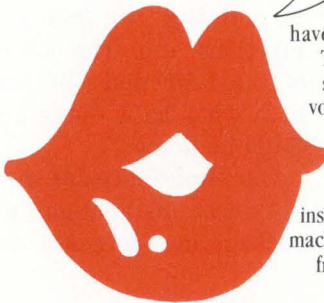
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CIRCLE NO. 143 ON INQUIRY CARD

Letters

tivity (for example, a secretary's output) by 140 percent. CP/M systems like WordStar are heavily screen-dependent and produce much less of an increase (typically 40 percent, maximum). By coincidence, the most effective WP packages (in the 90 to 180 percent improvement range) are written for the Apple and other direct-screen-display machines. Not being limited by a serial terminal and the screen-dependence it encourages, these packages (like Apple Pie by Programma) are able to develop the user's throughput to a level not possible by traditional typewriter philosophies (like WordStar).

Mr. Cherry's article was a welcome aid to your readers. It was unfortunate that he chose to describe the field in terms of screen-dependent packages like WordStar that owe too much to the traditional, mainframe approach to word processing. His article would be better aimed at the hobby market than the business arena. Real WP productivity does not lie with the Radio Shacks running CP/M and WordStar. It lies with the nontraditional μ cs using direct-screen display (instead of a serial terminal), immediate editing (instead of WordStar's slow scrolling to the next occurrence) and the character-stream mentality that the hobbyist simply has never encountered.

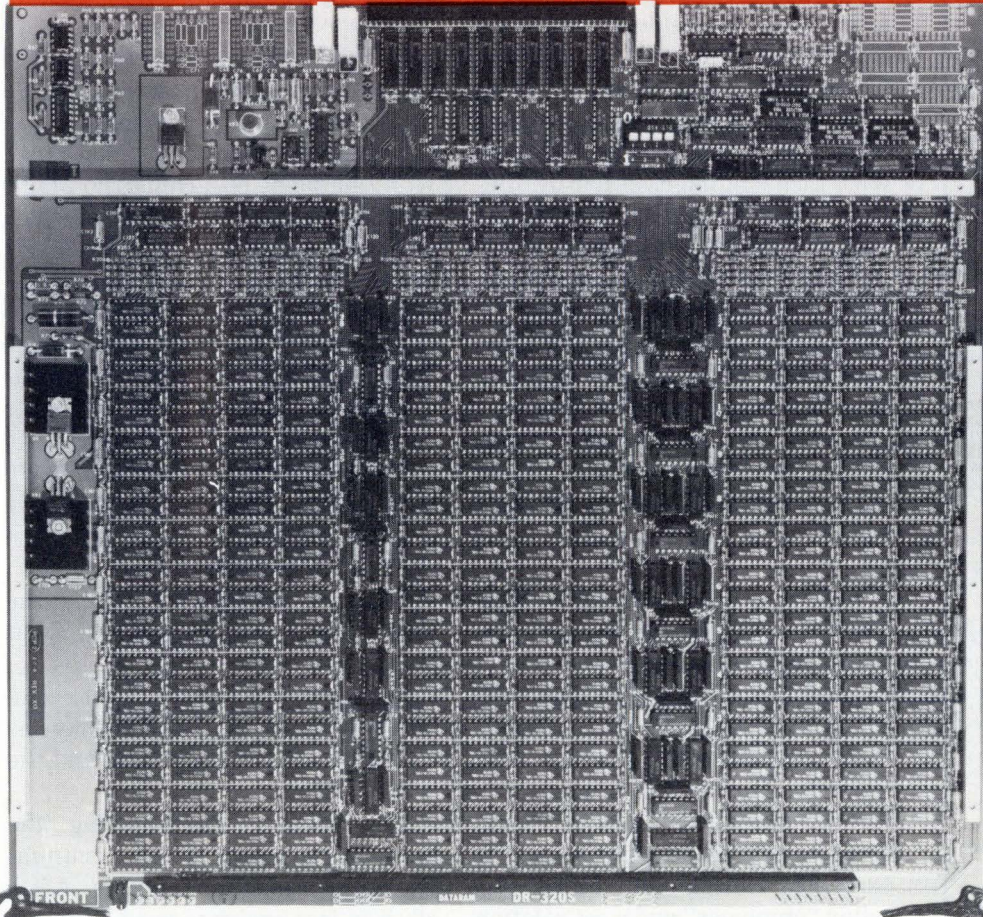
R.A. Baumann
Senior Consultant
Sam Spade Computer Consultants
McLean, Va.

REVIEW CORRECTIONS

To the editor:

We were happy to see Harvey Weiss's review of our data-base management system, MDBS ("Down-scaling DBMS to the microworld," April, p. 187). However, we would like to correct a few statements that

512KB ADD-IN FOR PERKIN-ELMER 3200



- Memory capacity up to twice the comparable P-E storage module
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- Test points available
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CIRCLE NO. 61 ON INQUIRY CARD

Letters

may cause confusion among some of your readers.

On p. 189, Mr. Weiss lists host languages with which MDBS interfaces are available. The added statement that MDBS supports "...any other languages that invoke the 'call' concept" is not correct. Typically, MDBS can be interfaced with such languages either by Micro Data Base Systems, Inc., or by a second party, but MDBS is not callable from such a language until after the languages interface has been constructed. Also, the list of languages with which MDBS has been interfaced was correct except that some language and company names were misspelled. These include Sorcim's Pascal M, Applesoft BASIC and MT Microsystems' Pascal MT+.

Also on p. 189, Mr. Weiss discusses set relationships in which record occurrences "own" record occurrences of another type. While MDBS does support such relationships, they are not unique to MDBS. What is unique is that MDBS permits record occurrences to "own" record occurrences of the same type. For example, consider a record type called "employees" and a set relationship called "suprvise". Employees that supervise other employees can be handled by having occurrences of "EMPLOYEEES" own set occurrences whose members are other "employees" occurrences.

On p. 190, Mr. Weiss states that our nonprocedural query language MDBS.QRS enables a non-programmer to "integrate" any MDBS data base on an ad hoc basis. The word should be "interrogate."

Christopher B. Barry
 President
 Micro Data Base Systems, Inc.
 Lafayette, Ind.

MAGIC MANUAL

To the editor:

I took some small satisfaction in

reading your Electric Pencil complaint list in your article on word-processing software (MMS, April, p. 123).

I appreciated and agreed with most of your comments on the difficulty involved in assessing WP software without spending a lot of time with the software. I disagreed with one point regarding the Magic Wand and its users manual in which you took exception with the Magic Wand, "which has its manual typeset." Your point was humorous, but inaccurate, since the Magic Wand manual provides numerous examples of letters and documents that were produced with its software and printed on WP equipment. These examples are printed copiously throughout the manual, in reduced size.

Also, you did not mention that the Magic Wand manual provides what appear to be actual photos of screen-formatted text with command examples so the user may see both the actual screen form and the printed form.

My belief is that having the discursive part of the manual typeset is a plus for the user. After all, it is just easier to read text that is typeset than text that is printed on a daisy-wheel printer because the typesetter has a greater array of character-spacing tricks at his disposal. It is also more expensive to typeset a manual, and I believe the Magic Wand people had their manual typeset for the very good reason of user comfort.

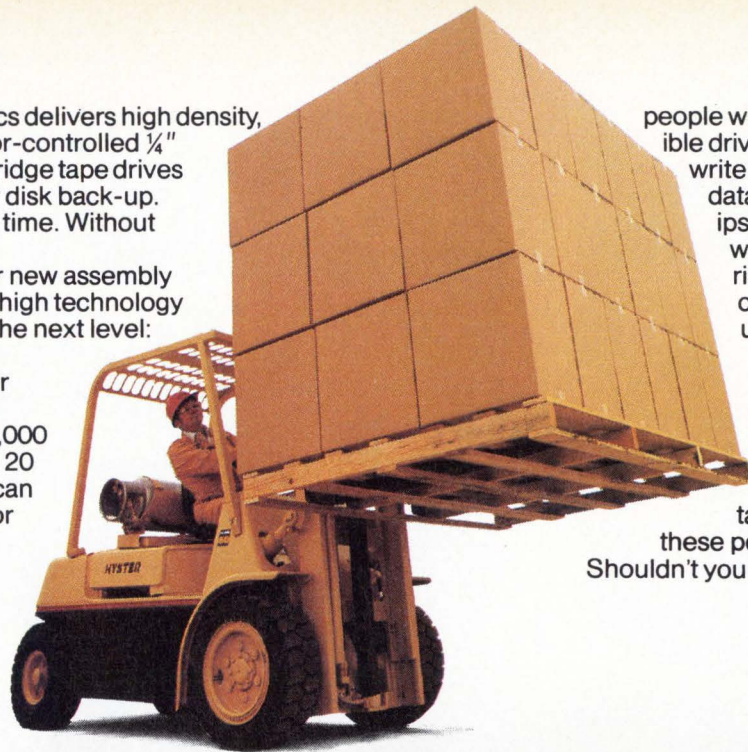
One last point: the Wand's proportional spacing requires a printer that accepts a proportional print wheel to operate properly. A friend of mine has one and says the Wand works fine in the proportional mode. I don't know about that since my model of Diablo will not accept the proportional wheel.

Mark Davidson
 PKay Corp.
 Costa Mesa, Calif.

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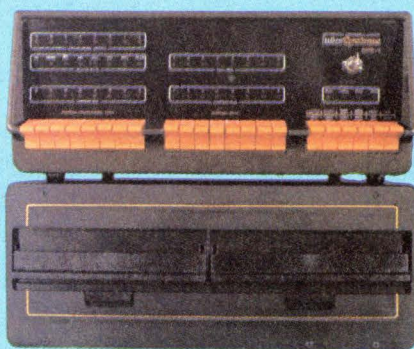
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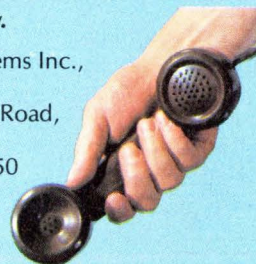
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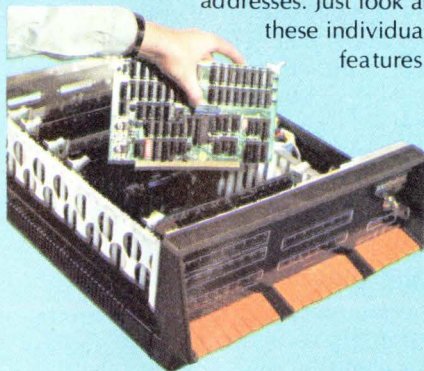
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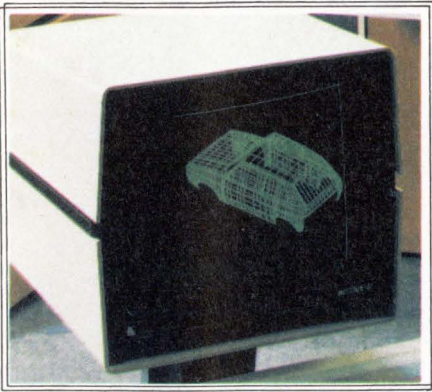
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115 Computer-aided design and computer-aided manufacturing (CAD/CAM) systems are interesting not only from a business point of view because they increase productivity, but also from a technical standpoint. Modern CAD/CAM systems combine the latest in graphics-manipulation hardware and software, data base management technology, state-of-the-art digitizing and plotting techniques and methods of simulation—all in one package. Contributing editor Malcolm L. Stiefel takes a look at CAD/CAM productivity and surveys several turnkey systems in a product profile . . . Also in our CAD/CAM report, Charles Simon of Vectron Graphic Systems suggests on p. 127 that companies become acquainted with CAD/CAM service bureaus, which can provide quick, accurate printed circuit board design and artwork . . . Some successful applications of CAD/CAM are described in two other articles—one on wire wrapping (p. 135) and the other on wheelchair design (p. 147).



157 Before the National Aeronautics and Space Administration launched its Space Shuttle, the agency discovered it needed better information-handling services when 6000 reporters applied to cover the event. NASA's answer was to build a system around an existing IBM 360/65, adding 18 System 3000 software-based word processors from NBI, Inc. Combining an older data-processing computer system with updated word-processing parallels a trend that will see network architects melding existing office equipment to new uses, primarily to serve prudent economics.



166 In the second part of "A primer on security" (p. 166), consultant J. Michael Nye explains that unlike analog voice communications—for which methods of protection are analog in nature—digital data protection may be accomplished by encryption. One of the advantages of digitizing voice communications is the additional level of protection that encryption offers.



176 The Department of Commerce has estimated that there are 20,000 small- and medium-sized U.S. firms—many in the high-technology field—that could be selling their products abroad, but are not. Attorney Fred M. Greguras analyzes the Export Trading Company Act, which the Senate recently passed in an attempt to encourage these companies to broaden their market horizons.

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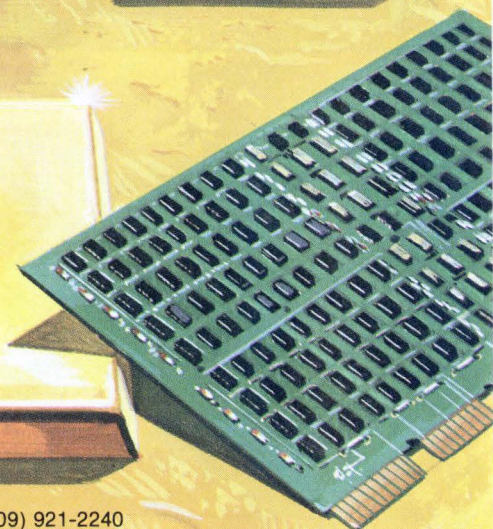
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CIRCLE NO. 66 ON INQUIRY CARD

CAD/CAM PRODUCT PROFILE

CAD/CAM spells productivity

MALCOLM L. STIEFEL, Contributing Editor

Computer-aided design and manufacturing systems increase in power, decrease in price and widen in applications

"We have been saving more than 1000 man-hours weekly," says Chuck Johnson. "Our designers now complete a job in two weeks that traditionally had required six weeks. They are also more confident that the numbers and tolerances are right. Speed of getting a job done is one important element, but the value of an error-free design is an intangible payback difficult to measure."

Johnson, computer graphics supervisor at Garrett Turbine Engine Co., Phoenix, is talking about the results his company is seeing with its Computervision computer-aided manufacturing/computer-aided design (CAD/CAM) system. Johnson is not alone. He is one of a growing number of CAD/CAM users who praise the productivity gains realized. Other users also report favorable results:

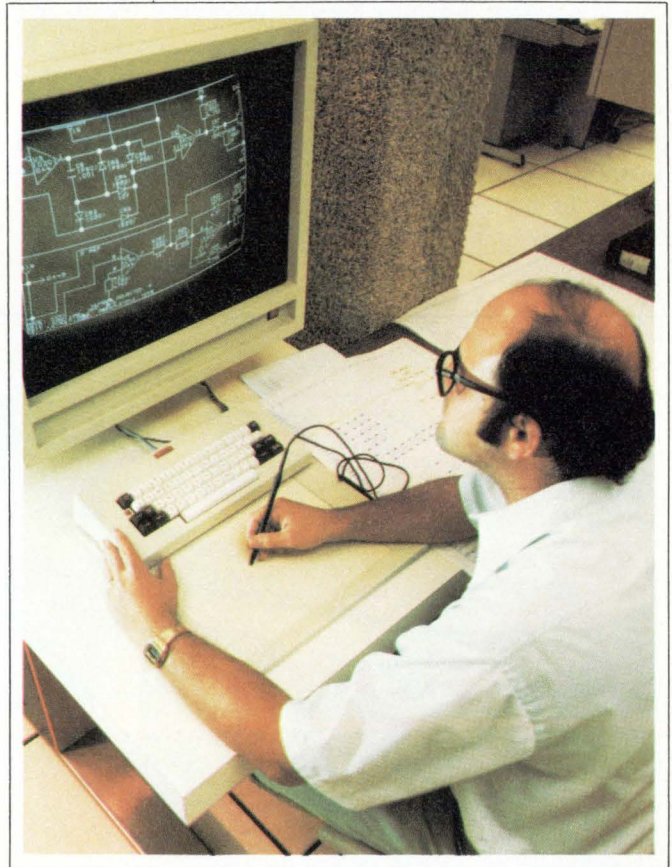
- Larry Crainich of Design Standards Corp., Bridgeport, Conn., says of his company's Summagraphics computer-aided drafting system (Fig. 1): "It's like a rubber stamp—after you've used it once, you're spoiled. I estimate it's three times faster than the purely manual process—and much more accurate; plus it's reusable." Crainich says that the company's designers no longer must do boring, repetitive details, thus freeing them to concentrate on the more creative aspects of design.

- Staff engineer John Hanlon of Stearn-Roger, Denver, says, "Eighteen people at six Auto-trol Technology Corp. graphic-design stations during three daily shifts are equal to 90 draftsmen working on the boards."

Vendors cite similar statistics. McDonnell Douglas Automation Company (McAuto) reports productivity increases of five times or greater and payback periods as low as 18 months for users of McAuto's Unigraphics CAD/CAM system (Fig. 2). Information Displays Inc. claims that "current user data" indicate productivity increases for original drawings of about 5:1, and from

10:1 to 30:1 for drawing revisions with its System 150. With results like this, it is not surprising that the market for turnkey systems is growing exponentially.

But these systems are interesting not only from a business point of view, but also from a technical standpoint. A modern CAD/CAM system (see "What's



A General Electric Corp. engineer creates new control circuits using a CAD system at GE's drive systems department in Salem, Va. The GE facility uses a wide variety of computer-aided design, manufacturing and testing equipment in the production of the adjustable speed-drive control systems it builds.

As time goes on and functional capabilities continue to evolve, users are presented with an increasing number of alternative methods of implementing CAD/CAM operations.

covered," p. 119), is in some respects, the most elegant embodiment of data processing. It combines the latest in graphics-manipulation hardware and software, data base-management technology, state-of-the-art digitizing and plotting techniques and methods of simulation—all in one package. As time goes on and functional capabilities continue to evolve, users are presented with an increasing number of alternative methods of implementing CAD/CAM operations.

The real explosion has occurred in the last three years, as technological developments have finally caught up with user requirements in processing power, storage capacity and software characteristics to make CAD/CAM cost-effective.

Configurations and applications

A typical turnkey CAD/CAM system (Fig. 3) consists of a CPU, disk storage, a work station for user interaction, a digitizer for graphic data entry and a plotter or other graphic hard-copy device. There are variables in CAD/CAM systems, however, particularly in application-software characteristics and processing power. Prices vary from \$20,000 for a stand-alone, μ p-based, IC design station, to more than \$800,000 for a 16-station system with a super minicomputer, 1M byte or more of main storage, several hundred megabytes of disk storage and a family of digitizing devices.

Small systems are intriguing because they attempt to

apply the μ p to an unsuitable application—the manipulation of pictures. As a result, chosen applications rely less on number-crunching power than on the ability to move information between a user work station and disk storage.

For example, Avera Corp. points out that its IC designer system (Fig. 4) concentrates exclusively on the initial design process. Subsequent functions, such as design-rule checking, layout verification and pattern generation, are delegated to a service bureau or an

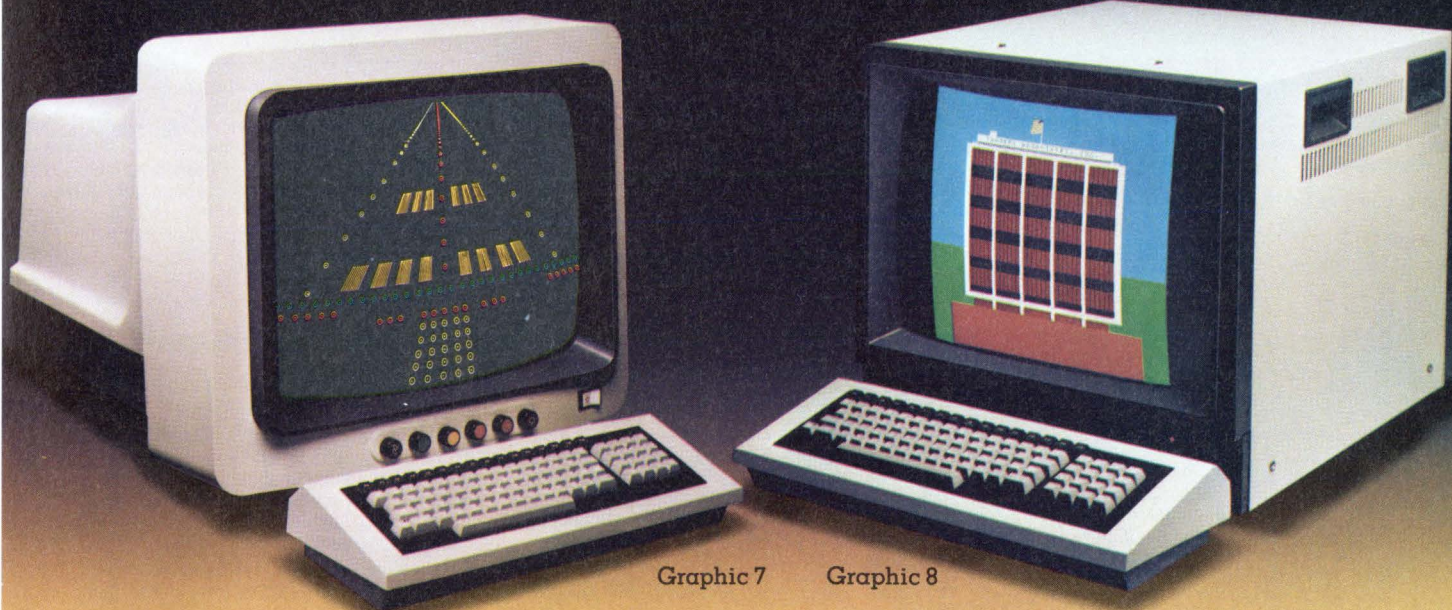


Fig. 2. McAuto's Unigraphics systems range in price from about \$20,000 to \$800,000 and can manage from one to 10 work stations. A total of 295 Unigraphics systems have been installed by McAuto worldwide to perform such applications as mechanical parts design and fabrication, pattern making, plastics-mold production and aluminum-extrusion die manufacturing.



Fig. 1. Users claim 3:1 productivity gains with the Summagraphics Datagrid III computer-aided drafting system.

THE BEST OF BOTH WORLDS: STROKE AND RASTER.



Graphic 7

Graphic 8

Want high performance raster graphics?

Sanders Associates' new Graphic 8 offers you up to 256 simultaneous colors. High resolution. Dynamic operation with double-buffered refresh memory...

Plus upward-instruction compatibility with the Sanders stroke refresh Graphic 7 and its color and 3D options.

But there's more.

Both display systems—Graphic 7 and Graphic 8—bring you built-in test, FORTRAN support, remote or local operation, interfaces to most computers, and other important user-oriented features.

Sanders' stroke refresh Graphic 7 and new raster Graphic 8 display systems: they put the best of both worlds at your fingertips. For more information, write or phone Sanders Associates, Inc., Information Products Division, Daniel Webster Highway South, Nashua, NH 03061. 603-885-5280.

The Graphics People
 SANDERS

The progenitors of modern CAD/CAM systems, drafting systems that appeared about 10 years ago, enabled users to digitize from sketches, create plots and edit plotted drawings on digitizing tables.

in-house computer. Avera essentially applies the notion of a personal computer to the IC design process—a concept that could be cost-effective for many users.

At the other end of the spectrum are full-scale, high-priced systems, exemplified by Computervision's Designer Series. The company, recognized as the leader in CAD/CAM system sales, has seen its products used in a wide range of applications, including mechanical design and drafting, manufacturing and numerical control, PC design, plant and piping design, cartography, IC design and structural design and analysis. The Computervision offerings (see Table) cover almost the entire range of common CAD/CAM applications, with the possible exception of architectural design, an area addressed by such firms as Applicon, Auto-trol Technology and Calma.



Fig. 3. The Computervision Designer system, an extremely popular turnkey CAD/CAM system, is a multi-module, hardware/software package that exemplifies the custom-configuration concept. Expandable from single-user, single-application systems to multi-terminal, multi-application systems able to support more than 30 users. The configuration shown includes a work station consisting of color raster or storage tube display, digitizer, keyboard and printer; graphics processor; disk storage and magnetic-tape drive. Additional I/O peripherals, such as pen plotters and photoplotters, as well as a broad range of additional or alternative storage devices, are available.

Manufacturer	Model	Applications	CPU and secondary storage	Work station	Input media
Applicon, Inc.	Graphics Processing System	Mechanical engineering and manufacturing, architecture/engineering, PC board design, IC and hybrid circuit design	Dual processor (DEC PDP-11 with as much as 208K bytes and Applicon Graphics model 32 (32-bit word) with as much as 192K bytes); 30M- to 800M-byte disk, as many as four magnetic-tape drives	As many as four raster scan and DVST, color and monochromatic displays, with function keys, thermal hard copy, 19- and 21-in. CRT	Digitizing tablet, digitizing table, tablet menu, electronic pen
Arrigoni Computer Graphics	Touch 'N Draw	Architecture	Tektronix 4054 graphics processor; 64K bytes, three 1.8M-byte Tektronix 4097 floppy-disk drives	4K x 4K addressable point 19-in. storage tube	120-position touch-control station
Auto-trol Technology Corp.	AD/380	Mechanical design and manufacturing, architecture/space planning, industrial plant design (piping, electrical, structural)	Sperry-Univac V77, 16-bit word, as much as 2M bytes, DEC VAX-11/780, 32-bit word, 10M to 80M-bytes disk storage, as many as four magnetic-tape drives	More than 20, 19- and 25-in. CRT screens, graphics and alphanumeric displays at each station, 240-position menu-function keyboard, thumbwheel or joystick	Gantry digitizer
Avera Corp.	GS1100, GS1120, GS1220	IC design	Dual Intel 8086; 192K bytes, as much as 10M-byte disk storage	One, monochromatic or color, 13-in. CRT, 564 x 832 pixels	Digitizing mouse or 11- x 11-in. tablet with pen
California Computer Products, Inc.	IGS-500, IGS-400	Architecture, engineering and construction	CalComp CC 16/40; 16-bit word, 128K to 512K bytes, 20.3M- to 50M-byte disk storage, magnetic tape	Multiple stations, graphics and alphanumeric displays, 15-in. CRT, joystick	Digitizing tablets, 11- x 11-in. to 60- x 44-in.
Calma	Chips, cards, DDM	IC design, PC design, mechanical design and manufacturing, architecture, engineering, and construction	32 bits; 300M-byte disk storage	Graphics and alphanumeric CRTs DVST, 20-in. screen, 512 x 512 to 1280 x 1024 pixels	11- x 11-in. tablet, 0.01-in. resolution; 57- x 76-in. digitizing table, 0.001-in. resolution, optional voice data-entry for control information
Camsco	Command	Parts design and manufacturing	H-P 2113 E computer; disk, tape	H-P 2649, 2649-C	42- x 60-in. digitizer
Computervision	Designer series	Mechanical design and drafting, PC and IC design, structural design, plant design and layout	Computervision CGP-100 and CGP-200; 168K bytes to 1M byte, 16-bit words, 40M- to 600M-byte disk storage, as many as two magnetic-tape drives, floating-point unit	As many as eight, raster or storage tube, 19-in. screen, hard-copy unit, monochromatic	11- x 11-in. or 17- x 24-in. tablet, 36- x 48-in. or 50- x 60-in. digitizing table

The success of these firms and their competitors in an ever-widening circle of applications testifies to the fundamental effectiveness of CAD/CAM systems as vehicles for improving designer and manufacturer productivity.

Alternatives to turnkey systems

When data-processing systems emerged in the 1960s, many companies found that they had potential use for these newfangled devices, but lacked the capital to acquire them. Others had the resources but not the

background in data processing, and wanted options that would not require them to make major commitments. To serve these groups, service bureaus sprang up, most in regional markets, but some on a national scale. Billions of dollars are now spent on service bureaus.

The same thing has occurred in the CAD/CAM market. Many small architectural and engineering firms, seeing the potential boost that CAD/CAM could give their productivity but unwilling or unable to buy a turnkey system, have turned instead to CAD/CAM service bureaus. Control Data Corp., McAuto and Structural Dynamics Research Corp. (SDRC) have been important factors nationally in this sector for several years. Some smaller organizations have entered the field more recently, and others soon will. For example, Cad Cam Inc., Dayton, Ohio, provides Computervision or McAuto systems and training in a customer's location. Similarly, the Cadcom division of ManTech International is introducing CAD and computer-aided drafting services for engineering firms that are "not ready for their own in-house CAD systems, but would benefit by using CAD techniques." Vectron Graphic Systems Inc., Santa Clara, Calif., offers PC board design service by which Vectron personnel can execute designs at the company's facility, or the customer can use remote computing services, with Vectron supplying a μ p-based digitizing terminal installed in the customer's facility. Interactive Design Systems, Inc., Toledo, Ohio, provides similar capabilities in CAD and computer-aided drafting.

A user can alternatively choose to use a software package that can run on his in-house system. Some of these packages are now being marketed in a unique fashion. The CPU vendor touts the software and supplies a completely configured hardware package, with work stations, digitizers, plotters and an operating system for the processor. The software vendor provides and installs the application software, and integrates it with the hardware. IBM uses this method with Lockheed Corp.'s CAD/CAM package for design and manufacturing. Digital Equipment Corp. and Perkin-Elmer use it with the AD-2000 mechanical design and drafting package sold by Manufacturing & Consulting Services, Inc., Santa Clara, Calif. DEC also sells the Sci-Cards program produced by Scientific Calculations,



Fig. 4. Avera Corp.'s μ p-based IC Designer sells for less than \$25,000.

Output media	Typical price	Circle No.
Flatbed, drum electrostatic and color ink-jet plotter, as large as 57 x 89 in.	\$300,000	443
Tektronix 4631 electrostatic screen copier or optional plotters	\$66,550	444
NC tape (via post-processor), flatbed and electrostatic plotters	\$200,000	445
Drawings on floppy disk, RS232 interface, thermal printer plotter	\$39,250	446
Drum, flatbed, beltbed and microfilm plotter	\$89,000 to \$300,000	447
Pen and electrostatic plotters, photoplotters	\$300,000	448
Directly interfaces to numerically controlled machine tools		449
24- x 24-in. photoplotter, electrostatic plotter, four-color pen plotter	\$180,000 to \$300,000	450

WHAT'S COVERED

The accompanying product table covers turnkey, computer-aided design/computer-aided manufacturing systems for which the vendor supplies interactive graphics hardware, an operating system and appropriate application software that enables a user to carry out specific design tasks. The hardware complement includes a central processor, disk storage, one or more user work stations (each with a monochromatic or color-graphic crt terminal) and one or more plotters or other graphic hard-copy output unit

The signal that the market is becoming saturated will come when vendor literature stresses performance characteristics rather than productivity gains.

Inc., Rochester, N.Y., for PC-board design, and MSC/Nastran, a finite-element analysis package from MacNeal-Schwendler Corp., Pasadena, Calif.

Applicon has comparable agreements with SDRC and University Computing Co. Both software vendors sell application programs that run on Applicon hardware and accept input files that are generated by Applicon programs.

Functional evolution

The progenitors of modern CAD/CAM systems, drafting systems that appeared about 10 years ago, enabled users to digitize from sketches, create plots and edit plotted drawings on digitizing tables. On some systems, a user could also create a symbol table to place symbols anywhere on the drawing. This feature

facilitated the production of electronic logic diagrams, in which the basic elements—the AND gate and OR gate symbols—could be moved around and connected with straight lines. Also available in these early systems was the ability to annotate drawings with alphanumeric information, enabling the creation of wiring and component lists as inputs to manufacturing.

The second major enhancement to functional ability was the implementation of design rules. For example, software prevents two elements from overlapping on a drawing, a feature important not only in preparing logic diagrams, but in facility layout, piping design and PC-board design (Fig. 5). For example, Vectron Graphic Systems, in its PC-board design services, provides 0.013-in. minimum air gap, 0.025-in. grid centers for trace features, 0.200-in. minimum spacing from a component to edge of board, and 0.050-in. minimum from a trace to edge of board.

Early parts-design programs operated in batch mode, producing paper tapes to drive numerically controlled machine tools. Today a manufacturing engineer interactively creates the machine-tool path through the CAD/CAM work station. Using an Applicon system, an engineer can view the tool path in 3D while

Manufacturer	Model	Applications	CPU and secondary storage	Work station	Input media
Decision Graphics Inc.	PEAC Series	Facility planning, office design, factory layout, engineering, architecture, construction	DEC PDP-11, VAX-11; 16 or 32 bits, 256K bytes to 1M byte, 20M- to 134M-byte disk storage	As many as two, 19- and 21-in. screen	Tablet, 44- x 60-in. digitizing table
DMT Corp.	ADS/200	VLSI design	DEC LSI-11/23 computer; 128K bytes, Winchester disk, 15M-byte tape cartridge	Graphics and alphanumeric displays, eight-color, 19-in. screen, 640 x 512 pixels	11- x 11-in. tablet; 44- x 60-in. digitizer table
Gerber Scientific Instrument Co.	PC-800 model 2	PC board artwork production	16-bit minicomputer; 64K bytes, 1M-byte floppy-disk drive	20-in. screen, cursor control arm	42- x 60-in. digitizer
Information Displays Inc.	System 150	Electrical and electronic design, facilities management, architectural engineering, mechanical design, housing and light construction		Color-raster CRT	Digitizers
Intergraph Corp.	IGDS	Architecture, engineering, construction, petroleum-industry processing, mechanical design	DEC PDP-11/44, PDP-11/70; 16 bits, 768K bytes, 80M to 675M- byte disk storage, magnetic-tape drive	As many as 16, dual raster display; 19-in. screens, 1280 x 1024 pixels, hard-copy unit, monochromatic and color	36- x 48-in. or 42- x 60-in. digitizers, 0.001-in. resolution
McDonnell Douglas Automation Co.	Unigraphics	Parts design and manufacturing	DEC PDP-11, VAX-11, DG S/230, S/250, MV/8000	As many as 10	
Nicolet CAD Corp.	System 52, System 54, System 81	PC-board and hybrid-circuit design	DEC LSI/11/2, LSI-11/23, Tektronix 16-bit processor, Nicolet 32-bit processor; 128K to 1.5M bytes, 1M-byte disk storage	19-in. DVST screen, 1024 x 780 and 4K x 4K resolution, 19-in. color-raster screen, 780 x 512 resolution joystick	36- x 48-in. digitizer, 0.001-in. resolution
Summagraphics Corp.	Datagrid II	Drafting, architecture, engineering, construction	64K bytes, 10M- to 30M-byte disk storage, magnetic-tape unit	11- or 19-in. screen, DVST, color raster display, alphanumeric display	36- x 48-in. digitizer with 0.005- in. resolution, other sizes and resolutions available
Synercom Technology Inc.	Infodraft	Drafting, architecture, engineering	DEC PDP-11/34, PDP-11/70	As many as eight with alphanumeric and graphics displays, 19-in. screen, 4K x 4K addressable points, hard-copy unit	10- x 10-in. tablet; 36- x 48-in. table, 0.005-in. resolution
T & W Systems, Inc.	T-Square	Drafting, piping layout and design	Terak 8510/a processor (DEC LSI-11); floppy-disk storage	12-in. raster-scan monochromatic or color display	11- x 11-in. tablet

it is being created. The tool path can be readily changed before any metal is cut. When the path is verified, a University Computing Co. software package is invoked on the Appicon hardware to create a program in the APT language for control of the machine tool. This is a far cry from the days when it was necessary to label drawings and manually write part- and tool-path descriptions and run programs on a computer, repeating the entire process until a satisfactory NC program was produced.

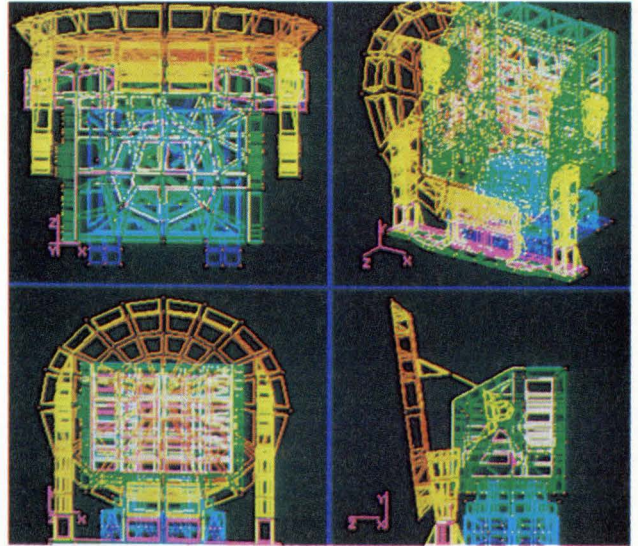
BNR, Inc., a subsidiary of Bell-Northern Research (the Bell Labs of Canada), has a μ p-based software package that automatically routes interconnections on PC boards with 100 ICs in a few minutes. This process previously took many hours of expensive mainframe computer time.

Substantial progress has been made in design, but relatively little has been made in manufacturing. It has been necessary to carry the outputs of the design process, such as NC tapes, to a machine tool. That situation is beginning to change also. Camsco's Command System provides direct computer interfaces to various machine tools, bypassing the NC tape. The Camsco system can also produce paper tape, magnetic

tape or floppy-disk outputs to drive tools that do not accommodate direct computer control.

A logical follow-on to the generation of a bill of material from an assembly drawing is the automatic scheduling and control of the various machine tools that

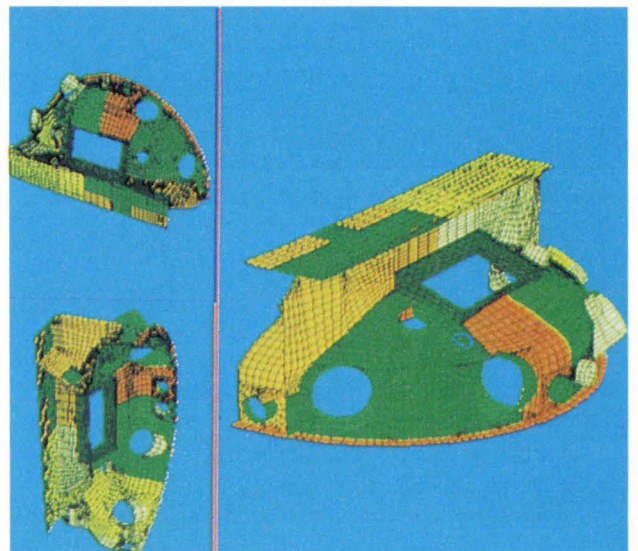
DESIGN IN COLOR



Distinctive color rendering can add considerable information to CAD applications. The accompanying hard-copy photographs, generated by Image Resources' Videoprint System, illustrate how the PATRAN software developed by PDA Engineering, Santa Ana, Calif., uses color to highlight features of complex 3D representations. PDA Engineering claims that PATRAN reduces the time to develop designs for stress analysis more than 90 percent.

The Videoprint above shows four "wire-format" views of a finite-element model of a radar housing and reflector dish. Color was used to separate physical sections of the radar rather than to translate stresses.

The Videoprint below, consisting of three views of the top portion of a nuclear reactor containment vessel, shows the use of solid-color fill. The "wires" show physical deformations, and the colors highlight areas of pressure and thermal stress.



Output media	Typical price	Circle No.
Three- or four-pen drum plotter; 22-in. wide electrostatic plotter	\$160,200 to \$471,540	451
Drum, flatbed, electrostatic plotters		452
Photoplotters	\$49,000 to \$96,100	453
Pen, electrostatic photoplotters, COM units, phototypesetters		454
Pen plotter, four pens, 52- x 80-in. or 34- x 60-in. 32-in.-wide drum plotter, 11- to 72-in.-wide electrostatic plotters, 200-dpi resolution	\$400,000	455
	\$220,000 to \$800,000	456
11- x 17-in. flatbed plotter, 12- to 54-in. wide four-color drum plotter, paper-tape punch for NC tape	\$98,200	457
34-in. drum plotter, 34- x 60-in. flatbed plotter	Less than \$50,000 to \$80,000	458
10½-in.-wide, 200-dpi printer plotter		459
11- x 17-in. plotter	\$17,950 to \$22,500	460

The low-cost system will ultimately evolve into a dual-mode unit that can operate alone or as an intelligent terminal tied to a remote host or to other terminals in a distributed processing network.

produce the parts and the assembly stations. Commercially available CAD/CAM systems do not go beyond generating a bill of materials and producing assembly drawings and instructions. The manufacturing procedures remain under local user control. In the next

FROM COMPUTER ROOM TO DESK TOP

A desk-top computer-aided graphics-design system that performs the same function as room-sized equipment of a few years ago is offered by the Avera Corp., Scotts Valley, Calif.

The GS-1100 is a sophisticated interactive work station designed to function as a stand-alone drafting system or as an input terminal for a large computer system. At \$40,000 for the basic system, its price is less than half that of other CAD systems.

The GS-1100 leaves such functions as design-rule checking layout, verification and pattern generation to service bureaus or separate in-house computers, allowing the designer to buy only the features he needs without paying a premium for functions better handled on a large computer.

The Avera system consists of a 17-in. display monitor, an electronic control unit, a graphics-input device (mouse or tablet) and an alphanumeric keyboard. Its vertical CRT screen is divided into four regions: the graphics display region, the text region, 24 function boxes along the sides, and two lines at the bottom that indicate system status. Text can also overlay the graphics region for a larger alphanumeric display.

The heart of the Avera system is its dual CPU processor, which uses twin 8086 computer boards, one for system operation and one for graphics. Each board contains 64K bytes of dynamic RAM, but the system can address 1M byte, which can be divided between the two processors.

Avera is aiming the systems at both end users and OEMs, in particular, software houses expert in developing design programs but that need sophisticated graphics.

generation of CAD/CAM systems, this segment of the business will also be automated.

The state of the CAD/CAM market is clearly indicated by the vendor's pitches; they address customers that do not have CAD/CAM systems and emphasize the productivity gains to be realized by abandoning manual methods. The market is clearly undersold, and will remain so for the next few years. Therefore, no one is yet attempting to convince organizations that already have CAD/CAM installations to switch allegiances.

The signal that the market is becoming saturated will come when vendor literature stresses performance characteristics, such as response time, capacity and

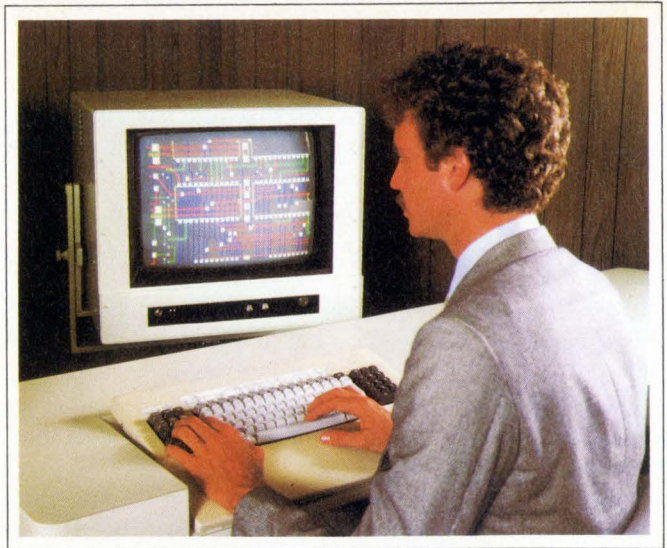


Fig. 5. Nicolet color refresh system 81 for printed-circuit design.

reliability of systems, rather than productivity gains. Meanwhile, the market will remain large enough to accommodate additional vendors, although it will become increasingly difficult for a newcomer to enter the full-scale systems market because of the enormous investment required. But low-cost competitors will continue to appear, and their numbers will swell more rapidly when 32-bit μ ps become available. These will allow additional processing power to be built into low-cost units.

At the same time (and for the same reason), the cost of software will begin to dominate the purchase price. Because the software capability of these systems will continue to escalate over the next few years—with increased use of simulation and manufacturing automation, as opposed to design automation—total system costs will remain stable, even with hardware prices dropping. Also look for service bureaus to continue to flourish as alternatives to acquiring full-scale systems.

The low-cost systems will ultimately evolve into a dual-mode unit that can operate alone or as an intelligent terminal tied to a remote host or to other terminals in a distributed-processing network. Local area networking techniques, so far absent from the CAD/CAM arena, are likely to be introduced very shortly to allow more effective uses of intelligent terminals.

Taken together, these movements make CAD/CAM one of the most intriguing markets around. ■



Malcolm L. Stiefel, now a group leader at Mitre Corp., has worked as a systems analyst, systems engineer and programmer on military command-and-control, hospital administration, investment securities and municipal information systems.

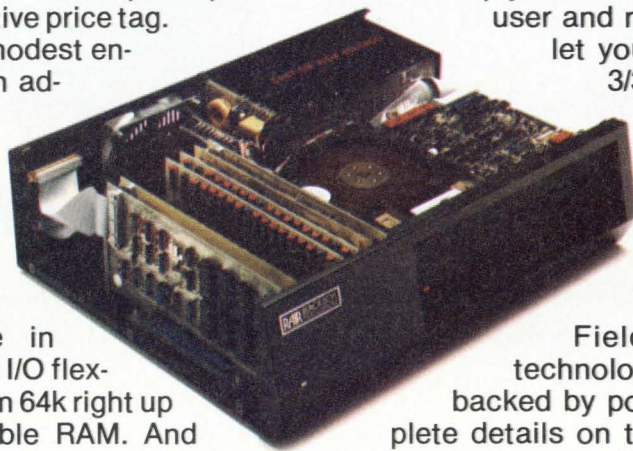
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CIRCLE NO. 68 ON INQUIRY CARD



Intel's Series 90/iQX. The memory

Intel's new Series 90/iQX is the first standard Intelligent Memory System to offer continuous operation and high maintainability at low cost.

Now, for the first time, OEMs can design systems with built-in protection against errors, downtime, and excessive maintenance costs. How? With Intel's new Series 90/iQX.



Series 90/iQX Intelligent Memory System

The iQX controller adds the intelligence of an iAPX 86 microcomputer

to the standard Series 90 Memory System. Intelligence that monitors memory operation directly, detects and corrects errors, runs local or remote diagnostics, and reallocates memory space as required. All without burdening the host system.

Fault-tolerant operation

Hard errors or soft, Series 90's iQX controller uncovers them. Soft errors are simply "scrubbed" and corrected. In case of hard errors or device failure, the controller routes data around the problem, allocating spare memory as needed. It then logs the error for future reference.

With protection like this, the Series 90 system will continue operating uninterrupted until all spare memory is filled.

And thanks to the iQX's memory status reporting, your customer will know well in advance of memory resource problems. Which not only improves data integrity, but increases reliability and reduces maintenance dramatically.

Instant diagnostics

To keep users continually apprised of conditions within their memory system, the iQX controller provides easy access to its complete diagnostic file. Information can be accessed by the host system either automatically via a simple message-driven software interface, or manually, using the iQX's Service Communicator. This detachable terminal allows technicians to instantly retrieve diagnostic data in plain English through a compact, alphanumeric keyboard/display. With no interruption of the host computer's operation.

For fast, simple maintenance, system diagnostics inform the user of any



machine with non-stop intelligence.

errors it has tracked—soft or hard, correctable or avoidable—and their precise location by row and column.

Many problems can also be solved using the iQX's memory tasking capability to move data blocks as required. Then too, the iQX monitors the system's power supply and signals a warning if voltages drop critically. As a final, double protection, the iQX controller even diagnoses its own operation continuously.

Diagnosing from a distance

To reduce maintenance costs for remote systems and networks, iQX diagnostics can be accessed over phone lines through a single diagnostic station. By being able to analyze problems from afar, you'll eliminate unnecessary service visits and shorten those that are required. And since one diagnostic station can easily serve up to 150 installations, the set-up and ongoing diagnostic costs are contained as well.

Consider the economics

The iQX's protection features offer important economic advantages for systems OEMs. Because of the increased demand for fault tolerance in today's marketplace, systems equipped with iQX capability add significant value to your products. In fact, many applications simply could not be justified economically *without* such self-healing and remote maintenance. Now, through Intel's leadership in 16-bit microprocessing, the Series 90/iQX brings you this capability at an incremental price only nominally above that of ECC alone.

In sum, iQX gives your systems state-of-the-art fault protection, reduced maintenance costs, and therefore increased value. Best of all, Intel is delivering Series 90 systems with iQX right now. For detailed information, return the coupon to Intel Corporation, 3065 Bowers Avenue, Santa Clara, CA 95051. Telephone (408) 987-8080. For hot line service, call (800) 538-1876.

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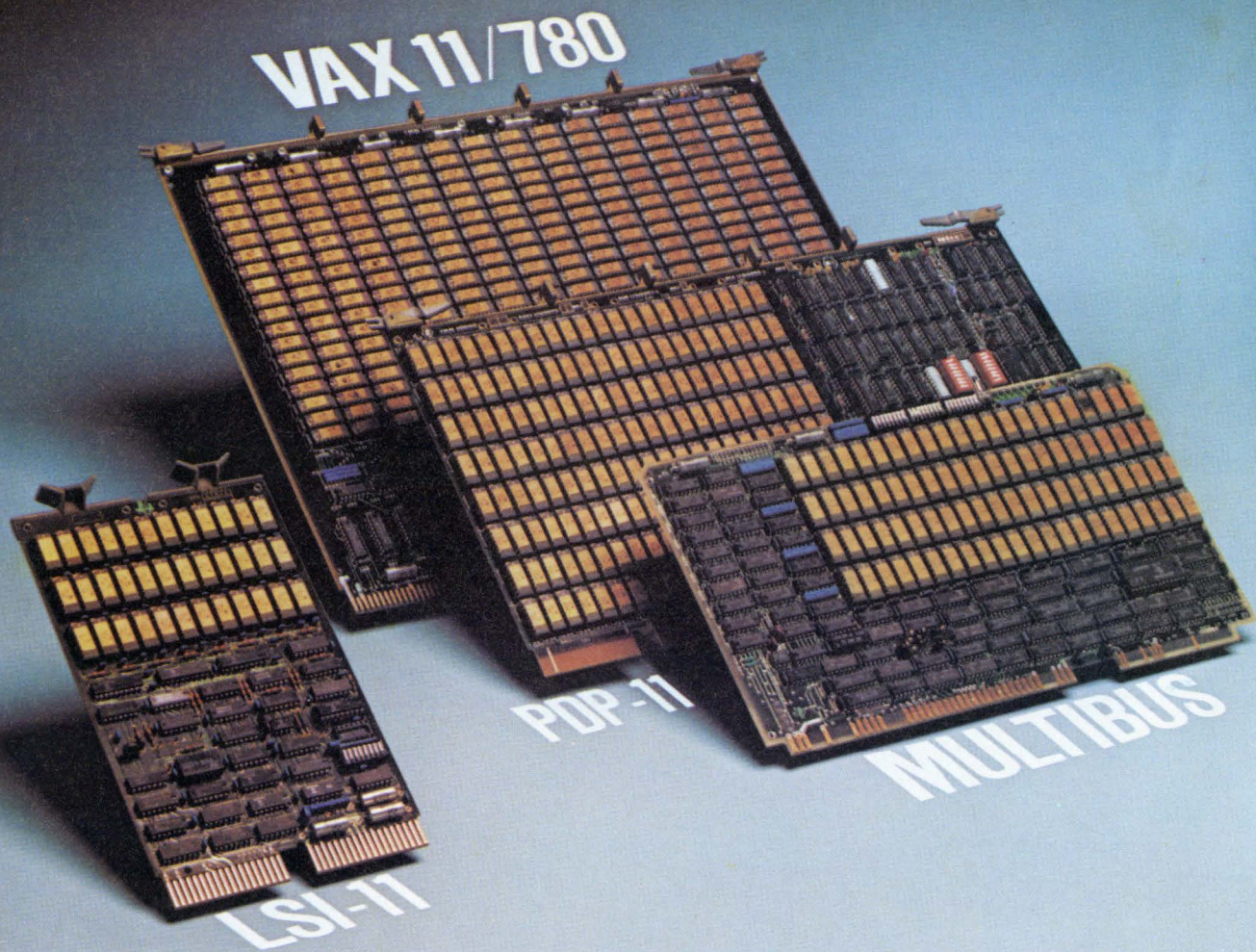
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CIRCLE NO. 69 ON INQUIRY CARD



TI leadership. In 64K DRAM technology. In Memory Systems.

Whatever bus you're using — VAX[†], PDP-11[†], LSI-11[†], or even Multibus[‡] — TI can supply add-in memory system boards with dynamic RAMs from our own high-performance 64K series.

When you specify TI's high-density, low-power boards, you save rack space. So you have more room for I/O — or whatever else you need. And, the low-power consumption of TI 64K DRAMs, compared to the old-fashioned 16Ks, cuts temperature levels and increases reliability. The reduction in memory package count by as much as four boosts reliability even more.

System reliability will be higher, too. Thanks to error correction/detection available on many TI memory boards. Using our own bipolar EDAC chip helps cut component count and system temperature, as well as improving basic system reliability. The EDAC chip replaces

about a quarter of a board of TTL circuitry.

All TI boards are 100% tested. 100% burned-in. All in TI's modern, high-capacity Houston facility. Delivery normally ranges from stock to four weeks.

Low cost

Representative pricing* for TI memory boards is as follows: \$1600 for TMM10000-04 (192KB); \$3800 for TMM20000-02 (256KB); \$9000 for TMM30000-01 (1MB); \$1845 for TMM40010-07 (64KB).

Custom capability

If you need custom memory systems in production quantities, be sure and talk to TI. We'll custom design boards for specific applications with the same meticulous attention to cost/performance effectiveness that our standard boards offer.

So for the latest DRAM technology, highest packing densities, lowest power consumptions, all at competitive prices, remember memory systems from Texas Instruments.

To find out more about TI boards call your local TI field sales office or authorized distributor. For details, call (713) 778-6549, or write to Texas Instruments Incorporated, Integrated Memory Systems, P.O. Box 1443, M/S 6404, Houston, Texas 77001.



TI MEMORY BOARDS — CURRENT AVAILABILITY								
System	TI Series	BYTES/BOARD						
		64K	128K	192K	256K	512K	768K	1M
LSI-11 [†]	TMM10000 ¹		X	X	X			
PDP-11 [†]	TMM20000 ²		X	X	X	X		X
VAX [†]	TMM30000					X	X	X
Multibus [‡]	TMM40010 ²	X	X		X	X		

¹ Parity optional ² EDAC standard

CIRCLE NO. 70 ON INQUIRY CARD

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CAD/CAM

Inside the outside CAD service bureau

CHARLES SIMON, Vectron Graphic Systems

Specialists in printed-circuit computer-aided design and design automation can be true 'friends in need'

Computer-aided design (CAD) and design automation (DA) service bureaus are valuable resources for companies needing quick, accurate printed-circuit-board design and artwork. If your company is like most, you turn to one at times of trouble. But when the deadline is at hand, your department has too much work, and panic has set in, there just isn't enough time to find the right bureau to handle your printed-circuit-board design and artwork.

Before that regrettable scenario unfolds, why not get comfortable with a couple of service bureaus? Visit several, send a job or two to the best candidates and compare the results. Then, when the pressure is on, you'll be dealing with a firm in which you have confidence. Here are some criteria for evaluating service bureaus and suggestions for dealing with them.

Selecting a service bureau

First, compare your current and projected needs with the services offered by various bureaus. Then, ask yourself these questions:

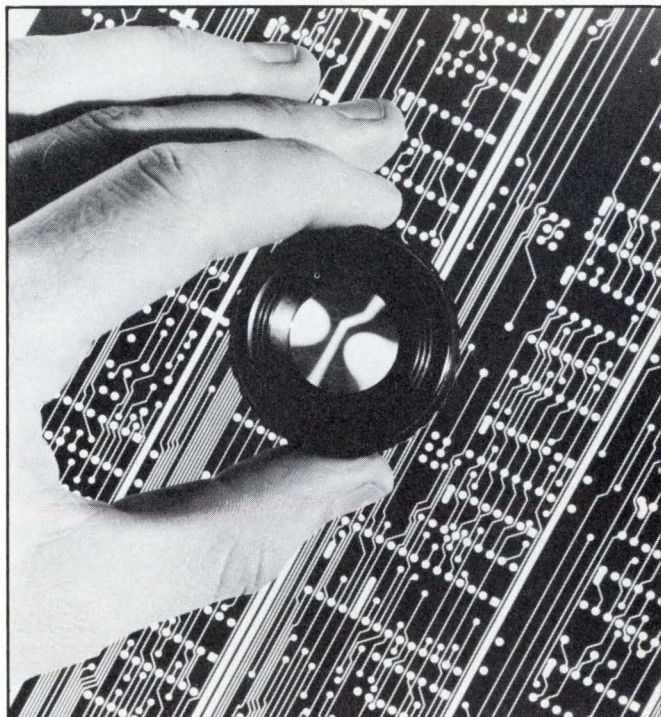
- Will I need a large volume of designs?
- Do I need the lowest possible price?
- Do I want computer-generated artwork?
- Is absolute reliability on turnaround important?
- Can I predict my future requirements?

By examining your answers, you can determine what sort of firm you should be hiring. Associating yourself with the lowest bidder may be a mistake, particularly if your volume will overload that service bureau. One late board a week may cost you more than the difference in quoted design prices.

Before engaging a service bureau, visit four or five and ask how they will handle your work. Because no single bureau can do everything well, learn the specialty of each. Geography should not govern your

selection; one-day air-express delivery makes New York and California neighbors. Your explicit, written instructions mailed from a thousand miles away should present no more of a problem to the service bureau than if they had been sent from across town.

Data is interchangeable among most CAD systems so you needn't worry about being locked into any particular vendor's system. If you have a dozen boards designed on a particular service's system and then buy your own system or switch services, you can typically



The computer-generated (CAD) artwork shown here is highest possible quality. Make sure the service bureau you select can produce artwork that is good enough for your fabrication needs.

If you have a dozen boards designed on a particular service's system and then buy your own system or switch services, you can typically transfer the data base intact.

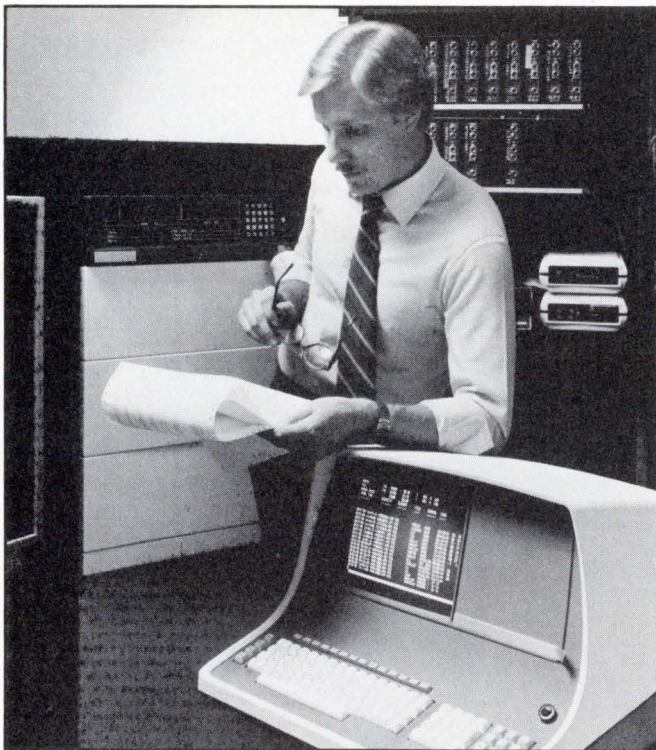
transfer the data base intact.

In evaluating service bureaus, be honest about your objectives, and be specific. This will accelerate your selection process. To start, check into their policy and performance on fast turnaround, large digital boards, single-sided boards, multi-layer boards, high-density two-layer boards, fine-line work, analog, ECL or other special capabilities. If you need services they do not handle, ask them to recommend appropriate companies. In the service bureau business this is not at all uncommon, and you will usually benefit from their recommendation.

After you have narrowed the field on specialty services, focus on their operations. How large is the design capacity? How long have they been in operation? How many designers are there? Do they use computer equipment, and if so, what kind? What are their procedures for handling your type of PC layout? What is their policy on delivery and checking, and what is their artwork guarantee? Also, ask the service bureau for references, and check them.

Once you get these questions answered, you will have a good benchmark for determining what to expect.

After you have chosen two or three candidates,



Design automation (DA) takes the design process away from the designer and gives it to the computer. A DA service bureau will spend more time at the computer terminal than at the drafting table.

prepare a request for quotation (RFQ). Include the following documentation:

- schematics
- board outline drawings
- descriptions of non-dip components
- specialized design rules (most services have their own standard)
- delivery requirements
- special instructions.

This list should be written with attention to such critical factors as size, speed and density.

Most services deliver a standard package. For a

Manual	\$15/IC at a garage shop \$30/IC at an established service
CAD capabilities	Add \$10 to \$20/IC
DA	\$35 and more/IC

Fig. A. Prices to expect for the three operations. CAD and DA are usually equivalent in quality and similar in price. DA is usually more reliable and faster because fewer manual steps are involved. The extra expense of photo-plotted artwork can be repaid in saved production costs.

two-layer board, it might include film for the front, the back, the drill master, solder mask, silk screen, fab and assembly drawings, and a marked-up schematic. The package may also contain drill tapes and other extras. For a valid comparison, your RFQ should be the same for each company.

Service bureaus tend to equate a sloppy RFQ with problems on the job and, in anticipation of extra costs, may quote higher than normal.

Should prices differ significantly, re-check your RFQ; some companies may be misinterpreting your instructions. Double check an exceptionally low quote to ensure that you are not being "low-balled" at the expense of quality. Table A gives you an idea of prices.

Once you have decided on a company, resubmit your information. If much time has elapsed since the original RFQ, your schematics or the service bureau's work and price schedule may have changed.

On your new submission, be sure to add footprint drawings of any non-dip component. Supply specific drawings of pad sizes, the dimensions between the pads and the size of the body of the components. Avoid submitting only one spec sheet with many different component sizes on it. If you can't avoid this, eliminate all irrelevant information.

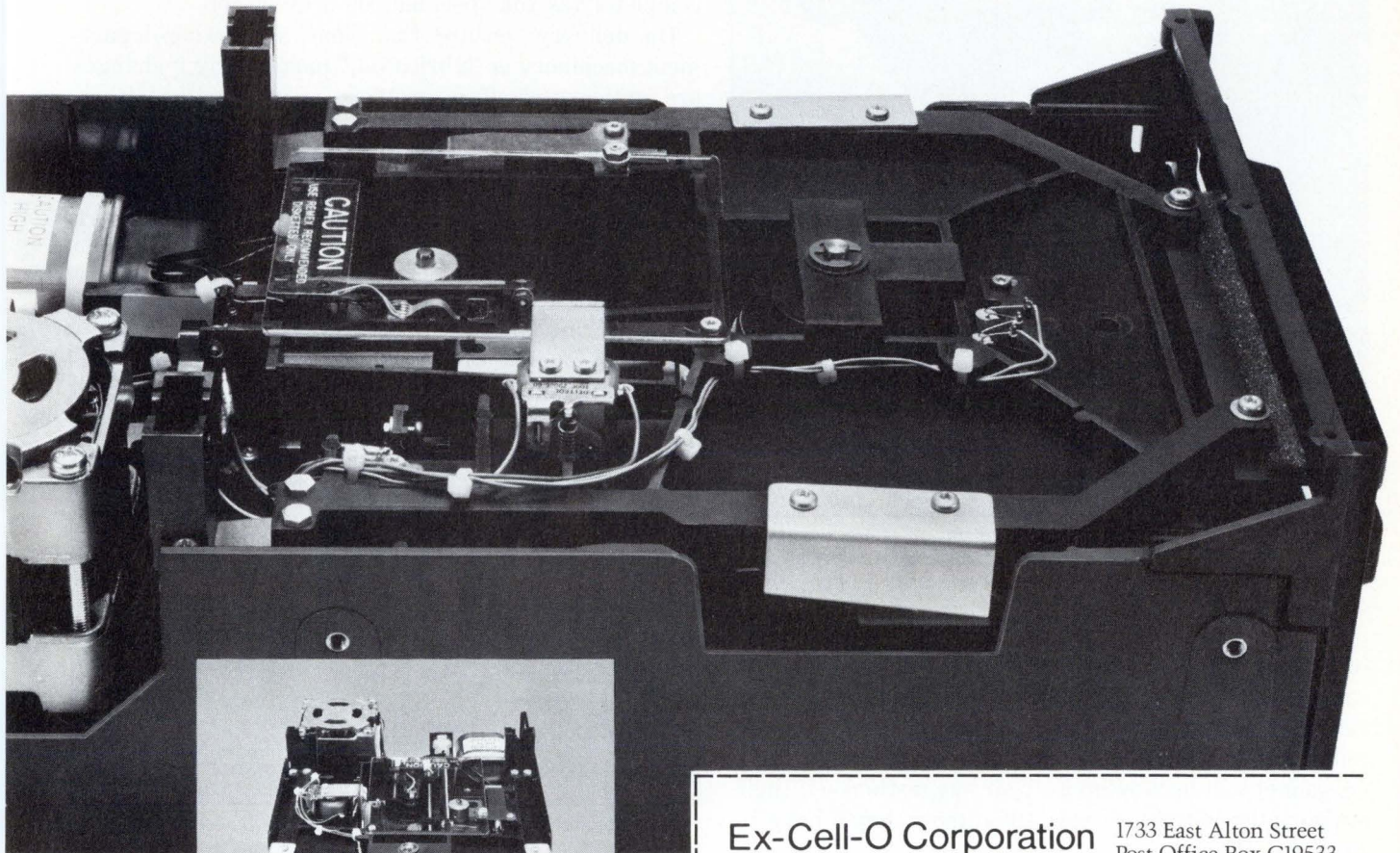
Furnish the service bureau a large, accurate drawing of the board. Include the pinouts of any non-7400 ICs. Spec sheets here will do fine. This saves design time and averts mistakes. Don't expect a service bureau to clean up poor documentation and organization or to derive precision from verbal directions. Remember, "garbage in" leads to "garbage out."

Your service bureau and you

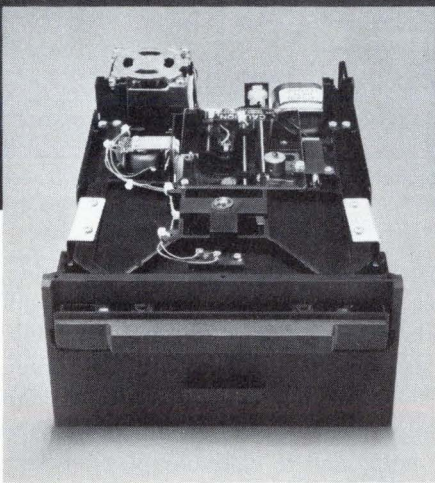
The relationship with a service bureau is a two-way street. Remember that the company you choose wants

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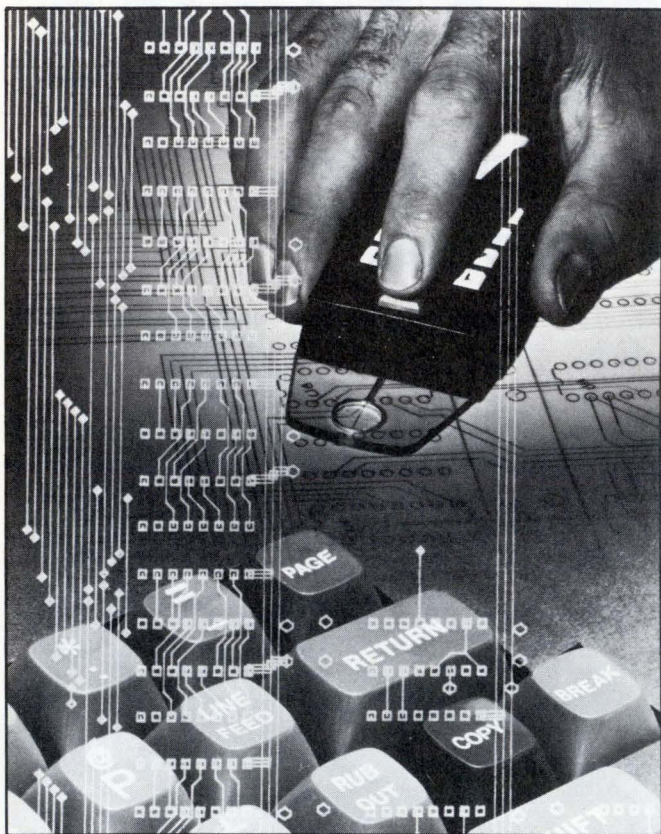
Company _____

Address _____

City _____ State _____ Zip _____

Phone _____

Service bureaus tend to equate a sloppy RFQ with problems on the job, and, in anticipation of extra costs, may quote higher than normal.



A service bureau with computer-aided design (CAD) will design your board by hand but enter it into a computer to make artwork. Shown here are some of the equipment and displays from such a computer system.

to do the best work possible. Don't worry about losing control over the job. If you've selected wisely, your service bureau will become a partner by keeping you in touch and in control at all points along the way. Their personnel will usually invite your suggestions—if their artwork doesn't please you, they know they'll have to re-do the job.

Keep in mind that service bureaus are in business for profit. If you try to minimize their profit, you will probably get just what you paid for. Establish a high-level relationship with a service bureau and you'll quickly realize the rewards.

While the bureau is processing your work, don't call every day to ask how the job is going. Continual updates are time-consuming and may increase the turnaround time. Don't dribble design changes one at a time; they are expensive to handle that way. Remember that what you think is a minor change may be a major design problem for the service bureau. Try to arrange a schedule to check the board at each milestone. This will allow the service bureau to reserve time for correcting any errors you find. Don't hold the

layout for weeks on end, because the service bureau's money is tied up in your half-finished job. If the company were to allocate liberal "contingency time" for every job, the costs would be staggering, and your deadline would probably not be met.

Delivery and inspection

On delivery of the job, make sure that all the artwork and documentation are as requested and that the film is of the expected quality. If there are problems, this is the time to get them corrected. Most service bureaus will try to iron out wrinkles, but don't expect corrections "immediately" if you have waited several months to point them out. When changes are needed, alert the service bureau so it can schedule your work. Specify the modifications you want as carefully and completely as you specified the original job.

On delivery, ensure that your accounting-department machinery is "lubricated," particularly if changes are anticipated—if a problem should arise with a subsequent job, a history of slow payment can make the best-intentioned company unaccommodating.

Virtually every service bureau has heard complaints such as "the job was late and had design errors, rework was slow and artwork was of poor quality." Because the

Price—Can they really meet your requirements at their low price?

Automated artwork—How much accuracy do you really need?

Turnaround time—How soon do you really need the work?

Capacity—Can they do your volume of work on time?

Experience—How long have they been in business?

Expertise—What is their specialty?

Organization—Are they more than a "mom and pop" operation?

Change policy—Will updates be easy and timely?

Artwork guarantee—Will errors be corrected?

Fig. B. Major criteria for evaluating a computer-aided design (CAD) or a design automation (DA) service bureau.

company does custom work, there will always be differences between what is expected and what is delivered. Be firm but realistic. Deal with a service bureau as you would your staff. Make sure your specifications are correct and complete. You will find these companies to be an excellent resource of quick, efficient help, and a valuable partner in overcoming workload swings that can cause nightmares in cost, performance and personnel problems. ■

Charles Simon is president of Vectron Graphic Systems, Santa Clara, Calif.

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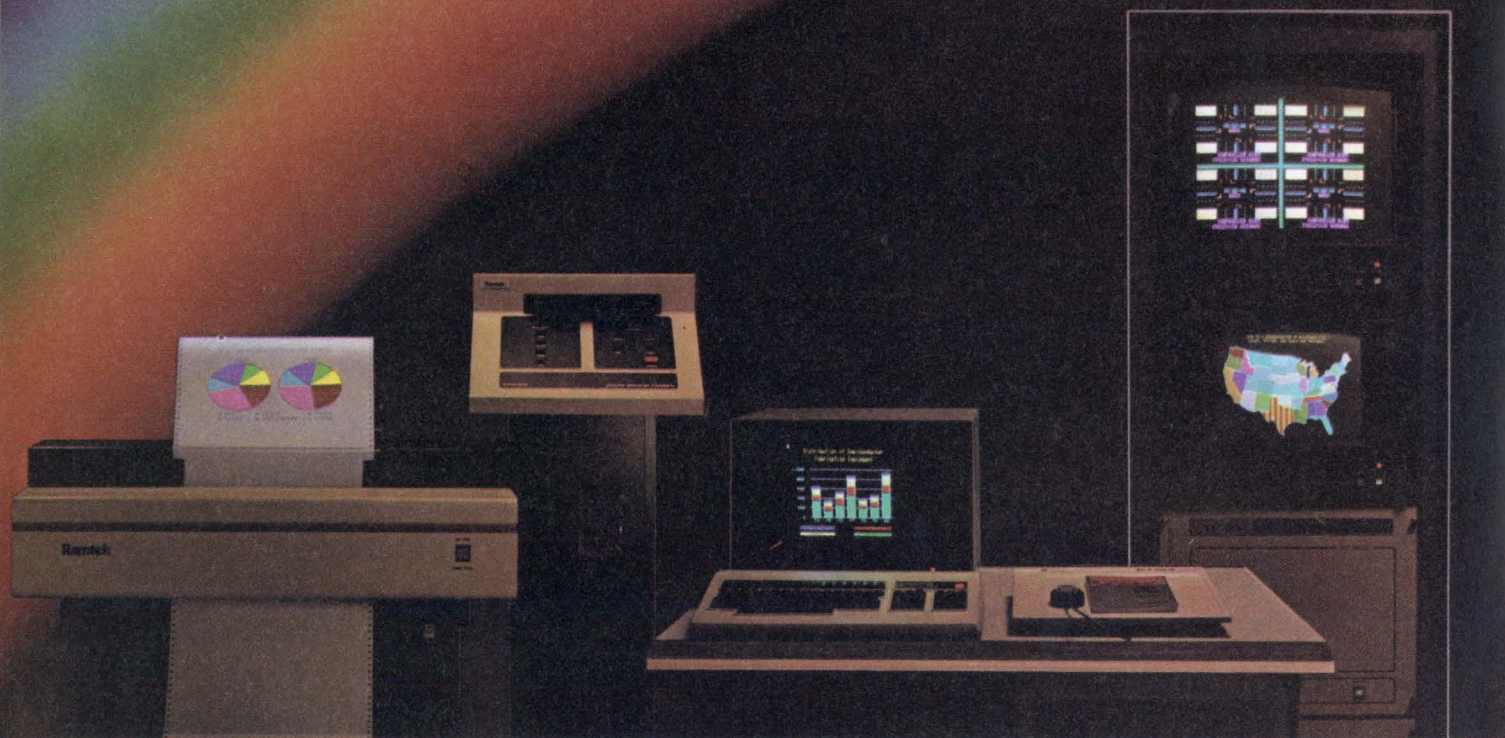
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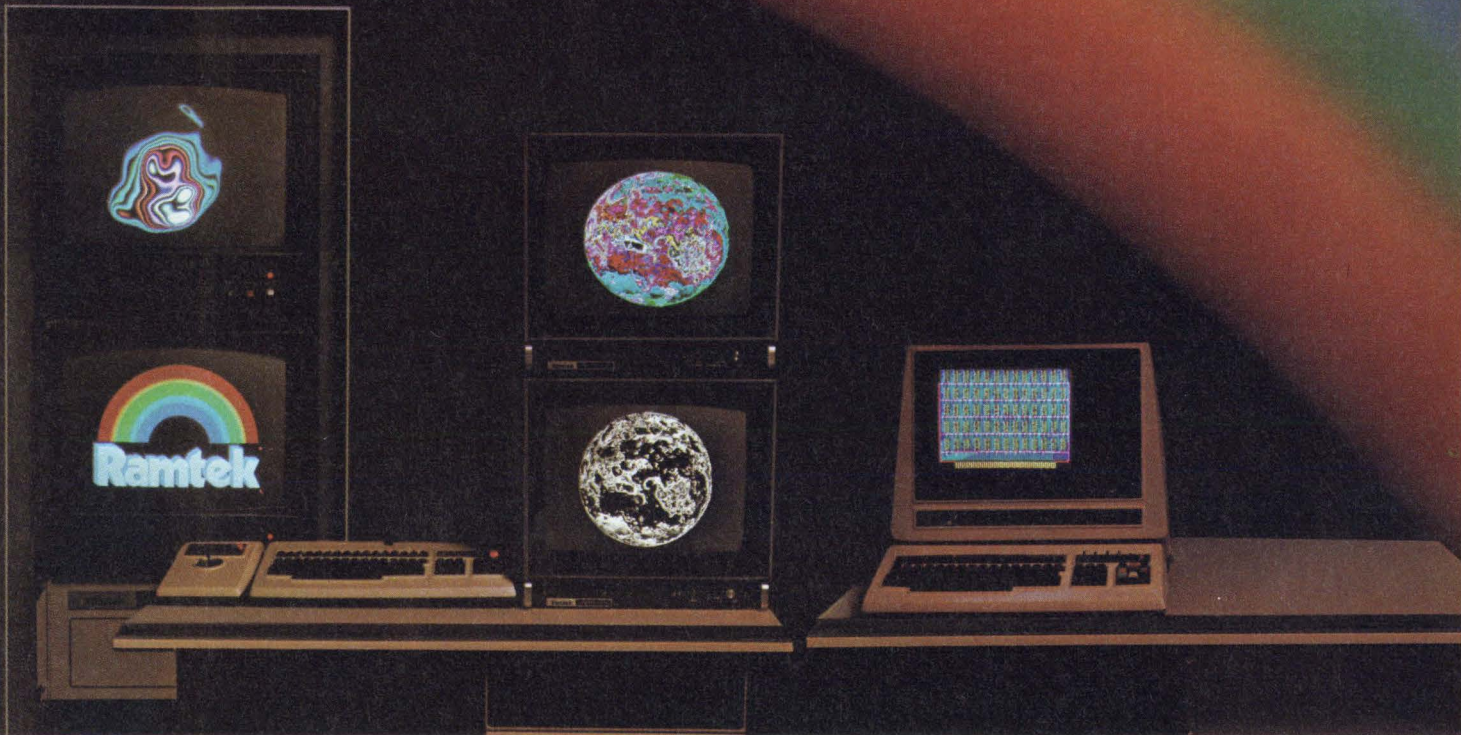
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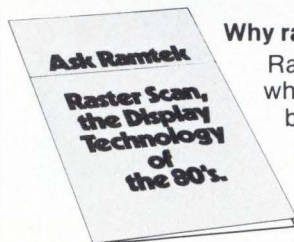


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APPLICATION CAD/CAM

Wire wrapping by μ c

ROBERT L. MYERS, Omnimation

Wave Mate's 'Wrap Mate' system overcomes the handicap of traditional wrapping methods and reduces time and cost as well

Wire wrapping is one of the most widely used electronic-packaging techniques. It is used to generate prototype circuits to verify circuit operation before committing to the expense of designing and manufacturing a PC board. It is also used for low-volume production where a PC board would not be cost-effective. The procedure has been and will probably continue to be the primary method of interconnecting backplanes.

Historically a time-consuming, tedious, error-inducing process, wire wrapping has been helped significant-

ly in its struggle to keep pace with other facets of the computer industry by μ c-based CAD/CAM technology. The user inputs the pin configuration and from-to list; the system computes the optimal connection pattern and wraps and tests what it designed. With NC-based CAD/CAM, an operator can design and wrap an average-sized wire-wrap board in just a few days. Other methods are not quite so convenient.

Approaches to wire wrapping

Manual wire wrapping begins with the extraction of

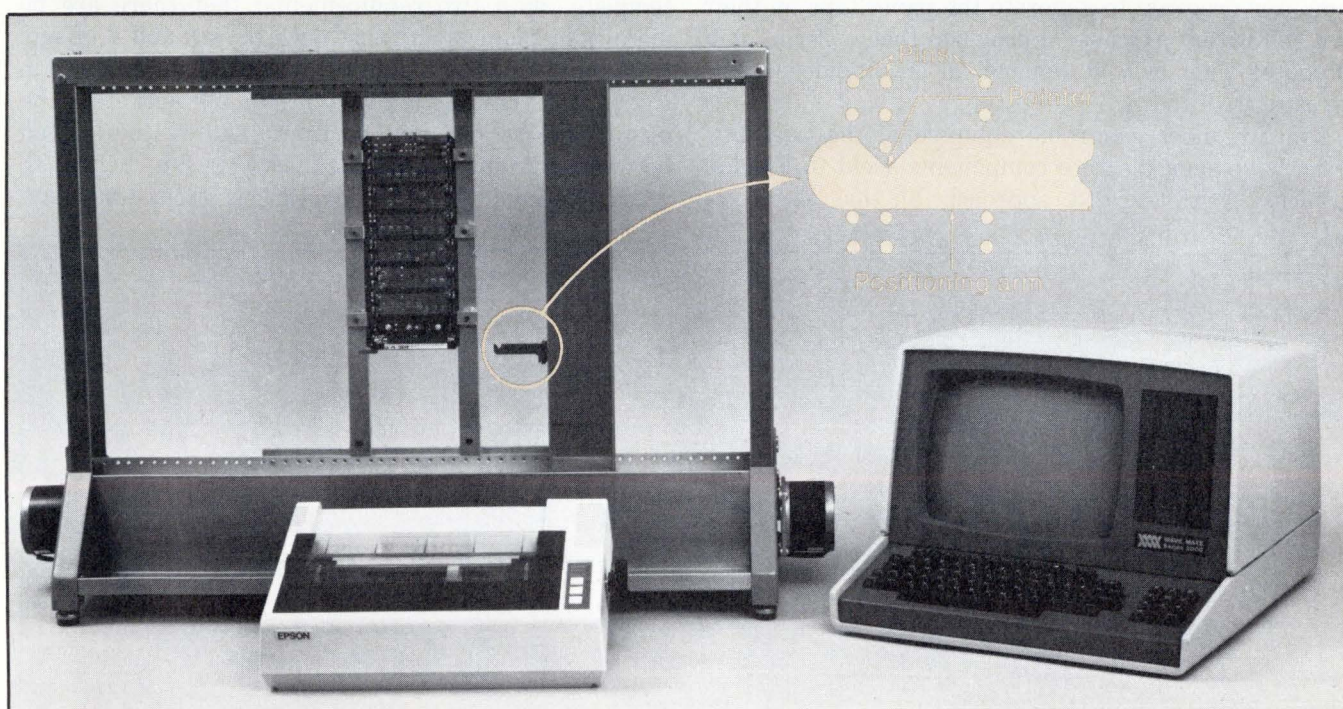


Fig. 1. The wire-wrapping frame holds the board of pins being wrapped. The positioning arm (inset) points to the pins in the proper sequence. A matrix printer and the Series 2000 μ c complete the Wrap Mate system.

Historically a time-consuming, tedious, error-inducing process, wire wrapping has been helped significantly in its struggle to keep pace with other facets of the computer industry by μ C-based CAD/CAM technology.

a net list from the schematic or wiring diagram. The net list is then organized into a wire list ("from-to") list, and sockets are located on the board. These are connected by wrapping wires on the pins called out in the wire list using a manual wire-wrapping tool. Both the extraction process and the counting of the pins to find the right pair to be connected are monotonous tasks that cause operators to make errors. The subsequent procedure—debugging the board or panel that has been wrapped—is also tedious.

Semi-automatic wire wrapping is a major improvement over the totally manual process. An operator must still use a manual wire-wrapping tool, but is aided by a positioning arm that points to the pins in the proper sequence. The arm is part of the semi-automatic wire-wrapping frame on which the board is mounted (Fig. 1).

Semi-automatic wire-wrap frames use a computer numerical-control device (CNC), which reads the sequence of pins and the X and Y coordinates of their locations from a paper tape. The CNC sends pulses to stepper motors in the X and Y axes to position the pointer. The major deficiency of semi-automatic wire wrapping has been creating the paper tape. Users of semi-automatic wire-wrap frames must either write a computer program to generate the paper tape on their own computer, purchase a program that will run on a computer they own or depend on an outside service bureau.

As with most electronic equipment, the past few years have seen discrete components yield to ICs and now μ ps. With the CNC approach, all that μ ps does is

reduce the chip count in the controller; the paper tape must still be generated elsewhere.

The CAD/CAM approach uses a μ C to generate the wire-wrap program and then directly control the wire-wrap frame. The Wrap Mate system is an example of CAD/CAM wire wrapping. The geometry to be wrapped and the connectivity required by the schematic or wiring diagram are input to a Series 2000 μ C. This machine combines the input data, computes the required connections and documents how the system designed the interconnections and troubleshooting aids, while storing on disk the series of commands to be given the wire-wrap frame during wrapping. In the wire-wrapping mode, the computer translates X and Y dimensions into pulse counts that drive two four-phase stepper motors, one for each axis (Fig. 2).

The Wave Mate Series 2000 μ C is based on a 2-MHz Motorola 6800 μ p. Its internal memory is 64K-byte dynamic RAM with hidden refresh and a 1K-byte ROM with boot and diagnostics. It has a dual minifloppy-disk drive with a total capacity of 368K bytes formatted on two double-density drives, a 12-in. video CRT and a keyboard controlled by a Z80 μ p and two RS232C serial I/O ports with software-selectable baud rates from 110 to 9600. Optional software packages are UCSD Pascal, BASIC, MTS6800 (multitasking) Operating System, word processing and business applications.

Defining pin configuration

A shorthand method of describing pin geometry is to create a library of pin configurations that will be used, as needed, to define a board or panel—a standard approach in CAD systems. These patterns of pins are called templates.

An arbitrary pattern of pins can be defined as a template, with two requirements: that there are no more than 255 pins and that each pin's X and Y offsets from the template's origin be defined. The template in Fig. 3 was created to add a 14-pin DIP socket to the board with its long axis horizontal. It will be located between a ground bus above and a VCC bus below. To guarantee minimum wire lengths for ground and VCC

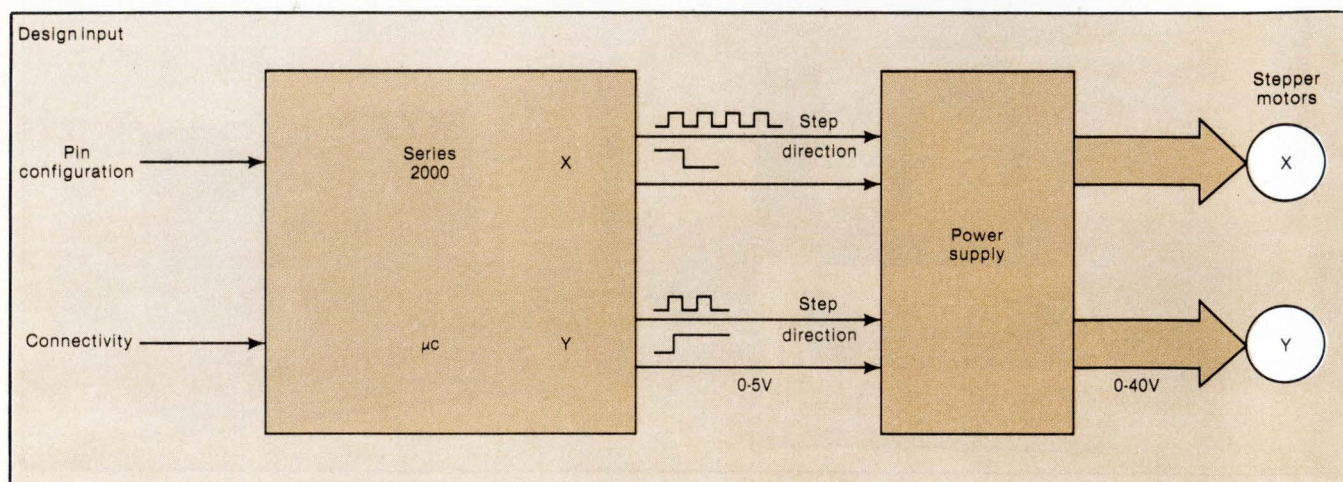


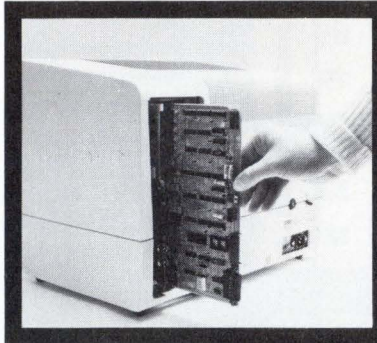
Fig. 2. The Wrap Mate system uses the Series 2000 μ C to translate X and Y dimensions into signals that drive the stepper motors.

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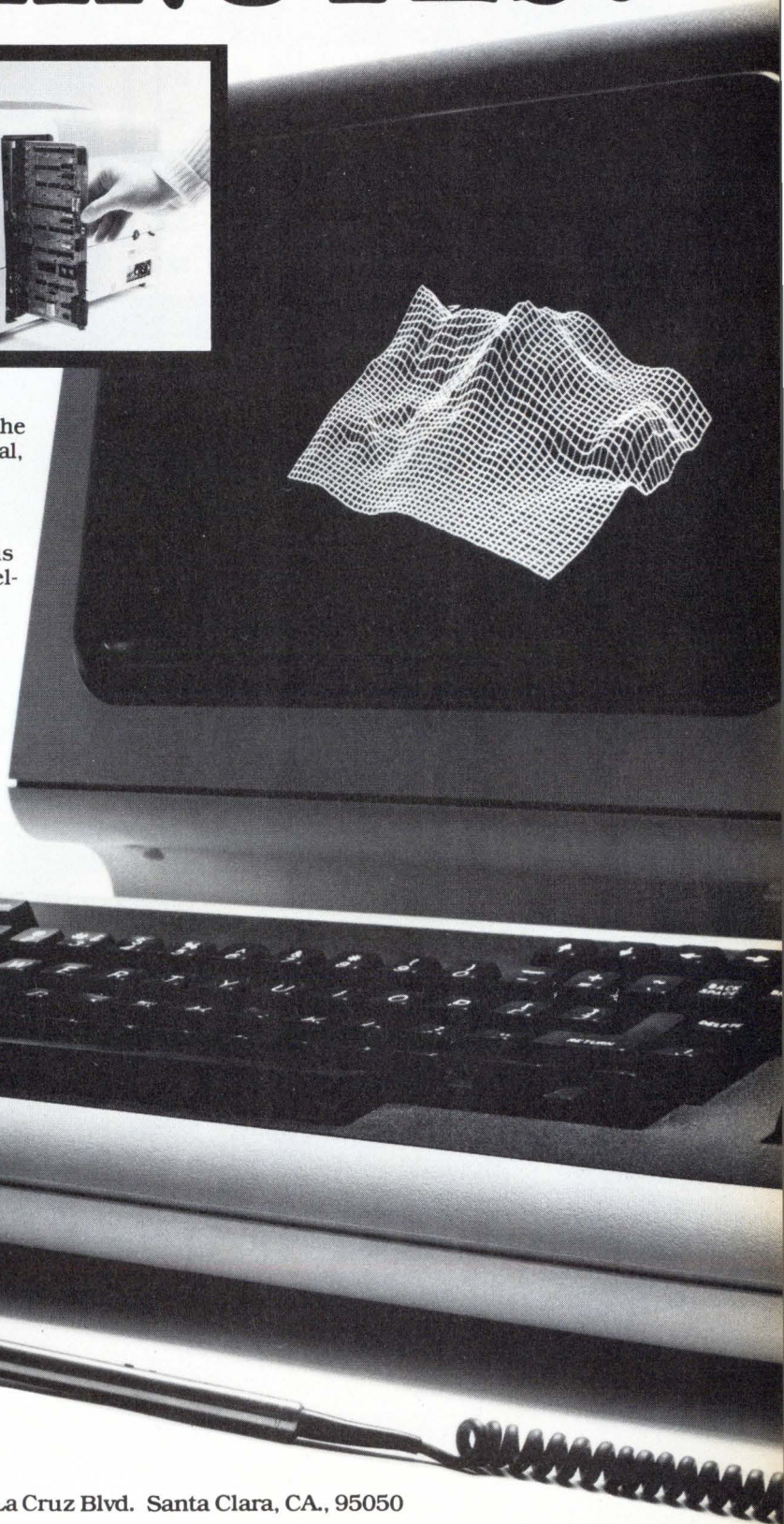
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The CAD/CAM approach uses a μ c to generate the wire-wrap program and then directly control the wire-wrap frame.

connections, pins 15 and 16 will be defined as part of this template, even though they are not physically part of the socket.

Every template in the library must have its own name. This template is called DIP14 and has 16 pins, the number of pins after the colon. The pins are listed with their X and Y offsets from the template origin.

Local connections are used to connect signals such as voltages and ground that are unique to a pin configuration. By telling the system GND = 16 and GND = 7, the system knows that GND is on pin 16 and to connect pins 16 and 7. Likewise, DC5 = 15 and DC5 = 14 tell the system that DC5 is on pins 15 and 14 and to connect those pins.

Net connections are used to connect pins to signals that may appear anywhere on the design. Defining 2 = RESET and 9 = CLOCK when creating this template tells the system, whenever this template is used, to find the signal called RESET and connect it to pin 2 and to find the signal called CLOCK and connect it to pin 9. Every time this template is added to a board, all of the above information is automatically input.

Templates will be in a library stored on one of the system's floppy disks. When defining the geometry, the templates are placed on a user-defined grid. There is no limit to the number of times a template can be used on a board. Proper use of local and net connections and grid definition drastically reduce the data input required. On boards with significant bussing, such as a memory board, net connections to connect a bus need be defined only once, and the same template can be used repeatedly. Using the system for just a short time will

build a library of templates that define all the pin configurations normally used.

Templates are placed on a board by first defining a grid and then placing templates on that grid. C4@DIP14 (X4, YC) tells the system that socket C4 uses template DIP14 and locates the template origin at the intersection of the X = 4 and Y = C grid lines. To avoid confusion in terminology, sockets are templates that have been placed on a design.

Adding the connections

After socket placement has been defined, all required connections not specified by local or net connections must be input to the computer. One entry will connect both ends of a wire.

A5-13 C2-4

A5-12 IRQ

The above entries would tell the system to connect A5 pin 13 to C2 pin 4, and A5 pin 12 to the signal named IRQ, wherever IRQ may be on the design.

Wrap Mate can be used as a stand-alone CAD/CAM system for wire wrapping or as part of a CAD system for PC boards. In the stand-alone mode, a from-to list is input using the computer's keyboard. When used with a CAD system, the from-to information comes from the CAD system's computer. Most CAD systems can accept rough schematics and produce high-quality finished drawings using pen or electrostatic plotters. These systems can also extract a from-to list for input to an automatic PC layout program. This net-list extraction process can be used, and the from-to list can be transferred to the Wrap Mate system via an RS232 data link. This eliminates the need for manual entry of the from-to list and any transcription errors. When a user signs off on the plotted schematic from the CAD system and the from-to list is extracted from the schematic, it is then transferred to the Wrap Mate System and used to wrap the board, reflecting the schematic exactly. What you see is what you get.

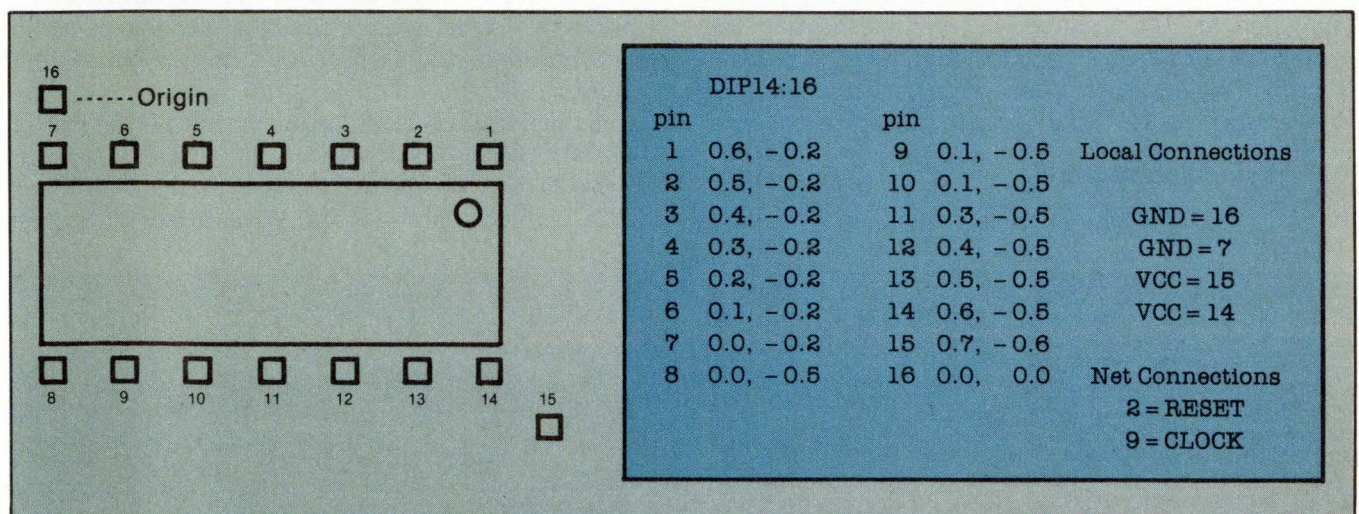


Fig. 3. A typical template is a pattern of pins (a). It must contain no more than 255 pins, and each pin's X & Y offsets from the template's origin must be defined. Template types are stored in a library on the system's floppy and called as needed by the user. The template is defined to the system as shown in (b). The pins are listed with their X & Y offsets from the template origin. The five alpha characters before the colon (DIP 14) are the template name and the figure after the colon (16) is the number of pins in the template.

Wrap Mate can be used as a stand-alone CAD/CAM system for wire wrapping or as part of a CAD system for PC boards.

Benefits of standardization

If the pin configuration is standardized, the only input required to wrap a new board is a new from-to list. All the input data would be stored on a floppy disk. The old from-to list can be deleted, and a new list can be entered. The new list can be merged with the standard pin geometry, and the board can be designed.

Westinghouse Industry Systems Division uses the Wrap Mate approach to wrap back panels for control systems. There are eight available panel configurations that can be used, each defined and stored on a floppy disk. The back panels' wiring diagram is digitized on an Applicon system, plotted and returned to the responsible engineer. After the wiring diagram is approved, the Applicon System extracts a from-to list and transfers it to the Wrap Mate system using an RS232 panel configuration. The panels are ready to wrap in 5 min.

When designing a circuit board that is part of a system having a standard bus, a template can be defined for the connector to the system bus. Net connections can be used to specify the bus signals on the proper pins. Once this template is defined and checked out, connecting to the system bus becomes easy and error-free. If, in the example above, a socket using the connector template were on the board, and if it contained a net connection attaching IRQ to its proper pin on the bus, A5 pin 12 would connect to the pin of the connector associated with IRQ. Assigning names to signals and having a template for the connector to the system bus that uses the required net connections is a simple solution to an otherwise perplexing problem. Not only will designing and wire wrapping the board be simplified and accelerated, but troubleshooting time caused by wiring errors will be eliminated, significantly reducing the time required to go from a schematic or wiring diagram to a wire-wrapped board or panel.

Design documentation

After all the required input has been defined and

entered into the computer, the pins are connected as specified. Fig. 4 (left) shows a possible wiring scheme for pins A through F that would satisfy the schematic, but wrap four wires on pin E. The Wrap Mate system will wrap only two wires per pin, minimizing the overall wire length. Pins A through F would now form a chain, the ends of which are pins F and D.

The first section of the documentation produced by the system for each design consists of a summary of the input data to verify correct data entry and the Chain List. All chains created by the system are listed in alphabetical order (Fig. 5). Chain 17 has been named *WRITE and connects BUS pin 26 to PIA pin 21 using a 2½-in. wire. Chains can consist of several wires, as does 69, or only one wire, as does 70. Chains can have names assigned to them, as do 69, 70 and 71 or, if they

```

68: *STCLK B8-14 [1.5] B7-14 [5.0] E3-13;
69: *UPDOWN C5-5 [1.5] C4-5 [2.0] D2-5 [1.0] D1-8;
70: *VCT BUS-9 [1.5] BUS-10;
71: *WRITE BUS-26 [2.5] PIA-21;
72: A1-14 [2.0] A3-11;
73: A1-17 [2.0] A3-12;
74: A2-5 [1.5] A3-5;
    
```

Fig. 5. The chain list consists of all chains created by the system, listed alphabetically. Those of minor importance need not be named. The figures in parentheses show the length of wire between pins.

are of minor importance, need not be given special names, like 72 and 73.

The second section of output data is a pin/chain cross reference list. Every pin on the board is listed in alphabetical order, showing the chain that includes it. Referring to Fig. 6, D1 pin 8 is part of the chain called *UPDOWN, D1 pin 11 is part of the chain called *RESET and D1 pin 7 is the name of the chain on D1 pin 7. D1 pin 12 is part of the chain called D1-7, a chain not requiring a distinctive name. Names can be a tremendous aid in connecting and troubleshooting a design but are not required.

The third section of the documentation is the wire list (Fig. 7). Chains are broken into wires, which are alternated between level 1, closer to the board, and level 2, farther from the board. Wires are first wrapped

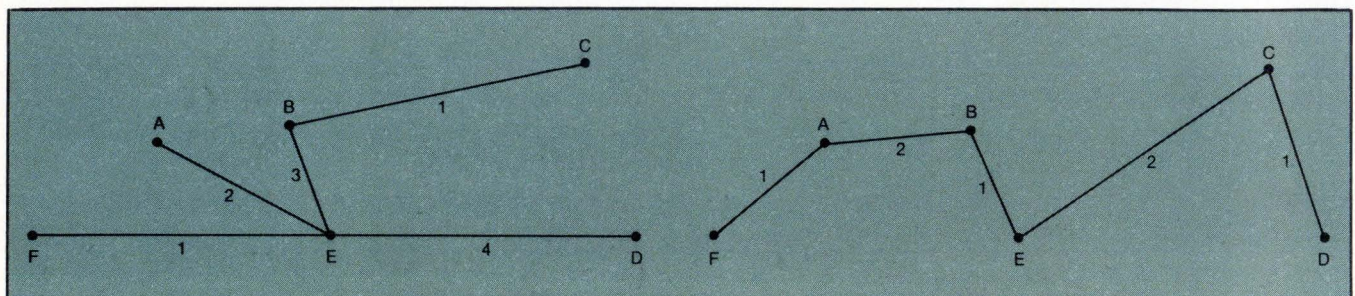
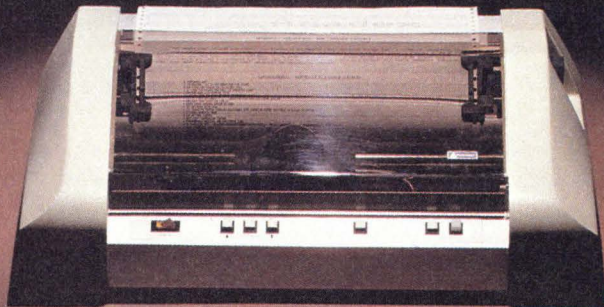


Fig. 4. Wrap Mate's chain-connection (right) of pins A through F minimizes wire length and uses no more than two wires per pin. A traditional scheme (left) needs more wire length overall and wraps four wires on pin E.

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CIRCLE NO. 76 ON INQUIRY CARD

μC-based CAD/CAM can shorten the time required to produce wire-wrap packaging, reduce its cost and increase productivity.

longer to shorter, starting with level 1. Both ends of a wire are wrapped on the same level. This is the actual sequence of commands that will be given to the semi-automatic wire-wrap frame when the board is wrapped.

Wrapping the board

All of the above information should be stored on a floppy disk. After the documentation has been reviewed and the input data has been verified, a computer can use the stored information to drive the semi-automatic, wire-wrap frame, providing direct numerical control and eliminating the delay and inconvenience of paper tape. The board or panel to be wrapped is mounted in the frame and aligned. The positioning arm indicates the pins to be wired in the proper sequence. Pressing the N key on the keyboard or a foot switch causes the positioning arm to move to the next pin. Using a computer instead of paper tape to drive the wire-wrap frame allows for greater flexibility, such as driving the arm to a previously defined home position by pressing the H key on the keyboard and executing the HOME command. Pressing the 0 key will execute the OOPS command and position the arm over the first pin of the pair being wired when the HOME command is given. This allows an operator to remedy problems as they occur rather than wait for the positioning arm to be homed every 25th wire or so.

The system's CRT display will show information describing the pin being pointed to as shown:

```

WIRE X1
LENGTH 9.0
LEVEL 1
END 1
FROM CON-16 TO A8-15
    
```

201 1: F4-17 [1.5] F4-16	202 1: F5-7 [1.5] F5-6
203 1: F5-11 [1.5] F5-14	204 1: F5-15 [1.5] F5-5
205 1: PIA-23 [1.5] A3-8	206 1: PIA-24 [1.5] PIA-22
207 1: C4-11 [1.5] C3-12	208 1: PIA-41 [1.5] PIA-20
209 2: E2-5 [5.5] E2-6	210 2: B7-14 [5.0] E3-13
211 2: C3-13 [4.5] F5-3	212 2: A3-8 [4.0] C3-3
213 2: B1-10 [3.5] D2-10	214 2: C8-5 [3.5] E8-11
215 2: D6-10 [3.5] F4-9	216 2: B7-4 [3.5] D7-2
217 2: B8-4 [3.5] D7-6	218 2: A2-11 [3.0] PIA-37
219 2: C5-7 [3.0] D3-1	220 2: C8-1 [3.0] E7-11
221 2: C4-7 [2.5] D3-9	222 2: C4-3 [2.5] D3-13
223 2: C4-6 [2.5] D3-10	224 2: C5-6 [2.5] D3-2
225 2: PIA-25 [2.5] B3-10	226 2: E3-12 [2.5] F5-12
227 2: D2-6 [2.5] E3-5	228 2: B1-4 [2.5] B5-3

Fig. 7. The wire list shows the chains broken into individual wires. The figure before the colon indicates whether the wire is wrapped closer to the board (level 1) or farther from it (level 2).

The display indicates that the pointer is over the first end of wire 1, which is CON pin 16. A 9-in.-long wire should be wrapped on level 1. Pressing the foot switch causes the display to read END 2 of wire 1 and the positioning arm to point to A8 pin 15. The next press of the foot switch causes the positioning arm to point to pin 1 of wire 2 and the CRT to display the data for wire 2. Wire lengths are sorted in decreasing size in increments of 1/2 in. A bell rings to notify the operator when the wire length changes.

After the board has been wrapped, the system can check its own work. The positioning arm points to the ends of chains for continuity testing, eliminating the need to check every wire. The chain shown in Fig. 4 would be tested from the socket side or the pin side, whichever is easier.

The CAD/CAM approach

The Wrap Mate system is CAD/CAM technology applied to wire-wrap packaging. Accepting a shorthand definition of the geometry to be wrapped and the required interconnections, the system designs the

```

PAGE 14 05/22/81 14:45:33
6800 Wirewrap Compiler V1.0
    
```

PIN/CHAIN CROSS-REFERENCE

D1-7 D1-7;	D1-8 *UPDOWN;	D1-9;
D1-10 D1-4;	D1-11 *RESET;	D1-12 D1-7;
D1-13 B1-12;	D1-14 D1-15;	D1-15 D1-15;
D2-1 PBI;	D2-2 B6-9;	D2-3 D1-4;
D2-4 D2-4;	D2-5 *UPDOWN;	D2-6 D2-9;
D2-7;	D2-8 D2-8;	D2-9 D2-9;
D2-10 B2-7;	D2-11;	D2-12;
D2-13;	D2-14 D2-15;	D2-15 D2-15;
D3-1 B5-1;	D3-2 B5-14;	D3-3 A;
D3-4 B5-11;	D3-5 B5-9;	D3-6 D3-6;

Fig. 6. The pin/chain cross-reference list, of which only a small part is shown here, consists of every pin in alphabetical order, with the name of the chain that includes it. Minor chains do not require a special name.

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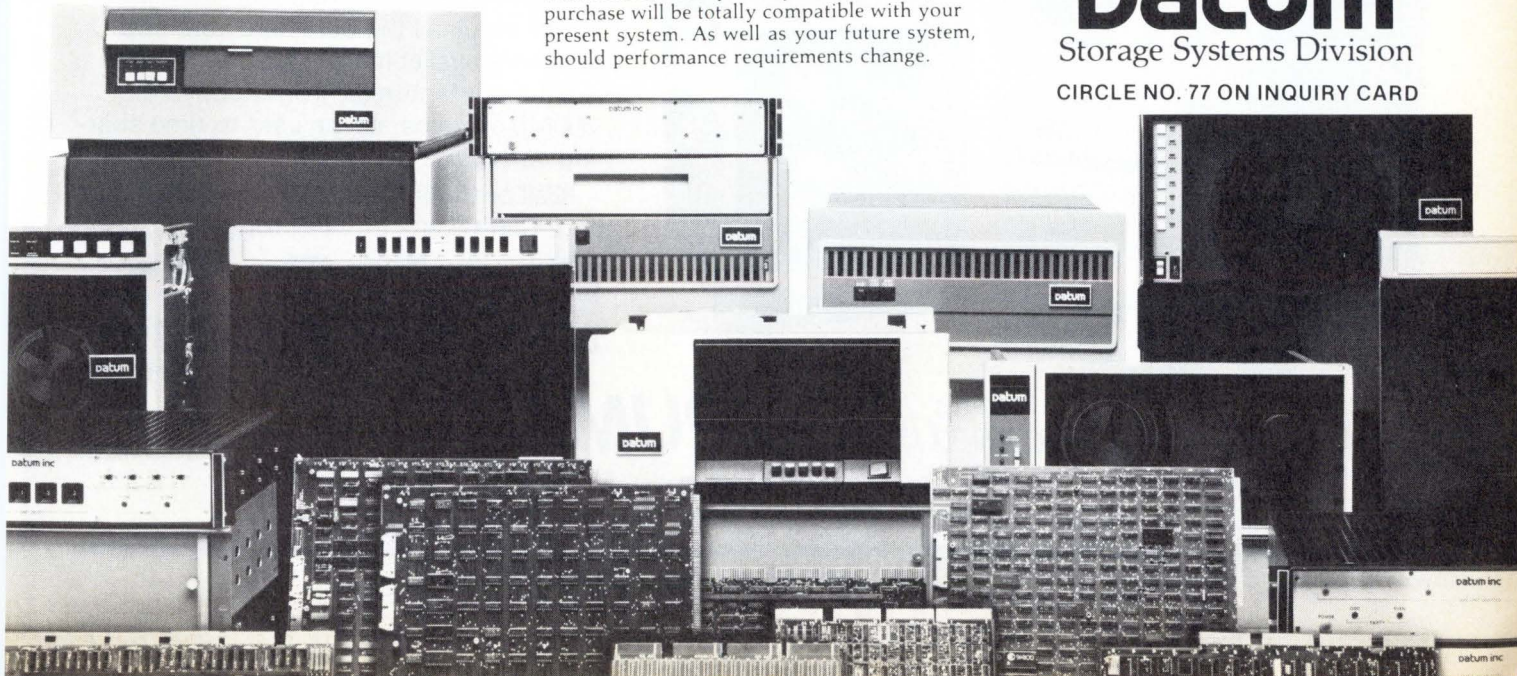
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Robert L. Myers is president of Omnimation, a San Pedro, Calif.-based company specializing in interactive graphics and CAD/CAM systems.

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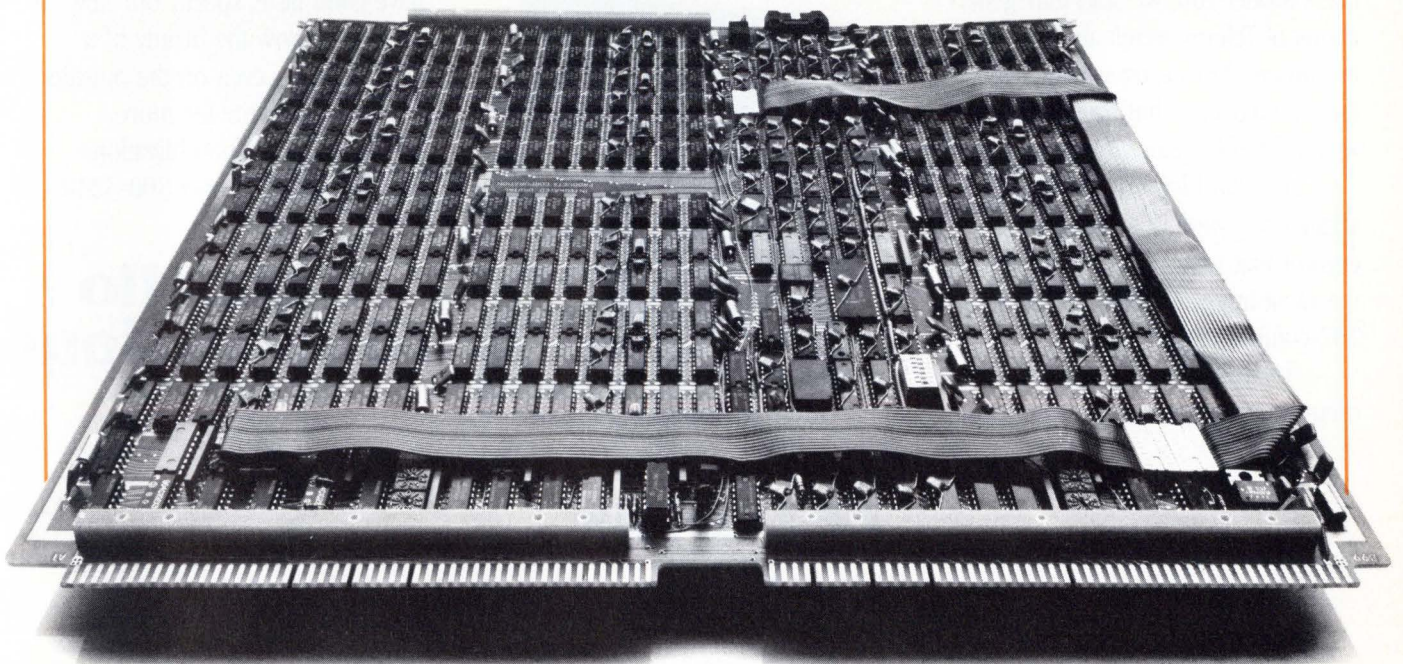
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CIRCLE NO. 80 ON INQUIRY CARD

CAD/CAM technology aids human rehabilitation

DR. V. AILEEN ROGERS and DR. ROBERT E. FULTON

Joint NASA-industry project leads to development of simulator that will be used to design an adaptable wheelchair

The U.S. health care delivery system is lagging behind other segments of U.S. industry in its investment in interactive design facilities, software programming and automation of machine tools to improve the design and manufacture of mechanical structures used in medicine. Computers have not been widely used in rehabilitation engineering to design artificial limbs, wheelchairs or other supporting devices. But advances in CAD/CAM technology, aided by the National Aero-

navitics and Space Administration (see "IPAD enhances CAD/CAM integration," p.152), have enabled the evolution of wheelchair technology to the point of developing a wheelchair simulator that can be adapted to individual patients.

The CAD/CAM concepts in this article, although used frequently in aerospace applications, also apply significantly to human rehabilitation. The wheelchair simulator will eventually be used by unskilled technicians

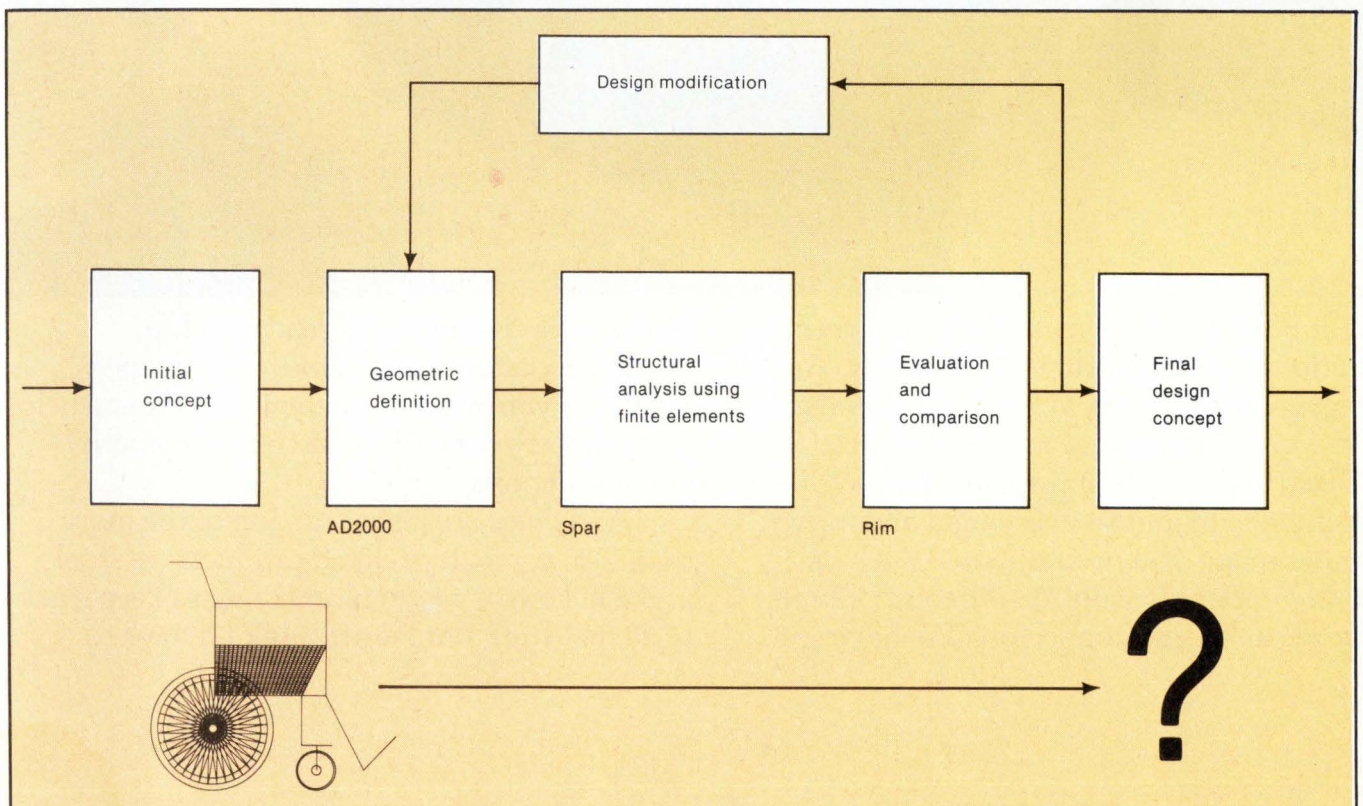
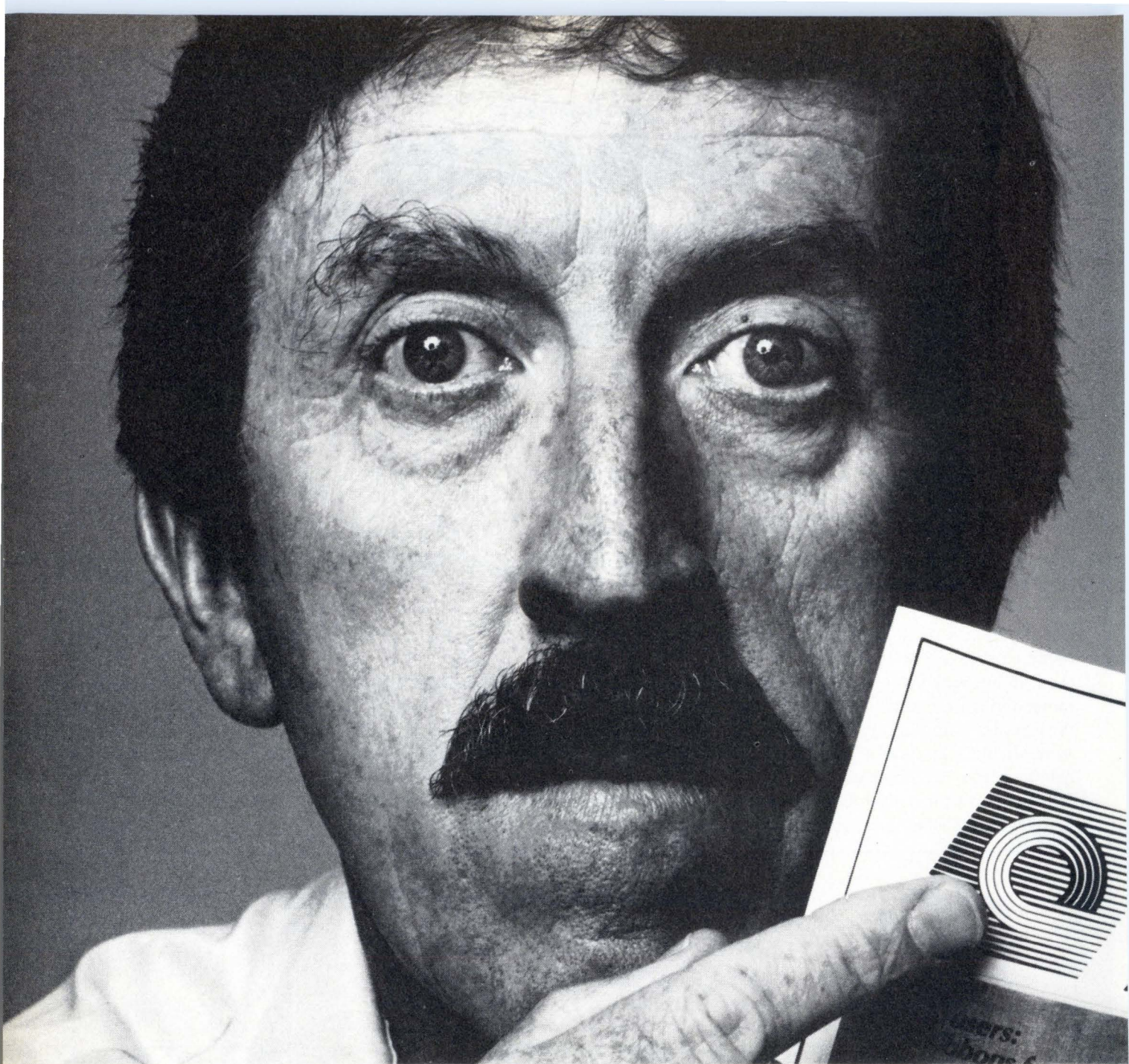


Fig. 1. Functional diagram of the design process.



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Aerospace CAD technology provides an available, customized software package for analyzing wheelchair design.

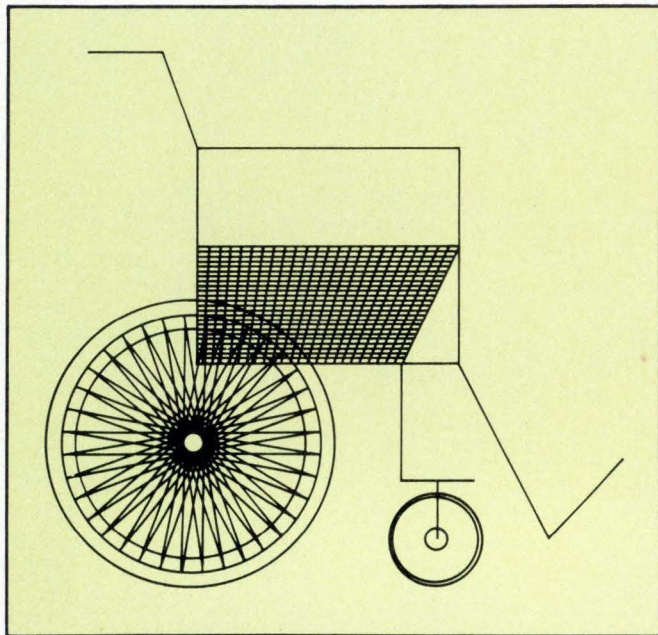


Fig. 2. A typical simplified wheelchair simulation.

working with a Digital Equipment Corp. VAX-11/780 or similar minicomputer.

CAD/CAM can contribute significantly to the goal of producing an artificial limb that esthetically, kinematically and functionally mimics a human limb. The development of such a limb would require mathematical modeling of biological kinematics, guiding machine tools that produce the artificial body parts during manufacture and evaluating the end result. The orthotic device or prosthesis, designed to substitute for a missing limb, should fully emulate the motions of a normal limb and of an amputee relearning coordination patterns. Optimization and replication of human motions require a quantitative knowledge of the dynamics involved and of the energy expenditures in a living system. Key to this knowledge is determining the mass centers and moments of inertia of both the biological entity and the manufactured replacement to evaluate the effectiveness of a design. CAD/CAM technology and software can be especially useful in this area.

CAD/CAM and wheelchair design

CAD/CAM technology can be readily applied in wheelchair design and manufacture. Wheelchairs, probably

This article is excerpted from a paper presented at the CAM-I International Spring Seminar held in April in Cannes, France. The entire proceedings, "Survival and growth of the engineering industries through integration of CAD/CAM technology," P-81-MM-01, is available for \$48, prepaid, in the U.S. (postage additional for overseas orders), from CAM-I Library, 611 Ryan Plaza Drive, Suite 1107, Arlington, Texas 76011.

the most commonplace aid for handicapped people, provide users more personal freedom, increase their physical functions and generally improve the quality of their lives. But wheelchairs have not changed appreciably for 40 years, even though great technological advances have occurred throughout the world in the same time period. Wheelchair users complain of frequent breakdowns, high maintenance costs and interminable delays in acquiring replacement parts. Wheelchairs are often purchased randomly, and users end up with devices that are too large or too small, painful, dangerous, difficult to propel, overly expensive and even harmful physiologically. It's time to reassess wheelchair design and to apply space-age technology to rehabilitating the handicapped.

Wheelchair design is complex: an engineer must consider specifications for materials, construction, overall dimensions, folding mechanisms, foot rests and supports, wheels, tires, brakes, clothing guards, accessories, joint construction, finish and quality-control testing. More importantly, the engineer must also take into account center of mass adjustments or stability, aerodynamic drag, propulsion methods, curb-climbing abilities, maintainability, aesthetics and whether a wheelchair is designed for the indoor, outdoor or recreational environment.

Computer-aided design (CAD) has been used for many years in developing aerospace vehicles, in which dynamic stability, light weight and minimal propelling power are important. Because these design criteria must be met in optimizing wheelchair performance, automated-aerospace-analytical techniques apply directly to designing wheelchairs. Aerospace CAD technology provides an available, customized, software package for analyzing wheelchairs design. Using an automated 3D geometric simulator, AD2000, and a structural-analysis software package, SPAR ensures that wheelchair design can progress beyond the "cut-and-try" methods of the past.

This study evaluates three CAD/CAM software packages for health-care applications—AD-2000, SPAR and RIM. These programs, from the NASA IPAD project, have found broad applications in diverse fields. AD-2000, automated design and drafting for 2000 AD, is a CAD/CAM software system that provides basic 3D geometry, mechanical-drafting, geometric-analysis and numerical-control operations. SPAR, a structural-analysis system, uses finite-element methods to determine the static and dynamic response of structures. RIM, relational information management, is data base management software that contains relational algebra-manipulating capability.

Once a design concept has been identified, it can be easily simulated and evaluated using CAD technology (Fig. 1). The initial design concept might be an existing wheelchair model, a modification of a model or an innovation. In any case, a wheelchair-design candidate can be geometrically defined using the AD-2000 graphics 3D simulator. Fig. 2 shows a typical wheelchair



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CIRCLE NO. 82 ON INQUIRY CARD

A wheelchair user is integral to a wheelchair's structure and contributes substantially to its stability or instability, and it is essential that each model be manufactured in five sizes.

simulation. Once this is accomplished, a wheelchair can be loaded with a human-body model, and stability relationships can be determined. Design recommendations can follow immediately from this simulation.

Human-body simulation

A wheelchair user is integral to a wheelchair's structure and contributes substantially to its stability or instability, and it is essential that each model be manufactured in five sizes: small child, large child, junior, adult and oversize. Most users believe that these five sizes are inadequate. To address this problem, human-body-configuration modeling is used in sizing the assemblies.

The current technique for obtaining nondestructive, inertial measurements of a 3D, nonhomogeneous, irregular semisolid, such as a human body, is complex. In the past, human-body models have been developed by using simple geometric shapes, such as the ellipsoidal segments in the work of McConville (Ref. 2) and Bartz (Ref. 3), for components of the human body. Cadavers have been used extensively to determine volume, mass center of mass, and moments of inertia of

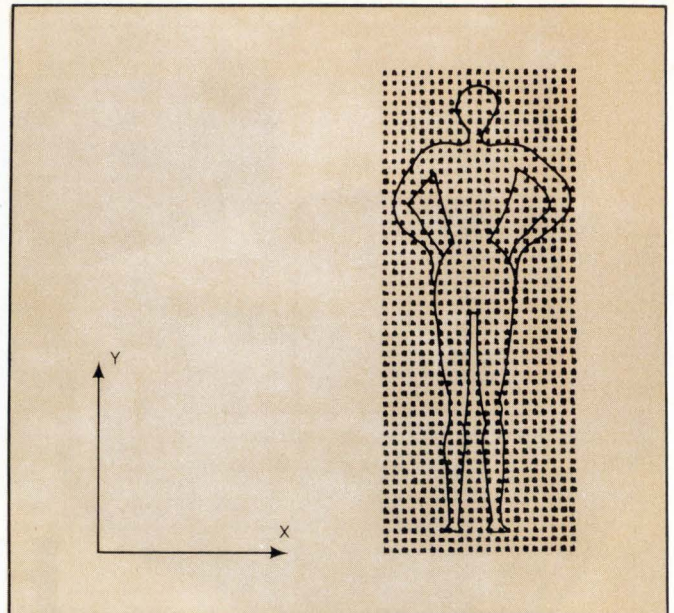


Fig. 3. Projection of body parts on the 3D lattice.

body segments. Jensen (Ref. 4) refined the model, using elliptical slices of uniform density for each segment. Watkins (Ref. 5) later proposed a method of predicting component mass properties based on experimental data for whole-body-mass properties.

The CAD/CAM software used here offers the integration of these methods with the biostereometric (2D photographic) work of Herron and Walker (Refs. 6 to 9) to produce a 3D human-body model that is not limited to

IPAD ENHANCES CAD/CAM INTEGRATION

The engineering industry relies more and more heavily on computerized automation and automatic controls to solve complex technological problems and to increase the productivity of its workers. Significant improvements are possible by applying current and future computer-aided - design - and - manufacturing (CAD/CAM) technology. The U.S. aerospace industry has become a leader in using computers to enhance the industrial rate of performance and quality of life of workers. The National Aeronautics and Space Administration has actively supported this effort through a joint NASA/industry multimillion-dollar project, called Integrated Programs for Aerospace-Vehicle Design (IPAD) (Ref. 1).

The IPAD project has been under way for several years and has made significant progress in advancing integrated CAD/CAM technology. The project's goal is to raise aerospace industry productivity through application of computers to integrate company-wide management of engineering data. Work under the IPAD

project is being implemented principally through a NASA contract to the Boeing Commercial Airplane Co. under the guidance of an Industry Technical Advisory Board (ITAB) composed of members of the aerospace and computer industries. System development is closely coordinated with the U.S. Air Force Integrated Computer Aided Manufacturing (ICAM) program.

A mature operational IPAD capability will consist of system software, including executive, data management and geometry/graphics programs, with disciplinary technical programs installed in IPAD to implement its integrated design features and project data. The IPAD project is developing prototype system software and will use available technical programs and data for demonstration and evaluation.

The IPAD design is composed of three major software components:

- **Executive software**, which controls user-directed processes through interactive interfaces with many terminals in simultaneous use by

engineering and management personnel and to provide communications among computer hardware in and outside of the IPAD distributed computing system.

- **Data management software**, which provides a comprehensive, versatile ability to store, track, protect and retrieve exceptionally large quantities of data maintained on multiple storage devices.

- **Geometry and graphics software**, which provides various capabilities for information and geometry creation, manipulation and display functions, including design/drafting and interactive and display graphics.

While IPAD is being developed for the aerospace industry, it should support other automated-engineering design processes. Representatives from several non-aerospace organizations serve as observers to ITAB and regularly participate in the review and critique of ongoing work. Members of the medical community are now becoming interested in automation and in participating in the leading edge of technological advance.

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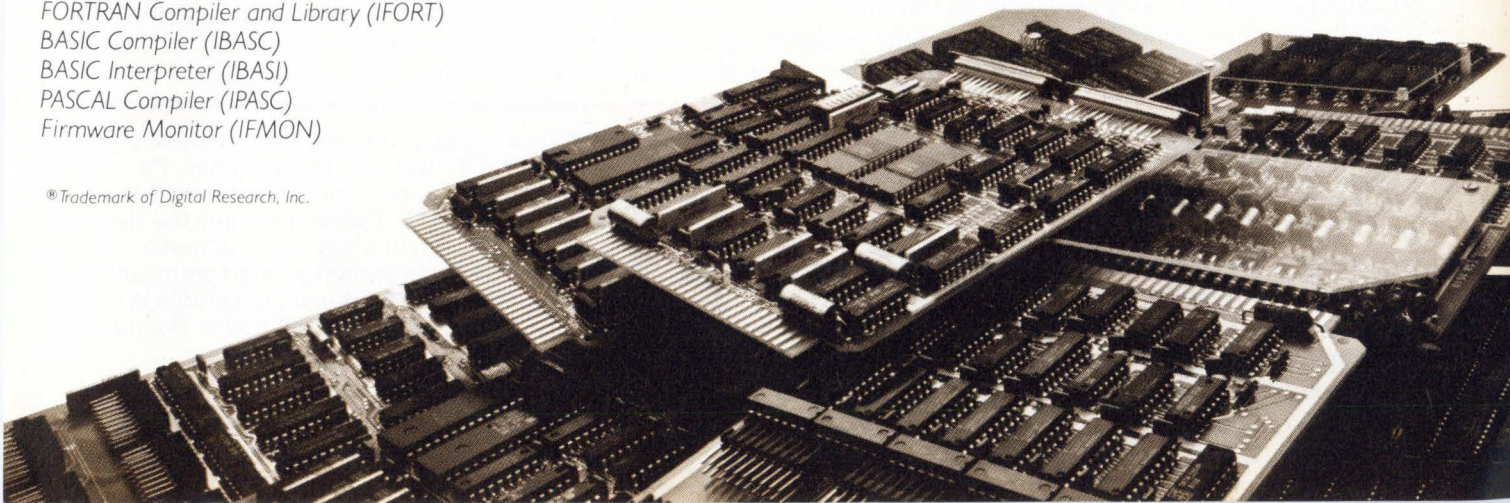
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CIRCLE NO. 83 ON INQUIRY CARD

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The RIM relational data-base management system enables a user to compare results interactively of one test with another or one chair with another.

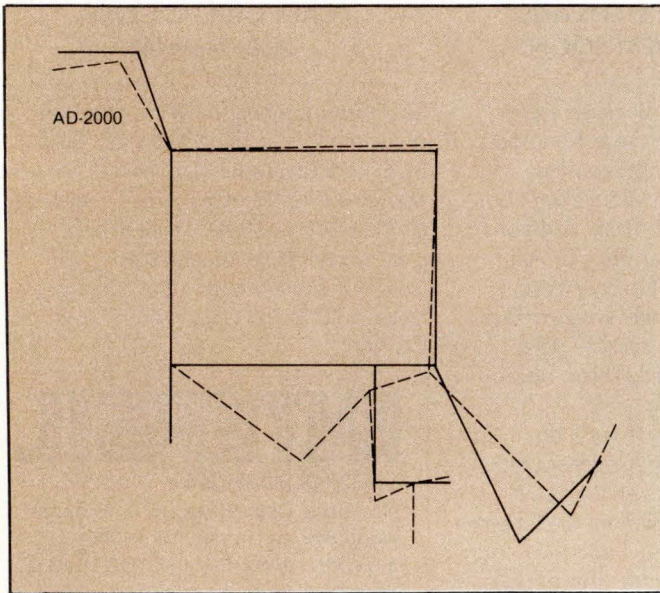


Fig. 4. A typical wheelchair analysis showing deformation. Solid lines indicate the structure prior to loading. Dotted lines show deflections created by the application of loads. Deflections are exaggerated for effect.

uniform densities or fixed geometric shapes. The method described in this paper enables the calculation of the necessary stability relationships for the chair and its occupant as a combined entity.

A method exists of finding each center of gravity or moment of inertia of a whole body or its parts. With this method, body silhouettes are input to a software system through a Tektronix pen-tablet digitizer. A 3D model is produced that is a summation of mass cells in a global-coordinate system in the body silhouette. Body-part boundaries can be chosen arbitrarily and mass density can be changed on an individual-cell basis. The number of mass cells is limited only by computer-storage space. Modeling is initiated by producing a 3D lattice of cells of any density (Fig. 3). The image to be produced is projected on the X-Y plane and the Y-Z plane of the lattice, and parts of the lattice or cells outside the projected image are deleted, thus producing a finished model. One key feature is that medical technicians unskilled in CAD/CAM technology can perform the methodology and geometric modeling.

Structural analysis of the wheelchair

Using applied loads calculated from the human-body simulation, structural analysis of the wheelchair is conducted. After geometric definition, input data for the structural analysis program, SPAR, is transferred from AD2000 to SPAR. SPAR calculates the static reactions, static deflections, stresses and dynamic response of the chair to vibrations and applied forces.

Constraints and applied forces can be simulated, and the weight of individual elements of the chair are optimized. The graphical analysis of a loaded wheelchair shows that the wheels are removed and the axis is fixed (Fig. 4). A static vertical load of 150 lbs. is applied to the lateral sides of the chair's seat. The unloaded chair is indicated by solid lines, and the deformed chair under load is shown by dotted lines. The deflections, joint locations, applied forces and stresses are printed on a disk file. Following structural analysis, the resulting data are stored in RIM, a data-management software package. RIM enables a user to compare results interactively of one test with another or one chair with another. A wheelchair design can be modified and the analytical procedure can be repeated, if evaluation and testing indicate. ■

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Dr. V. Aileen Rogers is assistant professor of mechanical engineering at Drexel University, Philadelphia, Pa. and conducts research in computer applications in rehabilitation engineering. **Dr. Robert E. Fulton** manages the NASA IPAD Project to develop technology and computer software for company-wide management of engineering information. He is also an adjunct professor at George Washington University, Washington, D.C. and Old Dominion University, Norfolk, Va.

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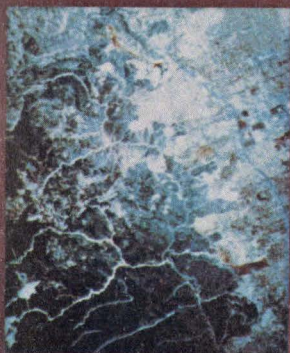
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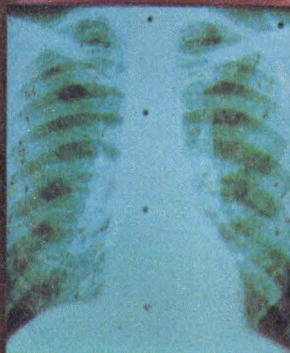
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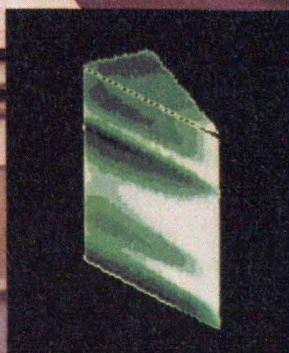
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CIRCLE NO. 85 ON INQUIRY CARD

**APPLICATIONS:
WORD PROCESSING**

Shuttle press coverage swamps NASA

*But 18-terminal distributed NBI-based network comes to the rescue
in accrediting and meeting the data needs of 6000 press people*

A new, geographically dispersed, data- and word-processing network acquired by the National Aeronautics and Space Administration greatly improves the timeliness and accuracy of press information associated with launching and tracking spacecraft. The new system gives NASA public-information specialists and the press immediate access to a mission-information

data base through a network of 18 on-line, interactive word-processing work stations located at various sites around the U.S. that are coupled to an existing data-processing mainframe.

The need for better information handling became apparent when NASA received more than 6000 requests from reporters who wanted to attend the first launch-



NASA's press center was the hub of all activity at the Dryden Flight Research Center, Edwards, Calif., for the Space Shuttle landing. On the day before the launch, Dryden staffers held a practice session on its distributed network.

In earlier days when spacecraft weren't so complex and NASA had more public-information specialists available, the space agency was able to use manual methods.

ing of the Space Shuttle in April. The last previous manned launch, an Apollo lunar-landing mission six years ago, generated only 3000 requests.

Combining an older data-processing computer system with updated word processing parallels a trend that will see network architects melding existing office equipment to new uses, primarily to serve prudent economics. In large networks such as NASA's, no single vendor is likely to offer a complete solution to the problem. The NASA experience suggests that large commercial office-of-the-future networks in the coming years will probably be similar multi-vendor marriages of convenience.

The way it was

Before acquiring the new system, NASA used a manual approach to provide press information such as launch and tracking information, preparation of astronaut-to-control conversation transcripts, press accreditation and press-kits. In earlier days, when spacecraft weren't so complex and NASA had more public-information specialists available—at least relative to the number of press people attending a given event—the space agency was able to use manual methods.

Questions that reporters were expected to ask, along with the answers, were put in a "query book." The public-information people would flip through the book when a question arose, and if the answer wasn't there, they searched around for somebody in the agency who had it.

This system, in addition to being slow and cumbersome, had some other shortcomings. Reporters sometimes got different answers to a question because answers depended to some extent on the information specialist's ability to interpret the query book. There was also considerable duplicated effort because there was no way to add a new question and the appropriate answer to the system. Yet similar new questions would arise repeatedly during a space mission.

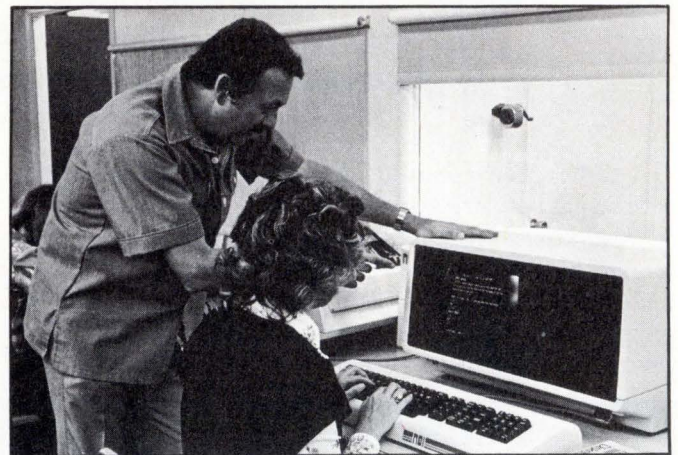
Another big problem concerned transcripts of communications between astronauts and the control center in Houston. These had to be typed, essentially retyped during transmission via teletypewriter, and retyped at the various information centers to produce camera-ready copy for offset printing and distribution to an impatient press corps. The whole process took hours and was a major source of frayed nerves among NASA personnel.

One other manual—and repetitive—public-information function seemed like a natural for the new system: correspondent accreditation. News people who

wanted to cover a launch formerly had to write to NASA headquarters in Washington for accreditation. Their names and affiliations were typed on master lists and sent to Cape Canaveral via facsimile equipment. There, they were retyped several times more—for the name badges needed to gain admittance to the launch site, for new master lists and even for a location service that permitted NASA to find the news people at their motels if anything dramatic happened. The process was time-consuming and highly labor-intensive.

The way it is

The new system, which got its initiation in April along with the Shuttle spacecraft, is intended to automate all these operations. Called Media Services Information System (MSIS), the network is built around an existing IBM 360/65 used by NASA for years to process data from manned spaceflights, plus 18 System



Terminal operator Molly DeHaan of NASA/Dryden enters a query on an NBI work station for a newsmen.

3000 software-based word processors from NBI Inc., each with hard-copy capability. The System 3000s provide on-line access to a large central data base in Houston from press facilities in Florida, California, Alabama and Washington, D.C. NASA has been in the forefront of computer technology almost since it was established in 1958. But in the past, the advanced equipment has all been connected with spaceflight itself. The administrative staff members on the ground have been the "poor relations" who have had to make do with antiquated office methods.

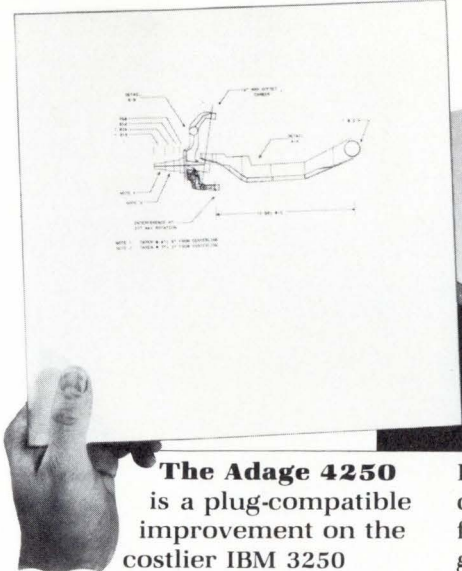
"For an agency on the cutting edge of technology, it's ironic that we were almost using quill pens," says Miles Waggoner, NASA's chief of public-information services at its Washington headquarters. "Besides, our staff has dwindled (Waggoner likes to point out that NASA is about the only federal agency that has been losing people in recent years), and our travel money has been cut. So when the Shuttle came along we suddenly began to ask ourselves, 'How are we going to do this?'"

No dress rehearsals

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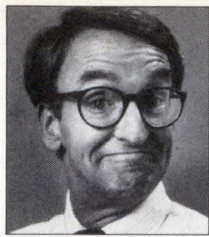
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Barney Stevenson just spent two years programming and de-bugging a process control system in assembly code.

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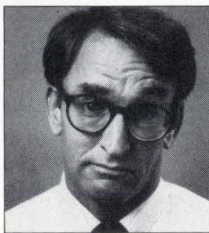
Sorry Barney,

NO CIGAR.

Barney Stevenson thought he deserved a pat on the back. As project manager at Smart Widgets, Inc., he had taken on the biggest real-time process control headache of his life. And after 24 months he'd finally succeeded in programming and de-bugging Smart's newest product.

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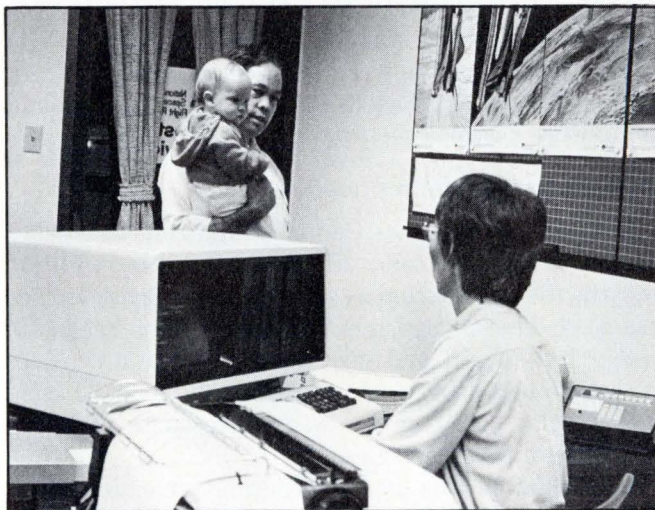
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Most communications between terminals and the mainframe were in the handshaking mode, in which a user notifies the mainframe to expect a file of data by logging on in a conversational mode, sending one line and waiting for the Word/One to send back a line feed.

Unlike the Apollo days, when spacecraft were checked out in unmanned flights, the first Space Shuttle flight was an "all-up" test. This meant that everything must work right the first time; two astronauts' lives and billions of dollars of investment depended on it. It also meant no opportunities for NASA's public-information staff to practice.

Furthermore, the mob of reporters, photographers and TV technicians on hand for the initial flight dwarfed anything ever seen before. Waggoner expected at least 3000 press people to be accredited to cover the launch at the Kennedy Space Center, Cape Canaveral, Fla.; another 2500 at the Dryden Flight Research Center, Edwards, Calif.; and smaller numbers at the Johnson Space Center, Houston, which was controlling the



At the guest services center in Lancaster, Calif., NASA public affairs aide Ida Ketchum verifies the credentials of one of the 2000 VIPs accredited for the Space Shuttle landing at Dryden.

mission; the Marshall Spaceflight center in Huntsville, Ala.; and NASA headquarters in Washington.

The solution to accommodating the needs of the press horde began to emerge a year before the launch when Waggoner discovered that there was some excess capacity available on the Johnson Center's IBM 360/65 that might be used to store flight data and update the status as the mission proceeded. Computer Sciences Corp., NASA's computing support services contractor at Houston, was already using the Word/One software package from Bowne Information Systems for entry, revision, reformatting and printing of frequently retrieved documents. It was relatively simple to add a

new software package, known as Keysearch, to provide search and retrieval capabilities to a data-base level of thousands of pages of documentation.

The trick was to get the necessary intelligent work stations that could deliver the information to the eagerly waiting press corps scattered around three principal locations and do it in real time. NASA's information-systems contractor, Planning Research Corp., studied the problem and sketched out a workable system for which NASA could request proposals from the computer industry. It was quickly determined that dumb terminals were out; they were too slow to keep up with the load. Also eliminated from ultimate consideration was a system using a single master terminal with all the other terminals slaved to it; NASA couldn't afford to have the whole system go down if anything happened to the master terminal. A distributed data-processing network seemed to offer the necessary redundancy, using stand-alone systems with local data storage in the field.

Just as it is in actual space operations, redundancy became a paramount concern. Hundreds of millions of people around the globe were expected to watch this launch, and representatives of overseas press organizations among them would have deadlines distributed throughout a 24-hr. day. Hence, NASA decided not to depend entirely on the mainframe for its data base, but to reproduce some of it on floppy disks to distribute data throughout the network.

The NBI-IBM connection

"We went out for bids last October," Waggoner recalls, "and NBI came closest to what we were looking for." NBI was the only bidder with equipment that could interface with the 360/65, he adds, which was the key requirement. "They really did their homework."

"It was a very simple setup," says Marc Nikolajevic, the communications specialist at NBI who has overseen the NASA installation from the beginning. Because the NBI equipment is software-based, he explains, it was no trouble to adapt it to the IBM 360.

Most communications between the terminals and the mainframe were in the handshaking mode, Nikolajevic says, in which a terminal user notifies the mainframe to expect a file of data by logging on in a conversational mode, sending one line and waiting for the Word/One to send back a line feed, which is the OK for the terminal operator to proceed.

At this point, the terminal operator feeds into the mainframe as much as the entire contents of a diskette, which can handle 100 pages—equivalent to 200,000 characters of information. Transmission can be via either NASA's 300- or 1200-bps lines with the only limitation being how busy the mainframe is with other tasks. Alternately, the NBI terminals can send data continuously to the computer until it tells them to stop, Nikolajevic adds. "It makes no difference to us," he says. "The operator can switch modes with a few keystrokes."

The Marshall Center was the switching center for the whole MSIS configuration; all 18 terminals were connected to it via leased lines.

The hardware began arriving in January, and all 18 NBI terminals were connected in the public information network by mid-February. The launch site at Cape Canaveral and the landing site in California's Mojave Desert account for six and five of the System 3000s, respectively. Three others were installed at the Johnson Center in Houston and two each at NASA headquarters and the Marshall Center.

One terminal at each of these locations was designated as an administrative desk that could input information to the system; the others normally receive only. Each 3000 had its own printer for real-time reproduction of all information available from Houston.

The Marshall Center was the switching center for the whole MSIS configuration; all 18 terminals were connected to it via leased lines. Twelve additional lines connected Marshall with the mainframe in Houston. The five lines for the administrative desks were dedicated; the remaining 13 terminals shared the other seven lines into the mainframe.

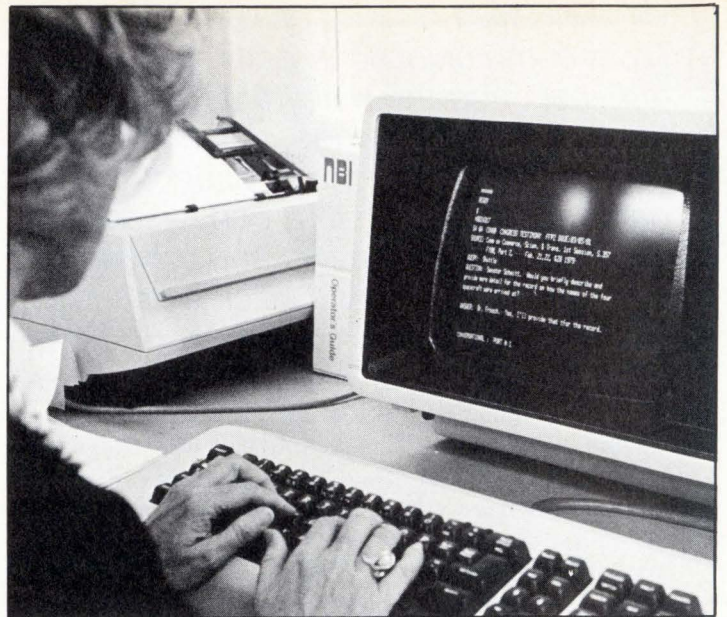
Loading the data

The basic news information, ranging from facts such as the cost of individual ICs to the weight of the whole spacecraft, was entered into the network data base before the mission. More information was generated beginning five days before the launch and continuing through the three days of the mission. For example, during the entire mission, complete status reports were entered every 4 to 8 hr. and available instantaneously to the press.

Information fed into Word/One from the participating NASA centers was edited and corrected at regular intervals by one person at the Johnson Center dedicated to this job. In pre-flight predictions, NASA anticipated that 50 new pieces of information a day would be generated from all sources and that entering them into the system would take about 10 min. total off-line time. All centers were to be notified when the system was down for this purpose and when it was back up.

During the actual mission, operations diverged somewhat from these expectations. "Although the system performed very well," says Phineas Fiddler, system site coordinator at Dryden, "our staff was so deluged with press inquiries that we didn't have enough time to enter all the information we would have liked into the data base." He adds that this was one of the few shortcomings of the network, and something that is targeted for improvement for the next mission in the fall.

The reporters did not use the system directly—at least not for the first Shuttle mission—but instead brought their questions to one of the query desks



NASA's data base provided a wealth of information such as this entry from Congressional testimony on how the Space Shuttle craft Columbia was named.

manned around the clock. The query-desk staff member first queried the Keysearch file, which has a capacity of 3000 pages of permanent storage. If the information is not there, he queried the Word/One file, with its 20,000 pages of temporary storage. If the information is in neither place, experts were brought in to add the new data to the system. Passwords, which can be changed daily, were used for security.

Filling a long-standing need

At the Kennedy Space Center, Hugh Harris, chief of public information and an 18-year NASA veteran, regards the new system as something the space agency has needed for a long time. "We cut the time needed to research a subject and give us an automatic printout without much danger of misunderstanding," he comments. "Otherwise we'd need 100 press-site people to take care of 3000 newsmen."

Accreditation was also considerably streamlined. A single person accredited press members by entering name, function (reporter, photographer or technician) and affiliation into the network data base. The associated hard-copy printers at the press sites automatically printed out labels for name badges and all the lists that are needed. The system also could be queried to determine if somebody claiming to be accredited was entitled to cover the launch. In all, the time required to accredit each press member decreased from about 5 to 10 min. to less than 1 min. The same process was used for NASA's VIP guests who visited the launch and landing sites during the Shuttle mission. The guest centers in Cocoa Beach, Fla., and Lancaster, Calif., each had one of the NBI work stations to issue name badges.

The transcript bottleneck disappeared with the new system. After conversations between astronauts and

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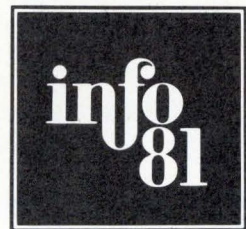
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After conversations between astronauts and ground controllers were recorded, they were transcribed on disks, fed directly into the Word/One at Houston and made available moments later to any of the other NASA centers on the system.

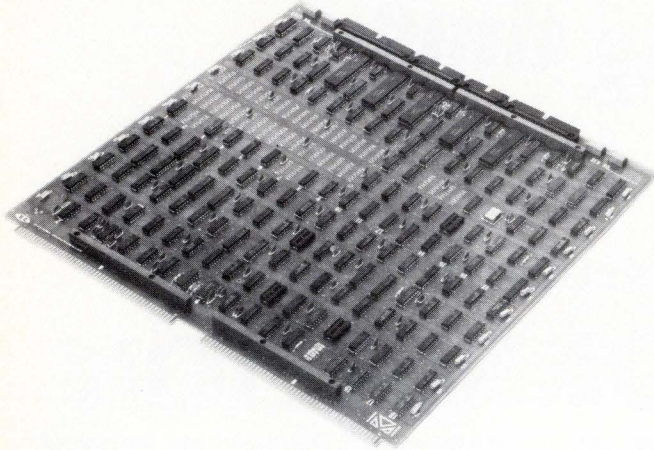
ground controllers were recorded, they were transcribed on disks, fed directly into the Word/One at Houston and made available moments later to any of the other NASA centers on the system. This feature worked quite well. For example, the transcript of the entire conversation between Vice President George Bush and the astronauts was available on demand at all five sites less than 30 min. after the conversation took place, a tremendous improvement over previous experience.

Room for growth

What does the system do between Shuttle missions? Waggoner is ecstatic about its potential. Because it is a complete word-processing network, it was used before April's launch to prepare NASA's press kits. A big plus of the NBI stations is that they allow previously unskilled operators to produce voluminous documents rapidly. "We used to print these at headquarters and ship them to the centers," Waggoner says. "Now in less than 5 min. we can transmit the information from the mainframe to disks at each center, which can take out the information 5 min. later, clean it up if necessary and do its own printing." This saves the week to 10 days formerly required to distribute the press kits, plus shipping costs.

"They (the NBI work stations) have saved our life," Waggoner says. "The word processor has changed our way of doing business altogether. After the staff overcame the initial terror of dealing with a new technology, we found that the machines made great communications devices." And the system has considerable growth capability left. One possibility might be input via optical character recognition, but Waggoner concedes that is now beyond the reach of the NASA budget. A more immediate possibility is direct access to the space agency's data base by news media without having to go through public-information personnel.

The large newspapers and news services already have video-display or word-processing terminals, Waggoner points out, adding, "It's quite embarrassing for us to be behind the newspapers." One news service, United Press International, has approached NASA about the idea of tapping directly into the system to do its own research. "I would love to see a time when the press could dial up our system for access to our data base at some reasonable fee, and do all its research directly without having to go through public affairs personnel," he comments. ■



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COMMUNICATIONS

A primer on security

J. MICHAEL NYE,
Marketing Consultants International, Inc.

Part II: Once digitized, voice or data can be encrypted by a variety of techniques using a variety of management schemes

The first part of this two-part article appeared last month (p. 139). Both parts are adapted from a chapter in Who, What and Where in Communications Security: A Users' Guide to Voice and Data Communications Protection by J. Michael Nye. Information on this publication is available by writing to the author at Marketing Consultants International, Inc., 100.W. Washington St., Suite 214, Hagerstown, Md. 21740.

Unlike analog voice communications, for which methods of protection are also analog in nature, digital data protection may be accomplished by encryption. One of the advantages of digitizing voice is the additional level of protection encryption offers.

The need for cryptography

In ancient times, people were sensitive to the possibility of information falling into an enemy's hands while being transmitted to a receiver. A simple ciphering device, the "Skytal," was a wooden cylinder around which a parchment tape was wound. A secret message was written across the entire length of the cylinder. The tape was then removed and transported to the receiver, usually disguised as a belt worn by the messenger. The recipient was able to read the message only after rewinding the tape on a cylinder of the same diameter. The Skytal, used by the Spartans against the Athenians, was based on the "transposition-of-information" principle. In today's electronic world, such elementary systems are no longer feasible because mathematicians can easily determine patterns of regularity.

During World War II, a significant increase in the development of new ciphering processes occurred. Since then, enormous progress in mathematics and digital-electronics technology has enabled the development of practical and reliable encryption devices designed to protect information as it is transmitted through a variety of communication facilities. The age

of the electronic office and credit cards demands careful protection of the transmission of valuable information.

Data communications are the most vulnerable to interception because computers can now automatically scan tremendous amounts of information at high speeds and locate portions of data in messages containing valuable information. Most companies protect computer equipment and data-file banks, a relatively easy task because companies control their facilities. But in modern telecommunication systems, a telecommunication manager has little or no control over the communications network used and, therefore, cannot protect the channel (Fig. 1). The most reasonable way to protect against data loss when transmitting is to protect the message itself by encryption.

Encryption, a proven, practical way to protect communication transmissions, transforms data in such a way that it becomes utterly useless to an opponent. It provides extremely high-level protection and prevents a determined opponent from extracting information from the communications channel. It can also eliminate the authentication problem by preventing an opponent from injecting false data into the channel or modifying the messages to insert misleading or confusing information.

Cryptography fundamentals

A message prepared for transmission is considered to be "plaintext," "cleartext" or an "unenciphered text or message." This message is usually transmitted over an unprotected communications channel that could easily be monitored by a casual or motivated eavesdropper. To prevent the unauthorized acquisition of this message, it is enciphered with a reversible transformation to produce a cryptogram or ciphertext (Fig. 2). When

an authorized receiver obtains the encrypted messages, he simply decipheres or decrypts it with the inverse transformation of the cryptogram, which converts it to the original plaintext version.

The method of transformation in a cryptographic system is determined by using a specific algorithm controlled by a unique number or bit pattern, usually called an encryption key. The key produces various enciphering sequences, but a specific, unique outcome results from a specific key. For general systems, the key is a set of instructions, piece of hardware or a computer program (software) that can encipher the plaintext and decrypt the ciphertext in a unique way determined by a specific key. Both a sender and a receiver must know the specific key to complete the process successfully.

A most important rule in security engineering is that the strength of a protection system should not depend on the secrecy of something that cannot easily be

changed or modified if it is compromised. Consequently, the strength of any system greatly depends on the key. The encryption key can be imagined as a resettable combination lock to protect a safe. The structure of the lock is available to anyone, but the combination is protected and kept secret by a user and can be changed whenever he suspects that the combination is known by unauthorized persons. Even when an opponent knows all the possible keys or combinations that could be used for the lock, it is still a difficult problem to discover which combination is correct at a given time.

The strength of a communications protection system resides with protecting the encryption key. This key must be provided to the other users of the communications network to enable them to send and receive encrypted messages. Key distribution is usually accomplished with a protected key-distribution channel using courier service, registered mail or a secure communica-

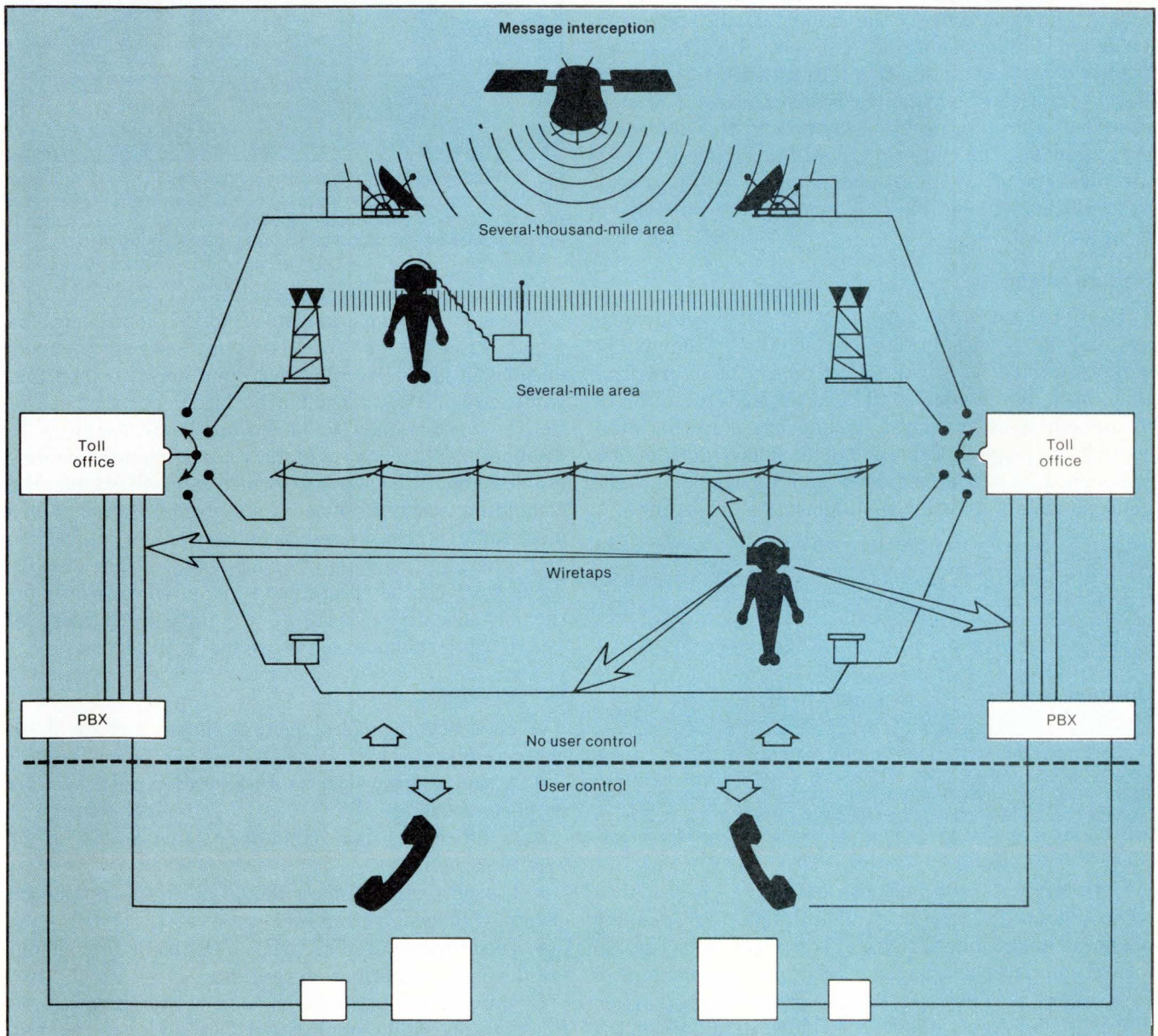


Fig. 1. Limited control of communications security is a fact of corporate life. Once communications extends beyond in-house facilities, message interception is possible at sites where the transmission media are essentially public in nature.

The most reasonable way to protect against data loss when transmitting is to protect the message itself by encryption. Encryption transforms data in such a way that it becomes utterly useless to an opponent.

tions channel.

A cryptographic system also helps solve the authentication problem because an eavesdropper who passively intercepts communications over a transmission channel obtains only the ciphertext (Fig. 3). By accepting only those messages enciphered with the correct authorized key, the receiver is protected against receiving modified messages, assuming the key has not been previously compromised.

When an opponent intercepts encrypted messages and attempts to convert the ciphertext into plaintext, or when the opponent attempts to encrypt a fake plaintext message into a cryptogram without using the key, a process of cryptanalysis takes place. The more resistant a cryptographic system is to the process of cryptanalysis, the more protected the system is. There are various of ways to implement a cryptographic system that will significantly increase the difficulty of cryptanalysis.

Secure systems

To determine the adequacy of a cryptographic system, the types of attack to which the system will be subjected must be evaluated. To do so, the information that may be available to a cryptanalyst must be examined. A cryptanalyst usually has only the intercepted message, perhaps some knowledge of his opponent's type of messages and knowledge of the general system used for communications protection.

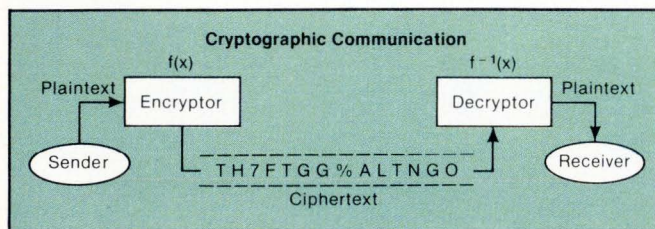


Fig. 2. Encryption/decryption is a simple process that involves a complex step. The process consists of performing a functional transform on the plaintext message to render it into ciphertext then performing the inverse function to render it intelligible again. But the step requires a complicated function for the process to be successful.

With computer or business data, the cryptanalyst often knows substantial amounts of corresponding plaintext and ciphered text. The rigid structure of formal computer languages used in programming or of data such as business forms guarantees that an opponent will know beforehand much detail about the plaintext message. In formal computer-programming languages, such as ALGOL, frequent occurrence of

words such as "procedure" and "integer" typically closely approximate known plaintext. For example, business information represented by ordinary computer communications codes is highly susceptible to a plaintext attack.

Two ways exist in which cryptographic systems can be considered secure. Systems in which the information available to the cryptanalyst is insufficient to determine the enciphering and deciphering transformations, no matter how much computing power and time is available to the adversary, are called unconditionally secure. When intercepted material contains sufficient

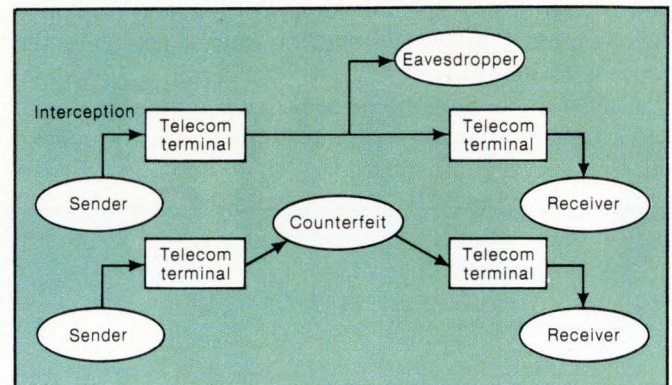


Fig. 3. Authentication, which protects the receiver from acting on counterfeit messages, can be as much a benefit of encryption as protection against interception by eavesdroppers. Authentication is accomplished by requiring that all messages be encrypted.

information to allow a unique solution to a cryptanalytic problem, there is no guarantee that this solution can be found. It is the goal of a system designer to make enciphering and deciphering functions inexpensive, while ensuring that any unauthorized decryption operation be too complex to be economically feasible. To decipher messages, a cryptanalyst must commit considerable computational power, which can well exhaust the computing resources of today's systems. A task of this magnitude is considered computationally unfeasible and, therefore, computationally secure. The "work-break cost" can be acceptable to an adversary only for the most sensitive messages—assuming the adversary knows when such messages are likely to occur.

Key systems

A good cryptographic system should include these characteristics:

- A simple encryption and decryption operation for authorized users.
- A difficult or impossible decryption operation for unauthorized users.
- The protection of data should not require that the cryptographic algorithm be kept secret.
- The efficiency and security of the algorithm should not depend on information content.

Cryptographic algorithms use a combination of functions operating on plaintext data under the control of a parameter, or key. The key assigns the permutation used to transform the data into ciphered text. A

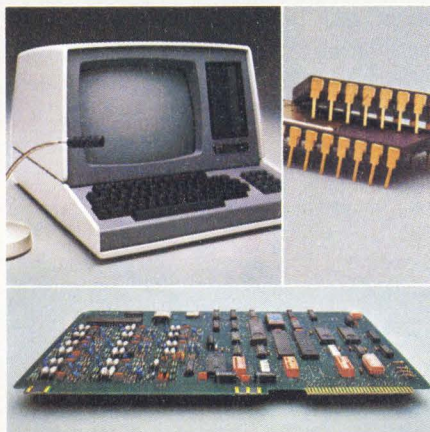


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The strength of a communications protection system resides with protecting the encryption key. Key distribution is usually accomplished using courier service, registered mail or a secure communications channel.

cryptographic key contains the parameters for creating the enciphered message, and the cryptographic period is the time between key changes. Subsequent cryptographic keys should be selected completely randomly, and the choice must be unrelated to the previously used keys. A secret key system uses the same key for enciphering and deciphering operations. In this case, all communications points within the network must possess the key. This is known as a crypto net.

Some future systems may use the concept of public-key cryptography. In this case a user, either a sender or a receiver, maintains two keys. One is public (encrypt only), and one is secret (decrypt only). The public key is known by everyone within a system, while the secret key is known only to the authorized receiver. In practical application, a sender who knows the receiver's public key enciphers the message in the established public-key code. A receiver, on the other hand, can decrypt the message only with his secret key,

which is mathematically related to his public key. Public-key systems have inherent advantages over secret-key systems. For a sender and receiver to communicate over the cryptographic system in a secret-key system, the sender and receiver must first exchange keys through a physically secure means, such as registered mail or courier service. Public-key systems do not require this transfer.

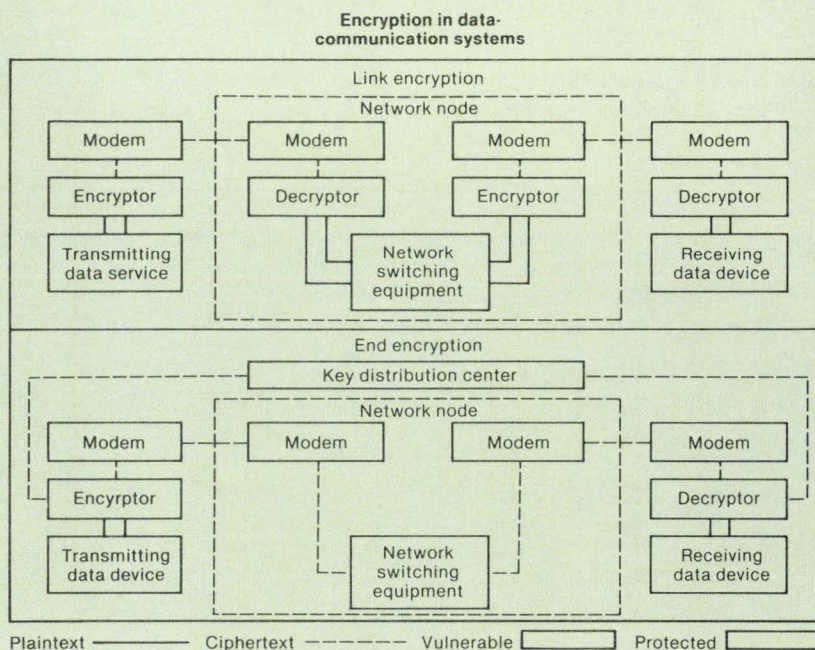
Frequent key changes are usually desirable in that they limit the amount of data compromised if an adversary learns the cryptographic key. Therefore, the strength of any cryptographic system rests with the key-management technique, a term that encompasses the generation, distribution and use of keying variables. Resorting to the distribution of keys to all potential user pairs by a physically secure means may be unfeasible, particularly for large communications networks. An approach to this problem is known as "link encryption."

With link encryption, each user has a key for communicating with a local network node. The message is decrypted and reencrypted as it passes through each successive node. Because the compromise of any node on the network compromises all messages passing through it, such a system is useful only in applications in which the node can be kept physically secure and staffed by cleared personnel. In many commercial networks, it is not economically feasible to maintain physical security of remote nodes when they are located

Fig. 4. Vulnerability of network nodes depends on whether link encryption or end encryption is used. Link encryption is the technique most commonly used with existing technology. Messages are encrypted only for transmission over the communications links between network nodes. Node pairs typically use

unique keys between each other. Any translation from one key to the next occurs within a node. Therefore, plaintext data passes through each node. This is the major disadvantage of this technique. It does, however, allow a node to extract routing information from the plaintext messages, which can be a problem when end-to-end encryption is employed. This is especially true for message- and packet-switching networks. The fact that plaintext data passes through each node when link encryption is used means that each node must be kept physically secure.

In end encryption each end point within the system holds a unique long-term key. The Key Distribution Center (KDC) also holds a copy of each key. When one input end point wishes to communicate with another, a request to this effect is sent to the KDC. The KDC then generates a temporarily unique conversation key, encrypts this in the long-term key of the originator and also in the long-term key of the recipient, and sends the appropriate version to each. The originator decrypts this just-received, encrypted, temporary key using its long-term key; the recipient does the same, and now the two parties can converse with end-to-end encryption. When the communication is broken the temporary key is destroyed.



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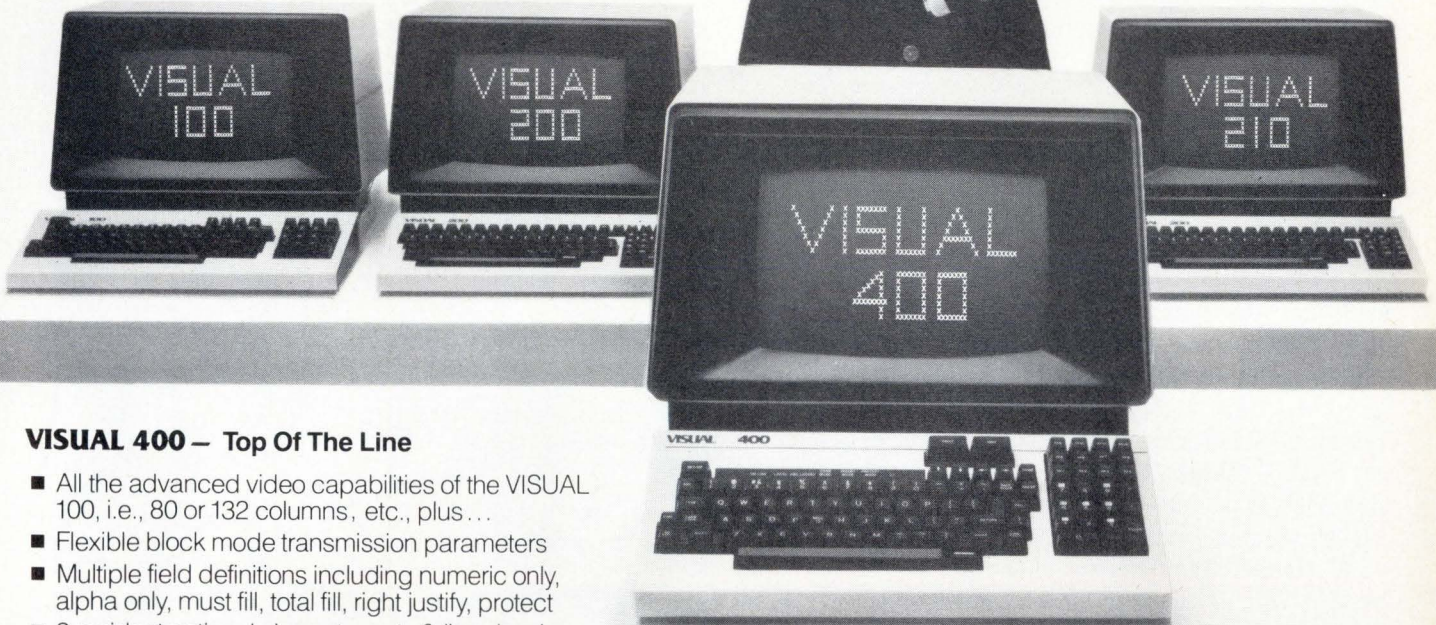
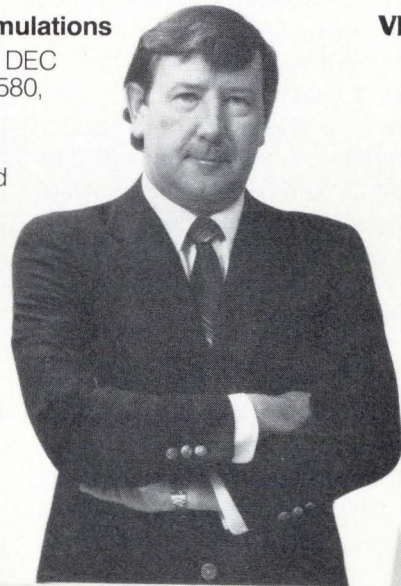
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It is the goal of a system designer to make enciphering and deciphering functions inexpensive, while ensuring that any unauthorized decryption operation be too complex to be economically feasible.

in distant cities and facilities in which a user is merely a tenant. In this arrangement, link encryption provides little or no protection.

A solution to this vulnerability is an end-encryption procedure (Fig. 4), in which each user, instead of sharing a key with a local node, shares a master key with a special network resource called the key-distribution center (KDC). When sender A wishes to converse with receiver B, a contact is made with the KDC, which sends a key to A encrypted with A's master key and a key to B encrypted with B's master key. The KDC withdraws, allowing A and B to communicate directly with their conversation-specific key. In this case, the security of this conversation depends only on the security of the KDC, rather than on the security of each node through which messages between A and B must pass. The security user must possess several master keys, each of which he shares with a different KDC. When starting a conversation, A and B receive a conversation key, properly encrypted, from each of the KDCs and combine all of these keys to create a new, unique key that both A and B will use. For such a network to be compromised, all of the KDCs would need to be subverted.

Interoperability

The current state of the art does not allow for true interoperability between a variety of senders and receivers without obtaining advance arrangements for communications protocols and the installation of identical cryptographic equipment. Even with the use of public-key systems, all users of the public-key technique must use the same encryption algorithm built into similar or identical firmware. The Data Encryption Standard (DES) algorithm, published by the National Bureau of Standards, is an initial attempt to standardize cryptographic technology. About a dozen devices have been developed with the validated DES algorithm.

However, each manufacturer has provided a unique set of control functions for these devices to optimize speed, cost, size and power consumption. These value-added enhancements have been designed to fill anticipated market requirements. Additional standards will be required for communications, to assure that products of different vendors can intercommunicate.

As with the telephone system, in which all telephones can communicate with one another regardless of the telephone company involved, all computer terminals and peripheral devices should be able to intercommuni-

cate in a cryptographic language. Until such standards are in place and accepted by industry, cryptographic systems must be considered closed-loop within pre-defined networks unique to each product.

Encryption methods

Plaintext information can be encrypted and transmitted by various techniques, some expressly providing for data authentication and some without authentication. Because the plaintext to be enciphered is usually of uncontrollable length, it cannot be easily handled all at once by a computing device of fixed size. A data message usually consists of short segments of information (bits, characters, words or phrases) as it is received

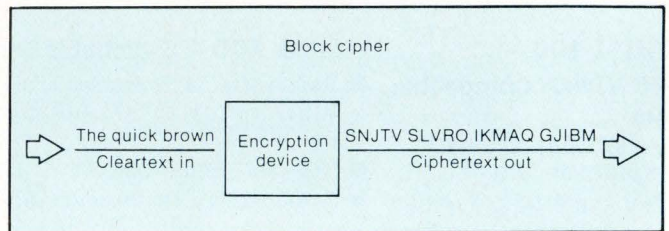


Fig. 5. Fundamental to the concept of block ciphering is that the ciphertext is a static function of some present coding algorithm performed on each portion (block) of plaintext. Each time the same block of plaintext is entered into the coding device, the same ciphertext is output; no ciphertext is output in the absence of plaintext.

from the communications device. There are two basic types of encryption: block and stream ciphering.

Block ciphering. The basic premise of block ciphers is the division of plaintext information into fixed blocks, with each block operated on independently (Fig. 5). A plaintext block is carried into the same ciphertext block each time it appears in the text. Block ciphers are, therefore, simple substitution ciphers and must have large alphabets to foil frequency analysis.

The desired property of a block cipher is that no bit of plaintext information ever appears directly in the ciphertext. Each bit of the ciphertext should instead be an involved function of all the bits of the plaintext and

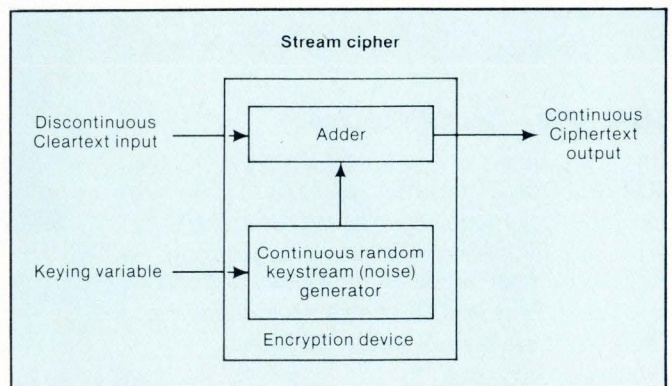
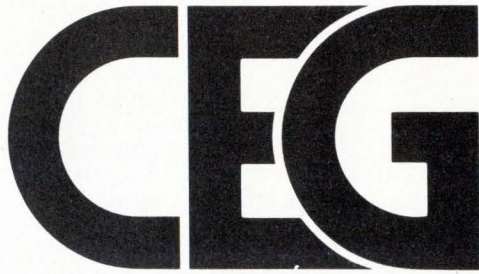


Fig. 6. Traffic-flow security is an advantage of stream ciphering, a dynamic process that produces ciphertext-like output continuously, even in the absence of plaintext. This makes it difficult for an opponent to distinguish between true data flow and noise. Because keystream (noise) generation is continuous and random, different ciphertext is output each time the same cleartext message is entered.



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The current state of the art does not allow for true interoperability between a variety of senders and receivers without obtaining advance arrangement for communications protocols and the installation of identical cryptographic equipment.

the key. This cipher should be designed so that changing even a single bit of either the plaintext or the key causes approximately 50 percent of the ciphertext bits to change.

Stream ciphering involves using the cryptographic equipment to generate a continuous random data stream (keystream) that is added to the plaintext to yield ciphertext. When input plaintext is not present, the keystream alone is transmitted. Because the keystream is indistinguishable from normal ciphertext, an interceptor cannot tell when messages are being transmitted. This property is known as traffic-flow security (Fig. 6).

Fundamental to any encryption technique is that the sending and receiving encryption devices must establish and maintain synchronization throughout the duration of the transmission. If synchronization is lost, all the text following the loss will be deciphered incorrectly. ■

J. Michael Nye is president of Marketing Consultants, Inc., Hagerstown, Md.

NEXT MONTH IN MMS

The August issue of Mini-Micro Systems will include a special report on CRT terminals, those windows into computer systems that are probably the most pervasive man-machine interface devices. The report will feature the following articles:

- Product profiles—surveys, including extensive tables, on dumb, editing and intelligent terminals.
- Terminal ergonomics—an article from market leader Lear Siegler detailing how ease of operator use has become a major concern of terminal designers.
- Touch-input technology—Xerox Corp. explains the technology that allows the tube's screen to augment the keyboard.
- Terminal modularity—Digital Equipment Corp. will discuss the future expandability built into the ubiquitous VT100 terminal through modular design.
- Terminal emulation—Cobar, Inc., will examine how manufacturers intending to emulate the popular terminals, including the VT100, can expand on the target unit's feature while remaining compatible.

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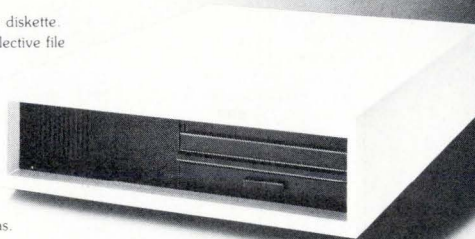
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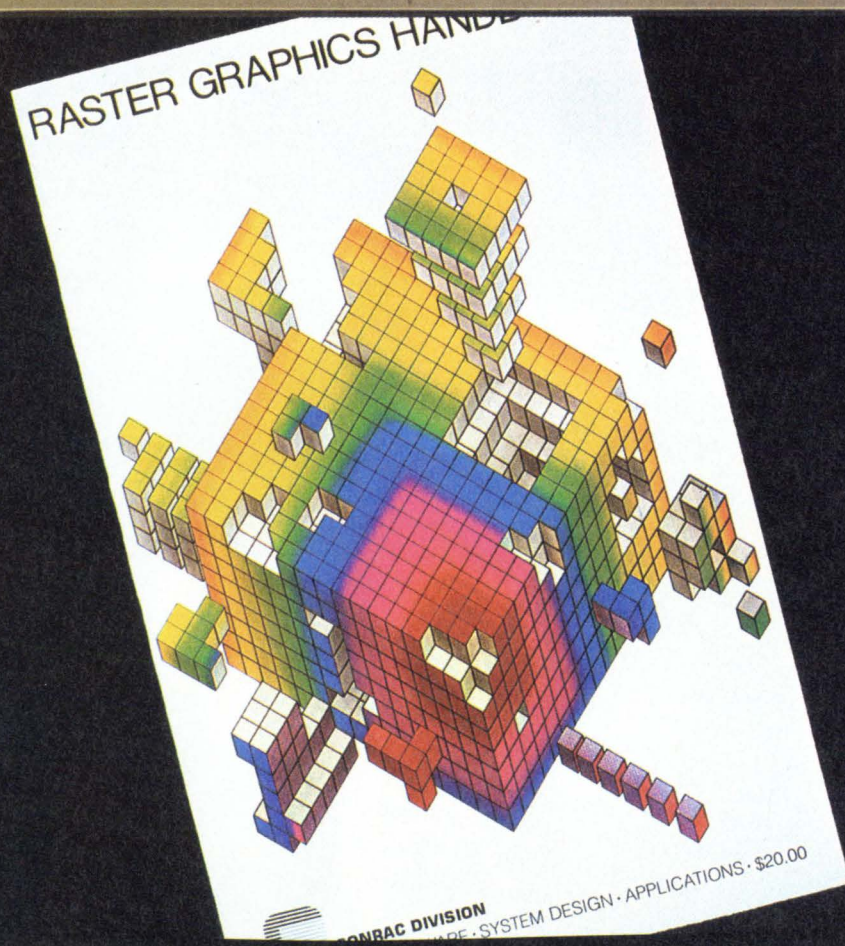
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Assisting small companies with exports

FRED M. GREGURAS, Kutak Rock & Huie

*Export trading companies
are intended to help mini-micro vendors 'make it'
overseas by softening earlier antitrust taboos*

The U.S. Department of Commerce has estimated that there are some 20,000 small- and medium-sized American firms—many in the high-technology field—that could be selling their products and services abroad, but are not. The Senate took a major step toward encouraging these firms to broaden their market horizon by passing the Export Trading Company Act in April.

The bill, essentially the same one passed by the Senate in 1980 (but not acted on in the House), is intended to facilitate the formation and operation of export trading companies and associations. If enacted, the measure could provide the means for computer and telecommunications equipment manufacturers to compete successfully in a market many have thought of as beyond their budget.

Penetrating foreign markets is often a difficult undertaking that can require a pooling of resources. While other nations have supported joint projects and integration among businesses to promote competitiveness in the world market, U.S. antitrust laws have deterred joint ventures and the consolidation of bids by American companies

seeking foreign business. To ensure domestic competition, classic antitrust policy has been applied even to the point of jeopardizing the long-term capability of American industry to compete effectively abroad. Current antitrust uncertainties and prohibitions relative to export activities would be reduced by the Export Trading Company Act through a Commerce Department certification process.

Another important aspect of the act is its provisions that would permit the American banking community to invest and participate in the operation of U.S. export trading companies. This would enable banks to provide the financial resources and expertise that have been essential to the success of foreign competitors, notably Japan. Although U.S. trading companies would not have the special financing arrangement with banks that Japan's trading companies have, the proposed coupling of banks and businesses would put U.S. companies on more competitive footing.

Types of trading companies

Under the legislation, an export trading company (ETC) would be any company, profit or nonprofit, oper-

ated principally to export goods or services produced in the U.S. or to provide various services to facilitate such exporting by unaffiliated companies or individuals. An ETC is, therefore, flexible enough to meet the needs of the export market.

One form of ETC could perform all export marketing services for U.S. producers, a "one-stop" facility for a

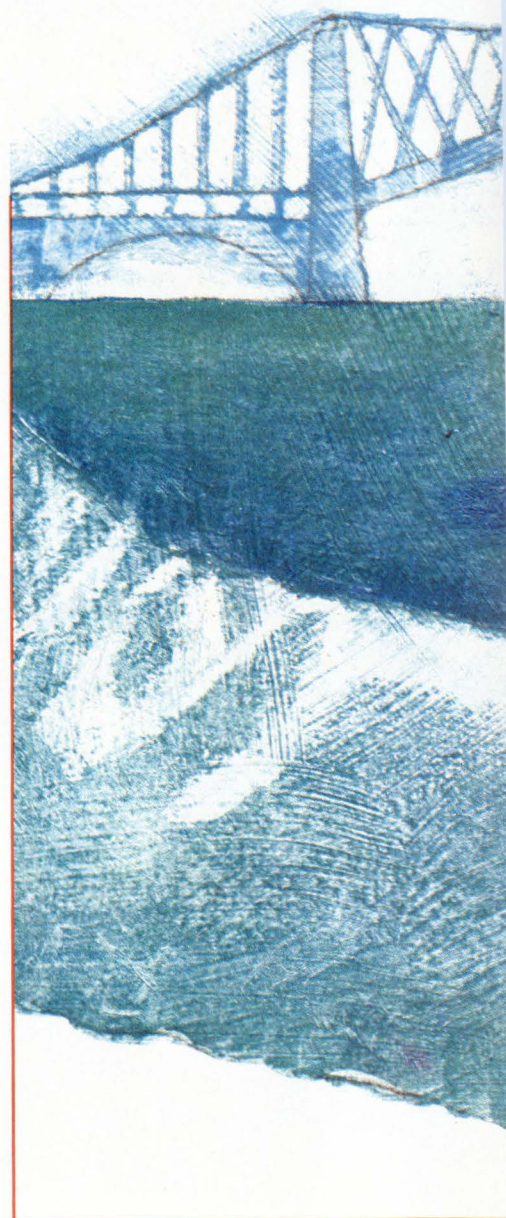
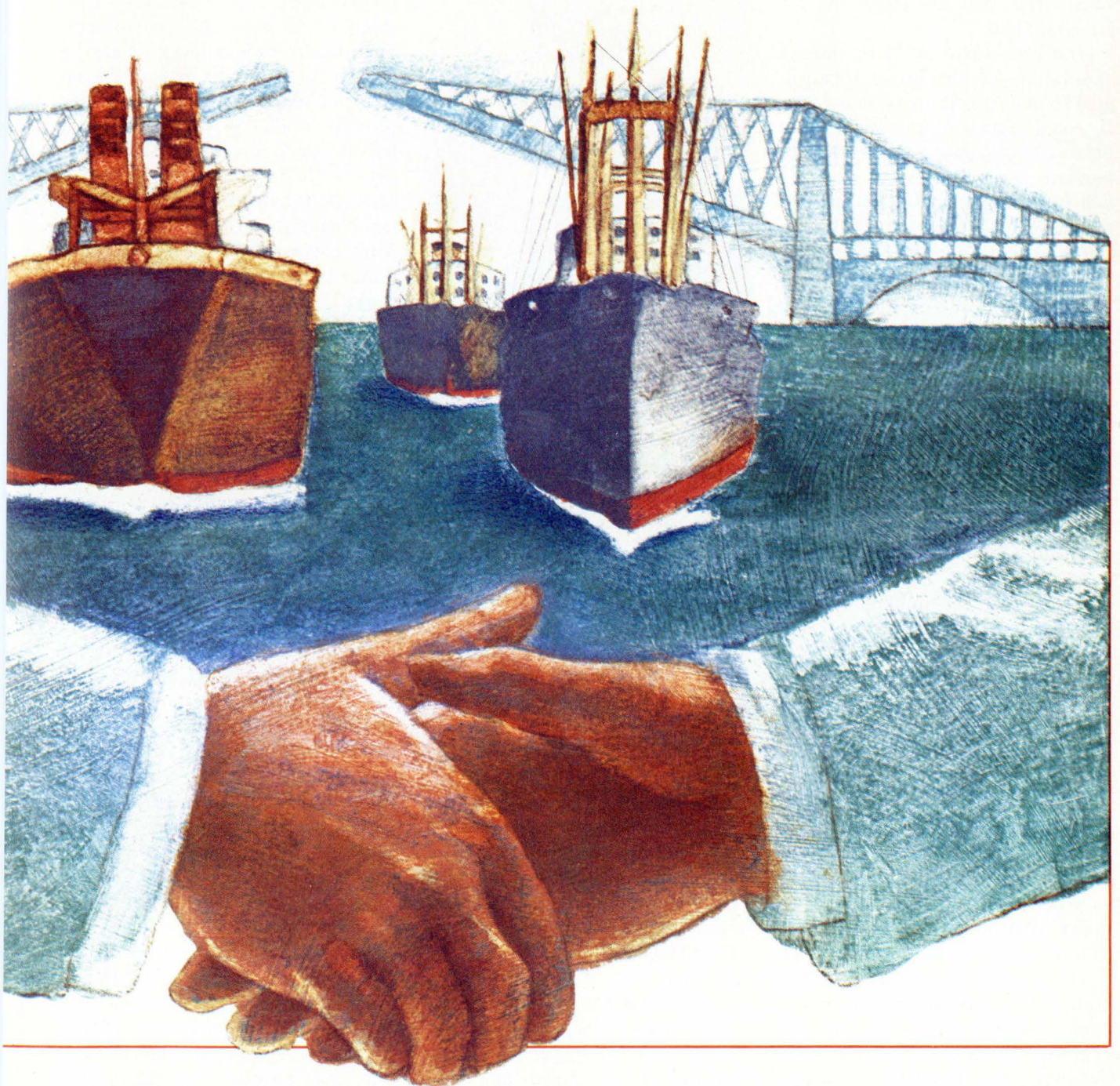


Illustration by Katherine Mahoney



firm interested in selling abroad. Such an ETC could specialize, for example, in bank technology. It could offer a full range of services, including international market research, sales representation, financing, insurance, freight forwarding, legal assistance and coordination of licensing under the Export Administration Act. The ETC could also

provide after-sale support for the sale of electronic fund transfer (EFT) networks of mainframe computers, transaction terminals, telecommunications equipment, software and service. Such a company could achieve greater savings and offer more specialized expertise than could individual organizations.

An ETC could also be formed to

purchase goods on its own from American manufacturers for resale overseas. It would seek U.S. products for which it had identified foreign markets, such as telecommunications controllers, modems and PBX telephone systems. An American manufacturer would immediately receive payment for its goods, and the ETC would bear the

risk of selling and collecting for the merchandise. With the bank financing permitted by the bill, the ETC could minimize the capital outlay of participating small- and medium-sized firms that are exporting for the first time.

Another form of ETC might specialize in obtaining foreign-government procurement contracts. It could put together the proper balance of U.S. goods and services to perform large contracts, many of which are being opened to international competition as a result of the Multilateral Trade Agreements. For example, West German universities, which must conform to German federal government procurement regulations, are a major market. This form of ETC could provide a turnkey computer system—including a computer, peripherals and software—provided by a consortium of developers and an association of maintenance service providers in response to both governmental and private procurements.

A consortium of equipment manufacturers and service firms could form an ETC to offer a total office of the future to the international market or could specialize in providing backup centers for full-service, data-processing facilities.

Bank participation

Bank participation is based on the rationale that both bank financing and contacts are essential to the success of ETCs. Banks are already a major source of funds for U.S. companies; ETCs will have as much need for capital as any other business. Furthermore, many banks already have a well-developed network of overseas relationships that would be invaluable to ETCs.

Under the Export Trading Company Act, banks could have an equity interest in and—if approved by the appropriate federal regulator—control of an ETC. "Bank" is broadly defined under the act to include a state bank, national bank, bank holding company and Edge Act corporations.



A consortium of equipment manufacturers and services firms could form an ETC to offer a total office of the future to the international market.

Equity investments in ETCs made by a bank would be limited to five percent of the bank's capital and surplus, and total investment combined with extensions of credit to ETCs, to 10 percent. Investments of as much as \$10 million, which would not obtain for the bank a controlling interest in any ETC would not require approval by any regulatory agency, although there would be certain notice requirements. Before a bank can invest more than \$10 million in ETCs or own more than 50 percent of an ETC's stock, the move must be approved.

The act has generated opposition in the House. Despite the demonstrated need and success of such relationships in Japan and elsewhere, some House members still do not want U.S. banks to be involved in trading companies, citing the risks of overseas trade. Other members have expressed concern over the scope of the antitrust exemption, and over the fact that bank-owned ETCs might have access to preferential bank credit (though foreign competitors

currently enjoy such an arrangement).

The latter criticism is unjustified because the act would not allow banks to extend credit at favorable terms to ETCs in which they own stock or to the ETCs' customers. Such banks would nevertheless be able to offer credit to buyers on ordinary market terms. The ability to offer credit to potential foreign buyers could mean the difference between winning and losing sales. This credit availability is even more significant in view of the Reagan Administration's proposed budget reductions for the U.S. Export-Import Bank and the resulting cutback on the capability of offering export credits.

Export trade associations

Export trade associations (ETAs) have existed for some time but have not been fully-exploited. They were formed to gain exemption from the antitrust laws under the Webb-Pomerene Act of 1918. Under that law, an ETA established for the sole purpose of engaging in the export trade of goods can claim exemption from some federal antitrust laws if it does not restrain trade within the U.S., restrain the export trade of any domestic competitor or intentionally or artificially enhance or depress prices within the U.S. of commodities of the type it markets. As long as they avoid these activities, the members of an ETA may fix prices, allocate markets and otherwise regulate and manage their members' export trade.

Congress believed that the Webb-Pomerene Act would enable American companies to enter previously blocked foreign markets. These expectations were briefly realized, but the number of ETAs has dwindled to around 30, accounting for only about two percent of total U.S. exports. This situation has been attributed to these factors:

- The rapidly expanding U.S. service industries have been excluded from qualifying for the antitrust exemption.
- The threat of antitrust litigation has deterred their broader use.

• The business community, traditionally placing top priority on the domestic market, has been slow to recognize the importance of the foreign market and the usefulness of ETAs in entering that market.

The Export Trading Company Act seeks to remove some of these disabilities. It would expand the scope of the antitrust exemption to services, which have been estimated to comprise 65 percent of America's gross national product. Thus, service industries, including those in banking, can enter the export market either as ETCs or as members of ETAs.

The Export Trading Company Act would clarify the application of antitrust laws. A certification procedure for antitrust clearance would be established so that export trade associations and companies could know in advance which activities would and would not be immune. The immunity would extend to all federal and state antitrust laws. If the certification process is streamlined, the Act will be used by American companies, but if it becomes clogged with bureaucracy and overwhelming information requirements, much of the positive impact of the legislation would be lost.

An export trading association or company whose export trade activities have been certified could be certain that those activities are exempt from the enforcement of both state and federal antitrust laws until the certification is revoked or invalidated. Even if revocation or invalidation occurs, the loss of the antitrust exemption is for future conduct only.

The Export Trading Company Act would help diminish the growing international trade gap faced by the U.S. by reducing self-imposed disincentives to export. ETCs would provide a more aggressive means of international market entry for many small businesses producing high-technology goods and services. ■

Fred M. Greguras is a partner in the law firm of Kutak Rock & Huie, Omaha, Neb.

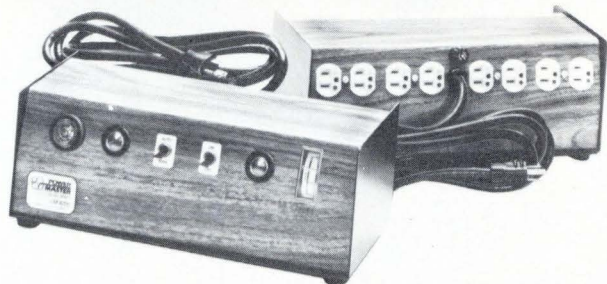
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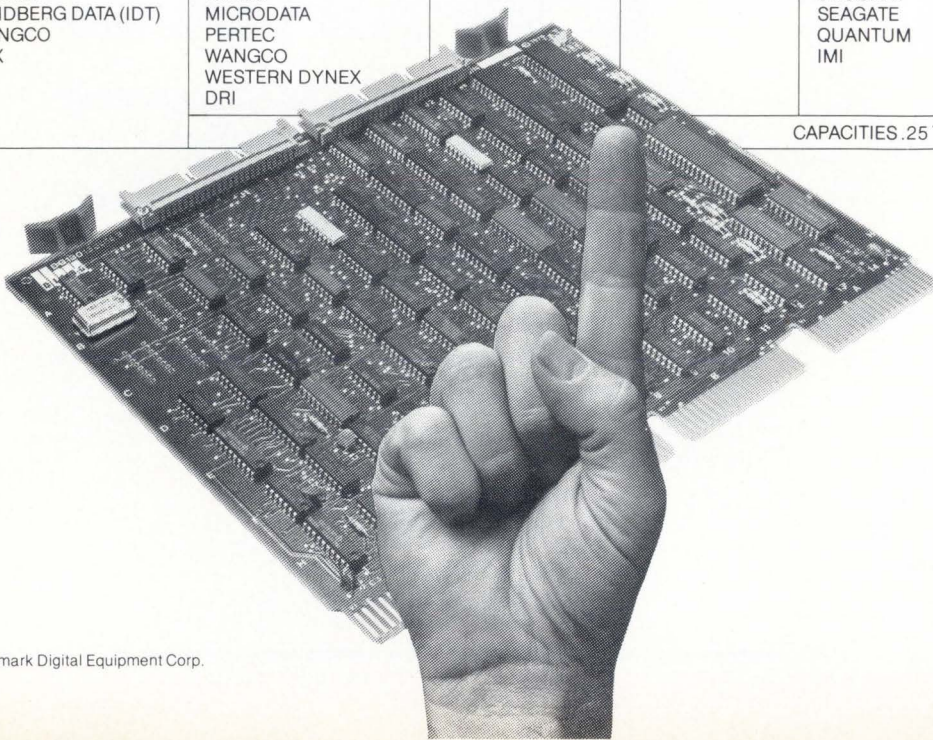
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APPLICATIONS

A computer in Hollywood

*Film and television animation are greatly speeded
by using HP 1000-based system in special-effects work*

Picture a high-speed battle of space ships set against an infinite, starlit sky, or the glowing title of a movie soaring loftily across the screen as the hero walks off into the distance. In either case, it is likely that a computer produced these special effects.

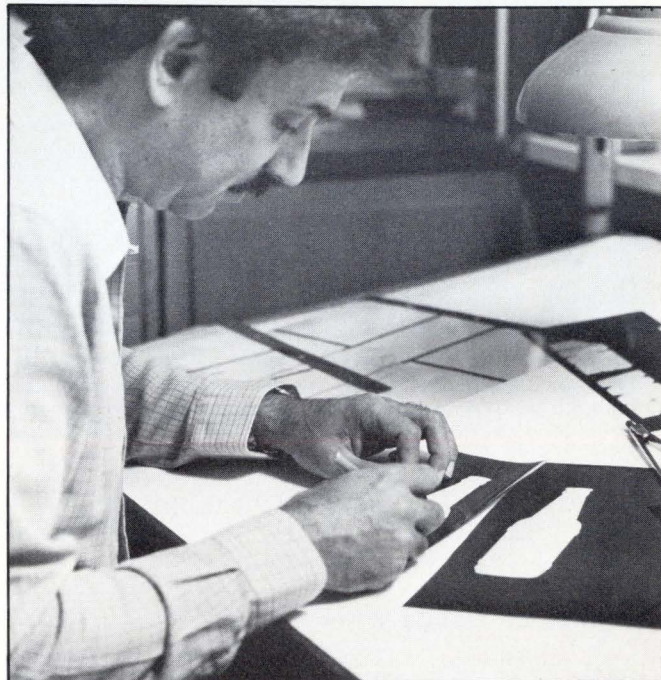
With the movie and television industries requiring increasingly complex special effects and faster-than-ever production turnaround times, computer animation systems are gaining a foothold in an application that was previously the domain of painstaking manual

methods. Creative Film Arts in Hollywood is one company that is using an advanced computer animation system to speed the production and enhance the quality of a variety of special effects for both television and motion pictures.

Dave Fiske, special-effects cameraman at CFA, says that the new system, developed by Cinetron Computer Systems, Norcross, Ga., around a Hewlett-Packard HP 1000 minicomputer, has more than doubled the output of the animation stand. "In addition," says Fiske, "the



Camerman Dave Fiske says the HP 1000-based Cinetron has more than doubled the output of the animation stand.

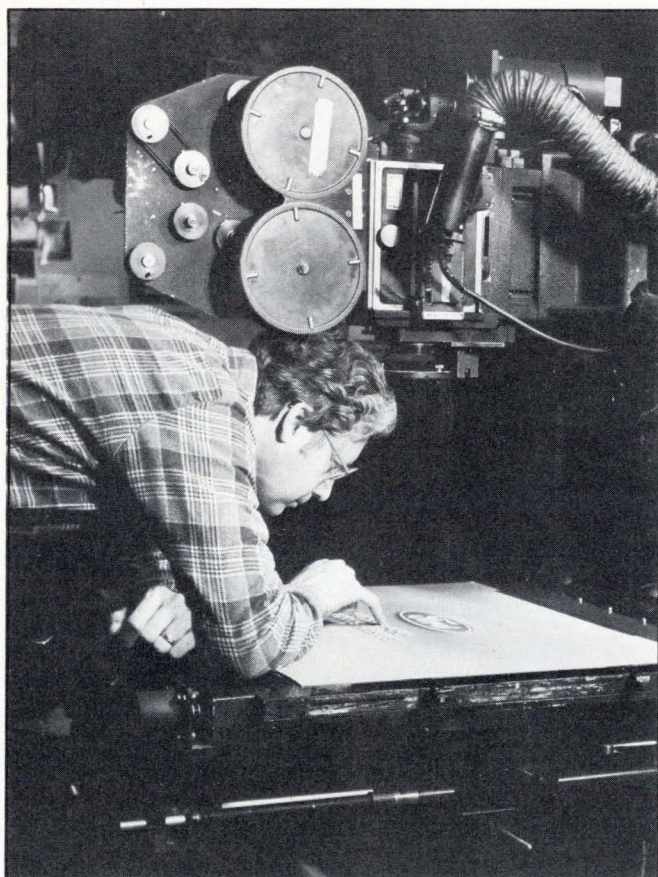


Personnel at CFA create mattes that are used for special effects and titles of films.

In addition to running the system from the keyboard, operators have available a complete set of controls that can regulate the motors directly.

system has helped us turn out a better product, and to do many effects that would have been impossible before."

CFA offers total post-production services, including film and video-tape editing, optical film effects, film-to-video tape transfers, computer animation, electronic digital effects, title design and film and video tape distribution. The firm, which was founded by Robert Williams in 1968, does special effects for some 1000 television commercials a year, including companies such as Budweiser, Paul Masson, Chrysler, Ford, Toyota,



Once a matte or title has been correctly positioned on the animation stand, the Cinetron system aids in computer animation. At CFA, the time required for a zoom-in on a piece of artwork requiring 10 ft. of film has been cut from 3 hr. to 20 min.

Pennzoil, Atari and Safeway. Movie picture credits include "The Sting," "Electric Horseman," "North Dallas Forty" and "The Deer Hunter."

A computer 'stands in'

CFA began searching for a computerized animation system in 1979, when the firm realized that both production speed and quality control could be greatly

improved with such a system. CFA had been using a manual animation camera and stand. The stand is a combination unit in which a camera, moving up and down on a vertical carriage, photographs artwork placed on a horizontal platform. The platform can move in two axes, and can also rotate. The cameraman previously had to calculate every position of the camera and table manually, twist the appropriate dials to bring about the appropriate moves for each frame of film to be shot and then snap the camera shutter.

"This was a time-consuming process," notes Fiske. "For a zoom-in on a piece of artwork requiring 10 ft. of film, we would have to make the calculations for 160 frames (16 frames per ft.). This would take us about 3 hr., and if we made a mistake, or if the client wanted a small change, we would frequently have to start from square one and go through the process again. Moreover, it all had to come out looking lifelike, which means that we needed to calculate the appropriate Farring curves to adjust for the fact that as you move closer to an object it appears to be moving faster." Farring curves are mathematical expressions that simulate psycho-ocular response, giving the allowable moves that will not produce jerkiness or an unnatural appearance.

It's all automatic

With the new computer animation system, however, Fiske simply tells the computer the camera's first position, how many frames should be shot, the distance that should be traveled and whatever other variables may be necessary. The computer makes all the necessary calculations, adjusts the camera and table and automatically snaps the shutter. "The system allows us not only to do the same 10-ft. job in only 20 min., but it also allows us to make subtle changes in positioning—to as much as 0.001 of an in.—that would not have been possible before," says Fiske.

CFA investigated eight computerized animation systems before deciding on the Cinetron system. "We talked to suppliers of these systems in terms of criteria such as reliability, expandability and price. We also talked to users of the systems—the people who operated and maintained them," recalls Fiske. "The Cinetron system, with the HP 1000 minicomputer, came out on top. We especially liked the fact that the Cinetron people really knew the film business; they were using their own products in their own optical effects house in Norcross to do many of the same kinds of jobs that we do."

Once the decision was made to install the new system, Cinetron personnel came to Hollywood to examine the firm's animation stand and camera, and modified the system to work with CFA's equipment. After training Fiske in Norcross in a two-week crash course, they then returned to Hollywood to help install the system.

"We went through the process step by step, so that I learned where every stepper motor and cable went,"

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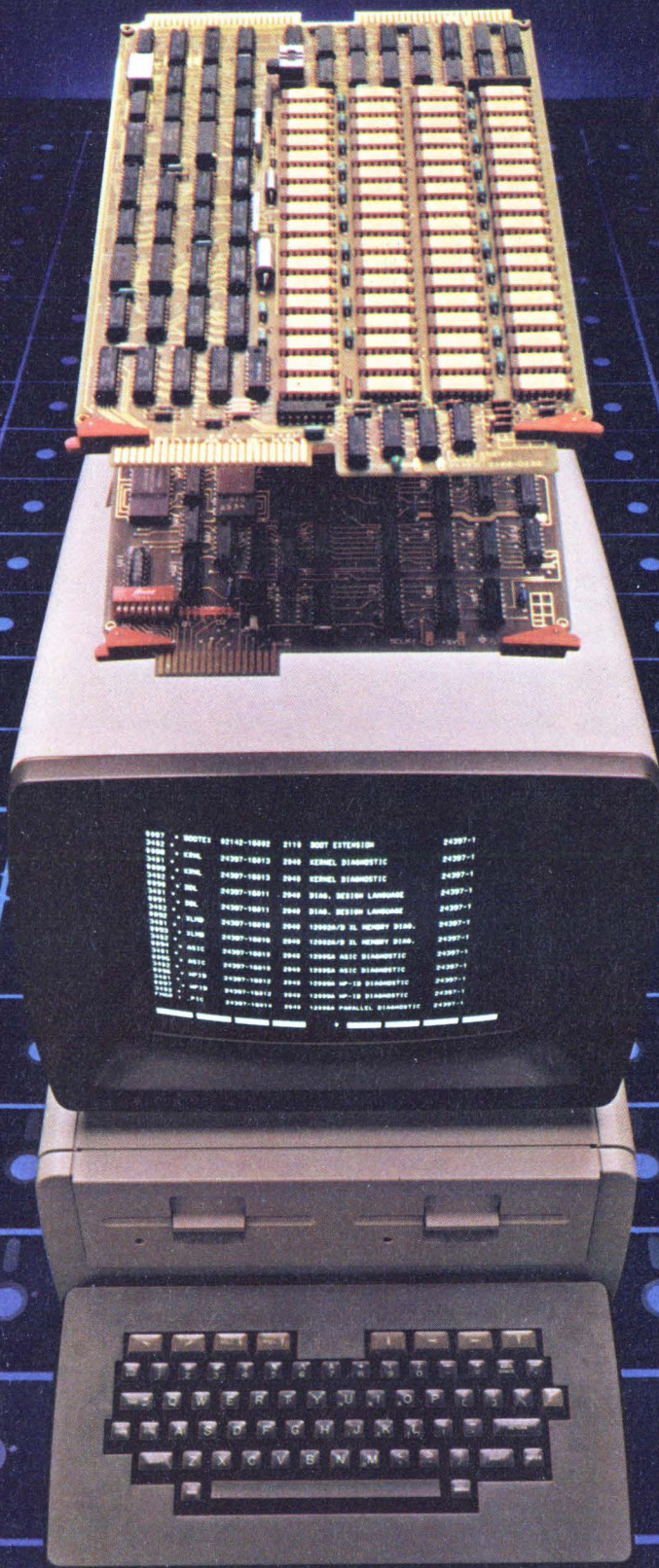
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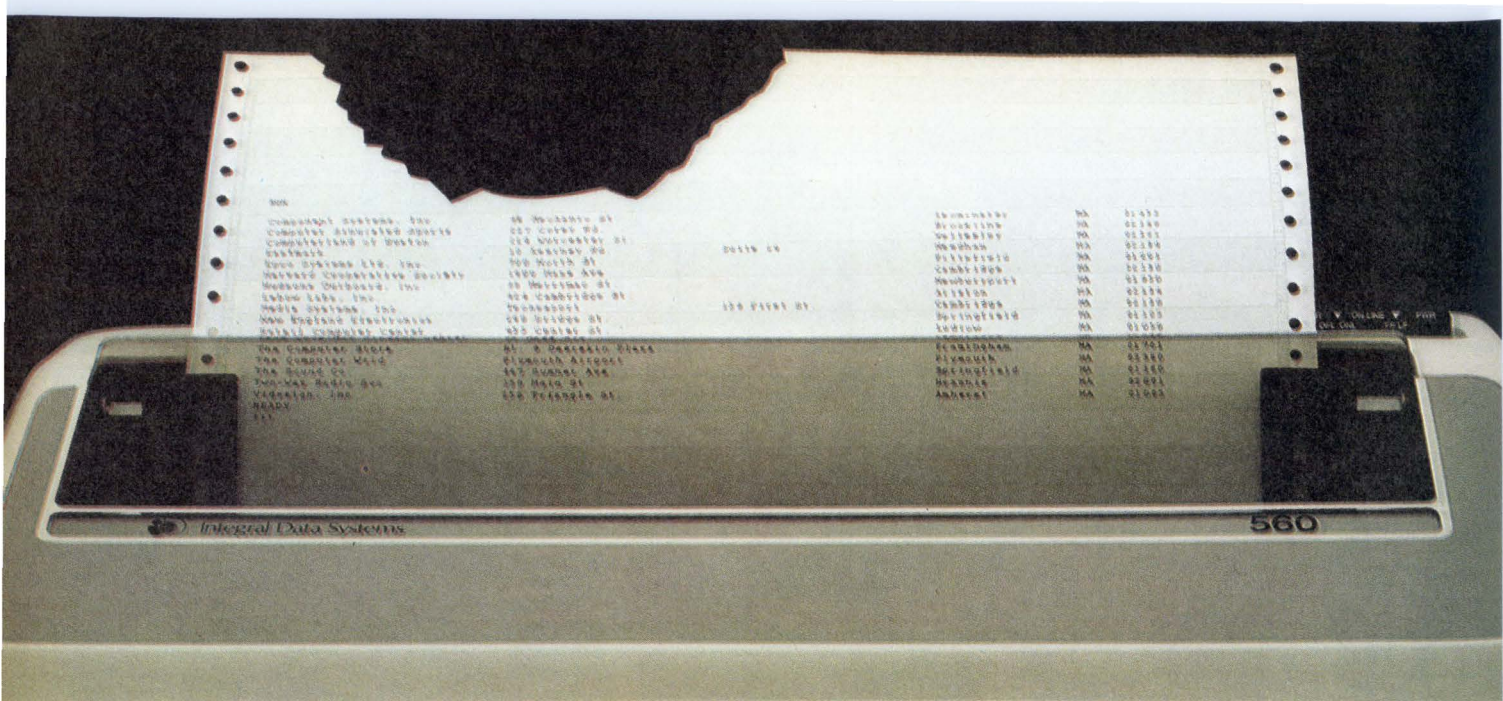
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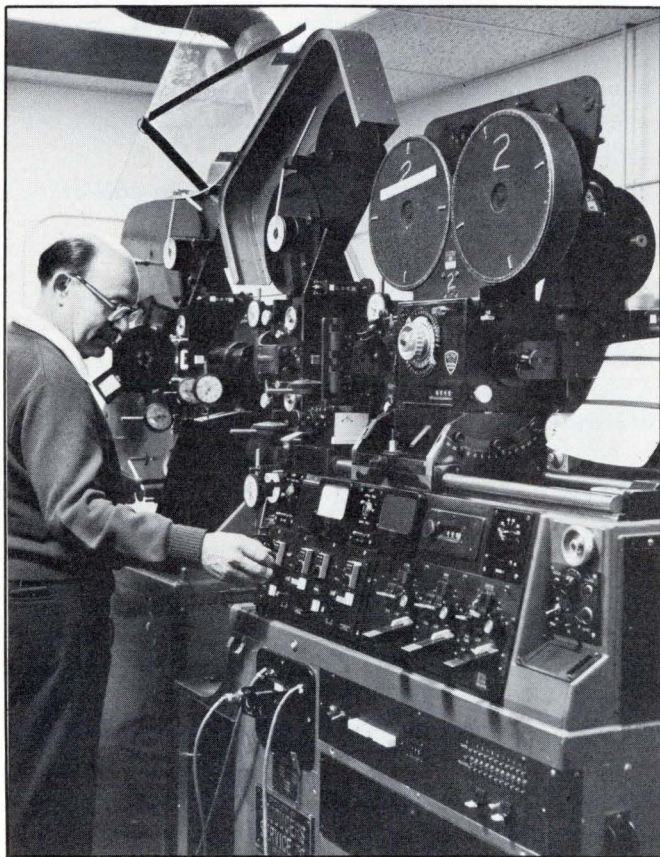
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CIRCLE NO. 100 ON INQUIRY CARD

After a matte is designed for a particular scene and shot on the animation stand, it is put into the optical printer and synchronized with the original scene.

notes Fiske. "I wanted to be able to troubleshoot and maintain the system as much as possible myself to ensure a minimum of downtime."

The system, installed in June, 1980, is a Cinetron model 800. It includes the HP 1000 minicomputer with 32K bytes of memory, an HP 2621P terminal, a cabinet and an operator control panel. The computer controls the animation stand by means of stepper motors. Fiske says commands are given through the terminal in



After a matte is designed for a particular series and shot on the animation stand, it is put into an optical printer, where it will be used, along with the original scene, to create the final film footage.

English and in a format familiar to animators. In addition to running the system from the keyboard, operators have available a complete set of hand controls that can regulate the motors directly. Even in this mode, however, the computer tracks everything that is done, so that personnel can easily shift from manual to computer control.

Special effects in action

At CFA, special effects are handled through two main

cameras: an optical printer and an animation camera. The optical printer, soon to be computerized, is used to do blowups, repositioning, reductions or any scene alterations required to modify the original camera photography. The film that comes out of this camera, called a dupe negative, is used to make the final motion-picture release. The animation camera, on the other hand, is used mainly for shooting titles, artwork or mattes that are often required for special effects.

To put a title on film, for instance, which is one of the most basic forms of optical special effects, requires both male and female mattes. The male matte, called a holdout, is a clear piece of film with a black title in the correct position. After the matte is designed for a particular scene and shot on the animation stand, it is put into the optical printer and synchronized with the original scene. The two pieces of film are then exposed together to create a new negative—the dupe negative—with no exposure in the area of the black title.

Next, the camera is backed up to the original synchronized position, the holdout matte and original piece of film are removed, and the female matte, called a cover, is put into the camera. This matte is a black piece of film with a clear title, which allows a color to be exposed over the title area not previously exposed. CFA's computer ensures that the male and female matte are registered correctly when they are first produced.

To create a title that moves across the screen, mattes must be generated for every frame that will be shot, and these mattes must be extremely accurate. The computer is especially useful here because it can automatically calculate the number of frames that will be needed to accomplish a given kind of movement, plus the exact position of the matte for each frame.

Fiske says the computerized system gives the animation stand operator maximum flexibility and accuracy to create a wide variety of special effects, including zooms, dissolves, fades and pans. "The system frees us to do more creative work and to plan the kind of special effects we want without worrying about the time or complexity involved in executing them," notes Fiske.

Further, and perhaps just as important, the system provides the kind of reliability required in the fast-turnaround, high-production television and movie environment. "So far, we've been running the system about 12 hrs. a day," says Fiske, "and it has never been down. We can start a complex job on the animation stand under computer control, and the computer will automatically complete the job while we're busy planning new jobs." ■

NEXT MONTH IN MMS

The August issue of Mini-Micro Systems will include a special report on CRT terminals, those windows into computer systems that are probably the most pervasive man-machine interface devices. The report will include surveys and extensive tables on dumb, editing and intelligent terminals.

CARTS & CRAFTS

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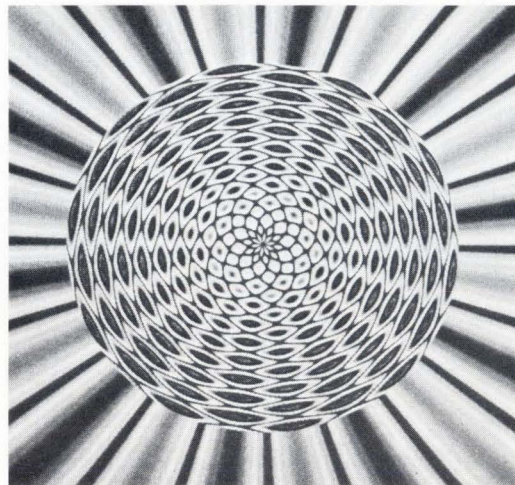
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SIGGRAPH / 81

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BOOKSHELF

Your first computer

To buy or not to buy—
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YOUR FIRST COMPUTER—A GUIDE TO BUSINESS AND PERSONAL COMPUTING, by Rodney Zaks, Sybex, Inc., Berkeley, Calif., \$7.95.

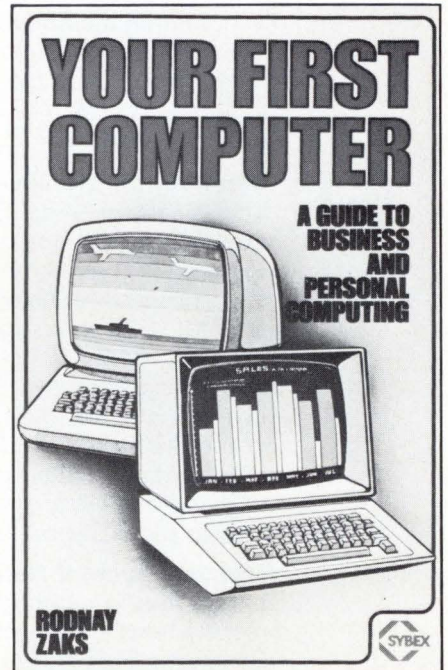
Reviewed by
Jean A. Miller

What begins like a fifth-grade science textbook quickly evolves into an adult's how-to and whether-to primer on purchasing and using a μ c system.

Your First Computer is the revised and expanded edition of Rodney Zaks's *An Introduction to Personal and Business Computing*, published two years ago by Sybex, Inc., Berkeley, Calif. The two editions are quite similar. The business computing chapter, however, now describes some hands-on experiences, including creating a mailing list and constructing and editing a letter. The computer language chapter is also updated. It contains a sample program in Pascal to accompany the BASIC and APL samples retained from the earlier book. Chapter 10, which includes an illustrated list of systems available, has been rewritten to reflect changes in the market.

Zaks investigates several computer systems and confronts the trade-offs involved in a buyer's first purchase—tape versus disk, speed versus memory space, assembler versus high-level languages, interpreter versus compiler and pre-packaged versus custom software.

An overview section (Chapters 2 to 4) exposes the book's lack of a glossary. Because the computer industry uses many acronyms and abbreviations, more than an index is



required for reference.

Although this book doesn't provide all the information a purchaser needs to make his decision, it does contain a balanced and clearly written discussion of all facets of μ cs. This should help tremendously in the initial stages of buying a system.

In each section, the lesson of the book is repeated: there is no best μ p, computer language, business package or set of hardware components. A user's specific needs and tolerances should dictate which products and approaches are most advantageous. ■

Jean A. Miller, a free-lance writer, was formerly an editor with Hemenway Associates, Inc., a Boston-based system software house specializing in operating systems and languages for μ ps.

GET THE FACTS

About the \$24 billion* minicomputer and microcomputer markets

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

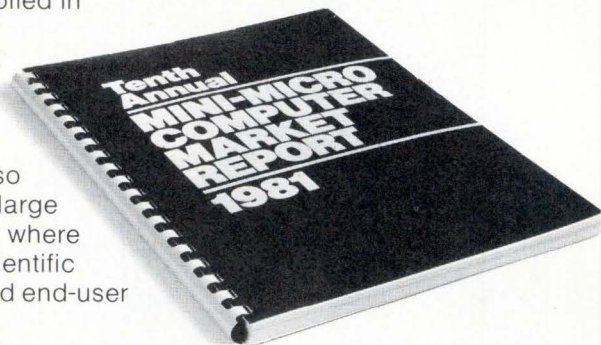
State-of-the-industry

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

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

Most comprehensive industry survey

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



Market Segment Data Base

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

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



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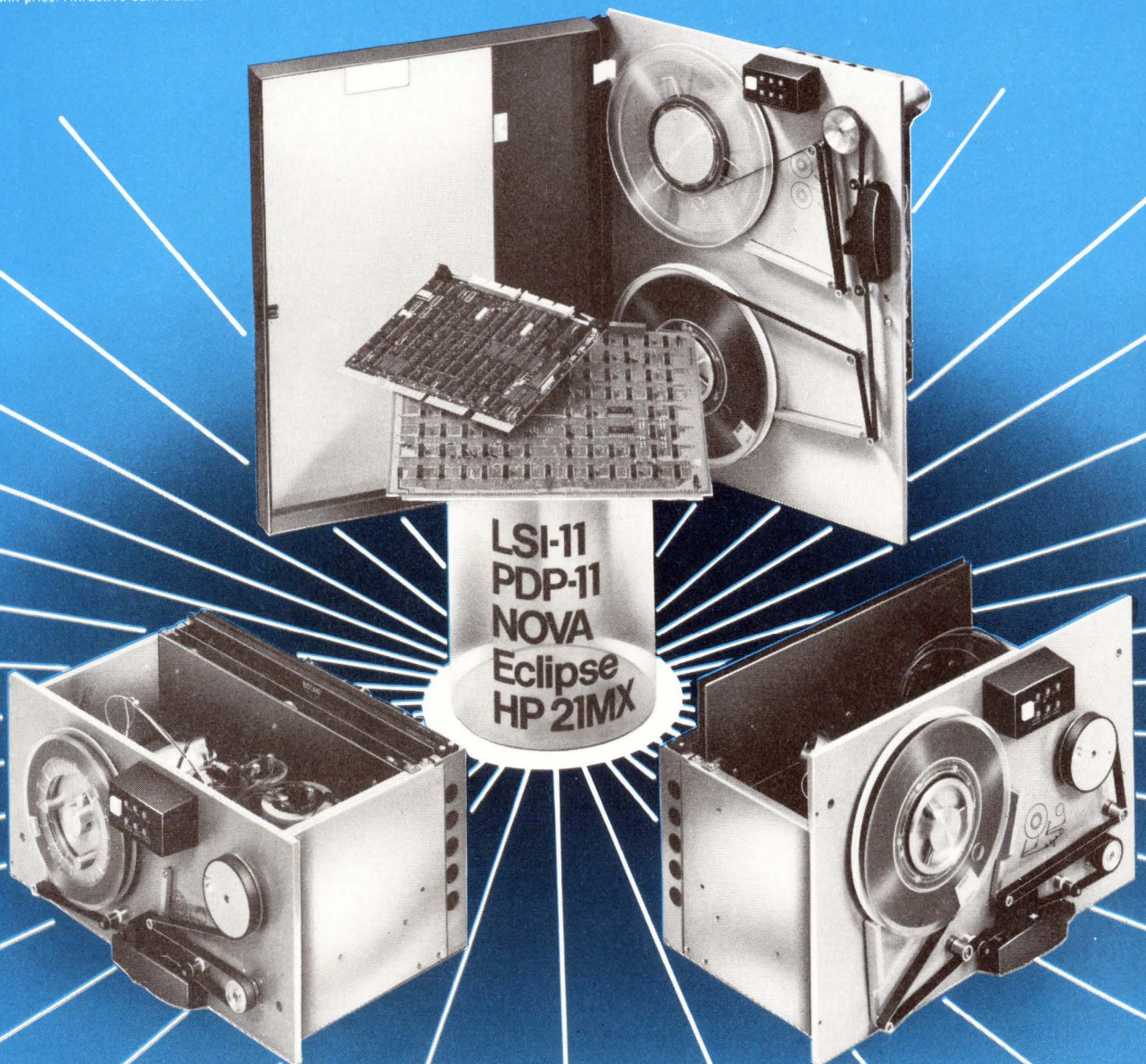
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CIRCLE NO. 134 ON INQUIRY CARD

Ampex's touch terminal uses scanning infrared beam

In an effort to provide a more natural man/machine interface, Ampex Corp. is expanding its Dialogue video-display line with the Touchterm 80, introduced at the National Computer Conference in May.

The terminal uses scanning-infrared-beam technology to provide a high-speed, reliable method for users to interact with a host computer. Because the unit responds to a touch on the display's surface, typing skills and the knowledge of special command languages are not needed.

Scanning-infrared-beam technology involves the use of four PC boards surrounding the inside of the display terminal's bezel. These boards contain the system's electronics. Infrared LED emitters are mounted on the left side and

bottom, and detectors are mounted on the right side and top. This produces a grid of infrared light beams, the intersections of which are X and Y coordinates.

The emitters and detectors are sequentially pulsed at the rate of approximately 80 Hz. Interruption of the beam by a stylus (pen, fingertip, pencil, eraser, etc.) transmits the X and Y coordinates, where the desired action occurs.

The Touchterm 80 offers brightness control, lower-case descenders, a non-glare display and a detached keyboard. User-defined escape codes provide for audible feedback to an operator in point or stream modes.

Point mode enables the system to output data each time the system is activated. The stylus must be removed so that there is at least one

scan (during which there are no broken beams) before the system is reset.

Stream mode enables an operator to move a stylus across the display, permitting data to be transmitted each time coordinate changes. A code is also transmitted if the stylus is removed from the screen.

A gloved hand is the maximum practical size for a stylus. As many as 1920 targets can be located on-screen.

The keyboard includes fast-repeat keys and a numeric pad section. Separate keys control the movement of the switch-selectable cursor that operates in block or underline and blinking or non-blinking modes. A new-line key performs the carriage-return and line-feed functions from keyboard control, but touch capability also performs these functions automatically.

A 25th line (switch-selectable on/off) allows an operator to determine the status of various operational modes and note detected errors.

The unit has an RS232C asynchronous interface, which operates at 19.2K baud in full- or half-duplex, and a standard serial-printer interface. The terminal also features a 24-line \times 80-character data format and a top-status line of 80 characters for a total of 2000 displayable positions on a 12-in. diagonal screen. Character format is a 6 \times 8 dot matrix in a 7 \times 10 field, using a half-dot shift feature and lower-case descenders.

The Touchterm 80 sells for \$2498 in single-unit quantities, and deliveries will begin in August.

—Fran Granville

Ampex Corp., Redwood City, Calif.

Circle No 201



Using scanning-infrared-beam technology, Ampex's Dialogue Touchterm 80 responds to a touch on the display's terminal, thus eliminating the need for a user to have typing skills or a knowledge of special command language.

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The lightweight, compact terminal is easily attached to your computer and is available with or without the color monitor. Software command transparency for Tektronix Models 4010 thru 4015, and compatibility with Compeda's 'Dragon' software is, of course, provided.

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CIRCLE NO. 135 ON INQUIRY CARD



EEC Systems unveils PDP-11 word-processing package

A word-processing software package for Digital Equipment Corp's PDP-11, LSI-11 and VAX computers is now being distributed for the first time in the U.S. by EEC Systems, Sudbury, Mass.

Established in 1975, EEC is the U.S. agent for Britain-based Ace Microsystems, Inc., which developed the package, called LEX-11. Although EEC markets hardware as well as software, its focus is on software, says company president Eric Dickman.

LEX-11 runs under RT-11, RSX-11M, TSX-PLUS, RSTS/E and VMS operating systems and is written in relational programming

language (RPL), developed in Cambridge, England.

The menu-driven package features editing facilities, a calculator function and a forms-mode facility, all aimed at invoicing; mass-mailing; and contracts-, forms-, manual- and statistical-table-production applications. The system can be adapted to any cursor-controlled terminal by using a plastic keyboard overlay. Other features include custom and single-keystroke functions, including the ability to insert or delete a blank line at a cursor position, justify a paragraph and exit from one menu and enter another.

Paragraphs and columns can be

moved anywhere in a document, and text can be examined by continuous scroll, rather than by displaying whole pages. Also included is an automatic-forward capability that searches for character strings over an entire document. Global replacement is achieved by using simple command strings.

Dickman stresses the program's ease of use and editing features as its primary selling points. The company has sold seven licenses of LEX-11 in the first six weeks the product was offered in the U.S., and approximately 150 have been sold in Europe and Australia.

Dickman says DEC has not developed its own word-processing package for the PDP-11, but does offer WPS-8, a word-processing package for the PDP-8 that can be adapted to the PDP-11.

A DEC spokesman notes that DEC

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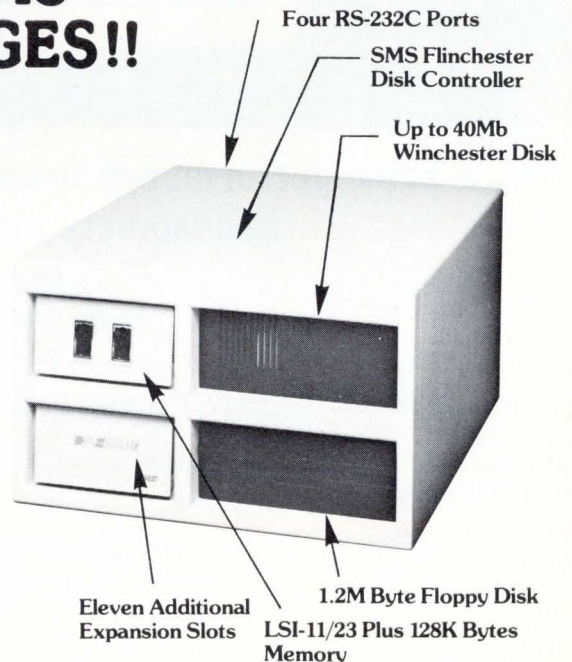
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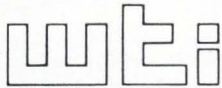
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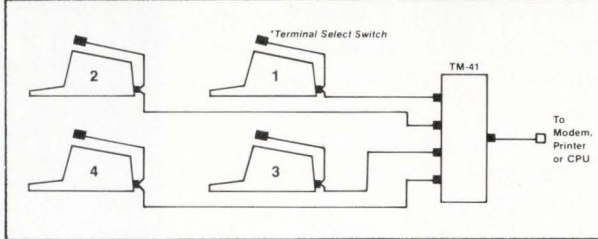
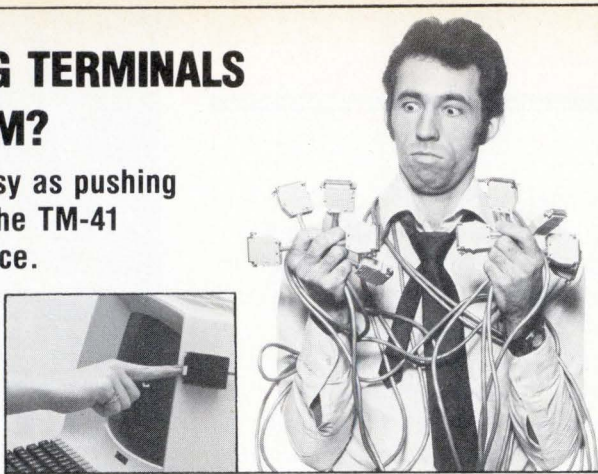
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CIRCLE NO. 130 ON INQUIRY CARD

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CIRCLE NO. 108 ON INQUIRY CARD

New Products

minicomputers or mainframes. The languages operate under MERLIN, a UNIX-like operating system.

The Sunnyvale, Calif.-based company claims the new μ c makes high-level processing economically feasible for more users because it eliminates the need for a mainframe with multiple terminals or an expensive timesharing system.

The device features an M68000 CPU, 256K bytes of high-speed cache memory and intelligent, high-speed control devices on one Multibus card. The CPU operates at 8 MHz without wait states.

The CTS-300 can directly address as much as 1.5M bytes of unsegmented memory. The company says most other μ p systems can address memory only in 64K-byte segments—a hardware and operating system restriction. Because the M68000 and the software impose no addressing restrictions, the CTS-300 can run programs as long as 1.5M bytes. Differentiation between code and data is optional, thus offering no limit on a FORTRAN array size or a Pascal procedure.

The M68000-based card plugs into one of the system's Multibus slots. The computer includes a CRT terminal, a detached keyboard and floppy- and Winchester-disk drives.

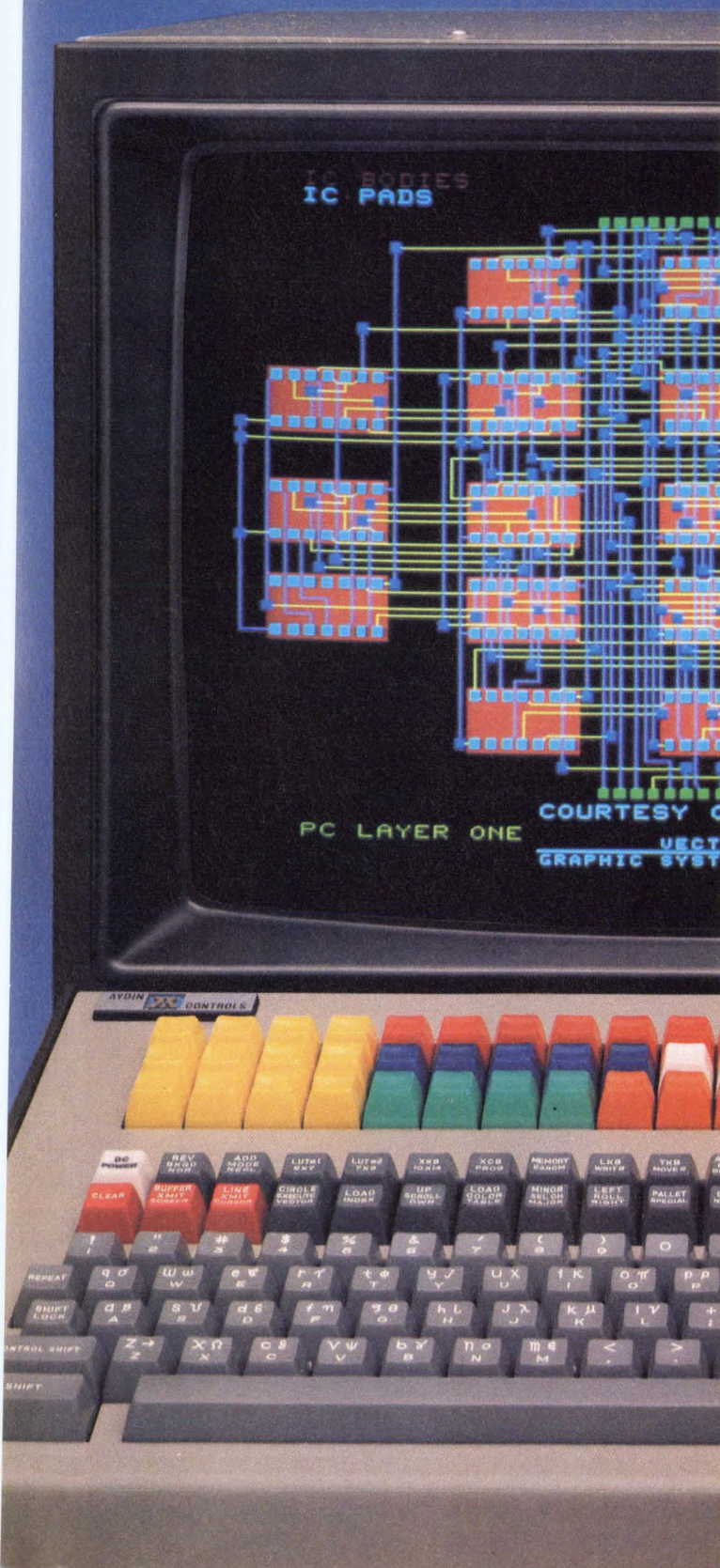
Software for the CTS-300 includes full ANSI-standard FORTRAN-77 and Pascal compilers, enabling programs written for large mainframes to run without modification. Also included are a 68000 assembler and linker, allowing Pascal and FORTRAN to be linked to assembly language, and a screen-oriented editor. The CTS-300 can also be used to write programs for large systems.

A minimally configured CTS-300 for FORTRAN-77 or Pascal sells for \$19,500. Delivery time for the system with Pascal is 60 days, and with FORTRAN-77, 90 days. **Codata Systems Corp.**, Sunnyvale, Calif.

Circle No 203

Quickens Your Draw

Aydin user-oriented, full-color graphic systems let you tackle complex design and processing projects quickly and easily.



Aydin 5216 high-resolution multi-processor-based color graphic systems lead the industry in fulfilling the needs of intricate process control CAD/CAM, simulation, C³I, image processing and many other sophisticated applications.

Versatility is the result of the Aydin growing family of hardware and 2D, 3D, imaging and CORE software modules. The 5216 gives you both the flexibility and programmability to design and implement your ideas efficiently and economically; a true man-machine interface.

For example, AYGRAF instruction sets provide both standalone and distributed processing capabilities to support 2D graphics in a standardized manner. The 3D system, which supports standalone and host-driven applications, is designed to give the user the full benefit of sophisticated graphics, all with interactive control that doesn't burden the host computer.

Aydin modular design also means that you can customize the 5216 to your strictest requirements, easily expand memories, add storage and utilize various user-programmable lookup tables. In addition, a host of interactive devices are available, including joysticks, trackballs, graphic tablets, touch panels and lighted or non-lighted function keys.

It all adds up to a user-oriented 5216 color system that is a reliable, flexible and economical solution to your graphics and image processing needs. Quicken your draw with Aydin, the industry leader in high-resolution, intelligent color graphics. For more information, contact Aydin Controls, 414 Commerce Drive, Fort Washington, PA 19034. Tel.: 215-542-7800. (TWX: 510-661-0518.)

Leadership Features:

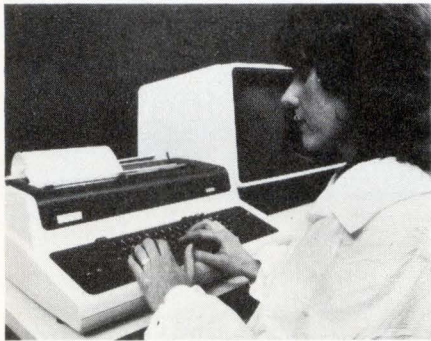
- High-performance multi-processor bus architecture
- Pixel or graphic DMA block mode data transfer (800 nanoseconds per 16-bit pixel)
- Multiple pixels per word
- Wide selection of display formats up to 1024 x 1024 x 16
- Video processing through lookup table RAM at bit rates to over 40MHz
- High-speed hardware vector and character generation
- Four sizes of alpha characters
- High-speed hardware math
- Both parallel and serial peripheral interfaces available
- User programmable
- 16-Bit microprocessor.

AYDIN  CONTROLS

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CIRCLE NO. 109 ON INQUIRY CARD

New Systems



Scientific Industries unveils sterilizer system

The Steritrol 2 computer systems for sterilizer monitoring, control and documentation, can be operated by magnetic card, punch card, microcassette tape or keyboard. The system can conduct a question-and-answer dialog with an operator via an on-line printer and CRT terminal. The operator exchanges with the instrument unit number, truck number, lot number, cycle time and operator identification

information. The CRT can periodically display time, temperature, pressure and accumulated F°. **Scientific Industries, Inc.**, Bohemia, N.Y.

Circle No 204

DSD offers DEC-compatible floppy disks

The DSD 440 double-density floppy-disk memory system offers software and diagnostic compatibility with the DEC RX02. Available with interfaces to LSI-11, PDP-11 and PDP-8 computers, the system can record data in either DEC double-density or IBM 3740 single-density format. The DSD 440 is packaged in a 5¼-in. chassis. The system offers stand-alone diagnostics for the controller and drive assembly. Price is \$3695 for a dual-drive system, with OEM discounts available. **Data Systems Design**, Palo Alto, Calif.

Circle No 205

TI introduces μ p development systems

Multi-AMPL, available in three versions, provides a complete set of hardware and software development facilities for the vendor's 16-bit 9900 family of μ ps and TM990 series of μ c modules. Each system offers concurrent multitasking operation, including compile, assemble, debug, edit and print, plus multiple processor emulation. Each standard system includes a CPU, a dual hard-disk drive unit and one to four 1920-character, 12-in. diagonal video display terminals with keyboard and software. The systems use a high-level debug and test procedure language using integer and Boolean mathematics to enable users to prototype and develop μ p-based systems. Prices range from \$37,700 to \$72,900. **Texas Instruments Inc.**, Dallas, Texas.

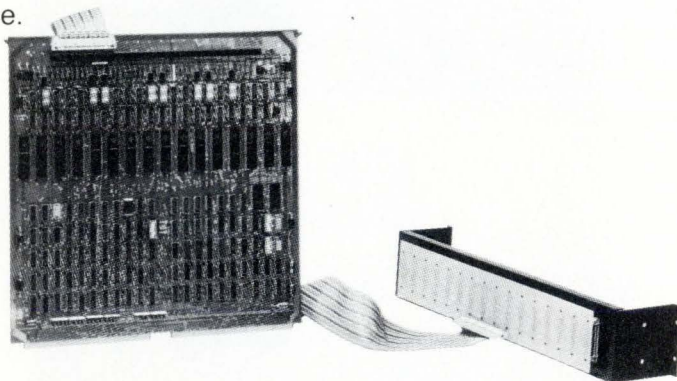
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CIRCLE NO. 110 ON INQUIRY CARD



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But they're just not the same as the original. Maybe that's because nobody knows as much about 5¼" floppies as we do. Or offers as much.

As a result, over 75% of the system manufacturers choose Micropolis. And over 95% of the double track density disk drives installed today are from Micropolis.

Our wide range of drives comes with a precision centering mechanism to insure accurate centering of a disk — every time (four times better than the competition). In addition, we include ceramic/ferrite double density recording heads, 10 msec track-to-track access time, stainless steel precision-ground positioning reference, and the highest quality electrical and mechanical components available. So you get high track storage capacity, fast access, lowest cost per K byte, significantly

greater reliability and best of all, 3 years delivery experience of 85,000 high capacity drives.

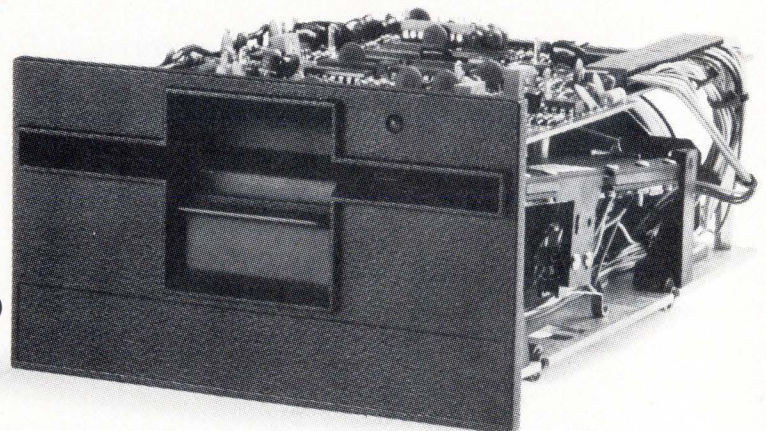
Our drive was designed from the ground up for its double density capacity, not merely redesigned from a single density unit. That's one reason we've shipped more high capacity 5¼" floppies by far than anyone else. Another is that no matter how many imitators there are, there's no substitute for the original.

	Maximum Capacity	# Delivered Through '79	Positioning Mechanism	Track Density	Av. Access Time (msec)
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MPI B91	960K	Evaluation only	steel band and capstan	96/100	240
TEAC 50C	960K	<10,000 Mainly in Japan	steel lead screw	100	865
Micropolis 1016/1015	1,100K	60,000	steel lead screw	96/100	365

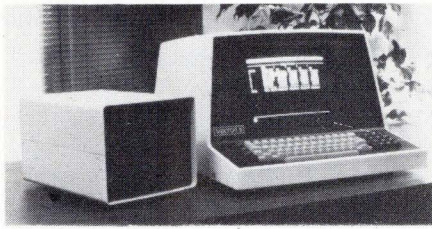
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CIRCLE NO. 112 ON INQUIRY CARD



Small-business system offers 1.2M-byte storage

The model 2600 small-business system includes a Vector 3 console with a 12-in. VDT and keyboard, a Z80-based single-board computer and 64K-byte memory. Mass storage units are dual, double-sided, quad-density, 5¼-in. floppy disks storing a total of 1.2M bytes. The unit also includes the DualMode controller board, which corrects 5 bits in every 256 bytes transferred from disk to CPU, and an RS232C interface port. Software includes the CP/M2 operating system, SCOPE screen-oriented program editor, RAID debugger, ZSM assembler and Microsoft BASIC 80 release 5. Prices start at less than \$6000. **Vector Graphic, Inc.**, Westlake Village, Calif. **Circle No 207**

Raytheon announces data-processing system

The PTS/1210 distributed-processing system is available in 3270, HASP, dual 3270 upline, 3270 and HASP, and dual 3270 upline and HASP communication modes. The 1210, which does not need disk storage, can be upgraded to distributed data-processing capability with the addition of disks. The system supports as many as 24 dual-intensity 1920-character displays with 3270-type typewriter or data-entry keyboards. **Raytheon Data Systems**, Norwood, Mass. **Circle No 208**

TRW-Fujitsu introduces data-processing system

The TFC 8500 multitasking, multi-user data-processing system can perform batch, on-line, or distributed-processing applications and

can be expanded to 80 work stations. The system's main memory unit uses 64K MOS LSI devices and has 256K bytes of system memory. Add-on storage units permit expansion to as much as 2M bytes. The system includes FORTRAN, COBOL and RPG. Peripherals include disk storage, display and printer work stations, magnetic tape units and

line printers. As many as eight magnetic-disk storage devices in any combination of fixed- and removable-cartridge units can be connected to provide as much as 800M bytes of storage. Prices range from \$25,000 for a single work station to \$200,000. **The TRW-Fujitsu Co.**, Los Angeles, Calif. **Circle No 209**

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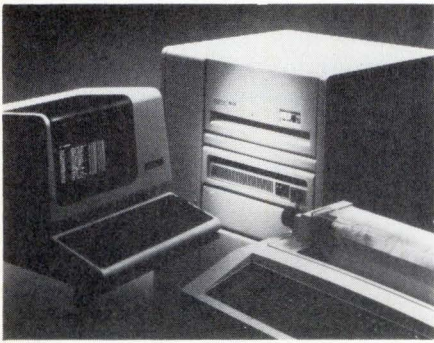
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New Systems



DEC introduces PDP-11/24 minicomputer

The PDP-11/24 general-purpose minicomputer uses a hex-height CPU with custom MOS/LSI technology, an extended PDP-11 instruction set and memory addressing. The CPU is available in 5¼- and 10½-in.-high chassis. The smaller unit provides as much as 768K bytes of memory using a 22-bit extended addressing option. The larger unit accepts 1M byte of memory. The CPU provides an on-board floating-

point instruction set and a commercial instruction set. Three packaged systems are available. One has 128K bytes of memory, dual RX02 floppy-disk drives and a choice of a DECwriter IV hard-copy or a VT100 video terminal. The second has 256K bytes of memory, dual RL02 10.4M-byte disks and a choice of VT100 or DECwriter III terminal. The third has 256K bytes of memory, dual 28M-byte RK07 disk drives and a DECwriter III terminal. Prices for the PDP-11/24 start at \$11,000. Prices for packaged system start at \$19,800, including software. **Digital Equipment Corp.**, Maynard, Mass. **Circle No 210**

Word-processing system has floppy or hard disks

The AdLex executive word-processing system, based on the Altos ACS-8000 μ c, provides floppy- or hard-disk storage of as many as

59 million characters. A minimum configuration consists of a CPU, a Televideo or comparable CRT, a Xerox 1700 series printer and a word-processing program package. Features include automatic tabbing; left- and right-hand justification with fill, centering, bold and shadow printing, underlining; and automatic mail-list integration. Prices start at less than \$9000. **ADL Enterprises**, Wharton, N.J. **Circle No 211**

Communications processor includes three serial ports

The MC-80 communications processor features modular software, end-to-end peripheral control, multidropped, polling front ends and communications between different computers. Device handlers allow the attachment of letter-quality or dot-matrix printers and CRT keyboard terminals. Diagnostic indica-

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- Host serial/parallel interfaces available ■ 2D and 3D
- Programmable motion ■ Up to 4 displays per processor

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CIRCLE NO. 114 ON INQUIRY CARD



tors include transmission errors and modem status. The system provides 16K bytes of ROM, 16K bytes of RAM, three serial communications ports and one parallel printer port. Price is \$1595. **Innovative Electronics Inc.** Miami Lakes, Fla. **Circle No 212**

Norango announces small-business computer

The z80-based iBEX small-business computer handles word processing, general accounting and data processing for manufacturers, distributors, doctors, dentists and retail or service organizations. It operates with the CP/M operating system. An entry-level system contains 64K bytes of RAM, a 5¼-in. floppy-disk drive with 80K bytes of disk storage, a typewriter-style 63-key upper- and lower-case keyboard with numeric and special-function keys and a 9-in. video-display screen with 24 lines of 80-cpl readout in upper and lower case. Prices start at \$4878. **Norango Computer Systems Inc.**, Don Mills, Ontario, Canada. **Circle No 213**

Desk-top system has 700K-byte floppy

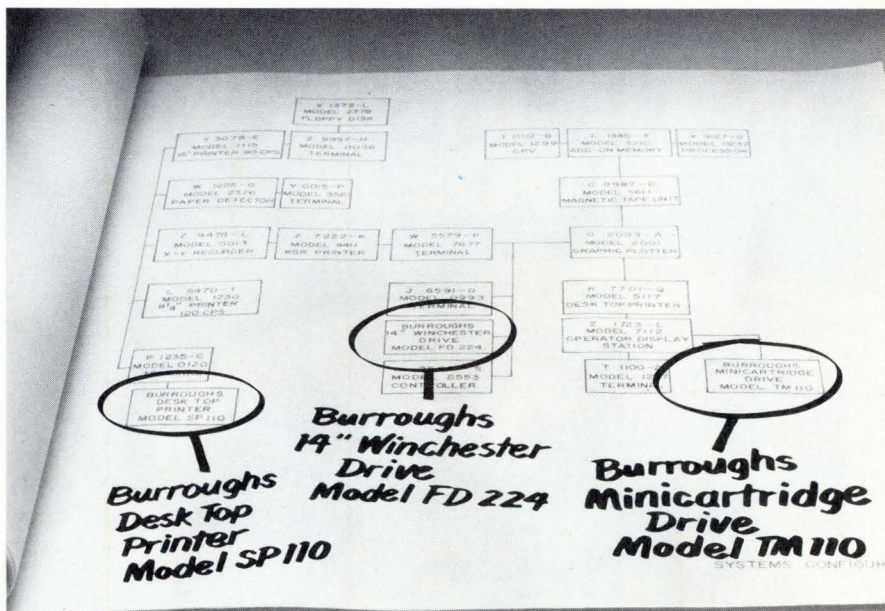
The z80-based System 10 desk-top computer runs most software packages under CP/M version 2.2. The system includes a keyboard, a CRT and 700K bytes of storage on two minifloppy-disk drives. Other features include a 65K-byte RAM, two RS232 ports, an IEEE-488 and an RS449 port and a hard-disk interface. Price is \$5950, with OEM discounts available. **Data Wholesale Corp.**, San Leandro, Calif. **Circle No 214**

Security system provides surveillance

The Dimension 2000 desk-top security-management computer system provides television surveillance, alarm monitoring, card-key access control and control of

security-related building operations. The system enables one person to monitor visually and to control all security-related activities in an office or plant and at remote, satellite facilities. Other features include a 9-in. CRT/CCTV screen for English-language data display and television surveillance, full English-language programming capabilities

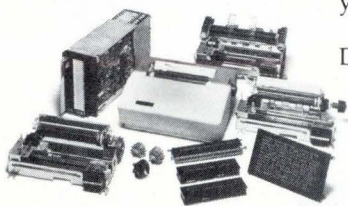
on a typewriter-like keyboard, accessible only by code word, access control for as many as 4100 cardholders at as many as 32 card-reader locations, built-in entry/exit and anti-passback control, 64 access levels, eight time zones and executive bypass to override controls. **Cardkey Systems**, Chatsworth, Calif. **Circle No 215**



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Burroughs

CIRCLE NO. 115 ON INQUIRY CARD

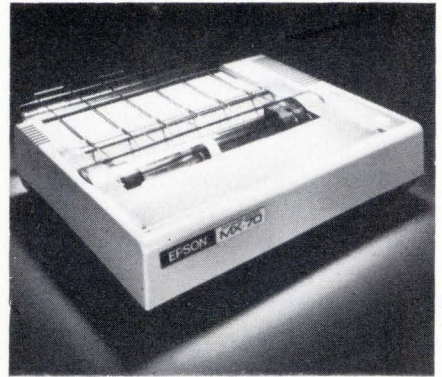
New Products

printers

Data Printer announces 1200-lpm band line printer

The 1200-lpm, 132-column model 3121 band line printer includes an optional switch-selectable feature that allows it to produce draft-quality output at 600 lpm. Features include more than 40 digital display

symbols; a spool ribbon system that provides more than 60 million character impacts; a full line buffer; a noise level lower than 65 dBA; operator interchangeable 48-, 64-, 94- and 128-character bands; and a gravity-activated paper-stacking system. Price is \$7800 in OEM quantities. **Data Printer Corp.**, Malden, Mass. **Circle No 216**



Low-priced MX-70 prints 80 columns

The MX-70 dot-matrix impact printer prints unidirectionally at 80 cps with 40 double-width characters or 80-column printing. It provides top-of-form recognition, programmable line feed and form lengths, a self-test mode and an adjustable tractor feed. It also features a high-resolution, 60-dpi capability. Price is less than \$450. **Epson America, Inc.**, Torrance, Calif.

Circle No 217

INTELLIGENT MODEM™



BIZCOMP 1022 for Computer Applications

Looking to have your small business system do late-night polling over the telephone net? Or how about store-and-forward electronic mailing, distributed networking or automatic data downloading? IMPOSSIBLE using acoustic couplers. FAT CHANCE with a "DUMB" modem. BIZCOMP's new 1022 Intelligent Computer Modem is designed for the versatility and performance needed in computer applications—at a price you can afford!

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Patent Pending

CIRCLE NO. 116 ON INQUIRY CARD

Dataroyal units offer compressed printing

The IPS 5000A matrix printer includes compressed print that places 132 characters into an 80-column space and 233 characters into a 136-column space, elongated printing for both compressed and standard print densities, a logic-seeking print method and programmable horizontal and vertical tabs. The printer can generate a standard 96-character USASCII at 10 cpi in a 9 × 9 dot-matrix format, with true lower-case descenders and underlining. Seven foreign-character sets are available, including British, French, German, Swedish/Finnish, Danish/Norwegian, Spanish and Italian. The 80-column version sells for \$1160 in single-unit quantities and \$735 for 100-unit quantities. The 136-column version sells for \$1345 and \$835 in single- and 100-unit quantities, respectively. **Dataroyal, Inc.**, Nashua, N.H.

Circle No 218

Play with a full deck.

Introducing the RM 65 line of microcomputer boards.

The RM 65 line gives you the options and flexibility to design precisely the microcomputer systems you need.

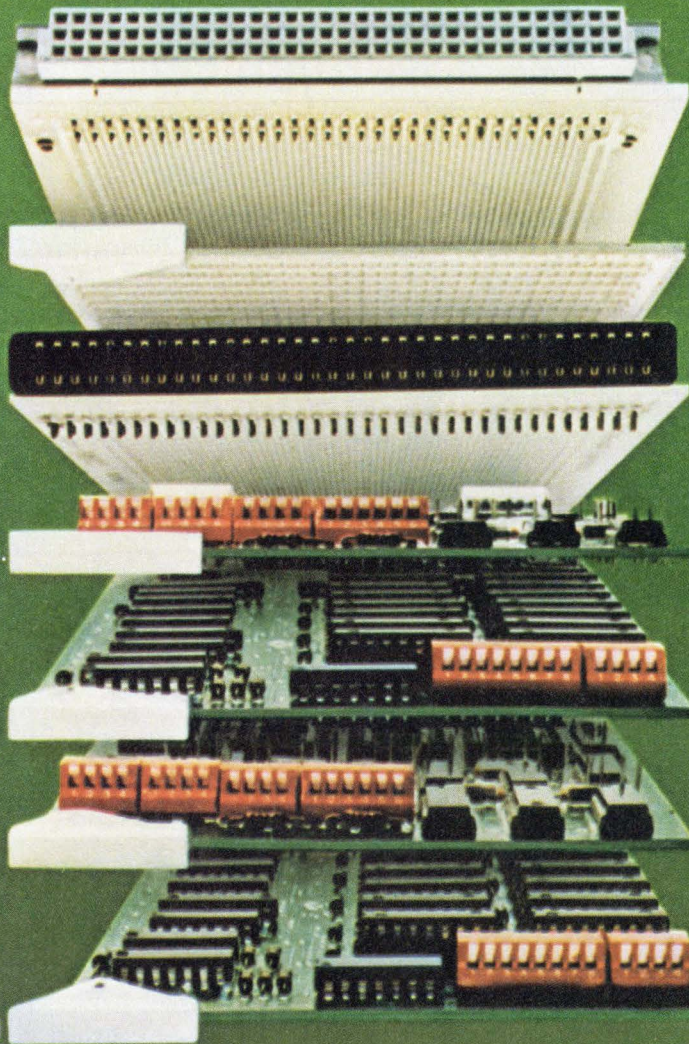
And you can do it quickly and economically. Because you're offered so many design alternatives.

Application software for the RM 65 line, for example, can be programmed in a number of languages: BASIC, PL/65, FORTH and Assembly Language.

RM 65 uses a motherboard interconnect concept so any card will fit any slot.

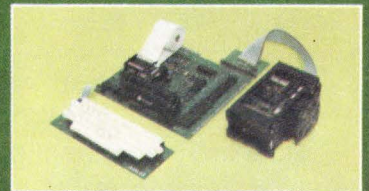
You can choose either edge connector or Eurocard versions.

And a set of card cages allows a broad variety of packaging options.



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Your functional system can be economically developed on the AIM 65 Advanced Interactive Microcomputer. At less than \$500, AIM 65—based on the high performance R6502 microprocessor—is the lowest cost development tool available for any board level system.



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R6502 CPU, 2K bytes static RAM, 16K bytes PROM/ROM capacity, an R6522 VIA and support circuitry on a single RM 65 module.

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- Adaptor/Buffer Module



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RM 65 MODULES

CIRCLE NO. 117 ON INQUIRY CARD

New Products

printers

Impact printer uses one hammer

The GP-80M dot-matrix printer prints both graphics and alphanumerics using one print hammer. It employs a rotating platen with protruding spines positioned be-

hind the paper. The image is created by multiple hammer strikes in rapid succession as the print head advances across the paper in front of the rotating platen. Features include ASCII upper- and lower-case character sets, as many as 80 columns with 12 cpi, adjustable tractor feed, three-copy reproduction, 12W power consumption,

Centronics parallel interface and full graphics capability with a resolution of more than 60 dpi. Single-unit price is \$399, and 1000-unit OEM price is \$250. **Axiom Corp.**, San Fernando, Calif.

Circle No 219

IBM introduces impact printers

The model 5219 impact printer uses a bidirectional print wheel and offers continuous forms feeding and automatic, dual-drawer sheet feeding options. Two models are available with rated burst speeds of as much as 40 and 60 cps. Other features include horizontal spacing of 10, 12 and 15 pitch, proportional spacing, 10 type styles available on 96-character print wheels and a print-wheel drop-in cartridge. Prices for the 5219 models B01 and B02 are \$5050 and \$5450, respectively; lease rates are \$200 and \$217 per month, respectively. **IBM Corp.**, General Systems Division, Atlanta, Ga.

Circle No 220

Harris announces band printers

The model 4320 300-lpm band printer prints 64 ASCII characters; a second model uses a 96-character set at 240 lpm. Features include 132-column print lines, with 136 columns optional, 12-channel vertical formatting, a self-test mode with diagnostic display and a cartridge ribbon system. Print band life is rated at approximately 30 million impacts per character. The 1000-lpm model 4240 prints 132 characters per line with a 64-character set. It is also available with 96 characters and a 132-character line, at 730 lpm. The model 4330 band printer prints 600 lpm with the 64-character set and 445 lpm with the 96-character set. Prices range from \$9500 for the 300-lpm printer to \$29,900 for the 1000-lpm model. **Harris Corp.**, Fort Lauderdale, Fla.

Circle No 221

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Fourteen years ago, Pertec® set the industry standard in mini-computer tape drives. Since then, a lot of other companies have followed with copies of their own — good copies.

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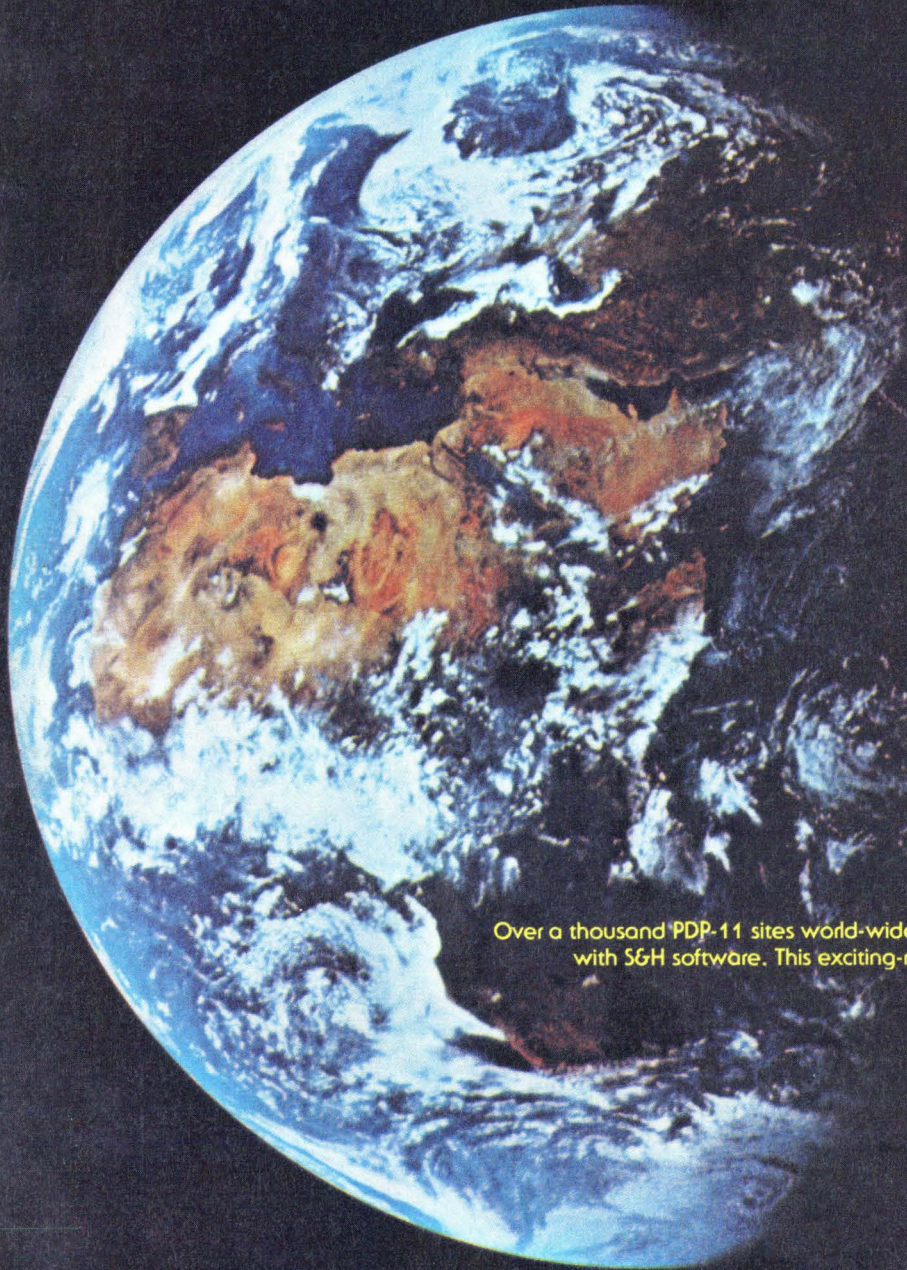
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CIRCLE NO. 140 ON INQUIRY CARD

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- RT-11 compatible.
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COBOL-Plus

- Highest performance of any COBOL system available for the PDP-11.
- Operates with RT-11, TSX and TSX-Plus.
- Automatic program segmentation feature eliminates the need for overlays.
- Fully symbolic interactive debugger.
- Multi-key ISAM files with dynamic B-tree structure — no overflow areas.
- Cursor positioning clauses with ACCEPT and DISPLAY statements.
- ANSI SORT statement when used with TSX-Plus.
- STRING, UNSTRING, INSPECT, CALL, COMPUTE and COPY statements.
- Shared file record locking when running under TSX-Plus.



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NASA photograph

CIRCLE NO. 118 ON INQUIRY CARD

MDBS . . . true data base management for small systems!

**Harvey M. Weiss,
an independent
software reviewer,
has this to say
about our system:**

"MDBS is truly a data base management system . . . , not a file management system."

"MDBS . . . offers the data manipulation, query, and report-writer capabilities of a DBMS found on much larger and more complex computer systems."

"MDBS has come to the rescue with . . . products whose ability to reduce development time and implement processes not available elsewhere make them invaluable to integrators and developers of μ C-based systems."

For the complete Weiss review, see "Downscaling DBMS to the Microworld," *Mini-Micro Systems*, April, 1981, pp. 187-195.

**Check these
advanced features
for yourself:**

Flexible, powerful data structuring capabilities: network and hierarchical data structures, including many-to-many relationships (not available elsewhere).

Genuine data base management capabilities: far surpasses file management in data independence, automatic maintenance of relationships, and complete lack of data redundancy.

English-like, nonprocedural query language interface: ad hoc queries result in the automatic generation of desired reports, tables, files, and relations.

Host language interfaces, including various BASICS, COBOLS, PASCALS, FORTRAN, PL/I, C, and several assemblers.

Extensive built-in data access security (256 levels).

Automatic transaction logging and data base recovery.

Dynamic data base restructuring.

Plus many other advanced data base management features.

**Is MDBS right
for your system?**

MDBS is written in Z-80, 6502, 8080 and 8086 machine language and run under CP/M (and similar derivatives) with CBASIC2, PL/1, PASCAL Z, PASCAL M, PASCAL MT+, BDS C, CIS COBOL, and Microsoft COBOL, FORTRAN, or BASIC; under North Star DOS and North Star BASIC; under TRSDOS or NEWDOS with TRS DISK BASIC; with Apple DOS and Applesoft BASIC; and with 86-DOS.

MDBS requires only 18K to 20K bytes for the Z-80 version, 22K for the 8080, and 30K for the 6502.

MDBS is independent of the types and sizes of disk drives.

To learn more

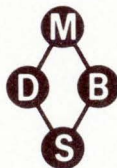
- For free literature about serious data base management on a microcomputer, please fill out and mail the coupon.
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New Products

interfaces and controllers

IEEE-488 card links Apple II to 1400 instruments

This IEEE-488 interface card is designed to link Apple II personal computers with more than 1400 scientific and technical instruments. The card package includes a cable connecting the card to a standard IEEE-488 female connector, which connects the bus shield to the Apple's case ground. The card functions as both a controller and a device and needs only basic commands to control the bus. The card implements a fully compatible subset of the IEEE-488 standard. Price is less than \$500. **Apple Computer Inc.**, Cupertino, Calif.

Circle No 281

Lobo announces Apple II disk controller

The LCA-22 disk controller board for the Apple II μ cs is software-compatible with Apple DOS and contains 256 bytes of on-board boot ROM. It controls as many as four 8-in., single- or double-sided, single- or double-density floppy-disk drives with a total storage capacity of 4.4M bytes. Other features include a 200-msec. average access time and a 62.5K-byte-per-sec. transfer rate. Single-unit price, including controller card, cable, diskette and documentation is \$699, with quantity discounts available. **Lobo Drives International**, Goleta, Calif.

Circle No 282

MCT announces controller for DEC Unibus

The SMV15 single-board storage module disk controller for the DEC VAX-11/780 and PDP-11 Unibus series features 32-bit data-error control and header error control and supports one or two SMD interface-compatible drives, including Winchester. The controller has jumper-selectable DMA throttle

rate, enabling users to choose transfer bursts of 1 to 15 words, or maintain constant transfer while monitoring for bus requests. The controller sells for \$3900 in single-unit quantities, with OEM and quantity discounts available. **Mini-Computer Technology**, Palo Alto, Calif.

Circle No 283

Printer controllers offer 1500-lpm capability

The model DPC 40-DS and DPC 50-DS controllers for Nova and Eclipse minicomputers accommodate the vendor's band printers with speeds of 300, 600, 900 and 1500 lines per min. Speed selection is through on-board switches. Both controllers are bus- and software-compatible with the minicomputer; no hardware or programming changes are required. The DPC 40-DS uses an 8-bit parallel data-transfer bus that handles a full ASCII 96-character set and vertical format paper-movement instructions. The DPC 50-DS has a 16-bit parallel input from the computer with an 8-bit parallel output bus and a 256-bit RAM. With controller installed, the printers sell for \$3250 to \$34,400. **BDS Corp.**, Menlo Park, Calif.

Circle No 284

MCT announces disk controller for DEC PDP-11

The EDC21 single-board emulating disk controller for the DEC PDP-11 Unibus emulates the DEC RH11 controller interfaced to multiple RMO2/03/05 disk drives. The controller runs with unmodified DEC operating systems, including RSTS/E, RSX-11M and RT-11. A stand-alone pack formatter/controller diagnostic is also included. The EDC21 can support as many as four SMD drives in any combination of capacities. Price is \$4900 in single-unit quantities and \$3800 in 25-unit quantities. **MiniComputer Technology**, Palo Alto, Calif.

Circle No 285

優秀

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CIRCLE NO. 120 ON INQUIRY CARD

211

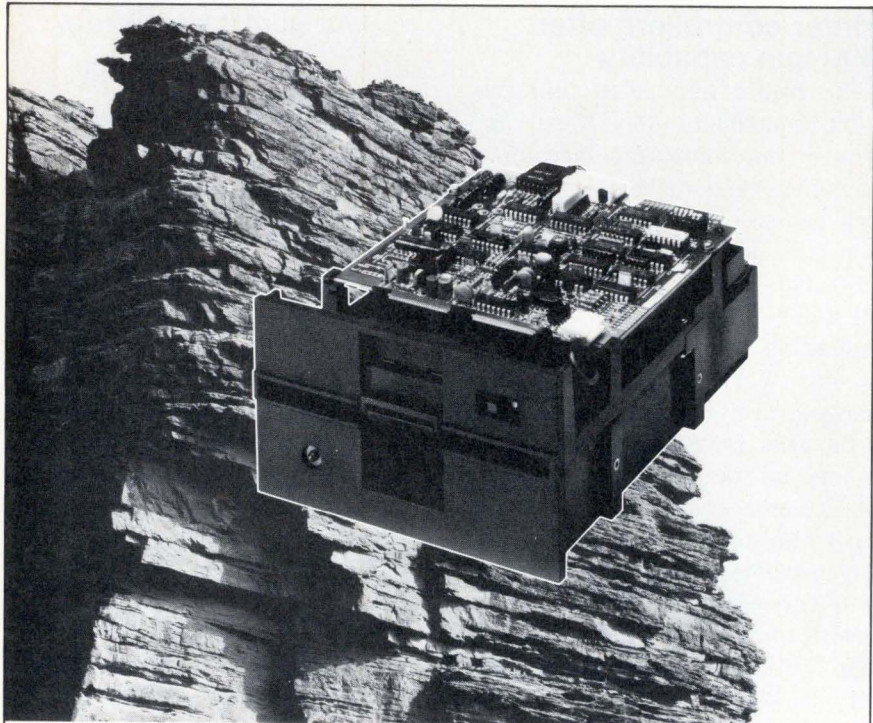
New Products

disk/tape

20M-byte drive sells for \$2300

The Series 8000 cartridge-disk drive includes a 10M-byte removable disk and a 10M-byte fixed disk. A μ p-controlled supervisory system

provides digital control of all servo electronics, velocity profiled look-up tables, digitally controlled brushless DC motor/drive and crystal-controlled sectoring with switch-selectable sector formats for the fixed disk. Price is \$2300 in OEM quantities. **Western Dynex Corp.**, Phoenix, Ariz. **Circle No 286**



ROCK-SOLID FLOPPY DISK DRIVES FROM TEAC

Unique DC Spindle Drives feature our continuously-running brushless DC motor whose typical life expectancy is over 10,000 hours. Rock-stable, no electrical noise will interfere with the integrity of your data.

Superior Chassis features fiberglass reinforced polyester (FRP) which, unlike aluminum, won't stretch with heat. Extra-rugged and precision molded, the unit also has a shield to insulate the head from outside interference.

25 Years of Leadership in all magnetic recording technologies is your assurance of a quality product you can rely on. For complete information on all TEAC Rock-Solid Floppy Disk Drives (FD-50 Series) — including our one-year warranty and full technical support and service — just write:

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RMS Winchester pack 12.72M bytes

These 5 $\frac{1}{4}$ -in. Winchester-disk drives offer capacities of 3.18M, 6.36M and 12.72M bytes (unformatted). Features include an electrical brake that secures the spindle to prevent media and head damage when the system is moved or shipped, a data separator that prevents errors and enables use of more efficient data codes, provision for a landing/shipping zone outside the data area, which protects data from head landings, and an electronically dampened actuator. The drive uses less than 20W of power. Prices range from \$750 to \$1270 in 500-unit quantities. **Rotating Memory Systems, Inc.**, Sunnyvale, Calif.

Circle No 287

DSD offers DEC-compatible floppy disks

The DSD 440 double-density floppy-disk memory system offers software and diagnostic compatibility with the DEC RX02. Available with interfaces to LSI-11, PDP-11 and PDP-8 computers, the system can record data in either DEC double-density or IBM 3740 single-density format. The DSD 440 is packaged in a 5 $\frac{1}{4}$ -in. chassis. The system offers stand-alone diagnostics for the controller and drive assembly. Price is \$3695 for a dual-drive system, with OEM discounts available. **Data Systems Design**, Palo Alto, Calif.

Circle No 288

CIRCLE NO. 121 ON INQUIRY CARD

DVA announces video disk player

The PR-7820-2 video disk player provides two-way communications with most computers. It uses a low-power laser beam to relay any combination of motion picture sequences, sound and still frames from a video disk to any standard television receiver or monitor. Features include slow motion, freeze frame, frame-by-frame viewing, forward and reverse scanning and direct automatic random access. Using a remote keypad, a user can locate a picture by reference to the appropriate frame number. Two audio channels can be used for either stereophonic sound or bilingual programming. Price is \$2475 in quantities of one to 24. **DiscoVision Associates**, Costa Mesa, Calif. **Circle No 289**

Dynalogic announces DEC RXV21 replacement

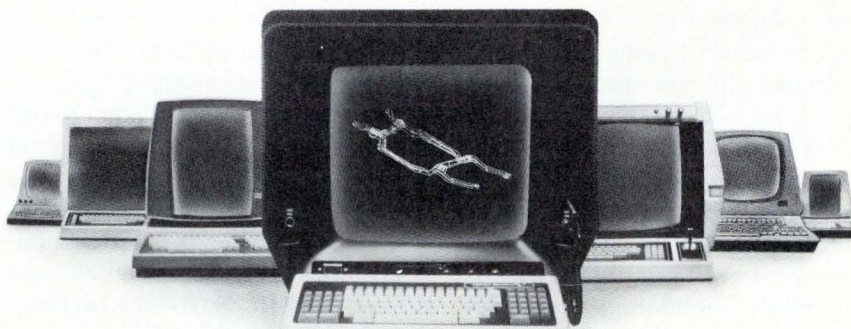
The model 8202 floppy-disk subsystem, which is software-, hardware- and media-compatible with DEC's LSI-11 μ c replaces DEC's RXV21 floppy-disk subsystem. The subsystem includes controller electronics mounted on a single dual-height card that plugs directly into any standard LSI-11, LSI-11/2 or LSI-11/23 Q-bus slot. The controller also incorporates an on-board bootstrap that boots single- or double-density diskettes. The unit is enclosed in a low-profile chassis including ball-bearing rack-mounted slides. Airflow enters and exits only at the front for efficient cooling when the unit is mounted in a cabinet. Price is \$3595. **Dynalogic Corp.**, Ottawa, Canada. **Circle No 290**

Winchester storage module is EXORbus-compatible

The 9670 series of disk- and tape-storage devices can be interfaced to the M6800/6809 μ p bus. Each configuration is a complete

storage system with one or more drives, an intelligent controller, a power subsystem and a host adapter that is pin- and outline-compatible with the Motorola EXORciser and Micromodules. The module includes a 10M- or 20M-byte 8-in. Winchester-disk drive and a 0.25M-, 0.5M- or 1M-byte, 8-in., double-sided floppy-

disk drive. The storage module controller responds to 10 high-level commands and features full-sector buffering and burst error correction. Single-quantity prices for the 10M-byte Winchester, 1M-byte floppy configuration is \$5295. **Creative Micro Systems**, Garden Grove, Calif. **Circle No 291**



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CIRCLE NO. 122 ON INQUIRY CARD

New Software

Job control system operates on Apple II

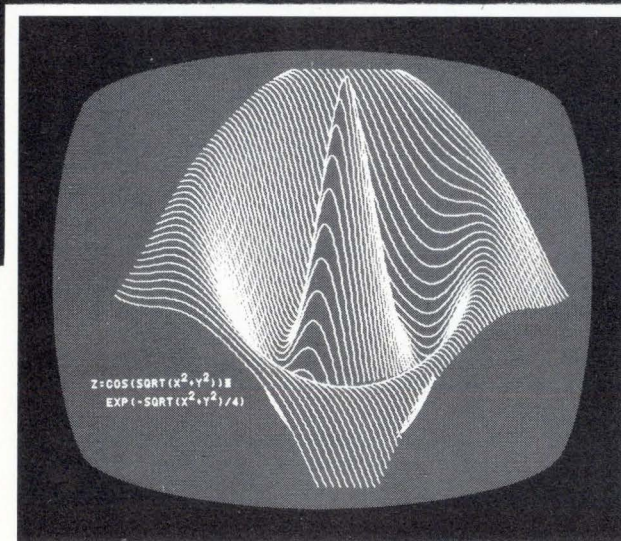
The Job Control System, operating on the Apple II computer with the Pascal language, provides job-status data for determining the cost of producing a product or providing a service. Labor hours, costs, production quantities and shipped quantities are posted to the system. Reports, including job listings, job-cost summaries, individual job reports, and work-in-progress reports, give profit-and-loss values and variances. JCS will also compute work-in-progress inventory values. Rate structures and report formats for as many as 500 cost centers can be tailored to user requirements. As many as 400 jobs in progress are permitted. Price is \$750. **High Technology Software Products, Inc.**, Oklahoma City, Okla. **Circle No 292**

Package provides FORTRAN word processing

MUSE provides word processing operations on ANSI-FORTRAN-compatible computers. Full-screen cursor control is provided. Pagination is automatic or under manual control. Formats for letters, reports and manuals are automatically defined or can be changed at any place in a document. Documents are displayed on the CRT terminal screens exactly as they appear in printed form. MUSE moves symbols, sentences and paragraphs to different parts of a document under operator control. An operator can also erase characters, words and sections. Page headers and footers can be added or changed anywhere in the document. A perpetual lease is \$6800. **MARC Software International**, Palo Alto, Calif. **Circle No 293**

ASAR provides DEC-To-Intel file transfer

ASAR allows the transfer of files between Intel ISIS formatted single-density diskettes and DEC PDP-11 systems operating under RSX-11M. Files can be transferred in either direction, with the required format corrections applied automatically. A user familiar with the ISIS operating environment can use ASAR immediately because the function and syntax of the ASAR command language exactly match those of the corresponding ISIS commands. A FORTRAN /IV subroutine library included with ASAR gives users the ability to access ISIS diskette files directly from their own programs. Price is \$795 in executable format and \$1850 in source-code format; media charges are extra. **Programming Concepts, Inc.**, Coram, N.Y. **Circle No 294**



The VIURAM family of video interfaces with advanced features makes your display I/O a natural extension of your computer software, not a choke point. Our direct-access alpha-graphic display hardware, by avoiding cumbersome serial methods, provides maximum efficiency, fast character and pixel thruput, and extreme ease of software implementation.

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Computer Technology Division

NEW

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CIRCLE NO. 124 ON INQUIRY CARD

The System/48 is the outstanding office automation computing system for the 80's — it's so productive we call it MAGIC[®]. Look at these features:

- One to eight interactive users per node
- Data management system
- Report generator
- Query processor
- Screen format generator
- Automatic interface code generator
- Up to 1/2 Mbytes of user memory
- Winchester disk with 18-million bytes (formatted capacity)
- 15-minute mean-time-to-repair
- Built-in protection from line-voltage spikes, noise, and brownouts

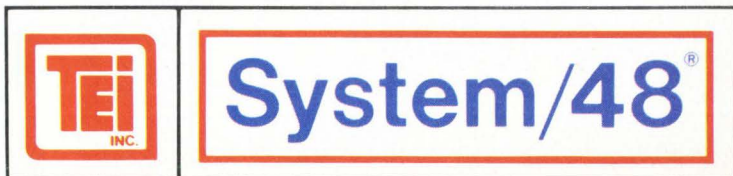
And, it features MAGIC[®], the Operating System that gets things done faster than you can say abracadabra because of its multi-keyed Indexed-Sequential Access Method and flexible file-organization. MAGIC[®] also offers high security, with password protection. MAGIC[®] supports global or local printers for as many users as desired.

MAGIC[®] also includes DataMagic II — TEI's red-hot database manager. DataMagic II has even more tricks up its sleeve — like automatic or manual record-lock protection and automatic transaction backout to protect the database. And it runs application software written for CP/M 2.X.

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Arrange to attend one of our regularly scheduled System/48 workshops (RSVP).

OEM and Dealer Inquiries Invited



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New Literature

Catalog examines VMOS power MOSFETs

A line of VMOS power MOSFETs is described in a brochure. The eight-page catalog, which includes photos, charts and diagrams, details silicon-gate technology and N- and P-channel devices. The brochure also covers impedance, drive requirements, paralleling and switching. **Ferranti Electric, Inc.**, Com-mack, N.Y.. **Circle No 295**

Application note features all-digital correlator

The TDC1023J all-digital correlator is described in an application note. The 22-page booklet covers direct comparisons of non-redundant and non-expanded data, comparisons of expanded-code data sequences and synchronization with incoming signals. The publication

also details logic analysis, time-delay measurement, identification of periodicities in a data stream, error detection and correction, interference reduction, code multiplexing, word and bit synchronization, correlation of multi-bit functions and convolution. **TRW LSI Products**, La Jolla, Calif.

Circle No 296

Booklet features development system

The Series 80 MANTIS application development system is detailed in a brochure. The 10-page bulletin covers programmer productivity, training costs, investment in short-lived applications, end-user involvement, corporate productivity and protection of software investment. The brochure also includes case histories. **Cincom Systems, Inc.**, Cincinnati, Ohio. **Circle No 297**

Brochure outlines CRT editing terminal

The 132/15 CRT editing terminal is detailed in a brochure. The four-page booklet describes the system's soft keys, screen, memory, communications and setup operation modes and options. The pamphlet also includes photos, and technical specifications. **TAB Products Co.**, Palo Alto, Calif. **Circle No 298**

Publication covers quad-channel instruments

The Series 5200 and 5300 high-density alarms, transmitters and computing instruments is detailed in a catalog. The 14-page bulletin explains the systems' principles of operation and includes specifications, I/O and wiring data, power supplies, enclosures, general dimensions and ordering information. **Rochester Instrument Systems**, Rochester, N.Y. **Circle No 299**

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MTSS Provides NOVA® Users
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DG users now have a choice when upgrading to a multi-user environment. Previously, the only way to support a true multi-user environment was to upgrade to AOS, but not anymore.

MTSS provides all of the standard RDOS features for up to 16 users simultaneously and each user is totally independent. Users may edit, compile and execute programs written in FORTRAN IV, FORTRAN V, ALGOL, BASIC, MACS, etc.

This means no software rewriting is necessary. No new operating system need be installed.

More importantly, MTSS supports all NOVA®'s as well as ECLIPSE®'s so no expensive hardware upgrade is required.

**Now Data General Users
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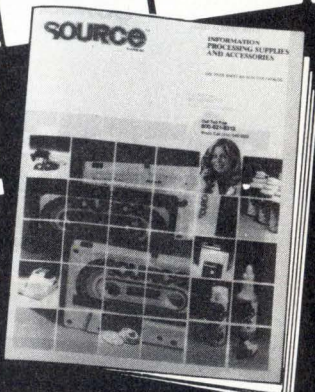
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CIRCLE NO. 126 ON INQUIRY CARD

MINI-MICRO SYSTEMS/July 1981

54 dB. Put up or shut up.

The Gauntlet Is Down

Can any dot matrix computer printer match the **INFOSCRIBE 1000**? Its sound level in normal, continuous operation is only 54 dBA. By independent sound laboratory test.*

That's right, 54 dBA. Like a group office where paper shuffling and throat clearing are making most of the noise.

As far as we're concerned, **INFOSCRIBE 1000** is the quietest serial matrix impact printer on the market.

Compare with the typical matrix printer that can sound like a blender full of ball bearings, and you have the Number One reason why your next printer will be an **INFOSCRIBE 1000**

Even printers advertised at 56dB are a **full 2 dB higher** than ours. (Remember, every 3 dB up doubles the noise.)

A New Generation Printer

If **INFOSCRIBE 1000**'s purr were its only benefit, you should still buy it for the sanity of your office staff. But it happens that **INFOSCRIBE 1000** is also the most feature-packed, the most beautiful, and the most economical printer in its class.

Graphics Galore

INFOSCRIBE 1000 doesn't print characters only. Under software control it produces charts, diagrams, graphs, signs, anything within a vertical and horizontal resolution of 70 dots per inch. Now we're talking about a capability that can enhance management presentations, sales reports, even technical documents.

Format Flexibility

INFOSCRIBE 1000 can produce data processing quality characters at 10, 12, or 16.5 characters per inch, or correspondence quality characters at 10. You also get subscripts and superscripts in any selected pitch, double-wide printing, true lower case descenders, and true underlining.

In addition to two different character sets stored in the printer, a third character set can be downloaded from the host computer. This offers a total of 288 different characters that can be selected on a character-by-character basis.

Gratifying Throughput

There's more to **INFOSCRIBE 1000**'s speed than a nominal 180 characters per second. High-speed paper movement with vertical and horizontal tabbing, plus bidirectional printing with logic seeking in both directions gets a lot of work out of the machine. And that's equivalent to having a faster computer.

Unmatched Elegance

It's almost unfair that **INFOSCRIBE 1000** is also the industry's best looking matrix printer. Slim, sleek, graceful, it makes those machines with the visible viscera look like remnants of early experimental days at Menlo Park. **INFOSCRIBE 1000** is completely enclosed, sealing dirt out while sealing noise in. Its controls use membrane switches, so not even knobs or buttons break its sculptured exterior.

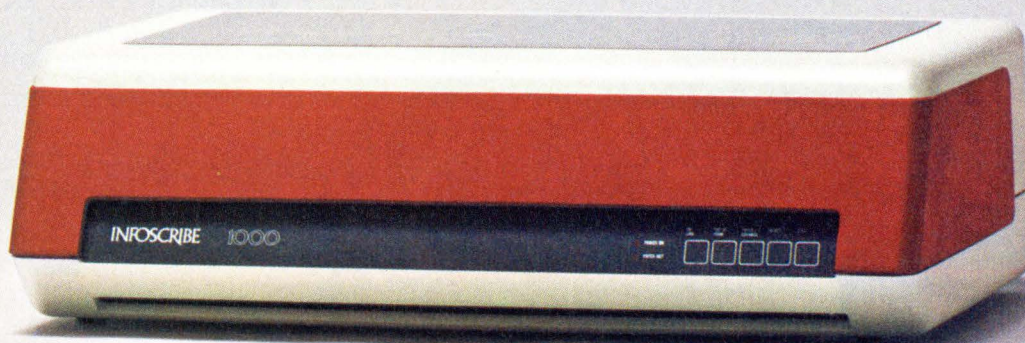
Demand the INFOSCRIBE 1000

Is there a single reason why you should have any printer but the **INFOSCRIBE 1000**? At \$1,825 in singletons (substantially less in OEM quantities), **INFOSCRIBE 1000** becomes mandatory for your system.

Insist on it from your system specialists. And if you are buying a first-time computer, no matter what make, ask for the printer that is setting a new standard: **INFOSCRIBE 1000**.

Get full details from your nearest Infoscrite distributor/representative. Or talk to your computer dealer. If he doesn't handle Infoscrite yet, he will.

**Contact Infoscrite for an abstract of the independent testing laboratory report.*



INFOSCRIBE™

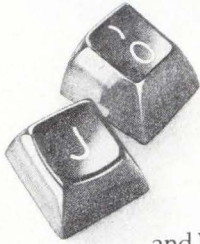
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Overseas Distributor Inquiries Welcome

CIRCLE NO. 127 ON INQUIRY CARD

Things that are easier to use do more work.



Video terminals are very personal devices. And many people who use them are not familiar with computers.

So we designed the VT100 and VT132 (for smart, block mode applications) to be as easy to use as possible.

Even friendly.

The keys on the detached keyboard are patterned and sculptured to feel like those on your favorite electric typewriter. Smooth scrolling of text onto the screen allows new data to be reviewed easily. You can

display 80 or 132 columns so you can review the data printed on 14-inch wide reports without wraparound.

Crisp, well-defined characters are easy on the eyes. And to make it easier to isolate information, lines can be made larger and characters can be reversed, brightened, underlined, or even made to blink. A line drawing character set makes video forms look like the printed forms you're used to.

You can even split the screen so new material scrolls smoothly, while other important data, such as column headings or status lines, remain stationary.

And best of all, you can easily customize Digital's video terminals to your own personal preferences straight from the keyboard, and save your preferences in a non-volatile memory. Thus you can configure them to suit a wide variety of work situations for any system supporting asynchronous ASCII terminals.

You would think that, designed as they are for easy use, our terminals would lead a life of ease.

They don't. You'll find they work even harder.

To buy a VT100 or VT132, contact your Digital terminals dealer. For the names of dealers nearest you, call 800-225-9378 (outside the Continental U.S. and in Massachusetts call 617-467-7068) between 8:30am and 5:00pm Eastern time, or contact your local Digital sales representative.

Digital Equipment Corporation, Terminals Product Group, MR2-2/M67, One Iron Way, Marlboro, MA 01752. Tel. (617) 467-7068. In Europe: 12 Av. des Morgines CH-1213 Petit-Lancy/Geneva.

In Canada: Digital Equipment of Canada, Ltd.

CIRCLE NO. 128 ON INQUIRY CARD



digital
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the world thinks.

New Literature



Bulletin features μ c software

System software for LSI-11/2 and LSI-11/23 μ cs is described in a brochure. The eight-page publication details the RT-11 development operating system and the RT² execute-only subset. The brochure also includes details on high-level language support, program development utilities, a DCL interface, optional high-level languages and support services. **Digital Equipment Corp.**, Northboro, Mass.

Circle No 300

EPTAK 700 controller detailed in a pamphlet

The EPTAK 700 controller is described in a brochure. The six-page booklet details the unit's CPU, I/O modules, power supply, programming terminals and software languages. The brochure also examines an error-detection-and-indication package, graphics display package and signal support services. **Eagle Signal Industrial Systems**, Davenport, Iowa.

Circle No 301

Bulletin features data-shield units

Security chambers for computer tapes, disk packs and microfilm are described in a bulletin. The four-page brochure details panel construction and a patented "Speed-Lock" joining mechanism. The publication also provides illustrations, cut away diagrams, characteristics, design information, speci-

fications and fire-safety test results. **Bally Case & Cooler, Inc.**, Bally, Pa.

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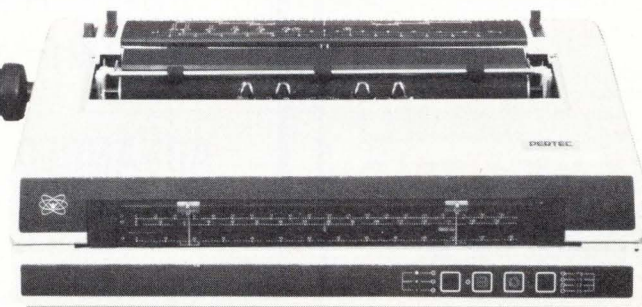
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

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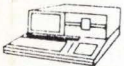
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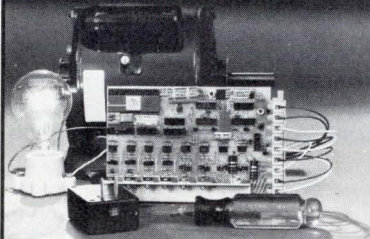
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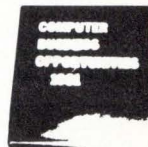


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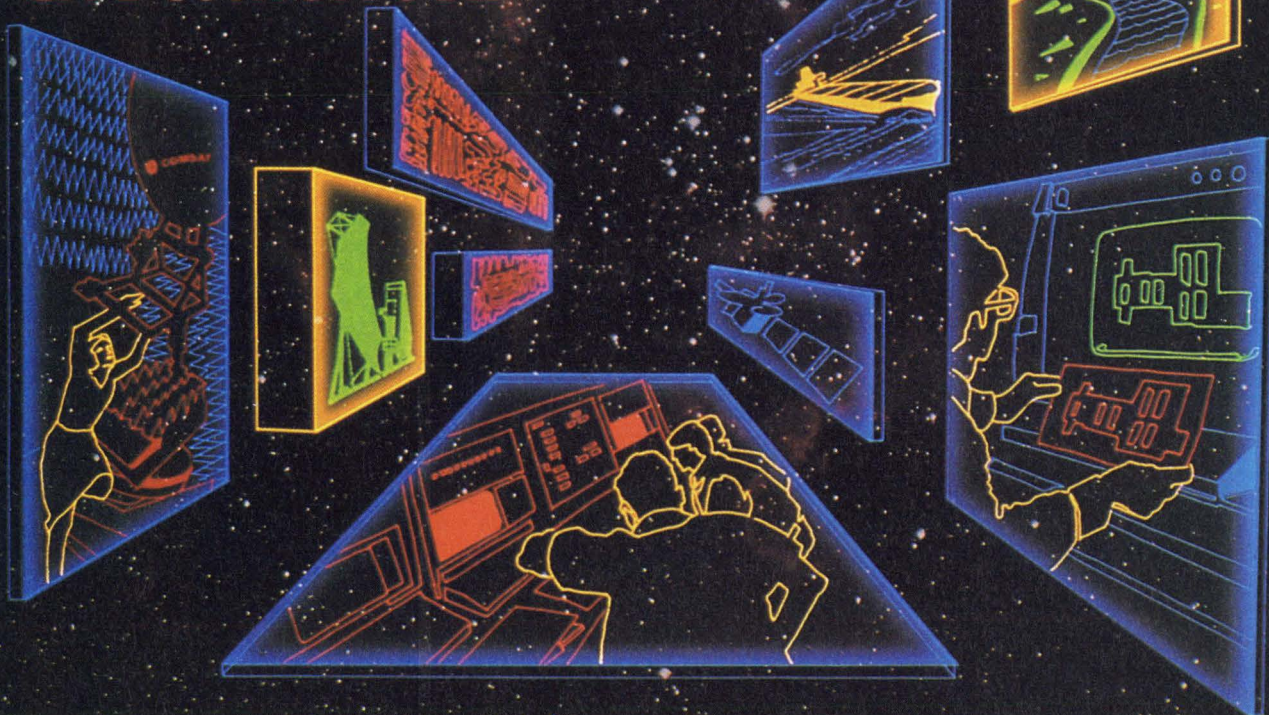


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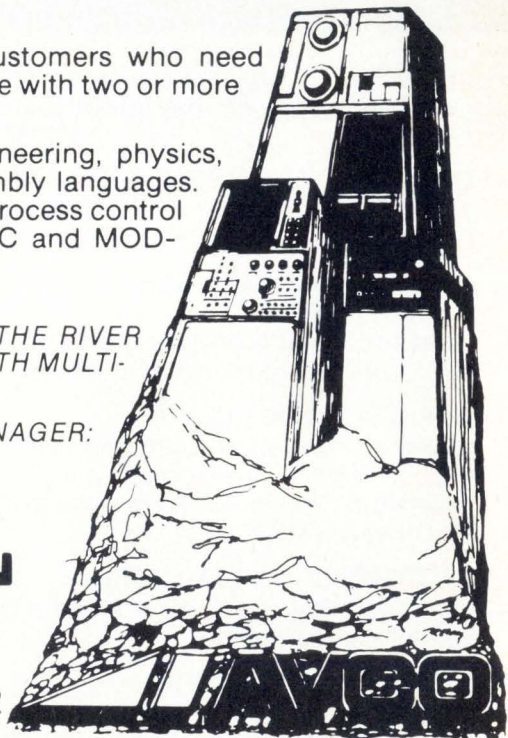
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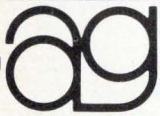
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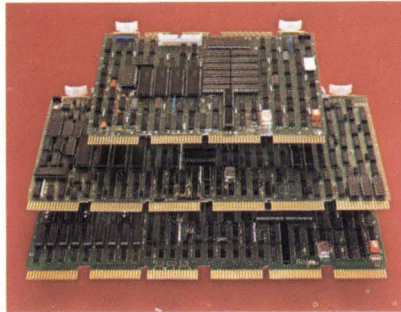
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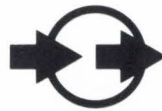
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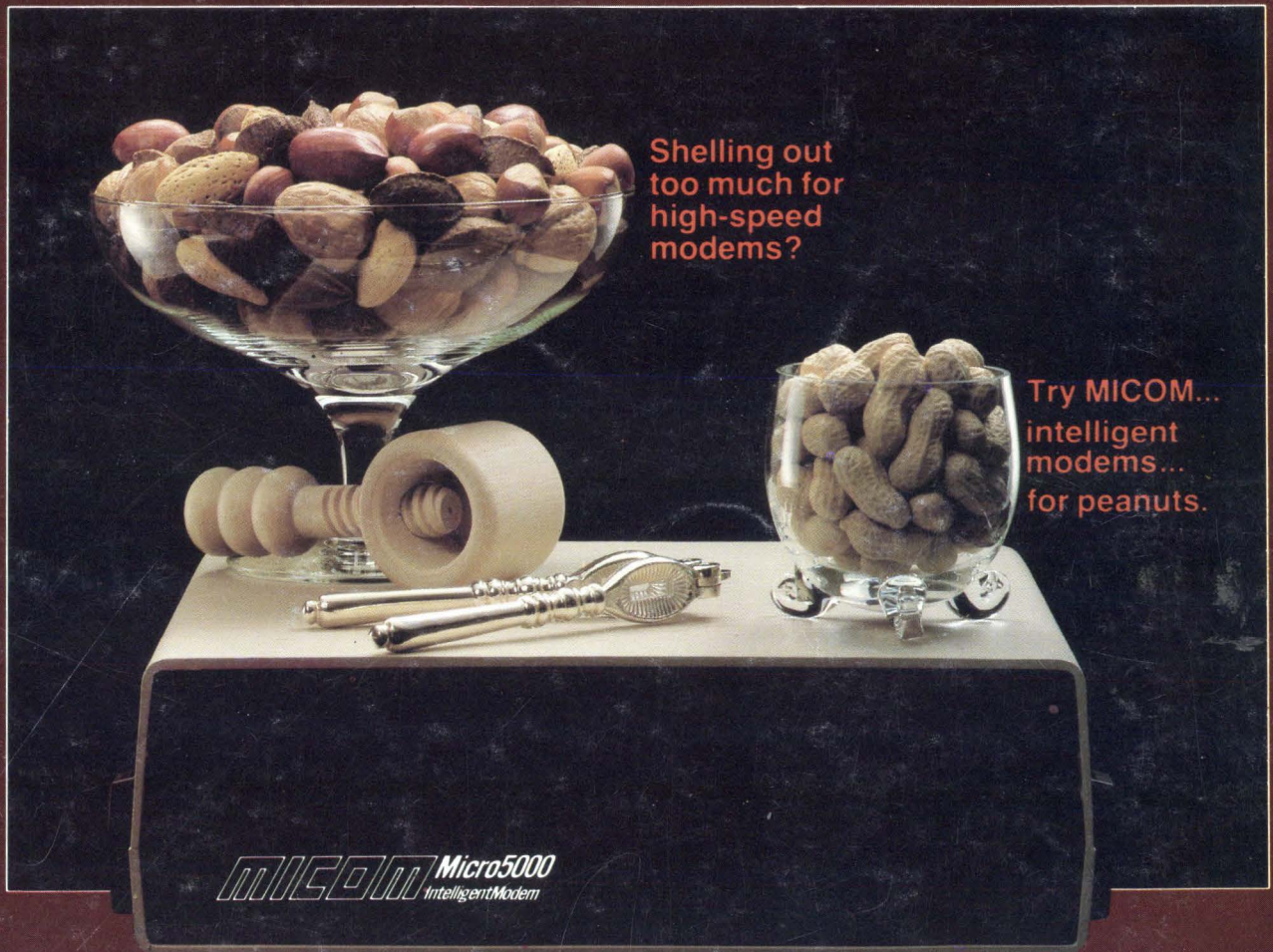
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