Mini-Micro Systems

A CAHNERS PUBLICATION

APRIL 1980

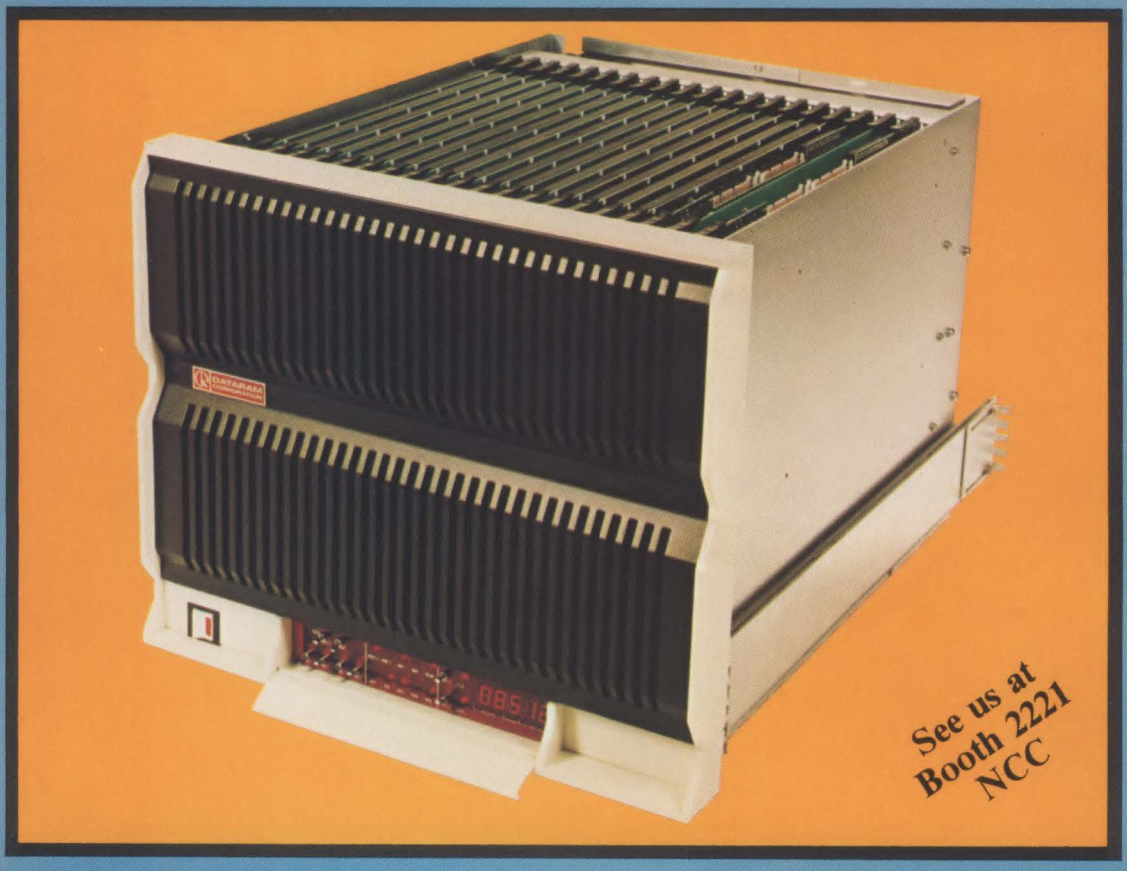
INTRODUCING THE MICRO-WINCHESTER

High-level languages for microcomputers

Data communications: Part II

THE INDUSTRY STANDARD

BULK CORE BULK SEMI



The choice of hundreds of minicomputer users

Give your minicomputer the added benefit and flexibility of economical, high-capacity storage with BULK MEMORY from Dataram.

The only company to offer both core and semiconductor BULK MEMORY systems for minicomputer users, Dataram today has hundreds of BULK CORE and BULK SEMI users throughout the world, in use in applications that range from process control and data acquisition to disk swapping and main memory expansion. Utilizing capacities from 256KB to 16 MB, and featuring —

★ Controllers for DEC, Data General, Perkin-Elmer, and ROLM minis
★ Core or semiconductor technology
★ Dual-port capability
★ Built-in Self Test

BULK MEMORY from the leader. Capability you can use. And only from Dataram. Now.

Find out today how BULK CORE and BULK SEMI can help you get more out of your minicomputer. Contact Dataram at 609-799-0071.

DATARAM CORPORATION

PRINCETON-HIGHTSTOWN ROAD CRANBURY, NEW JERSEY 08512
TEL:609-799-0071 TWX:510-685-2542

Canada: Ahern & Soper Ltd., Alberta, British Columbia, Ontario, Quebec • **Finland:** Systek OY, 90-737-233 • **France:** YREL, 956 81 42 • **Hungary/Poland/Rumania:** Unitronex Corporation, WARSAW 39 6218 • **Italy:** ESE s.r.l., 02 600 733 • **Netherlands:** Technitron b.v., 020-45 87 55 • **Sweden:** M. Stenhardt AB, (08) 739 00 50 • **Switzerland:** ADCOMP AG, 01 730 48 48 • **United Kingdom:** Sintrom Ellinor Ltd., (0734) 85464 • **West Germany:** O.E.M.-Elektronik GmbH, 07 11-79 80 47 • **Australia/New Zealand:** Anderson Digital Equipment, (03) 543 2077 • **India:** Industrial Electronic Instruments, 79281 • **Japan:** Matsushita Electric Trading Co., Ltd., 03 (435) 4501

CIRCLE NO. 1 ON INQUIRY CARD

CENTRONICS COVERS THE COURT

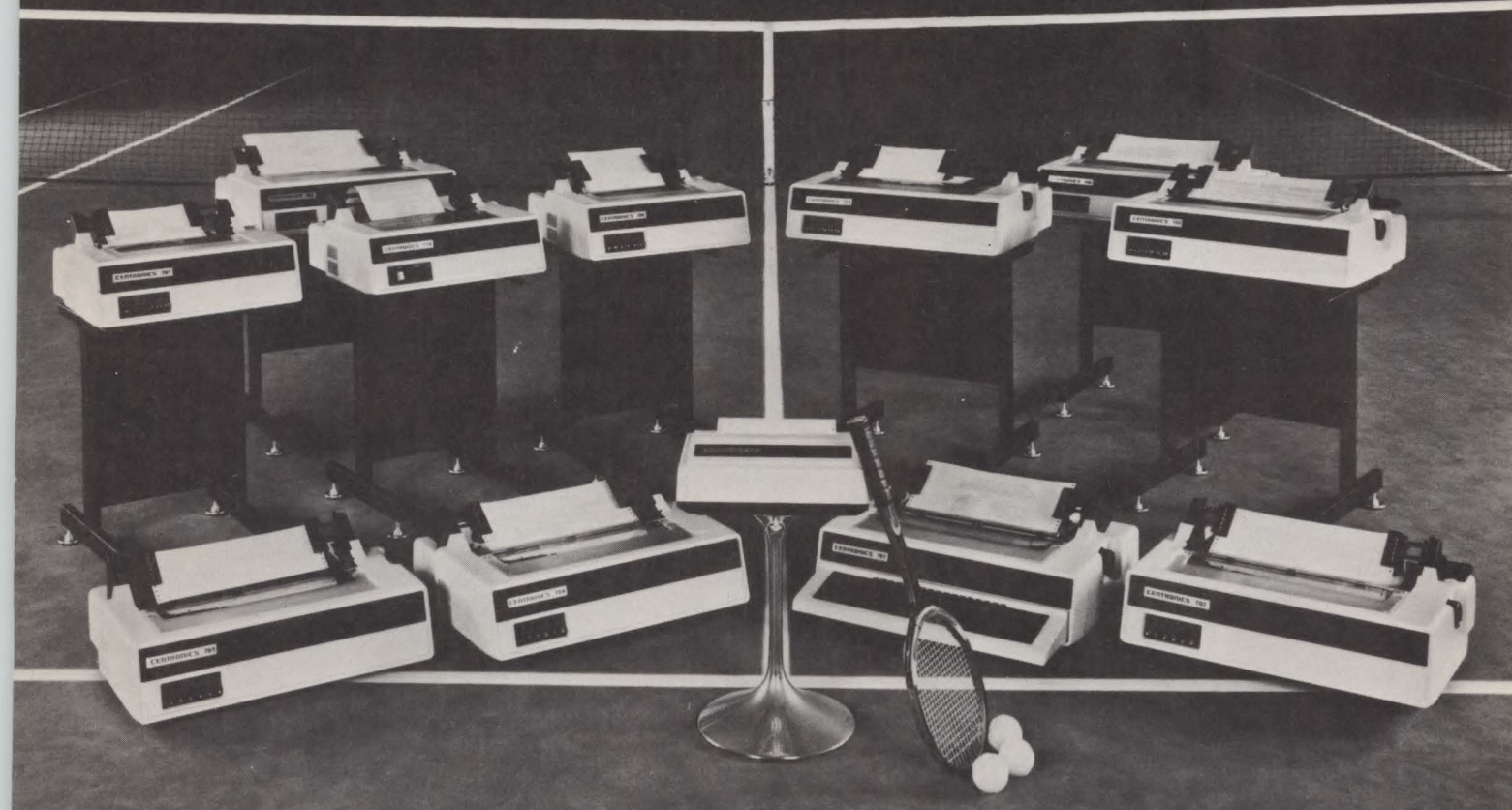
...with new, low-priced printers for small businesses

Now small businesses can have the advantage of Centronics performance. We have new models to meet the needs of small businesses—a selection that covers the court. And we've followed-through by pricing them lower than other printers that can't match Centronics' features and reliability.

TOP-RANKED TEAM We understand your small business needs—that's why Centronics has sold more printers to the small business market than anyone else. We have new, fully-featured models designed for small business applications. High throughput for inventory control. Full 132-column width for accounts receivable. Versatile forms handling capability for invoicing, payroll, and statements. Plus excellent print quality for labels and listings. The bottom line: with Centronics, small businesses can have mainframe performance at micro prices.

READY FOR ANY TOUR These printers are designed to deliver maximum in-service time, a key consideration for a small business. And we have the largest worldwide service organization of any independent printer company.

DON'T WRITE—phone Bob Cascarino today at (603) 883-0111, extension 4032, or contact any of our 15 U.S.A. or 9 international sales offices. Centronics Data Computer Corporation, Hudson, New Hampshire 03051.



CENTRONICS® PRINTERS
...the advantage

CIRCLE NO. 2 ON INQUIRY CARD

INTRODUCING THE DOUBLE DOUBLE

DOUBLE SIDED. DOUBLE DENSITY. DOUBLE THE DEC® RX02.

FULL RX02 COMPATIBILITY—HARDWARE, SOFTWARE, AND MEDIA.
DOUBLE THE CAPACITY—ONE MEGABYTE ON EACH DISKETTE.
BUILT-IN BOOTSTRAP—CONFIGURE AN ENTIRE LSI SYSTEM IN A FOUR-SLOT BACKPLANE.

THE DSD 480

- FOR PDP®-11 OR LSI-11 SYSTEMS.
- ALL IBM AND DEC DISKETTE FORMATS—convenient data exchange between DEC and IBM systems.
- EXCLUSIVE "HYPERDIAGNOSTICS"—Built-in intelligence for switch-selectable self-testing and display.

THE DSD 470

- FOR LSI-11 SYSTEMS.
- LSI-11/23 FOUR-LEVEL INTERRUPT ACKNOWLEDGEMENT—DEC standard for all future peripherals.
- ON-BOARD DIAGNOSTICS FROM ODT—Simplified incoming inspection or system analysis.

LOW PROFILE, MODULAR PACKAGE—ONE HALF THE SIZE OF THE RX02.
HIGHER PERFORMANCE—34% FASTER AVERAGE ACCESS THAN THE RX02.

Advanced technology and innovative engineering deliver DEC-compatible flexible disk systems with added capabilities and superior performance. When you need increased storage capacity and proven reliability for your DEC computer, look to the leader—DATA SYSTEMS DESIGN.

☐ Please call me. ☐ Please send me more information.
My system: ☐ LSI-11, PDP-11/03, LSI-11/2, ☐ LSI-11/23, ☐ PDP-11/____

Name_____ Title_____ Company_____

Address_____ City_____ State_____ Zip_____

Telephone_____

MMS 4/80

Data Systems

Data Systems Design, Inc.
3130 Coronado Drive
Santa Clara, CA 95051
(408) 249-9353
TWX 910-338-0249

Eastern Regional Sales
990 Washington Street, Suite 101
Dedham, MA 02026
(617) 329-5730
TWX 710-348-0563

® Registered trademark of Digital Equipment Corporation

CIRCLE NO. 3 ON INQUIRY CARD

Mini-Micro Systems

A Cahners Publication

Volume XIII Number 4 April 1980

COVER

Shugart Technology has taken the evolution of the Winchester drive one more step with the introduction of the ST500, the first 5¼-in. Winchester. See p. 79. Photo by Gary Travis, courtesy of Shugart Technology.

All correspondence regarding advertising and editorial should be addressed to the publication offices at:

MINI-MICRO SYSTEMS
221 Columbus Avenue,
Boston, MA 02116
(617) 536-7780

VBPA ☆ABP

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. Controlled Circulation 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 US 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 — U.S.; $35.00 — Canada; $45.00 — all other countries (12 issues). Single issues $3.00 — U.S.; $4.00 — Canada; $5.00 all other countries.

MINI-MICRO WORLD

32 BRINGING ELECTRONIC MAIL TO THE CORPORATE OFFICE . . . *more vendors offer systems to automate routine office functions.*

35 PIGGYBACK MODULES ENHANCE INTEL'S COMPUTER BOARDS . . . *adding new functions or expanding existing ones on standard boards.*

38 TRADE WITH CHINA OFFERS PROMISE, PITFALLS . . . *computer vendors step up marketing efforts to attract Mainland users.*

50 INDEPENDENT PROGRAMMERS TAKE A NEW MARKETING TACK . . . *spawning entrepreneurial ventures in marketing software.*

58 FORMATION BRANCHES OUT WITH IBM-COMPATIBLE MINI . . . *new Formation 4000 helps company shed its RCA-oriented image.*

61 LOWER COSTS FUEL BOOM IN THIRD PARTY MAINTENANCE . . . *independent service vendors offer users an alternative.*

63 PUNCH CARD MAKER TRIES TO ENTER PRINTER MARKET . . . *Decision Data diversifies in an effort to fight its financial woes.*

69 'LARK' DISK DRIVE OFFERS SMD/CMD COMPATIBILITY . . . *and it combines a fixed platter with a removable disk for backup.*

71 IBM UNVEILS 5120: ITS LOWEST-PRICED SYSTEM YET . . . *the new desk-top computer faces stiff competition from other vendors.*

72 SMART INTERFACE HANDLES WORD-PROCESSING CHORES . . . *and does not require the writing of complex control algorithms.*

FEATURES

79 INTRODUCING THE MICRO-WINCHESTER . . . *Shugart Technology's ST500 is the first 5¼-in. Winchester disk drive.*

89 HIGH-LEVEL LANGUAGES FOR MICROCOMPUTERS . . . *most popular high-level languages can now be run on microprocessors.*

114 REDUCING COMMUNICATION LINE COSTS WITH MULTIPLEXORS . . . *'black boxes' let several terminals share one phone line.*

123 THE 8086 FAMILY: A SECOND WAVE . . . *they add a multiprocessing capability to Intel's 16-bit microcomputer line.*

DEPARTMENTS

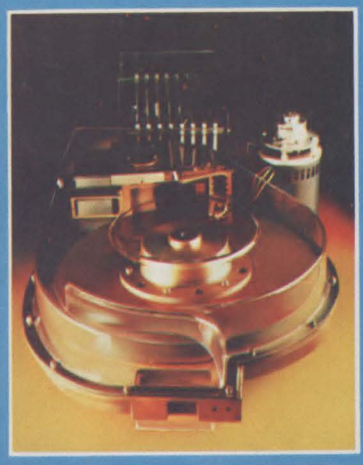
8 LETTERS
15 PUBLISHER'S LETTER
19 EDITORIAL
20 CALENDAR
27 BREAKPOINTS
44 MINIBITS
139 NEW SYSTEMS
140 NEW HARDWARE
152 NEW SOFTWARE
156 NEW LITERATURE
161 CLASSIFIED ADVERTISING
162 CAREER OPPORTUNITIES
164 INDEX TO ADVERTISERS

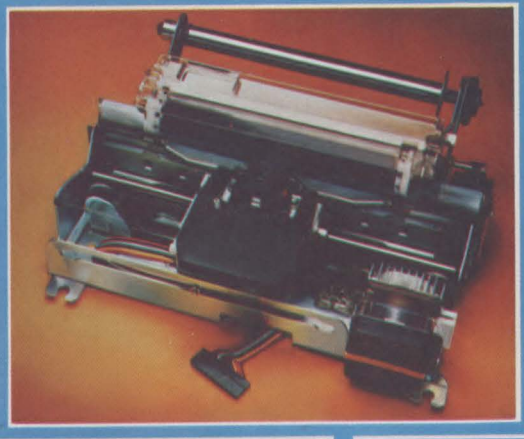

It's nice to know
into the systems
Now get the
peripherals you need
from a supplier
you can depend on.
Burroughs

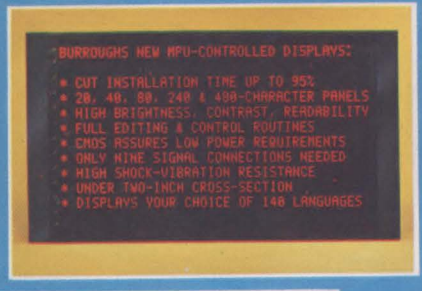
you've built Burroughs quality you've put your name on.

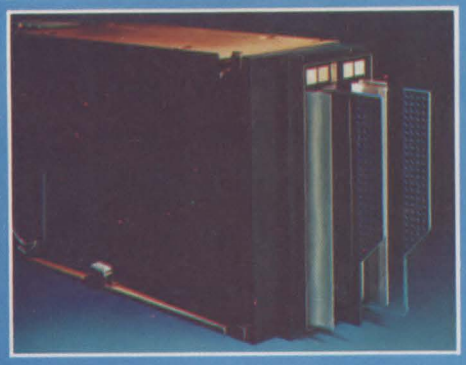
As an OEM systems decision maker, you may not be aware that Burroughs peripherals are available to the OEM. In fact, Burroughs now offers a growing line of OEM peripherals including floppy disk drives, fixed disk drives, printers, displays and many others. Rugged. Dependable. And backed by the Burroughs warranty. With worldwide production facilities to assure your supply.

For additional information, call or write **Burroughs OEM Marketing,** Burroughs Place, Detroit, MI 48232 (313) 972-8031. In Europe, High Street, Rickmansworth Hertfordshire, England. Telephone Rickmansworth (09237) 70545.



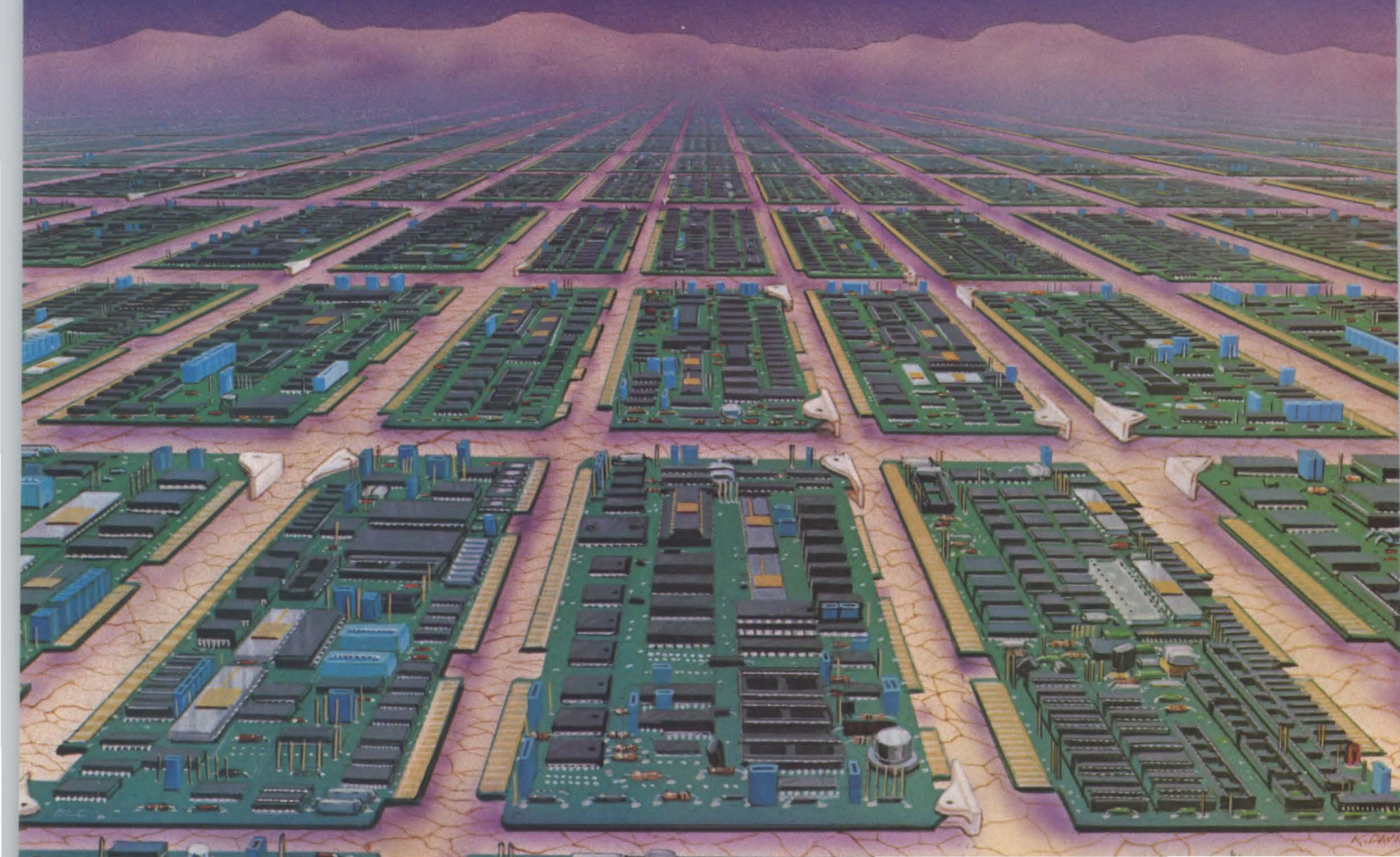






Burroughs

Series/80 microcomputer products brought back down to earth.



National Semiconductor doesn't just make over seventy-five Series/80 computer products. We make them practical with test points, options, functional design and availability.

We brought Series/80 microcomputer products down to earth to give you what you want.

We don't build flashy boards loaded with far-out technology. Technology you don't need and won't ever use.

We make practical, reliable boards that do just what you buy them for.

And we make more kinds of those practical, reliable Series/80 products than any other manufacturer. Anywhere.

First where it counts. Although many of our customers depend on us to deliver plug-for-plug replacements for Intel SBC products, our Series/80 line is hardly just a second source supply. We're not second where it really counts. No supplier beats National reliability, functionality of design, user options, variety of products or warranty coverage. We don't build a product unless it solves your problems better than anything the competition has to offer. For example our line-up includes:

National BLC-8222—a single/double density floppy disk controller.

National BLC-8538—an 8-channel communications board with twice as many communications ports as others have available.

National BLC-8715—an intelligent analog input board that allows users to implement distributed analog signal processing on a single board.

National BLC-8737—an analog I/O board with 12-bit resolution that behaves like RAM addresses.

And of course, we make more than just these boards. Our product line also includes CPUs, memories, controllers, analog and digital I/O, peripheral controllers, firmware, card cages, power supplies, cables and just about anything you need for just about any application.

Our test procedures make them practically perfect. You buy boards to reduce implementation and testing time, save money and lower your inventory requirements, right?

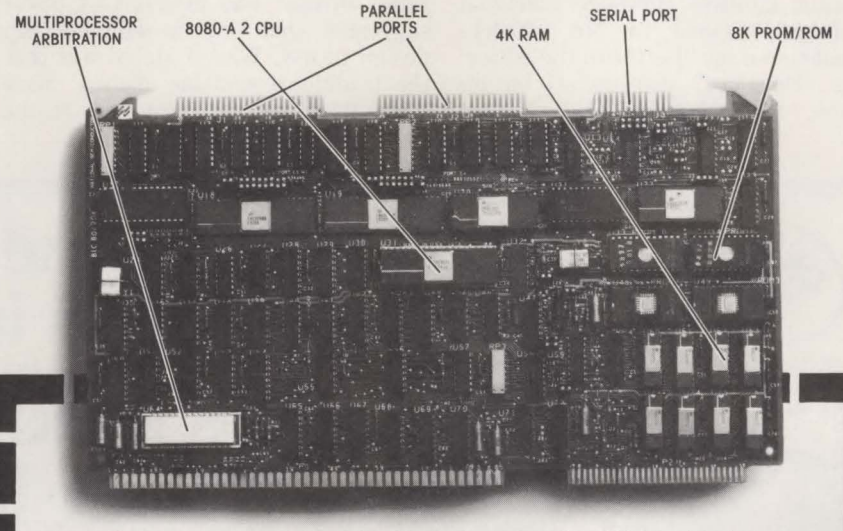
That's why we build boards the way we do.

Test points are designed as an integral part of the board. We start testing right in the design phase and continue through our unique dynamic high temperature burn in, thereby reducing board infant mortality.

And we make it easy to make our products part of your system. Our boards are designed to be functional, easy to design in and totally consistent in operation. So whatever you want your system to do, we've got what you want. And we stock at the distributors worldwide so you can get what you need when you need it.

When you buy our boards we give you a full one year warranty. The longest warranty in the industry. If you have trouble, just mail your board back.

Nothing could be so simple. We've got a Series/80 board or related microcomputer product that will do the job for you no matter what kind of job you do. So send us the following coupon or call us at National Semiconductor (800) 538-1866; in California (800) 672-1811. We're the company that finally brought space age technology back down to earth.



For more information write National Semiconductor Corporation, 2900 Semiconductor Drive, Mail Stop 15236 Santa Clara, California 95051 (800) 538-1866; (800) 672-1811 in California. In Europe, mail coupon to: National Semiconductor GmbH, Industriestraße 10, D-8080 Fürstenfeldbruck, West Germany Tel: +49 08141 1031 Telex: 0527649

Name _____ Title _____

Company _____

Address _____

City _____ State _____ Zip _____

Telephone _____ Ext _____

National Semiconductor
The Practical Wizards of Silicon Valley

CIRCLE NO. 5 ON INQUIRY CARD

Letters

MISLEADING HEADLINE

To the editor:

The article by John Trifari on Perkin-Elmer's new disk drive (MMS, January, 1980, p. 40) was very well-written and well-received. However, you should check headlines carefully—the one used in the article misleads the reader and is wrong.

Darryl Lloyd
President
Darryl Lloyd Advertising & Public Relations
North Hollywood, Calif.

(The editor replies: We regret that our headline writer—not John Trifari—introduced the word "Winchester" in the headline; the Perkin-Elmer drive is not of the Winchester type.)

DBMS CONTEST OF WORDS

To the editor:

I don't mean to develop a contest of words concerning the evaluation and selection of DBMSs. However, I feel that I should respond to Mr. Stiefel's comments on my "Letter to the editor" (MMS, February, 1980, p. 8) on his article, "Surveying data base management systems" (MMS, November, 1979, p. 94).

Reviews of clients who have already acquired and implemented DBMSs and then found that they did not function in the manner in which they were designed, were the basis of my original comments. In those sites where we have performed these reviews, we have found the DBMS to be often used as another file access method rather than a true method of processing data, which was its original intent. Price, response time and compatibility are desirable requirements that one must look at and, as Mr. Stiefel admitted, are very subjective. Some concrete criteria that we utilize include the capability of a DBMS for data manipulation, query, application programming, physical files, data communications interface, systems installation and secondary features.

Mr. Stiefel's interpretation of my comments which resulted in his feeling that "only consultants can adequately select DBMSs" was incorrect. I never suggested that only consultants can design DBMSs. What I stated was that the traditional systems analyst, more often then not, does not look at the DBMS as a new method of processing data, only as a new file access method. Establishing user requirements, developing systems requirements and selecting the DBMS to meet those systems requirements utilize different processes. My comment only suggested that until an organization's technical team has performed this work, it is heartily suggested that this organization obtain guidance from someone, regardless of whether it is paid for or not, so that the effort might be a successful one. Implementing DBMS often takes two to five years. It would be a sorry sight for a company to allow untrained people to perform this work.

In addition, with the advent of the term "Information Resource Management," the DBMS is becoming the most critical asset of a corporate data-processing center. It would do many organizations well to evaluate their acquisition of a DBMS on the basis of what it can do now and in the future as far as total corporate requirements.

Harvey M. Weiss
President
Weiss & Associates
Denver, Colo.

PDP11/03® PDP11/23®
MICROCOMPUTER SYSTEMS

FIRSTMICRO™ PDP11®

FIRST COMPUTER CORPORATION NOW OFFERS MICROCOMPUTER DEVELOPMENT SYSTEMS IN BOTH 11/03 AND 11/23 CONFIGURATIONS.

The Basic PDP-11/03 systems offer the designer a low cost compatible alternative to the larger members of the PDP-11 family. The larger faster PDP-11/23 systems offer the power, expandability and operating systems of the larger members of the PDP-11 family while retaining the proven cost effective Q-Bus architecture. These systems save you money, improve programming efficiency, and boost productivity.

	11T03-L	11V03-L	11T23-L	11V23-L
PART #	SRVXLLB	SRVXSSB	SRWXLLA	SRWXSSA
BACKPLANE	KD11-HA CPU 11/03	KD11-HA CPU 11/03	KDF11 CPU 11/23	KDF11 CPU 11/23
	MSV11-DD 32KW Memory	MSV11-DD 32KW Memory	MSV11-DD 32KW Memory	MSV11-DD 32KW Memory
	RL01 Controller	RX02 Controller	MSV11-DD 32KW Memory	MSV11-DD 32KW Memory
	RL01 Controller	DLV11-J Serial (4)	RL01 Controller	RX02 Controller
	DLV11-J Serial (4)	OPEN	RL01 Controller	DLV11-J Serial (4)
	OPEN	OPEN	DLV11-J Serial (4)	OPEN
	OPEN	OPEN	OPEN	OPEN
	OPEN	OPEN	OPEN	OPEN
	BDV11-AA Bootstrap	BDV11-AA Bootstrap	BDV11-AA Bootstrap	BDV11-AA Bootstrap

Serving the world with cost effective computer systems.

TM **TWX NUMBER 910-651-1916**

First computer corporation

corporate square/825 north cass avenue/westmont, illinois 60559/(312) 920-1050

SS-3

NOW CLEANING YOUR
COULD SAVE YOU A
AND A L

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

And that service call might not even be necessary.

3M SOLVES THE PROBLEM IN SECONDS— AND LEAVES YOUR HEADS "COMPUTER ROOM CLEAN".

The new Scotch® 7400 head-cleaning diskette kit lets *you* clean the read-write heads on your 8″ or 5¼″ diskette drives. In just 30 seconds, without any disassembly, mess or bother, the heads can be completely

cleansed of dirt, dust, magnetic oxides – all the things that can get into your machines every day. And foul them up.

Just saturate the special white cleaning pad in its jacket with the cleaning solution. Then insert the jacket into the diskette drive and turn it on. Your machine does the rest. The heads are microscopically cleaned without wear or abrasion.

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

AT ONLY $1 PER CLEANING IT'S THE BEST INSURANCE YOU CAN GET.

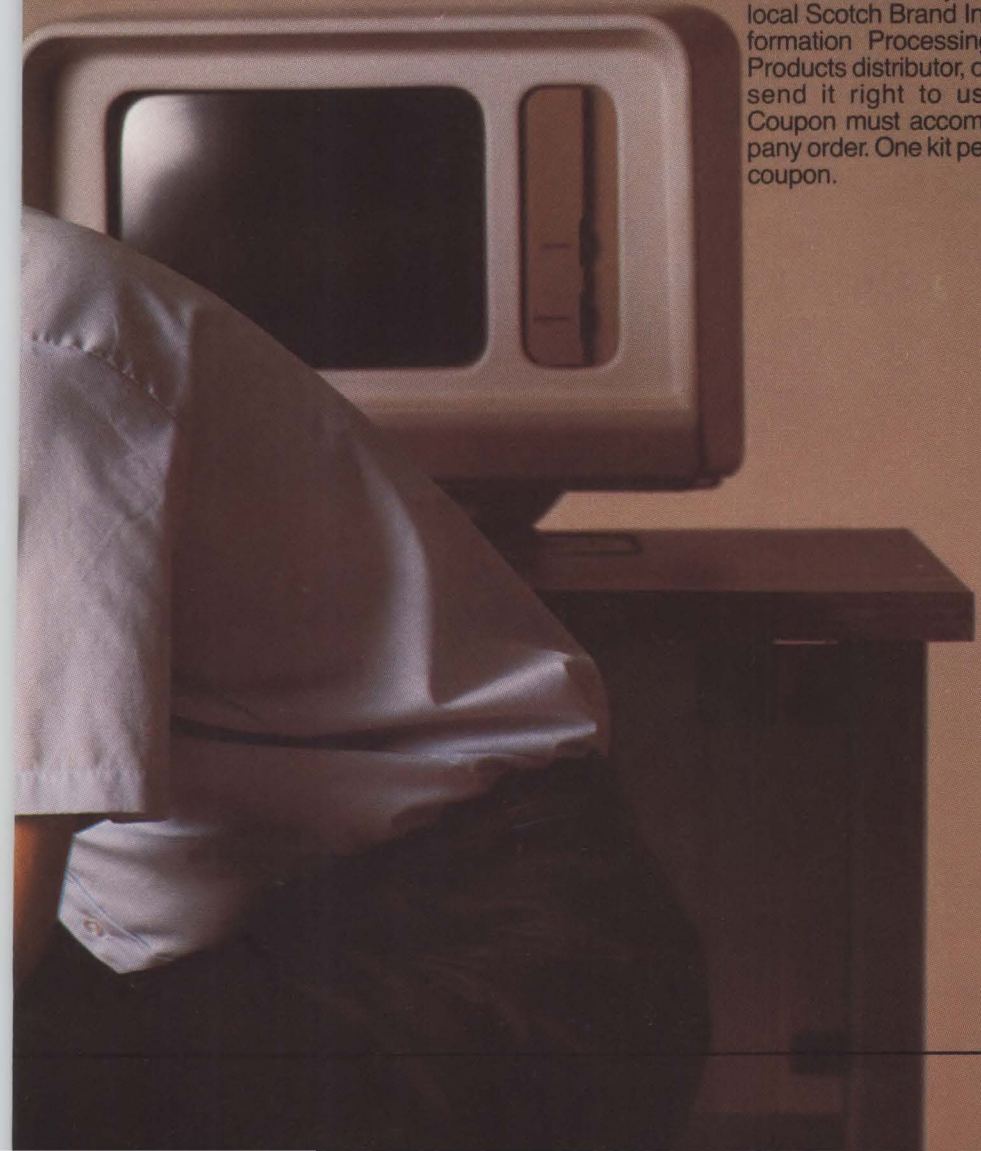
This fast-cleaning new Scotch kit comes with everything you need (including special fluid, applicator tip, cleaning diskettes) to handle up to 30 cleanings. That's only about a dollar a cleaning. Frankly, it's *outstanding* insurance. Use the Scotch cleaning diskette

WN DISKETTE HEADS
$40 SERVICE CALL.
T MORE.

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

frequently, to make sure your diskette heads are kept clean. And to help them perform at the level specified by the manufacturer.

You could save yourself a lot more than just a service call. So we want you to try this remarkable new kit now. Order before June 30 and get $6.00 off... a full 20% discount. Order from your local Scotch Brand Information Processing Products distributor, or send it right to us. Coupon must accompany order. One kit per coupon.



$6.00 OFF!

We'll take $6 off the list price when you order the 7400 Kit with this coupon and your check or money order. So send for this special offer today. (Send to: 3M, Dept. P, P.O. Box 33984, St. Paul, MN 55133.)

My Name_____
(PLEASE PRINT)

My Company_____

Address_____

City_____

State_____ Zip_____

Please send my new kit for $24. I enclose ☐ Check ☐ Money Order. Add state sales tax where applicable. Make check payable to 3M.

Diskette size: ☐ 5¼" ☐ 8" (Not yet available for Burroughs Mini-Disk II or Vydec drives.)

(Offer good in U.S. and Canada only. Void where prohibited by law. Expires June 30, 1980.) Offer valid only if coupon is completed.

MMS4

3M

Now that Infoton has changed its name to there's only one button to push for

We're General Terminal Corporation. GTC, for short.

Over the past decade, as Infoton Incorporated, we've come a long way by pushing all the right buttons for our customers.

In the decade ahead, as GTC, we'll be pushing even harder to become the only connection you'll ever really need, in display terminals.

And we don't have far to go.

Because we already have extraordinary products like the GT-101 and GT-400. Both right on the button for quality, versatility and reliability. Both with standard features that'll beat the options off their competitors.

Because we already have the capacity to deliver and service our products anywhere in the world, at push-button speed.

Because we're now the one and only display terminal manufacturer with major production and service facilities on both U.S. Coasts. So we can help you keep a button on today's ever-increasing freight costs.

And because we've always been willing to break away from button-down thinking. To try new-fangled innovations in the spirit of old-fashioned service.

So if you're ready for all these things today, and more to come in the years ahead... you don't have far to go.

Just push the right button.

General Terminal Corporation, all your display terminal needs.

GT-101	
ENGINEERING HIGHLIGHTS	
• Z-80 microprocessor	• Solid state keyboard
• Modular firmware	
STANDARD FEATURES	• Line drawing character set
• Block mode	• Printer interface
• Dual intensity	• ADM-3A mode
• Reverse video	
OPTIONAL FEATURES	• Composite video output
• 8-user programmable function keys	• 220 volt operation

GT-400	
ENGINEERING HIGHLIGHTS	
• Z-80 microprocessor	• Modular firmware
• Block/character mode	• Function keys (8 std./24 option)
OPTIONAL FEATURES	• Modem cable/modem printer cable
• Line drawing character set	• Hazeltine 2000 emulation
• 2 additional pages of display memory	• Time sharing option

For more information on GTC products and services, call toll-free today. In California, dial 800-432-7006; anywhere else in the United States, dial 800-854-6781. Ask for Barbara Worth. Or write Barbara Worth at General Terminal Corporation, 14831 Franklin Avenue, Tustin CA 92680. We have offices throughout the world. In Canada, contact Lanpar Limited, 85 Torbay Road, Markham, Ontario, L3R 1G7. 416-495-9123.

GTC®

The right button to push.™

General Terminal Corporation

CIRCLE NO. 9 ON INQUIRY CARD

The Cook-able Computer

Configure Your Severe Environment System With Our SECS 80/10A Microcomputer And Support Modules

Buy a few cards or a complete system

Take our ruggedized SECS 80/10A Microcomputer, a functional counterpart of Intel's standard iSBC* single board computer, surround it with our equally ruggedized support modules, and you have the building blocks you need to design a system which will operate under the most severe environments.

This versatile SECS 80 System likes it cold — or hot. Meets Mil-E-5400, 4158, 16400- and more, making it perfect for space, missile and other military systems and tough industrial applications.

A multitude of modules

With these versatile modules, you'll save valuable time and development costs.

- **SECS 80/10A Microcomputer**
- **RAM, ROM & EPROM Memories**
- **Digital Tape Recorder & Controller**
- **1553 Serial I/O Board**
- **Digital Input/Output Board**
- **Analog To Digital Converter**
- **High Speed Arithmetic Unit**
- **Power Supplies**

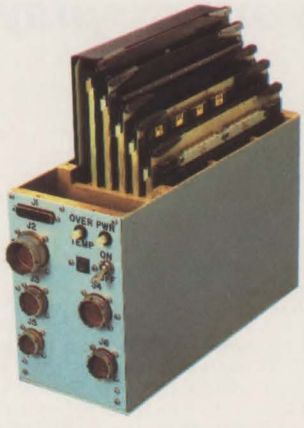
System packaging

All system modules are mounted on 9″ by 6″ shock and vibration resistant boards. A 7.62″ by 4.88″ 12.62″ chassis (½ ATR) holds up to 6 boards.

Other EMM-SESCO products

We've got core and semiconductor memories for military and commercial use, a Digital Data Acquisition System for the 1553 bus, and a compact Digital Tape System with 23 megabit capacity.

When you're faced with a tough environment – "Buy SESCO... it works!"



EMM SESCO

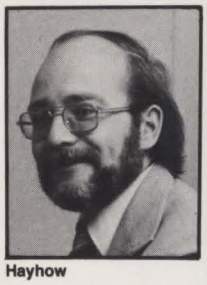
A Subsidiary of Electronic Memories & Magnetics Corporation

20630 Plummer Street • P.O. Box 668 • Chatsworth, California 91311

*Trademark of Intel Corporation

CIRCLE NO. 10 ON INQUIRY CARD

Our editorial expansion


Hayhow


Kinnucan


Valigra

The editorial staff of *Mini-Micro Systems* is expanding, just as the magazine's advertising revenues continue to grow, tracking the continued upward growth curve in the industry itself. Ever since Larry Curran became editor in January of last year, he has been looking for a managing editor to oversee the day-to-day details that add up to getting the magazine published each month. These responsibilities range from editing staff-written and industry-authored articles to positioning each article in the issue—plus exercising occasional "gentle persuasion" to make things happen faster in typesetting and printing.

The man selected after the long search is Peter P. Hayhow, who came to us last month from *Purchasing* magazine, another Cahners magazine headquartered just two floors away from us in Boston. Pete was a senior editor for *Purchasing*, and is an experienced journalist. His background includes copy editing at *The Boston Globe* and a suburban Boston daily newspaper, plus the managing editorship of a group of five weekly newspapers based in Walpole, Mass.

Pete is a graduate of Bridgewater State College, Bridgewater, Mass., and a veteran of the U.S. Navy, and Larry says that Pete already has contributed greatly to our primary editorial goal: providing our readers with well-written and carefully edited information that gets to them on time.

An important portion of that information is news, encompassing products, people and corporate developments in the industry. We believe the role of a monthly magazine is to put those developments into perspective for our readers, and Paul Kinnucan has become news editor to track developments and help provide that perspective. Beginning with this issue, Paul moves over from the feature section, where he had been planning, soliciting and editing the lengthier articles that appear in the middle of the magazine, most of which are contributed from authors in the industry.

Paul's new domain is the "front-of-the-book," primarily the Breakpoints and Mini-Micro World sections, where our news, product focus, corporate & financial and people stories appear. He's been on the staff since 1976, and has developed the industry perspective required to recognize and interpret news developments.

Paul came to *Mini-Micro Systems* from a program manager assignment at the Massachusetts Institute of Technology, where he helped develop a computer-controlled astronomical telescope. He is especially proud of his bachelor's degree in literature from MIT—a degree not often conferred by the Cambridge, Mass., institution that is renowned for its scientific and engineering curricula. Paul progressed from features editor to executive editor most recently, and was eager to take on the fast-paced front-of-the-book sections when Larry asked him to succeed Ron Rosenberg, who has joined *The Boston Globe* staff.

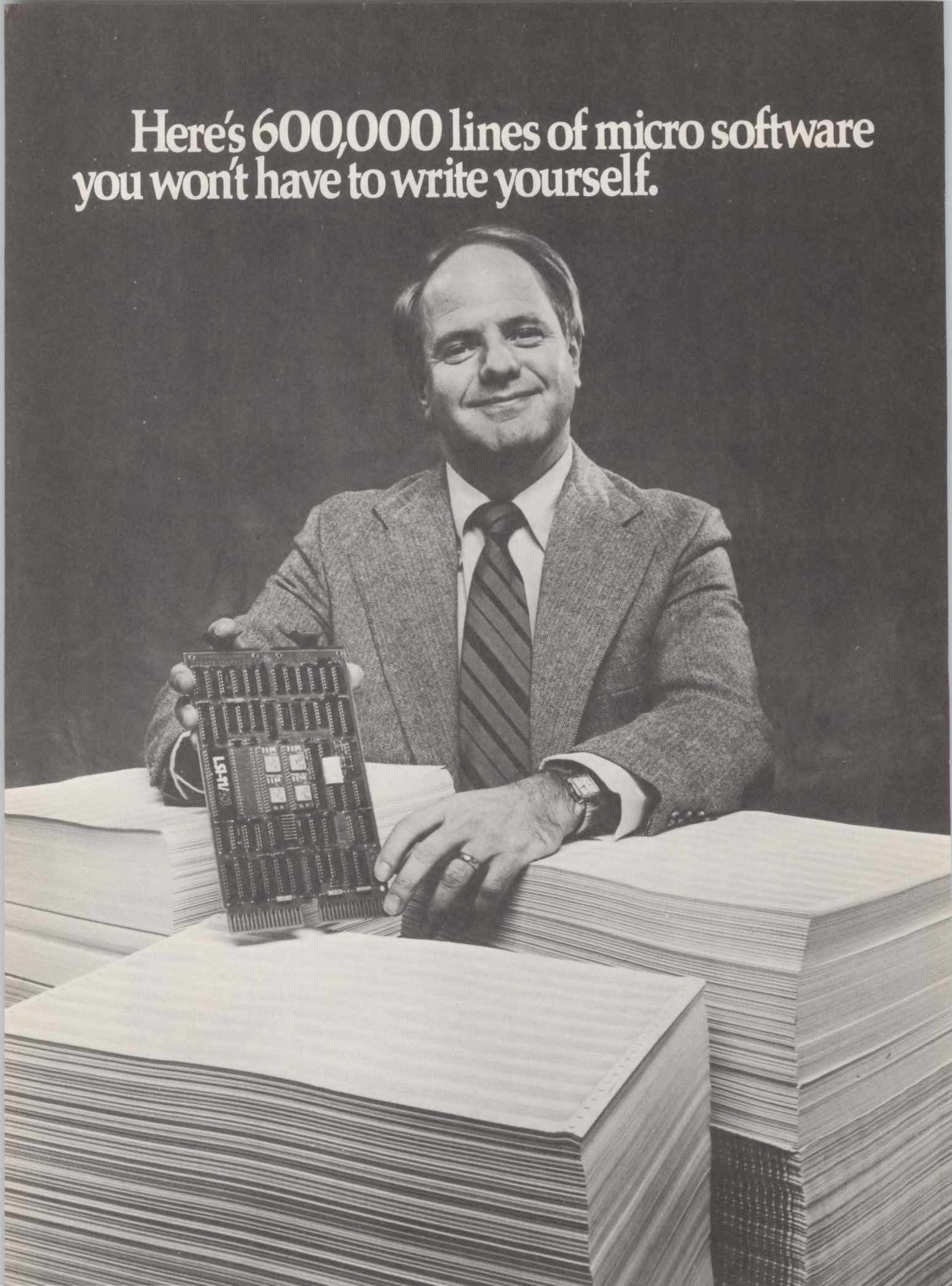
Paul is already getting valuable help from assistant editor Lori Valigra, another recent addition to our editorial staff. Lori comes to us from a staff writer assignment at a Boston area public relations and advertising agency concentrating on computer and peripherals companies. Lori has also been an editor in the Sea Grant program at MIT, and a conference program assistant at Data Communications Interface. Her B.S. degree is in medical technical writing from the University of Pittsburgh, and she received an M.S. in journalism, specializing in science communication, from Boston University.

You'll be seeing Paul's and Lori's bylines more and more in Mini-Micro World, as well as in the feature section. And the staff continues to grow. We'll soon announce an additional editor on the West Coast to assist John Trifari, who is based in Los Angeles, plus another senior editor in the Boston office.

S. Henry Sacks

S. Henry Sacks
Publisher

Here's 600,000 lines of micro software you won't have to write yourself.



Most micro companies are new to 16-bit architecture. Which means they leave you to your own devices when it comes to software.

But with Digital's LSI-11/23 micros, you start off with 600,000 lines of the best real-time software in the micro industry: RSX-11M.

It's the multitasking operating system that's already been proven and refined in five years of use with our PDP-11 minicomputers.

And that's a headstart you won't get from any other micro company.

State-of-the-art programming.

RSX-11M can make your most complex application manageable.

For example, it lets you break your programs into simpler segments. So several programmers can work on the same application at one time, using one of our multiuser development systems.

Then you can link and integrate your application either on your target system, or on the development system. And you won't have to worry about timing problems showing up, because our development systems are based on the same processors as our micros.

You get to work with advanced development tools, too.

Like an optimized FORTRAN IV-PLUS compiler. Line-by-line assembly. And interactive debugging through every stage of development, with English diagnostics that make it easy to pinpoint bugs before you ever run your programs.

Smaller applications are easier, too.

If you don't need all the resources of RSX-11M, you can use RT-11 – the real-time operating system we designed for smaller applications.

With a FORTRAN package that automatically segments your programs into read-only and read-write sections. And it's a full implementation of the language, complete with I/O statements, data formatting and data conversion facilities.

Program one, and you've programmed them all.

Best of all, Digital's micros are software-compatible. So what you learn on one, you can apply to the others.

In fact, our micros are even software-compatible with the world's broadest family of minicomputers – the PDP-11s.

So your migration will always be easy, no matter how far you or your customers may go.

The total approach to micros.

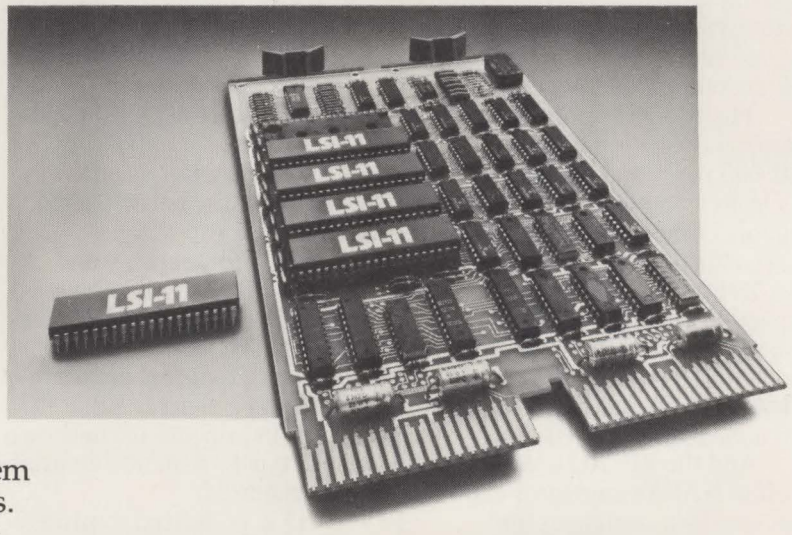
Advanced programming is only one way we make microcomputers easy to work with.

We also offer hundreds of hardware tools – micros in boards, boxes and systems. Memory and interface boards. Terminals and printers.

And we back it all with over 13,000 support people worldwide.

It's the total approach to micros, only from Digital.

For more information, contact **Digital Equipment Corporation,** MR2-2/M70, One Iron Way, Marlboro, MA 01752. Or call toll-free 800-225-9220. (In MA, HI, AK, and Canada, call 617-481-7400, ext. 5144.) Or contact your local Hamilton/Avnet distributor. In Europe: 12 av. des Morgines, 1213 Petit-Lancy/Geneva. In Canada: Digital Equipment of Canada, Ltd.



It took the minicomputer company to make micros this easy.

digital

CIRCLE NO. 11 ON INQUIRY CARD

Space Station.

NASA shuttles information with TI's 810.

NASA required a printer that was both fast and reliable to handle the heavy workload in their Logistics Management System for inventory control. They chose TI's OMNI 800* Model 810 Receive-Only Printer. For over a year the field-proven 810 has been working virtually nonstop as an inventory tracking station printing out information at a speedy 150 characters-per-second.

The 810 RO prints out the status and location of over 470,000 parts and supplies for all Orbiter and Orbiter ground-support components for NASA's space shuttle program. Using TI's 150-million character-life impact printhead, the 810 RO also prints transaction reports, local stock movements, purchase requests, forecast requirements and approved parts lists.

And the 810 RO is proving itself in NASA's simulator capsule used for designing the space shuttle. The 810 RO prints out data on the simulator's specification, design and testing results. It gives NASA scientists and engineers the fast, easy-to-read information they need to design and refine the space shuttle interior.

The 810 RO has also had quite an impact on NASA's accounting operations. Its wide, adjustable carriage easily handles a variety of multi-copy forms for accounting, travel authorizations, balances and fund source reports.

Versatile, reliable and speedy, the 810 is finding assignments in other industries outside aeronautics. Airline, newspaper and real estate industries are using the 810 RO Printer in projects of their own where quick, dependable printing is required.

TI is dedicated to producing quality, innovative products like the OMNI 800 Model 810 Receive-Only Printer. And TI's hundreds of thousands of data terminals shipped worldwide are backed by the technology and reliability that comes from over 30 years of experience in the electronics industry.

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. That's why TI has been appointed the official computer and calculator company of the 1980 Olympic Winter Games.

If you would like more information on the OMNI 800 Model 810 Receive-Only Printer, contact the sales office nearest you, or write Texas Instruments Incorporated, P.O. Box 1444, M/S 7784, Houston, Texas 77001, or phone (713) 937-2016.

Fifty Years of Innovation

*Trademark of Texas Instruments †Service Mark of Texas Instruments

TEXAS INSTRUMENTS

We put computing within everyone's reach.

CIRCLE NO. 12 ON INQUIRY CARD

A really big show

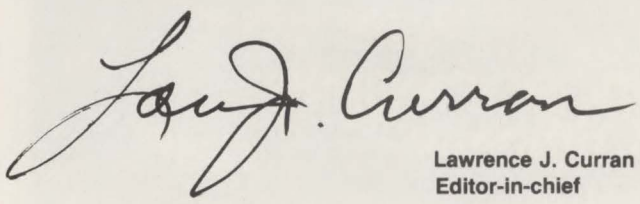
The National Computer Conference has become a very big show. It has certainly outgrown the facilities in Anaheim, Calif., where next month's extravaganza will be staged May 19-22. The Anaheim Convention Center and local hotels and restaurants groaned under the strain of record attendance and a bumper exhibitor crop there two years ago. The traffic can only get heavier this year, with exhibitors spilling over into Orange County hotels they hope will get enough traffic to make it worthwhile. Officials at the American Federation of Information Processing Societies, Inc., NCC's prime sponsor, realize that only the biggest facilities in the biggest cities can accommodate NCC. Accordingly, the sites for the next two National Computer Conferences are Chicago's McCormick Place and New York's Coliseum. But even the Coliseum isn't big enough for today's NCC.

As the show gets larger, the arguments get louder for breaking it up in some fashion. There are those who yearn for a return to a format similar to that used in the days of the spring and fall joint computer conferences, alternating them from coast to coast. But the computer and peripherals industry has grown too large for that idea, which would do little more than present essentially the same cast of exhibitors to two somewhat regional audiences. The attendance probably wouldn't vary much, so crowding could still be a problem. If there's to be a change in format, it should be one that encourages the greatest exhibitor participation to allow as many vendors as possible to show their wares.

One of the regrettable things about NCC's size now is that AFIPS always has a waiting list of companies eager to exhibit "under the big top" if there's a late cancellation of booth space, but who end up in an outlying hotel suite because cancellations are few. All too often these are new companies who can't get onto the exhibit floor because they haven't accumulated any points under the AFIPS method of allotting booth space. That system is based, in part, on a company's prior exhibit history at NCC. It's not a bad system; long-time exhibitors should get some preference for their loyalty.

But often a start-up company brings more innovation to an industry than do established firms. The principals in a fresh company are often entrepreneurs whose ideas weren't encouraged by their most recent employers—the management of established, cautious and slower-moving companies. The entrepreneurs tire of the frustration, find a backer and launch a new company. Their product needs exposure, and, no matter how many smaller regional shows there are in the computer industry, NCC is still the "biggie" for exhibitors.

These companies need to get into the main show, not the hotel fringes. Maybe the time has come for AFIPS to sponsor more vertical shows that would become the biggies in their segments of the industry, accommodating almost anyone who can pay to exhibit. The Office Automation Show last month in Atlanta could be a start, and even though attendance there wasn't earthshaking, the effort is to be applauded; new shows take time to become established. Many exhibitors there said they got plenty of attention from true buyers, not just shoppers. If the smaller format of a more vertical show means more exposure for the innovators, we're all for it.



Lawrence J. Curran
Editor-in-chief

Calendar

SHOWS & CONFERENCES

APRIL

23-25 **International DP Training Conference,** Chicago, sponsored by Deltak, Inc. Contact: Ross H. Stemer or John P. Montgomery, Daniel J. Edelman, Inc., 221 North LaSalle St., Chicago, Ill. 60601, (312) 368-0400.

24 **California Computer Show,** Palo Alto, Calif., sponsored by Norm DeNardi Enterprises. Contact: Norm DeNardi Enterprises, 95 Main St., Los Altos, Calif. 94022, (415) 941-8440.

28-30 **Federal DP Expo,** Washington, sponsored by The Interface Group. Contact: Peter B. Young, The Interface Group, 160 Speen St. Framingham, Mass. 01701, (800) 225-4620 or (617) 879-4502.

29-30 **Fiber Optic Marketing Conference,** Chicago, sponsored by Information Gatekeepers, Inc. Contact: Barbara Coffin, Information Gatekeepers, Inc., 167 Corey Road, Brookline, Mass. 02146, (617) 739-2022.

APRIL 29-MAY 1

Second International Parametrics Conference, Cherry Hill, N.J., sponsored by the International Society of Parametric Analysts and RCA PRICE. Contact: Henry Apgar, ISPA Vice President, Box 5009, Westlake Village, Calif. 91359, (213) 889-2211, ext. 2852.

APRIL 30-MAY 2

Computerized Office Equipment Expo-Midwest '80, Rosemont, Ill., sponsored by the Chicago Association of Commerce and Industry. Contact: Susan Bishop, Industrial & Scientific Conference Management, Inc., 222 West Adams St., Chicago, Ill. 60606, (312) 263-4866.

MAY

1-2 **"An Assessment and Forecast of Computer Graphics" Conference,** Westchester, N.Y. Contact: Bob Sanzo, Director of Marketing, Frost & Sullivan, Inc., 106 Fulton St., New York, N.Y. 10038, (212) 233-1080.

2-4 **IASSIST Annual Conference 1980,** Washington, sponsored by the International Association for Social Science Information Service and Technology. Contact: W. Jon Heddesheimer, Publicity, IASSIST 1980 Conference, Suite 700, 1990 M St., N.W., Washington, D.C. 20036.

6-8 **1980 International Symposium on Computer Architecture,** La Baule, Brittany, France, sponsored by the Association for Computer Machinery and the IEEE Computer Society. Contact: Daniel E. Atkins, Department of Electrical and Computer Engineering, The University of Michigan, Ann Arbor, Mich. 48109, (313) 763-0038.

6-8 **Micro/Expo '80,** Paris, France, sponsored by Sybex, Inc. Contact: Robert Maraziti, U.S.A. Show Coordinator, Sybex, Inc., 2344 Sixth St., Berkeley, Calif. 94710, (415) 848-8233.

7-9 **DPMA Conference and Business Exposition,** Tampa, Fla., sponsored by Tampa Chapter, Data Processing Management Association. Contact: Chris Meyer, Chairman CDP, Tampa Chapter, DPMA, P.O. Box 3052, Tampa, Fla. 33601, (813) 961-3902.

NEC Trimliners. A generation ahead.

300-600 LPM band printers that set new standards.

At NEC, we've been working on band printer technology for more than seven years. While others were contemplating the possibilities of this practical, low-cost method, NEC was constructing its first units, getting the bugs out, improving the designs. Bringing state-of-the-art electronics to band printer controls. Adding serviceability. Reliability. Durability.

Today, NEC offers two band printers with speeds of 300 and 600 lines per minute. Available now, they are also reliable—now. They incorporate a technology which is now. The band technology. Low-cost, very reliable, extremely flexible.

A new enhanced-print feature allows the user to change speeds under either software or hardware controls to produce higher quality printed output. The feature reduces the 300 LPM speed to 170 LPM, and the 600 LPM rate to 350 LPM.

NEC's Trimliner printers have *never* experienced any band breakage. They have uptimes 50% higher than the competition. Trimliners average less than 30 minutes to repair. They're quiet, modular, ultra-cool and available in desktop, pedestal-mounted or two models of quiet cabinetry.

The technology of the 80s in a printer for the 80s from NEC—a company that was preparing for this decade and its band printing needs while others were just thinking about it.

NEC's Trimliner band printers. A generation ahead.

NEC. Going after the perfect printer.

NEC

NEC Information Systems, Inc.

Head Office: 5 Militia Drive, Lexington, MA 02173, (617) 862-3120
Eastern Office: 36 Washington Street, Wellesley, MA 02181, (617) 431-1140
Central Office: 3400 South Dixie Drive, Dayton, OH 45439, (513) 294-6254
West Coast Office: 8939 S. Sepulveda Blvd., Los Angeles, CA 90045 (213) 670-7346
Southern Office: 2945 Flowers Road South, Atlanta, GA 30341, (404) 458-7014

CIRCLE NO. 14 ON INQUIRY CARD

Calendar

7-9 **"Perspective on the 80s" Conference,** Ellenville, N.Y., sponsored by the Data Processing Management Association Empire Region. Contact: John G. Kemberline, Exxon Corp., 1251 Avenue of the Americas, New York, N.Y. 10020, (212) 398-3492.

11-14 **Association for Systems Management 1980 Annual Conference,** New Orleans, sponsored by the Association for Systems Management. Contact: Richard B. McCaffrey, Assistant Executive Director, Association for Systems Management, 24587 Bagley Rd., Cleveland, Ohio 44138, (216) 243-6900.

12 **Electro/80 Marketing Conference,** Boston, sponsored by Electronic Conventions, Inc. Contact: Robert Myers, Electro, 999 North Sepulveda Blvd., El Segundo, Calif. 90245, (213) 475-4571.

12-14 **Canadian Information Processing Society's Annual Conference,** Victoria, British Columbia, sponsored by CIPS. Contact: Marion Hart or Peter Vanderlee, CIPS, 243 College St., Fifth Floor, Toronto, Ontario, M5T 2Y1, (416) 593-4040.

13-15 **Electro/80 Show and Convention,** Boston, sponsored by Electronic Conventions, Inc. Contact: Robert Myers, Electro, 999 North Sepulveda Blvd., El Segundo, Calif. 90245, (213) 475-4571.

13-15 **"Ideas in Science and Electronics" Show,** Albuquerque, N.M., sponsored by The New Mexico Electronics Representatives Association (NMERA). Contact: Renee Stein, Show Coordinator, ISE, 6201 Copper N.E., Albuquerque, N.M. 87108, (505) 266-5202.

13-16 **MUG '80, Mumps Users Group Meeting,** San Diego, Calif., sponsored by The Mitre Corp. Contact: Dr. Jack Bowie, MUG '80 Program Chairman, The Mitre Corp., Mail Stop No. 641, 1820 Dolley Madison Blvd., McLean, Va. 22102.

21-22 **Clemson Small Computer Conference and Exhibit,** Clemson, S.C., sponsored by Clemson University. Contact: J.K. Johnson, Continuing Engineering Education or W.J. Barnett, Conference Chairman, Electrical and Computer Engineering Department, Clemson University, Clemson, S.C. 29631. (803) 656-3308.

JUNE

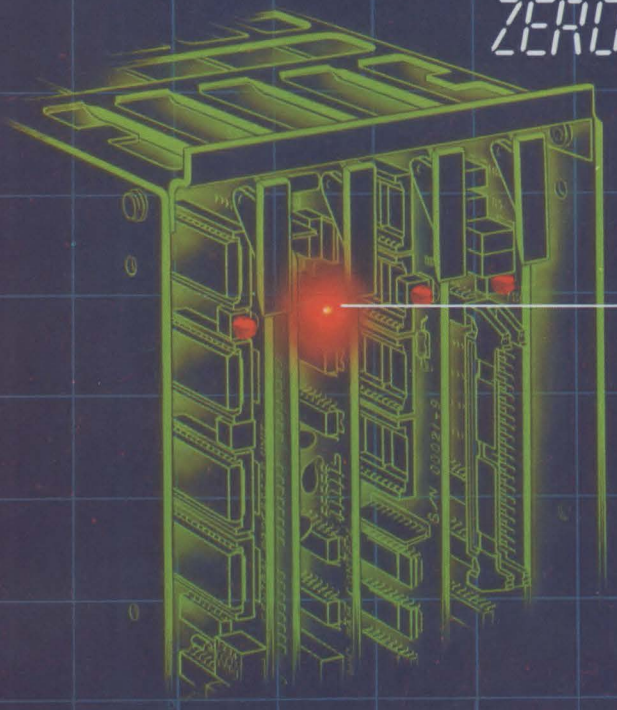
17-19 **IMM/DATACOMM '80 Exposition,** Geneva, Switzerland. Contact: Industrial & Scientific Conference Management, Inc., 222 West Adams St., Chicago, Ill. 60606, (312) 263-4866.

18-19 **National Estimating Society Second Annual Conference,** Anaheim, Calif. Contact: Noel Hargrove, Conference Chairman, P.O. Box 5009, Westlake Village, Calif., (212) 889-2211, ext. 2868.

JULY

14-18 **SIGGRAPH '80, Seventh Annual Conference on Computer Graphics and Interactive Techniques,** Seattle, Wash., sponsored by The Association for Computing Machinery Special Interest Group on Computer Graphics. Contact: Harvey Kriloff or Bob Ellis, Conference Co-Chairmen, SIGGRAPH '80, P.O. Box 88203, Seattle, Wash. 98188, (206) 453-0599.

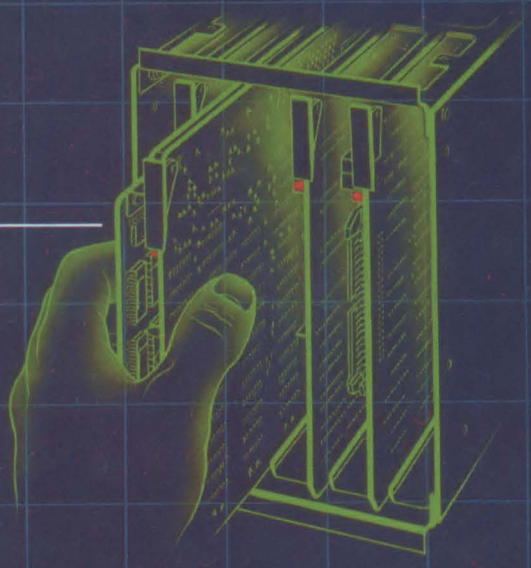
SCOUT™ MINICOMPUTER WITH ISOLITE™ INSTANT SELF-TEST FOR VIRTUALLY ZERO DOWNTIME.

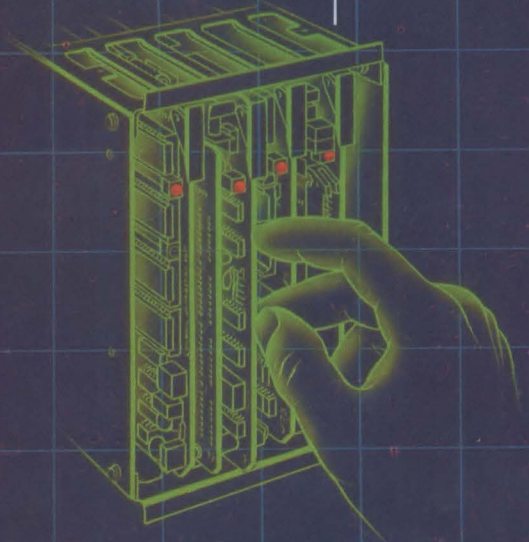


ISOLITE CIRCUIT AUTOMATICALLY TESTS EACH BOARD IN SCOUT SYSTEM.

RED LIGHT SHOWS BOARD BEING TESTED. IF LIGHT GOES OFF, BOARD IS GOOD. IF LIGHT STAYS ON, BOARD IS BAD.

USER REPLACES BAD BOARD WITH SPARE 6.25" X 8.3" CARD IN 3 MINUTES. NO TECHNICAL PERSON OR OEM SERVICE ENGINEER REQUIRED TO MAKE REPLACEMENT. MAINTENANCE COSTS DRASTICALLY REDUCED.





SAVE MONEY WITH SCOUT. GET 16-BIT CPU WITH 32K BYTE RAM, I/O AND CARD CAGE FOR $985 LIST PRICE (VOLUME PURCHASE DISCOUNTS APPLY). CALL OR WRITE FOR MORE INFORMATION.

ComputerAutomation NAKED MINI® Division

WHERE OEM'S COME FIRST.

18651 VON KARMAN, IRVINE, CA 92713, PHONE (714) 833-8830, EXT. 455.

SCOUT AND ISOLITE ARE TRADEMARKS OF COMPUTER AUTOMATION, INC.

CIRCLE NO. 16 ON INQUIRY CARD

The new VISUAL 200 terminal has the features of competitive terminals and will code-for-code emulate them as well. A flick of a switch on the rear panel programs the VISUAL 200 for compatibility with a Hazeltine 1500, ADDS 520, Lear Siegler ADM-3A or DEC VT-52. This allows you to standardize on the new, reliable VISUAL 200 for virtually all of your TTY compatible video terminal applications, with no change in the software you've written for the older, less powerful terminals. And you're not limited to mere emulation; you can outperform them at the same time by taking advantage of the additional features and human engineering of the VISUAL 200, such as:

- Detachable Solid State Keyboard
- Smooth Scroll
- Tilt Screen (10° to 15°)
- Large 7 x 9 Dot Matrix Characters
- Others in the Feature Comparison Chart

For a pleasant surprise on prices, call or write us today.

FEATURE COMPARISON CHART

FEATURE	Visual 200	Hazeltine 1500	Hazeltine 1420	Lear Siegler ADM-3A	Digital VT-52	ADDS 520	ADDS Regent 20	ADDS Regent 40
24 x 80 Screen Format	STD	STD	STD	STD	STD	STD	STD	STD
7 x 9 Dot Matrix	STD	STD	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Background/Foreground	STD	STD	STD	**NO**	**NO**	**NO**	**NO**	STD
Insert/Delete Line	STD	STD	**NO**	**NO**	**NO**	**NO**	**NO**	STD
Insert/Delete Character	STD	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Clear End Line/Field/Page	STD	STD	**NO**	**NO**	STD	**NO**	**NO**	**NO**
Blink	STD	**NO**	STD	**NO**	**NO**	**NO**	**NO**	STD
Security Mode	STD	**NO**	STD	**NO**	**NO**	**NO**	**NO**	STD
Columnar and Field Tab	STD	**NO**	STD	**NO**	**NO**	**NO**	**NO**	STD
Line Drawing	STD	**NO**	**NO**	**NO**	STD	**NO**	**NO**	STD
Upper/Lower Case	STD	STD	STD	**OPT**	STD	**NO**	STD	STD
Numeric Pad	STD	STD	STD	**OPT**	STD	**NO**	**NO**	STD
Composite Video	STD	**NO**	**NO**	**NO**	**NO**	STD	**NO**	**NO**
Current Loop	STD	STD	**NO**	**OPT**	**OPT**	STD	STD	STD
Serial Copy Port	STD	STD	**OPT**	STD	**OPT**	**NO**	STD	STD
Hold Screen	STD	**NO**	**NO**	**NO**	STD	**NO**	**NO**	**NO**
Detachable Keyboard	STD	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Solid State Keyboard	STD	**NO**	**NO**	**NO**	**NO**	**NO**	STD	STD
Typamatic Keys	STD	STD	STD	**NO**	**NO**	**NO**	STD	STD
Cursor Addressing	STD	STD	STD	STD	STD	STD	STD	STD
Read Cursor Address	STD	STD	STD	**NO**	**NO**	**NO**	**NO**	STD
Cursor Control Keys	STD	**NO**	STD	**NO**	STD	**NO**	**NO**	STD
Secondary Channel	STD	**NO**	**NO**	STD	**NO**	STD	**NO**	**NO**
Self Test	STD	**NO**	STD	**NO**	**NO**	**NO**	**NO**	STD
Baud Rate to 19,200	STD	STD	**NO**	STD	**NO**	**NO**	**NO**	**NO**
Smooth Scroll	STD	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Microprocessor	STD	STD	STD	**NO**	STD	**NO**	STD	STD
Tilt Screen	STD	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Switchable Emulations	STD	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

The new VISUAL 200 obsoletes competitive terminals without obsoleting the software.

VISUAL See for yourself

Visual Technology Incorporated
Railroad Avenue, Dundee Park, Andover, MA 01810

CIRCLE NO. 17 ON INQUIRY CARD

Color it Dunn.

Communicate with Color Hard Copy from the 631 System

Exciting computer images, digitally processed or original graphics, should not be confined to your color terminal. Their communication value is wasted. That's why Dunn Instruments invented versatile, affordable photographic hard copy. Made by the 631 Color Camera System.

For over a year now, 631 Systems have been at work in applications ranging from remote sensing to animation, from business presentation graphics to NASA's Saturn mission.

Media versatility Instant 8x10 prints on Polaroid® Type 808 film, overhead transparencies, 35mm slides and animated 16mm film – all are within the capabilities of a single system. Their incredible resolution, chromatic vividness and accuracy will astonish you. So, too, will the speed, ease and assurance with which you produce them, thanks to microprocessor-automated camera operation and exposure control.

Multi-imaging power Recording images side by side aids in comparative analysis and presentation planning. It also reduces film cost. Our software-based format selection means the freedom to tailor the

configuration of images to your needs. It's a Dunn Instruments exclusive.

Interfacing ease The 631 System interfaces with ease to every kind of computer system and color terminal. It is sold complete, and installed worldwide by an experienced sales and service force.

Call 415/957-1600 and we'll put you in touch with your nearest Dunn Instruments representative. Or write us at 544 Second Street, P.O. Box 77172, San Francisco, CA 94107.

THE 631 COLOR CAMERA SYSTEM

DUNN INSTRUMENTS

"Polaroid" is a registered trademark of Polaroid Corporation

Outside the U.S., the 631 System is distributed by CalComp International.

CIRCLE NO. 18 ON INQUIRY CARD

Little Impact.

Meet the IMPs. A pair of stylish 3½ inch high impact printers that will look great on any desk.

Styled for desk top use, these sleek units stand just 3½ inches high, yet the unique fan-cooled printing system can knock out 80, 96 or 132 columns of crisp hardcopy with continuous throughput of one line per second.

A winning pair. IMP-1, with friction feed, can make multi-copies on plain 8½ inch wide paper, or on teletype rolls. In addition, IMP-2 has tractor feed and full forms control, with tractors adjustable from 1 inch to 9½ inches.

Interfaces abound. All IMPs have Centronics parallel and RS232C/20mA serial inputs as standard equipment. But if you need something different, then we make interfaces for just about any system — high speed serial, Apple, Pet, TRS-80, IEEE 488...

Versatile, too. 96 ASCII character set is standard. And you can select 6 character sizes, even graphics, under software control. Options include 2K buffering and special character sets.

Service — a big difference. No other printer manufacturer offers Axiom's combination of low cost and nation-wide service and distribution — in the USA and eighteen overseas countries.

Pssst — the price!!! It's low. $695 for IMP-1. $795 for IMP-2. And that's the single unit price.

Better phone, write or mail the bingo card today!

AXIOM
AXIOM CORPORATION

5932 San Fernando Road, Glendale, CA 91202
Tel: (213) 245-9244 • TWX: 910-497-2283

CIRCLE NO. 19 ON INQUIRY CARD

Breakpoints

IBM'S PANTHER GETS READY TO POUNCE

IBM Corp.'s Office System 6, introduced with much fanfare several years ago, turned out to be something of a paper tiger. Now it's rumored that the industry giant is about to spring a different cat from its product menagerie. According to various industry sources, an OS/6 successor, code-named Panther, is being readied for June introduction at IBM's office products division in Franklin Lakes, N.J. While details are still sketchy, Panther apparently will be a stand-alone word-processing system like OS/6, with a CRT display, two floppy-disk drives and a printer. But it will incorporate some major enhancements, sources say, including a larger screen (possibly a full-page display) and a more powerful text editor. More importantly, the sources report, Panther will be significantly less expensive than OS/6, selling for less than $10,000 with the printer. Although intended to operate alone, Panther reportedly will be able to tie into the 5280 Office Administrative System — a multistation word-processing system recently introduced by IBM's General Systems Division in Atlanta. First deliveries of Panther are more than a year off, according to one industry source. When asked to comment, an IBM spokesman declined to discuss the rumored announcement.

PRIME FOUNDER LAUNCHES NEW VENTURE

How do you nurture a new company's growth to become public, raise $6 million in equity and achieve multimilion-dollar revenues within three years? That's the conundrum facing William Poduska, a founder and former engineering vice president at Prime Computer, Inc., who's now struck out on his own with a new venture — Apollo Computer, Inc., Burlington, Mass. Since leaving Prime in late December, Poduska has already managed to line up more than $1.5 million in seed capital, including an infusion from three prominent venture capital firms — Sutter-Hill, Venrock and Hellman Gal. Incorporated in early February, the new firm has nine employees and is expected to grow to 20 by mid-May. Joining Poduska as founders are two other former Prime employees — Michael Greata and David Nelson, who served respectively as directors of advanced systems development and research at Prime. Apollo's initial product, Poduska says, will be a local distributed network system supporting intersystem communication speeds in the megabyte-per-second range. The system will also include X.25 protocol support for remote communications via public networks. Slated for third or fourth quarter introduction, the system will sell for about $20,000 to end users, Poduska says.

MEGATEK PLOTS MOVE INTO GRAPHICS SOFTWARE

Watch for graphics hardware manufacturer Megatek Corp. to make its first foray into the graphics software business later this month. As its initial product entry, the San Diego-based firm plans to market an enhanced version of the U.S. Army's GCS graphics software — a machine- and peripheral-independent package that runs on any computer with a word length of 24 bits or more. According to a Megatek spokesman, the Army package is available to commercial users for a nominal fee, but comes without maintenance or support. "We've cleaned the package up, added enhancements and will support our version with a training program and hot line," the spokesman says. In addition, a company official claims that the Megatek version will be the first commercially available package to be compatible with SIGGRAPH-CORE — a graphics software standard developed by the Association for Computing Machinery's special-interest group on computer graphics.

TANDON MEDITATES A 2M-BYTE MINIFLOPPY

In addition to moving into the Winchester fixed-disk-drive market (MMS, March, p. 28), Tandon Magnetics Corp. plans to expand its line of 5¼-in. double-sided floppy-disk drives. Due this quarter is a 96-track-per-inch 1M-byte drive with a $325 OEM price. Next on the list, says Sirjang Lal Tandon, president and founder of the Chatsworth, Calif., hardware house, is a quad-density 2M-byte device that will operate at more than 10,000 bits per inch using MFM recording techniques. The new drive may appear in evaluation quantities by year-end, says Tandon, adding that the only thing keeping the $375 device off the market is inadequate media supplies.

Breakpoints

TI RUMORED TO BE DEVELOPING SMALL COMPUTER/WORD PROCESSOR

Look for Texas Instruments Inc., to become an even larger force in the small systems market. Rumored for introduction early next year is a combined small business computer and word processor equipped with Winchester-disk drives tied to tape-cartridge backup. According to a number of reports, TI has already talked to a number of companies about evaluation versions of 8-in. hardware, including Memorex, Micropolis and Priam. Such a move may signal an end to the semiconductor giant's intensive efforts to develop small rotating memories in-house. Despite TI's interest in outside suppliers, the company apparently does not intend to get out of the disk drive business. TI is reportedly talking to media suppliers as well, leading several observers to speculate that any contract with a primary drive source could include an in-house second-sourcing agreement.

Although TI's intentions have yet to be determined regarding disk drives, its plans for backup in the unnamed system seem more firm. A number of sources report that TI has signed a high-volume contract with San Diego-based Data Electronics, Inc. (DEI), for 17M-byte tape cartridge drives. First shipments of the backup hardware are reportedly scheduled to begin by year-end. Neither the disk drive makers nor DEI would comment on negotiations with TI, nor would a spokesman at TI's Computer Systems division in Austin, Texas, discuss the system.

PRODUCTION PROBLEM STALLS HIGH-FLYING CENTRONICS

A seemingly insignificant component problem in one of its printers has caused Centronics Data Computer Corp. to report its first no-growth quarter and has precipitated an earlier-than-planned reorganization of the company along product lines. According to Robert Howard, Centronics president and board chairman, a microprocessor "runaway" problem triggered by static electricity forced the Hudson, N.H., firm to halt production of its model 730 mini-printer for six weeks starting in mid-January. As a result, Howard says, Centronics was unable to deliver $4 million to $5 million worth of the $795 matrix printer during the third quarter, and revenues remained about the same as second-quarter results ($32.7 million). Howard attributes the runaway problem to a packaging design flaw, which made the 730's custom microprocessor susceptible to static electricity. Howard declines to identify the chip's supplier nor will he say what legal action, if any, Centronics contemplates. Centronics does not plan to recall the thousands of mini-printers that have been shipped with the faulty chip, because Howard says the failure probability is statistically small (1.7 percent). Instead, printers in which the problem shows up will be replaced under Centronics' normal warranty policy.

In a related development, Ken Estey, Centronics vice president of field service, has been named to the newly created post of vice president and general manager, mini-printer product line, which includes the troubled model 730 and the recently introduced model 737 draft quality printer. The appointment is the first step in the planned reorganization.

IMI OFFICIALS DENY ACQUISITION RUMOR

Reports that 8-in. Winchester pioneer International Memories, Inc. (IMI), is entertaining acquisition offers because of problems in funding its 20M-byte 7720 disk drive are not true, according to company officials. They concede that while the drive is behind schedule, the delay has been caused mainly by shortages. "We haven't talked to anyone about an acquisition," stresses one executive at the Cupertino, Calif., hardware house. "Nor have we talked to any outsiders about financing."

Meanwhile, evaluation 7720s are starting to trickle out, as production quantities of the firm's older 7710 11M-byte Winchester hit 500 units per month. Also in the wind are some new drives. Due next quarter is a three-platter 45M-byte Winchester designated the 7740. According to one report, the new drive will operate at double the track density of the 7720, and may incorporate glass-bonded heads — with cores embedded in the substrate — instead of conventional ferrite heads. The new drive will fit into the same package as the earlier 7710 and will use the same interface. IMI plans to double bit densities again next year to achieve an 85M-byte drive to be dubbed the 7780.

Imagine...

from mind to matter. With Megatek.

Imagine a computer-aided graphics system that interfaces directly to the mind's eye, that takes a designer's visual perception of his design and does everything but weld it together.

Manufacturing and Consulting Services, Inc. has done it with their AD-2000 software package... CAD/CAM software that does it all—from design to fully annotated drawings to complete numerical control tapes. It can even calculate and assemble a bill of materials for an entire project.

The visual interface that enables the designer to communicate directly with the computer is a Megatek vector refresh terminal. Dr. Patrick Hanratty, MCS president, tells why.

"Megatek's refresh display is an extremely powerful tool for visualizing, manipulating, experimenting and altering design parameters.

"Megatek systems interface easily to a broad range of computers and enhance the engineer's feeling of direct interaction with his design."

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

"Customers for our software package can select any graphics terminal they want. A large percentage choose Megatek. Price/performance is the reason why. If I were going to put down dollars for a production refresh terminal, I'd put my money on Megatek."

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

MEGATEK/WHIZZARD

COMPUTER GRAPHIC SYSTEMS

CIRCLE NO. 20 ON INQUIRY CARD

Data Warehouse. When Floppies aren't enough. But you can't live without them.

There comes a time when your system outgrows flexible disk drives.

You need more storage capacity and higher throughput. But you don't want to give up the input/output convenience of floppies.

The Remex Data Warehouse storage system just solved this dilemma. It gives your system 20MB Winchester capacity, reliability and speed. Plus, it gives you the flexibility of floppies.

And Remex put it all together in one self-contained package under the common command of an advanced controller/formatter.

THE BRAINS BEHIND THE DATA WAREHOUSE.

The most complex and time-consuming task in building your own disk subsystem is designing the controller. We've done it for you.

Our very intelligent, microprocessor-based controller gets you to market quickly, with "capabilities previously associated only with large disk-oriented systems," to quote *Computer Design* magazine.

In fact, our built-in controller is so powerful that it increases throughput by *40% or more* over existing systems.

Normally about half of I/O overhead is between CPU and disk. We've cut these communications to a bare minimum with techniques such as DMA (direct memory access) of commands and status, as well as data.

PACKET POWER SUPER-CHARGES YOUR SYSTEM.

Whenever data is transferred to or from the disk, the controller retrieves packets containing all command data via DMA. The starting memory address of these packets is stored in the programmed I/O portion of the CPU. And that's all the CPU needs to instruct the controller to retrieve data, perform functions, transfer data and communicate status of that function to the CPU. When the function is complete, the controller returns the starting memory address of the packet to the CPU.

With DMA, multiple sector transfers of up to 64K words are accomplished with a single command.

The Data Warehouse also copies "off-line" so that updated or newly-created files can be safely stored outside the system.

Simply, the Data Warehouse distributes intelligence to the disk and frees your CPU for computing.

AVAILABLE NOW. SO YOU DON'T HAVE TO LIVE WITHOUT IT.

The Data Warehouse is packaged for 19" rack mounting and includes its own power supply. For increased value-added applications, it can be purchased in various "unbundled" configurations.

Best of all, Data Warehouse is available today in OEM quantities complete with a variety of interfaces for most popular mini and microcomputers. Write Remex Division, Ex-Cell-O Corporation, 1733 E. Alton Ave., P.O. Box C19533, Irvine, CA 92713. Or call (714) 957-0039.

Ex-Cell-O Corporation

REMEX DIVISION

DATA WAREHOUSE

CIRCLE NO. 21 ON INQUIRY CARD

NEWS

BRINGING ELECTRONIC MAIL TO THE CORPORATE OFFICE

Apparently feeling the first tinglings of market pressure, office automation equipment manufacturers have begun to introduce electronic mail systems that enable users to send correspondence via computer terminals. Wang Laboratories, Inc., was first on the market last June with its Mailway system, followed by IBM Corp. with the 5520 Office Administrative System and by Datapoint Corp. with its Integrated Electronic Office system (MMS, January, 1980, p. 26).

Now two more companies have jumped into this emerging market—newly formed Axxa Corp. and Interactive Systems Corp., a Santa Monica, Calif., system software house. Both firms recently announced multifunction systems that automate routine office functions—word processing, interoffice mail, conferencing, simple computations and data base inquiry. Both companies have also targeted the same market—large banks, brokerage houses, law firms, financial institutions and Fortune 100 corporations.

But the two companies approach the market differently. Axxa Corp., a spin-off of Citibank, the nation's second-largest bank, is selling a turnkey system that comes ready-to-use with integrated software and hardware. Interactive Systems, on the other hand, offers software only—at least for the present (see accompanying story, "Another corporate communications system").

Axxa's System 90 Electronic Office was originally developed for Citibank by Lexar Business Communications, Inc., a wholly owned Citibank subsidiary. After deciding to go commercial with the system last year, Lexar created Axxa to market the system. That move was dictated by banking regulations, which forbid a bank or its subsidiaries from offering commercial products. Axxa, however, retains close ties with Citibank, which has installed 15 Systems 90s. Citibank has a substantial (but minority) interest in the Los Angeles-based firm and is its principal lending institution. Also, three top officials of Axxa are former bank employees.

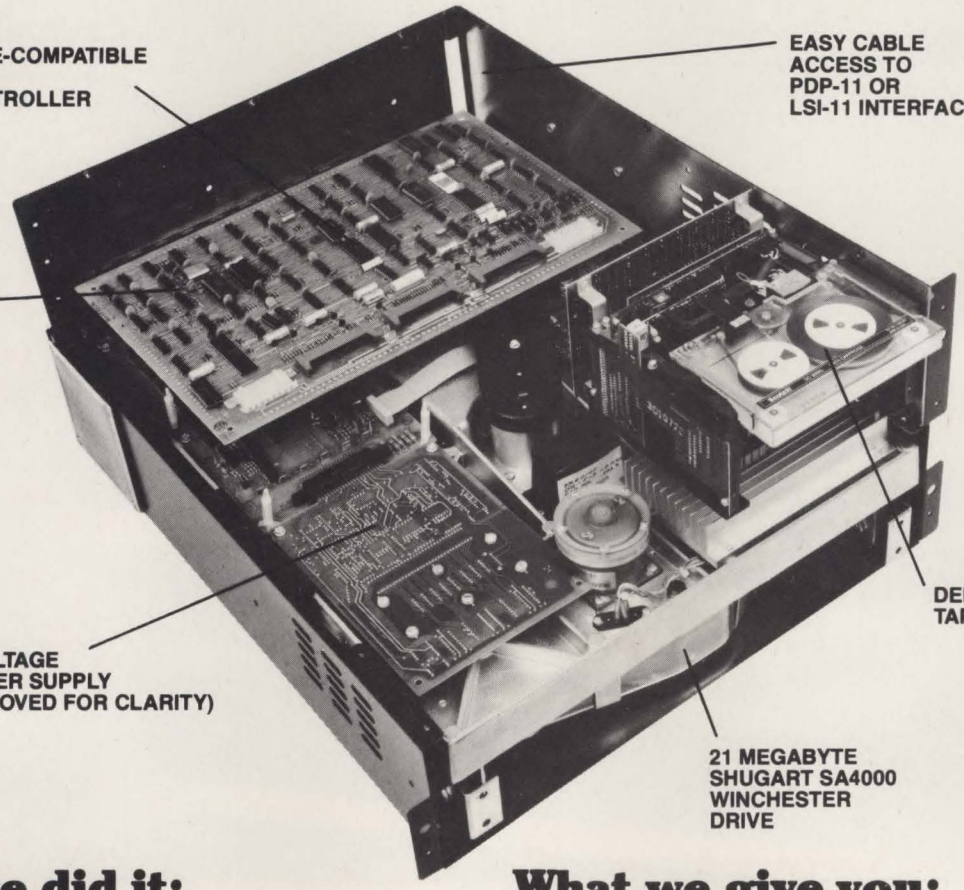
The Axxa System 90, *a turnkey electronic mail system, comes ready-to-use with integrated software and hardware.*

In line with Axxa's turnkey approach, the System 90 is designed to fit smoothly into existing office work patterns. "We don't want to disrupt the traditional relationship between executives and their secretaries," says Axxa president David W. Willoughby, who was president of Lexar before the Axxa spin-off. He was formerly a vice president in charge of corporate services at Citicorp, Citibank's parent company.

To this end, the System 90 supports two work stations, one for an executive and another for his secretary. The Intel 8085 microprocessor-based system also includes two 512K-byte floppy disks, a daisy-wheel printer and communications interfaces. The system comes with a BASIC compiler and applications software to do word processing, calendar management, electronic filing and other office functions.

But the System 90's real strength lies in its communications facilities, Willoughby maintains. For example, the system's electronic mail facility automatically determines message recipients' addresses, batches messages for regularly scheduled pickup or overnight delivery and verifies that messages have been received. In addition, the system has an asynchronous communications interface that enables a manager to access public data bases, such as the New York Times' Information Bank and Dunn & Bradstreet's stock quotation service.

The inside story of our DEC-11® Winchester disk system with fail-safe cartridge tape back-up.



Why we did it:

The HD-11 Winchester Disk system is CRDS's fail-safe solution to data loss should the sealed disk ever be unrecoverable.

We've combined the industry-standard Shugart SA4000 Winchester Drive with an optional DEI cartridge tape back-up module. CRDS disk/tape controller, interface cards and all related hardware complete the package. Of course, the HD-11 is RL01 instruction set compatible, and is equally at home in a PDP-11 or LSI-11 based system.

So now you can have an ultra-reliable storage system for the most popular CPU's available, in a familiar software environment, all at a cost many times less than DEC peripherals!

We did it because we knew you needed a system like HD-11. Send for details today. Once you compare prices and check the specs, you'll be glad we did.

What we give you:

In a single, complete 10½" rack-mountable enclosure, you get the equivalent capacity of four RL01's. HD-11 disk-only system single-quantity price is $6,500; backup tape option is $2,200. Plus you get:

- 21 megabyte formatted disk storage
- RL01 instruction set compatible
- 15 MB cartridge tape backup option
- ECC data protect on both disk and tape
- Q-bus and Unibus compatible
- Four write-protect switches
- High-technology controller prevents latency while using bandwidth more efficiently
- 2-way peripheral for most cost-effective, reliable approach to storage applications

®Registered trademark of Digital Equipment Corporation

Charles River Data Systems, Inc.

CRDS

4 Tech Circle, Natick, MA 01760 Tel. (617) 655-1800 TWX (710) 386-0523

CIRCLE NO. 22 ON INQUIRY CARD

DYNAGRAPHIC™

DYNAGRAPHIC terminals put the power of MOLEX at a chemist's fingertips.

MOLECULAR DESIGN LTD., Hayward, California, has developed a unique system which helps chemists design new compounds.

Called MOLEX (the molecular executive), it is the first interactive search and retrieval system for chemists, and the first to exploit the advantages of computer graphics.

Molecular Design chose DYNAGRAPHIC so they could rapidly implement their system. Fully supported by a FORTRAN Host Library, Terminal Firmware which supports the user, and a convenient RS232 Host/Terminal interface, the IMLAC terminals were easily integrated into their system. Equally important, these intelligent terminals support all of the interactive features of MOLEX.

Users can easily access and interact with a large, proprietary database using keyboard and light pen. They work more productively because they use their own language, the chemical structure diagram. Structures can be entered in rough form, and the system displays smoothed, symmetrical versions. Geometric relationships between compound elements may be viewed to help predict the compound's behavior in a living system.

Dynamic changes to any part of the display are quickly made using DYNAGRAPHIC's Selective Erase feature. Time-saving graphical templates can be stored locally in the terminal's memory for easy recall.

DYNAGRAPHIC is the interactive tool which brings users and systems like MOLEX together. Productively. Economically. That's why it should be part of *your* CAD system. Call or write for complete details.

IMLAC Corporation, 150 A Street, Needham, Massachusetts 02194. Telephone (617) 449-4600.

IMLAC
A Hazeltine Company

CIRCLE NO. 23 ON INQUIRY CARD

ANOTHER CORPORATE COMMUNICATIONS SYSTEM

While Axxa's System 90 supports interoffice mail, Interactive Systems' corporate communications software package takes the electronic mail concept a step further: supporting communications between companies. This is made possible by an interface that enables users to tie into the worldwide TWX message network.

Besides the TWX interface, the Interactive Systems software includes four other packages: an interactive text editor, word processing, electronic mail and an X.25 communications protocol handler. Also included in the package is Interactive Systems' IS-1 operating system—an enhanced version of Bell Laboratories' UNIX system that runs on large DEC minicomputers. The software package sells for $50,000 to $75,000, according to Peter Weiner, founder and president of the $7 million-a-year company.

Although Interactive Systems would like to market turnkey systems based on its software and will offer to configure systems for customers, it has been having trouble getting hardware from DEC. "Because of DEC's backlog, we have been put in the position of selling software only," says Weiner, who comes from an academic background. He founded Yale University's computer sciences department and later headed The Rand Corp.'s information sciences department.

Weiner founded Interactive Systems in 1977 to market enhanced UNIX software, primarily for program development and text-processing applications. The company has 60 installations worldwide and has doubled its revenues annually. Weiner says he envisioned entering the office automation market from the beginning: "We saw UNIX as a way to get a start in that market."

Indeed, Weiner claims that the UNIX system with its powerful software development capabilities, gives his firm a unique competitive advantage. "It allows us to develop new features very quickly," he says. For example, he says the company was able to add teleconferencing to its electronic mail package in a month.

Industry observers, however, are skeptical about Interactive Systems' approach. The company already has a showcase customer—Davis, Polk & Wardwell, a New York City law firm that employs 200 lawyers. But Davis, Polk has had to do extensive software development to tailor the system to its own needs. Furthermore, it is still evaluating electronic mail, according to William A. Kaynor, a partner in the firm.

Patti Seybold, publisher of the *Seybold Report on Word Processing,* points out that David, Polk is unusually receptive to new technology for a law firm. An Interactive Systems competitor also claims that most potential customers would prefer a turnkey system. "They are willing to forego a certain amount of capability for a ready-to-use system," he says.

One surprising communications omission does show up, however. The System 90 does not support the IBM 3270 communications protocols. This would prevent many executive users from accessing their own corporate data bases, which typically reside on IBM mainframes. However, 3270 communications support is in the works, according to a company source.

Another potential drawback of the system is its high price. A basic two-terminal system with printer, floppy disks and software sells for about $42,000. That's nearly double the per-terminal cost of a typical word-processing system. "At $42,000 for a two-terminal system, it's only going to work for a small number of Fortune 100 companies," says Patti Seybold, publisher of the *Seybold Report on Word Processing.*

"The System 90 would be very expensive if used only for word processing," concedes Frank Richardson, Axxa sales vice president. But he maintains that its communications features justify the price.

Despite a flurry of recent product introductions, some industry observers question whether the market is ready for electronic mail. "I don't think most companies are going to sprinkle a lot of terminals on their executives' desks," says Seybold. Another industry source points out that Wang has yet to snare a single customer for its Mailway system.

But Terri Meyers, Axxa vice president of product management, insists there is "tremendous interest" in electronic mail on the part of large corporations. "We could sell all the systems we can make to the prototype market alone," she says. **—Paul Kinnucan**

PIGGYBACK MODULES ENHANCE INTEL'S COMPUTER BOARDS

It's hard to please everybody with a standard microcomputer board. Some boards have too few features, others too many, to suit a particular application. But now Intel Corp. has devised a solution to this perennial problem—a series of miniature plug-in modules that ride piggyback on a standard board to add new functions or expand existing ones.

Systems designers will get an initial peek at Intel's new concept this month, when the Santa Clara, Calif., firm unveils the first in a series of products intended to support the concept. The product announcement will include an enhanced version of Intel's iSBC 80/10 single-board computer and three expansion modules, called Multimodules, that plug into the new version.

The new iSBC 80/10B single-board computer is compatible with its predecessor, now labeled the 8010A, and, at $560, carries the same price tag. However, it contains twice as much RAM (4K) and four times as much EPROM (16K) expansion capacity as the earlier version. In addition, it includes a plug and bus-expansion logic to accommodate the new piggyback modules. Those modules include:

- **The iSBX 350 parallel I/O** board. This module enables a designer to add 24 parallel I/O lines to the 48 already contained on the iSBC 80/10B host board.
- **The iSBX 351 serial I/O**

A process-control engineer wants a high-speed, low-cost computer to monitor and control a factory operation. He checks out the Supercomponent™ specs and moves on to the next project. This job's done.

A systems engineer is designing a blood analyzer on a really tight schedule. He needs a digital controller to record, analyze, compare, file and retrieve data. He reviews the Supercomponent technical manual, then moves on. The job's done.

A systems designer wants to control a radar telemetry system. There are special software considerations, and real-time data is needed. (Last year, a design just like it took him six months.) He spends a couple days with Supercomponent specifications and moves on. The job's done

Here come the Supercomponents!

Advanced Micro Devices announces a family of LSI-intensive boards built to save the serious systems designer a whole lot of time and money. Supercomponents are changing the make-or-buy rules. Here's why:

They're absolutely state of the art. They are designed-in like components and they think like VLSI. They save you a ton of interface design time. They're plug-in ready. All are iSBC80* compatible and have a Multibus.* And, of course, we have all the enclosures and power supplies and card cages and back planes and software you need to cut your costs and accelerate your project.

Now for the big reason: Supercomponents are better because the parts are better. They're made from the finest, freshest, most advanced LSI in the business.

You picked a terrific time to be in this business. Supercomponents are here.

The Am95/4005.

Our single-board computer, The Monoboard,™ is very powerful. It has all the features others in its class have, but—over and above—it includes a sophisticated arithmetic processor, four DMA channels and speeds up to 4 megahertz!

The Am95/6110.

Our floppy disk controller has its own built-in intelligence. It has its own Am8085A CPU plus a high-speed buffer and its own PROM-based firmware. A DMA is included. There's much more. You'll have to read the full specs to believe it.

The Am95/1128.

128K bytes of RAM on a board plus parity with its own built-in refresh. The RAM can be dual-ported. Smaller capacities can be achieved by depopulating the board. The Am95/1128 has twice the capacity of its nearest competitor.

These are just a few members of our Supercomponent family. Call or write us for the facts on all of them.

*iSBC and Multibus are trademarks of Intel Corp.

Advanced Micro Devices

901 Thompson Place, Sunnyvale, CA 94086, Telephone: (408) 732-2400

CIRCLE NO. 24 ON INQUIRY CARD

Mini-Micro World

board. With this module, a designer can add a second RS232/449 interface to the 80/10B. The board includes an Intel 8251A USART, a programmable baud-rate generator that supports data rates as high as 64K baud and two programmable 16-bit interval timers that can be cascaded to provide timing intervals from 1.63 μsec. to 7.8 hr.

• **The iSBX 332 floating point math board.** This module enables the host board to perform 32-bit or 64-bit additions, subtractions, multiplications and divisions at high speed. For example, a 32-bit multiplication takes 50 μsec.

According to Gary Sawyer, product manager at Intel's OEM microcomputer systems division in Hillsboro, Ore., the piggyback approach will enable Intel customers to integrate additional functions into their systems in smaller—and less expensive—steps. "Before, our customers had two options: overbuy or roll their own boards," Sawyer says.

Another advantage of the piggyback approach, according to Sawyer, is that the modules do not add any extra load to the Multibus. That's because they interface to the host board through a separate 8-bit I/O bus, called the iSBX expansion bus.

Because piggybacking is new to the microcomputer industry, Sawyer says Intel anticipates concern about the mechanical reliability of the piggyback board connection. To allay such concern, Intel submitted the boards to Viking Laboratories, a Mountain View, Calif., testing house, for vibration testing. The result? "In the shake, rattle and roll test, the boards failed before the iSBX interface," claims Sawyer. Intel plans to publish the test results in June, he says.

Intel's initial product announcements are the first in a projected family of Multimodule boards. The boards will come in two standard sizes—single width (2.5 × 3.7 in.) and double width (2.85 × 7.5 in.).

In addition, Sawyer says that future Intel single-board computers will be fitted with plugs to accommodate the Multimodules, with each board containing as many as three plugs. "Beyond that, it would no longer be incremental expansion," Sawyer says.

To allow customers to build their own Multimodules, Intel plans to sell the male half of the iSBX connector, which was developed to Intel specifications by an independent connector manufacturer. Intel will also publish the specifications for the iSBX expansion bus, Sawyer says.

As a result, he foresees a new second-source industry springing up to market iSBX-compatible boards to Intel customers. "We expect the iSBX bus to become an industry standard, like the Multibus," he says.

At press time, pricing had not yet been set on the initial Multimodules. However, Sawyer says they will be priced between $140 and $500. Both the Multimodules and the new iSBC 80/10B single-board computer are available immediately.

—Paul Kinnucan

TRADE WITH CHINA OFFERS BOTH PROMISE AND PITFALLS

Efforts by vendors of low-cost computing hardware to tap the huge sales potential represented by the Peoples' Republic of China may soon start to pay off on a large scale, claim a number of industry sources.

Although the exact size of small-systems shipments to Mainland users and the dollar volume they represent are not known, some executives are talking about exporting thousands of microcomputer-driven systems to China. Other small-systems suppliers are taking a different view, however, contending that China's EDP act is not in order. Until it is, they say, untold quantities of hardware and man-hours will be expended in a vain effort to satisfy a

OUR MICROCOMPUTER TALKS TO YOUR WORLD.

When you need a powerful processing system that talks to your world... you need a COMMANDER COMPUTER. Four standard RS-232C ports handle serial data to 19,200 baud, allowing you to add low speed peripherals or even communicate with remote devices over a phone line. But if you need higher speed or more flexibility, use COMMANDER's parallel I/O under program control. And, if that's not efficient enough, select the optional DMA port to process parallel data on a cycle-steal basis direct to memory. COMMANDER's optional IEEE/488 controller gives you direct interface to the world of instrumentation and a host of compatible devices readily available. The optional Real Time Interface module gives you individual bit I/O to input status lines and digital sensor signals ...or to output alarms and commands. And you can use up to four independent programmable real time clocks for precise time interval control without wasted processor time. Inquiries for custom features are welcome.

BUT THAT'S NOT ALL...Select the COMMANDER configuration to fit your system need. The models 500 and 900 have an integral CRT and keyboard while the models MX and FX (not pictured) can be married to a simple terminal for operator interface. Add the optional arithmetic unit for high speed fixed point or floating point processing. And, if your application requires graphics, optional memory is added to provide 512x256 video graphics capability.

All COMMANDER models will execute higher level programs in BASIC, FORTRAN or COBOL or machine level programs in MACRO-80 Assembler. Operating programs are executed under CP/M™ FDOS, the new MP/M™ operating system or UCSD Pascal.™

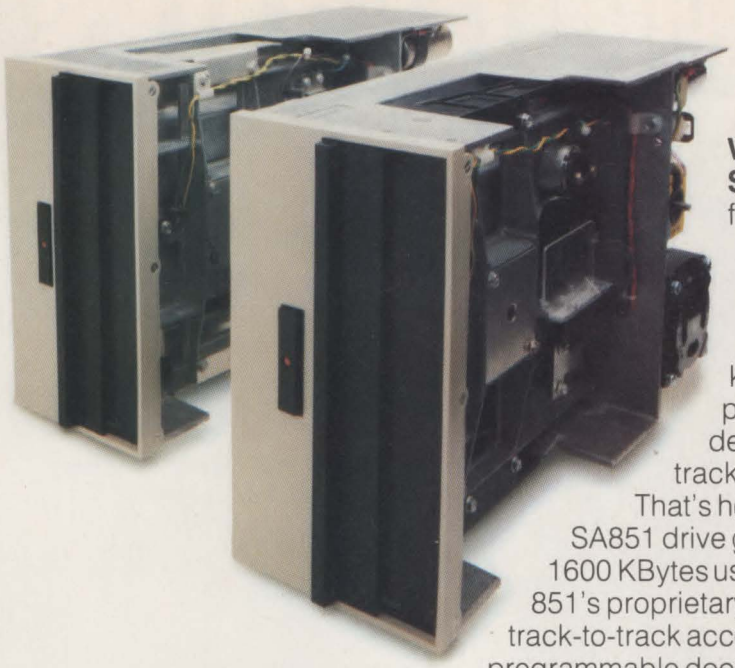
...AND COMMANDER COMPUTERS START FOR LESS THAN $3000 IN QUANTITY 50 TO OEMS. CONTACT COLUMBIA DATA PRODUCTS TODAY FOR MORE DETAILS.

COLUMBIA
DATA PRODUCTS, INC.

Computer Systems Division
9050 Red Branch Rd.
Columbia, Md. 21045
Tel: 301-992-3400 TWX: 710-862-1891

™CP/M and MP/M are trademarks of Digital Research

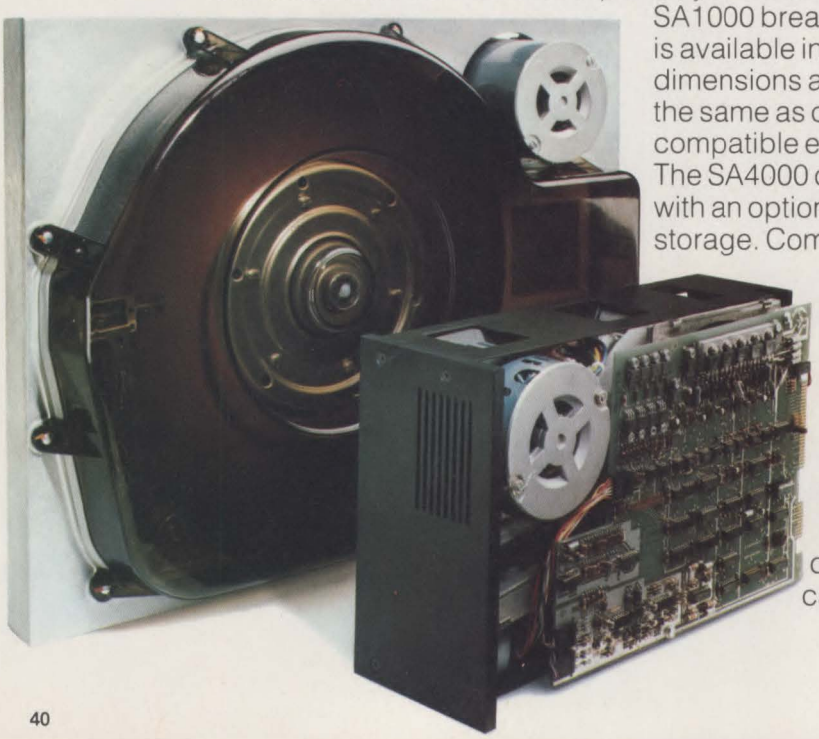
CIRCLE NO. 41 ON INQUIRY CARD



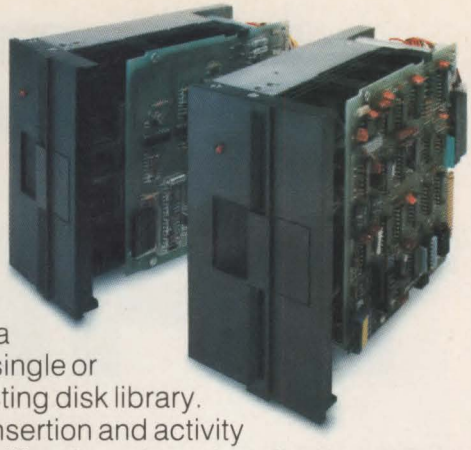
Want 800-1600 KBytes? Choose our SA801/851 series. With the SA801 8-inch floppy, you have a choice of 400 or 800 KBytes in single or double density, on the same drive for the same price. Well over half a million of these standard-setting drives have been specified by OEM's around the world. They know that they can count on Shugart's proprietary read/write head technology to deliver media life of over 3.5 million passes per track, and head life of more than 15,000 hours. That's headstrong performance. And the double-sided SA851 drive gives you even more capacity. It stores 800 to 1600 KBytes using single or double density recording. The 851's proprietary Fasflex™ band actuator improves track-to-track access time to a fast 3 ms. There's also a programmable door lock and write protect. The headstrong SA801/851. Solid performers from the leader in floppy technology.

The head Choose your

Moving up to 5-29 MBytes? Check Shugart's SA1000 and SA4000 fixed disk drives with the lowest cost per MByte in their capacity range. The new 8-inch SA1000 breaks the $1,000 price barrier and is available in 5 and 10 MByte versions. Its dimensions and mounting holes are exactly the same as our floppy drives, and it's more compatible electrically than competitive drives. The SA4000 offers 14.5 and 29 MByte capacity with an optional 144 KBytes of head-per-track storage. Compact and lightweight, it uses only 5¼ inches of panel space and weighs only 35 pounds. All Shugart fixed disk drives use proven Winchester head and media technology to ensure better data integrity and longer life. And system integration is easy because both the SA1000 and SA4000 can share a power supply with your floppy drives. Shugart fixed disk drives. The head of the family in capacity and cost/performance.



™ Trademark of Shugart



Need 220-440 KBytes? The famous Minifloppy™ is the right choice. Choose the original SA400 Minifloppy or the double-sided SA450. You can store up to 218.8 KBytes single-sided and up to 437.5 KBytes double-sided (unformatted, double density). Both are the same compact size and weigh only three pounds. Both are I/O compatible, and use Shugart's own glass bonded ferrite/ceramic read/write heads. The double-sided SA450 uses our new Bi-Compliant™ head assembly for superior compliance and data reliability. Both drives allow you to read and write data on any single or double-sided minidiskette, so you can continue to use your existing disk library. Low heat dissipation, DC drive motor, write protect, positive media insertion and activity light are all standard. Since we invented the Minifloppy, over half a million have been installed in systems like yours—proof that this is the 5¼-inch floppy with the right capacity and the right price/performance. Choose the original. Minifloppy.

strong family. capacity.

Choose the Headstrong Shugart disk drives. No matter which disk drive you select from our family, you get the competitive edge when you go with Shugart. We are Headstrong about helping to keep you competitive too, with high volume deliveries of drives that offer superior reliability, quality, and value. This Shugart commitment is also backed by all the support you need including helpful technical services, in-depth documentation, and design assistance. And when your product line grows, we'll be there with a complete family of floppy, Minifloppy, and fixed disk drives in a full range of capacities. Reliable products, volume delivery, superior quality, and value. That's what we're Headstrong about at Shugart. □

Shugart Associates: 435 Oakmead Parkway, Sunnyvale, CA (408) 733-0100

Sales & Service: Sunnyvale, CA; Costa Mesa, CA; Minneapolis, MN; Richardson, TX; Waltham, MA; Landing, NJ; Atlanta, GA; Toronto, Ontario; Paris, France; Munich, Germany. □ Shugart products are also available off the shelf from local Hamilton/Avnet outlets.

Shugart®
The Headstrong Family

CIRCLE NO. 27 ON INQUIRY CARD

TWO MAJOR VENDORS CLOSE COMPUTER ORDERS WITH CHINA

Large-scale minicomputer vendors are also enthusiastic about the potential of trade with the People's Republic of China. Earlier this year, Hewlett-Packard Co. closed a $1.8-million order with the United Nations Development Program for five H-P 3000 Series III 16-bit superminis. The hardware will be used to assist the Peoples' Republic in establishing an information-processing and training center to support the country's social and economic modernization efforts, notes one H-P spokesman, and will be installed in five sites in Peking this year.

The 3000 Series hardware will be used by government agencies, and state and municipal bureaus. A university will also use the Series III for distribution analyses, hospital management and housing construction studies.

Included in the order, in addition to the 3000 Series III CPUs, are 46 terminals, 20 disk drives, seven line printers, 15 hard-copy terminals and software. Initially, the systems will be supported from the U.S. and Hong Kong and by on-site H-P personnel.

Another company that is enthused about the Chinese market is Perkin-Elmer Data Systems, Inc., which recently signed a $500,000 contract with China for 32-bit minicomputer systems.

"Without a great deal of effort we have popped $2 million worth of business with China," says Graeme Brown, Perkin-Elmer's international marketing manager. "They came to us; we didn't go to them," explains Brown, who adds that he has received several Chinese delegations and has a standing invitation to travel to Peking to meet with trade negotiators.

Brown concedes that support is a problem. "Training software people doesn't come overnight. I think that's why the Chinese do business the way they do. They want long warranty periods and extensive installation support and training programs."

Brown notes that the Chinese drive a hard bargain.

"They really like to nail your foot on the floor," he says. Consequently, Brown is trying to draw up a standard agreement with the Chinese to avoid having to negotiate future contracts individually.

Although Perkin-Elmer's instrument division has a sales office in Peking, Brown has been unsuccessful thus far in getting the Chinese to allow the data systems division to open field offices there. "Their only response to the idea has been a curt smile," says Brown. For the moment, therefore, Brown plans to use the Peking office as a "front door" to China, and to provide support from the data system division's southeast Asia field office in Hong Kong.

Despite the difficulties, Brown remains enthusiastic about selling computers to China. "We see it as a very exciting potential market."

marketplace that essentially does not exist.

But for those who think this market is viable now, small business systems represent a golden opportunity to modernize one of the world's most powerful, yet technologically backward, countries.

"These systems will not be used to open and close garage doors," stresses one observer of American attempts to bring computer hardware to China. "Rather, they will be used to power basic data-processing applications—a capability that simply does not now exist in the Peoples' Republic." The American hardware will also be used for commercial and educational applications, he adds, as well as for agricultural work such as calculating crop yields.

"In essence, they want to come out of the past," says Gerald Lundt, president of the Cuyler Corp. in Elk Grove Village, Ill. Lundt, whose import/export consulting firm is working with Heath/Zenith, has already shipped a number of systems to China based on letters of intent signed with his firm and unspecified Chinese organizations.

But what's more exciting, he says, is the future. According to Lundt, Cuyler and China are firming up a contract that could result in the shipment of thousands of systems per year.

Details of the contract are not

National Council for U.S.-China Trade

Several U.S. vendors *who have signed contracts to supply the People's Republic of China with minicomputer systems are optimistic about the future of trade with China. Here, a Chinese delegation visits the plant of one major U.S. supplier.*

now clear, nor is it clear whether Heath will be the only hardware supplier involved. Barry Watzman, product line manager for computers at the St. Joseph., Mich., hardware house, says his company has no comment on any dealings involving China.

Also uncertain are what the systems configurations will be, how much money is involved and who will be the ultimate end users of the machinery. Lundt notes that hardware support will be handled by Chinese technicians, but he has no comment on the question of software support.

He also reports looking at other offerings, including medium-range systems from Burroughs Corp. and Digital Equipment Corp., the Starplex microcomputer development systems manufactured by National Semiconductor Corp. and small business systems manufactured by Dynabyte, Inc., Menlo Park, Calif. At the moment, however, he says he is not pursuing any arrangements with Burroughs or DEC, and the need for export licenses is temporarily tying up any dealings with National and Dynabyte.

A spokesman for National confirms that the company has talked with Cuyler, but stresses that "at the moment nothing is going on." Dick Smith, director of marketing at Dynabyte, says he is unaware of any discussions involving Cuyler, pointing out that his firm already has an arrangement to export computer hardware to China. "We're moving 40 to 50 systems per month through Hong Kong," he says, noting that all sales are to CM Technology, Palo Alto, Calif., which takes delivery of the Dynabyte hardware. CM also arranges shipment and bears the ultimate responsibility of dealing with Bank of China, the government agency issuing letters of credit needed for the sale.

Also dealing with CM is Cromemco, Inc., Mountain View, Calif. According to sales manager Barry Job, "substantial" numbers of System Two, System Three and Z2H S-100-based computer systems—the latter with 11M-byte, 8-in. Winchester disk drives built by International Memories, Inc.—have been shipped in the past year. Moreover, says Job, "The Chinese plan on buying lots more."

MINIBITS

IDS TO UNVEIL A $1500 LETTER-QUALITY PRINTER

Low-cost printer maker Integral Data Systems, Inc., plans to introduce a $1500 letter-quality printer this month. Intended to bridge a price and performance gap between dot-matrix and daisy-wheel printers, IDS's Paper Tiger Plus printer uses an overlapped dot-matrix printing technique to achieve print quality approaching that of daisy-wheel printers, according to a spokesman for the Natick, Mass., firm. Yet, the IDS printer costs about half as much as daisy-wheel devices, and at 120 cps, is nearly three times as fast, the spokesman claims. Moreover, a variable-density feature allows the unit to print draft documents at more than 200 cps, although with poorer quality. Other features include 80-column lines (132 columns with condensed characters), variable character sizes for program-controlled highlighting and formatting, a nine-wire bidirectional print head and transmission rates from 110 to 9600 cps.

LEXITRON MOVES INTO CLUSTERED SYSTEMS

Kicking off the first of 12 product introductions planned for 1980, word-processing pioneer Lexitron Corp. unveiled its first multistation system, Raytext, at March's NCC Office Automation Show in Atlanta. The new system comprises a 128M-byte central controller, as much as 320M bytes of disk storage capacity (equal to 125,000 text pages) and as many as 10 Lexitron work stations with their own printers and floppy disks. According to Lexitron, Raytext is a "shared resource system," which means work stations can share central peripherals and files, while retaining their ability to operate independently. Although not the first such system on the market, Raytext is the only one available with an IBM 3270 terminal emulator, the Raytheon Corp. subsidiary claims. The emulator package allows Raytext users to communicate interactively with an IBM host computer. A basic Raytext system with four work stations and a 10M-byte disk sells for $63,450. Deliveries are slated to begin this month.

INTEL ANNOUNCES 8086 OPERATING SYSTEM

Intel Corp. this month introduced a real-time operating system, RMX/86, for its model 8086 16-bit microprocessor. While similar to an 8080-based predecessor, RMX/80, the new operating system incorporates some significant enhancements. Perhaps the most important is multiprogramming support; RMX/80 supported only multitasking. Other new features include support for device-independent I/O operations and hierarchical file directories. Written in PLM/86, the new operating system requires about 90K bytes of main memory. License fee is $7500, with a $300 per copy annual royalty. Quantity discounts are available.

A NEW TREND IN TRADE SHOWS?

Those who came to NCC's new Office Automation Show in Atlanta last month expecting throngs crowding aisles and exhibit booths, found an unexpected reprieve. Attendance was about 5500 for the technical sessions and more than 100 exhibits. A random survey of exhibitors shows they were generally pleased with the show's low noise level. A mix of data-processing- and word-processing-oriented companies addressing the office automation market, the show marked the first major meeting of vendors and attendees from these two groups. According to exhibitors, the attendees were well-informed about both word-processing and data-processing systems and were attempting to fit the pieces together. Says one exhibitor: "We're interested in quality. Rather than running 1000 people through with 10 buyers, just send me the 10 buyers. It's a good show, and we will be back next year."

QDMS
IT'S ABOUT TIME!

WE'LL MATCH ITS SPEED AGAINST ANY OTHER DEVELOPMENT TOOL YOU CAN NAME.

QDMS. The **Q** could stand for quick. Real quick. **QDMS** cuts programming time by as much as 95%. It's got a report generator that gives you vital reports fast. Non-technical people can learn the system in no time. And users commonly compress application development from months to days, even hours.

That's only part of the reason Datapro's recent survey showed users rating QDMS over any other PDP-11 data management system.

There's more. **QDMS** has the fastest sort available; it handles huge files; it has powerful access and display facilities; and now we've added even more comprehensive reporting as well as the ability to link up to 5 files.

The Best Part — $8,175. QDMS costs far less than many data management systems that can't do nearly as much, or as well. So get the story. **Quick.**

Call or write Tom Schreier. (203) 728-6777

Quodata®
Specialists in DEC Systems
196 Trumbull Street • Hartford, Ct. 06103
CIRCLE NO. 29 ON INQUIRY CARD

Mini-Micro World

Hardware support for the Cromemco gear will also be handled by Chinese technicians trained by the import/export operators responsible for moving the hardware. Software support, he says, "will be no problem," explaining that all applications programming will be done by the end users themselves.

Although several systems houses share Cromemco's enthusiasm, one vendor, who has talked with Cuyler, feels it has little substance, and has opted to drop out of the running.

"For the moment, sales to China are a dead issue as far as I'm concerned," notes the marketing vice president at one Bay Area small computer house. "The Chinese have expressed verbally a need for 10,000 systems this year, but they appear to be very vague about what they want." He says he knows of only one specific need—to donate two of his systems with software to the Chinese, who would then evaluate it.

This arrangement simply was not appealing, he says. "I have no intention of throwing my computers into a big black hole. If they request a bid from me, that's one thing. But to hand over hardware to them with no guarantee that it will come back is something else again." Even Lundt concedes that the Chinese have been unsure of their requirements. "They want one from column A; one from column B," he says of their previous procurement efforts.

Heath apparently has accepted the idea of donating hardware to the Chinese via Cuyler. But neither Dynabyte nor National has made such arrangements. How the Chinese evaluated the Dynabyte hardware now being shipped via CM Technology is uncertain. And Cromemco's Brian Job says he does not know who evaluated his company's equipment.

Lundt also concedes that exporting computer hardware to China is

Rental Electronics is renting

Desktop computer systems and graphics terminals
from H-P . . . plus data terminals and printers
from just about everyone else . . .
off-the-shelf, right now.

Rental Electronics, Inc.

(800) 227-8409

In California (213) 993-7368 or (415) 968-8845 or (714) 879-0561

GSA Contract # GS-04S-21963 Neg.

CIRCLE NO. 32 ON INQUIRY CARD

GenRad/Futuredata delivers Intel, Zilog, Motorola, Rockwell, RCA...

8086
8085
8080
Z8000
Z80
6809
6802
6801
6800
6502
1802
3870

WE SUPPORT MORE CHIPS

When it comes to developing development systems that support more microprocessors, no one can touch us. Our universal development system doesn't box you in with a single chip or chip family. Our system sets you free to design with any or all of the most popular processors.

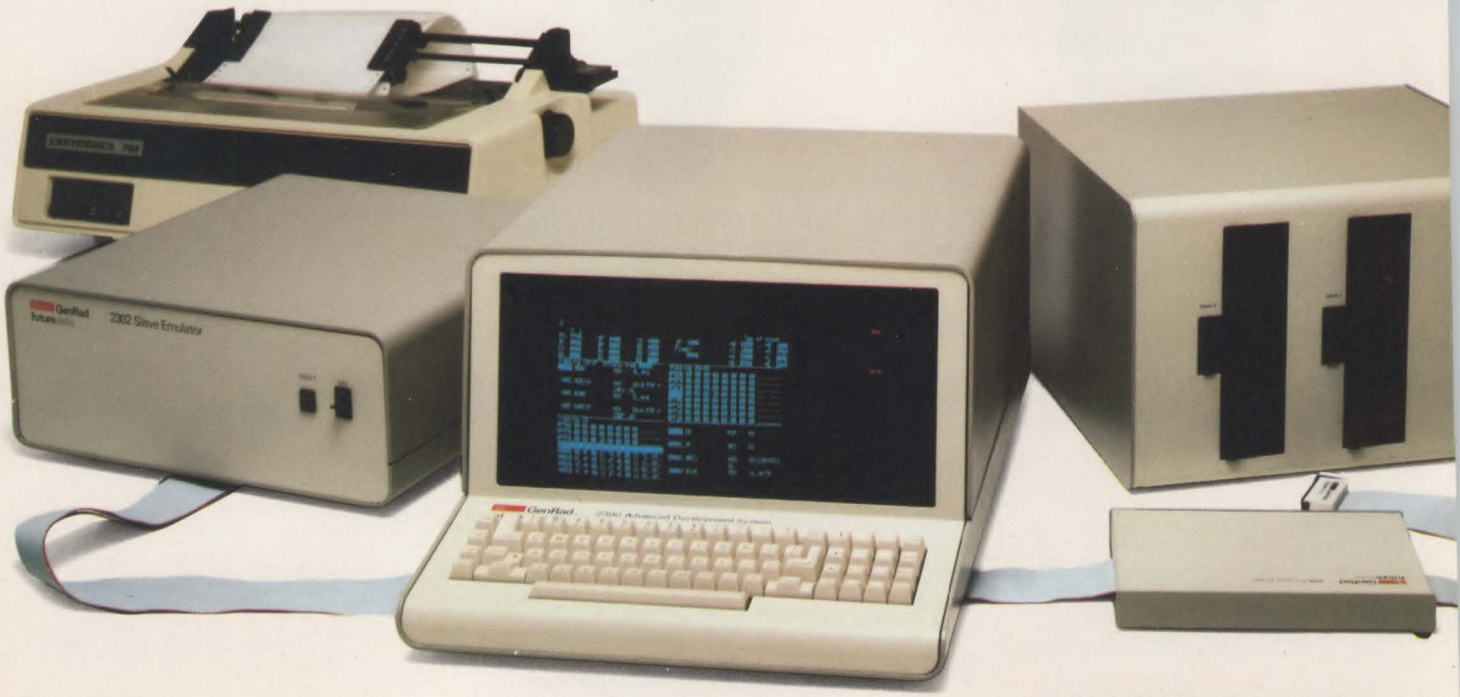
In your smart-product race through the '80's, switching development systems will be the pits. With our system that won't be necessary.

WE ADD NEW CHIP SUPPORT FASTER

Thanks to our unique slave emulation system we can add new chips to your system in a matter of weeks. Remember, we don't make the chips – just the development system. And we don't have to redesign our system for each new chip – we just add another slave emulator. And, that's all you pay for. So, we're faster and more economical, too.

WE SET THE PACE FOR EMULATION

Ours is the only system capable of delivering transparent, non-stop, full-speed emulation



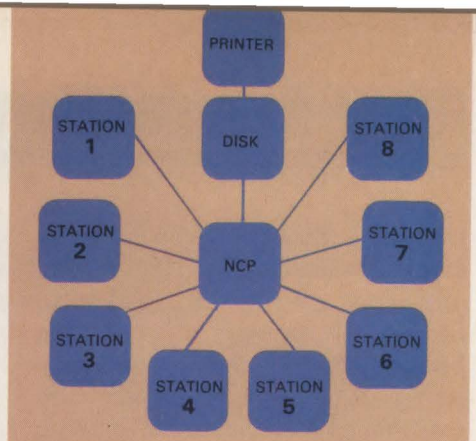
2300 series

advanced development systems

to 10 MHz. And it's the only system capable of emulating many different processors simultaneously.

Transparent, non-stop, full-speed emulation takes all the guesswork out of choosing the right microprocessor for your application. It allows you to evaluate each chip thoroughly, accurately and objectively.

The ability to emulate several different chips simultaneously paves the way to development of smart products using more than one processor.



2300 Series multi-station networks share disk and printer with up to eight stations. Each station is universal and may be ordered with the software and/or hardware capabilities required.

TYPICAL 8086 SNAPSHOT

The 2302 Slave Emulator allows you to view your program in single-step, snapshot or logic analyzer modes. This view can be formatted to match your requirements even for the most complex memory segmentation, interrupt-driven or multi-processor environments.

WE KEEP YOU IN THE FAST LANE

Our system has been designed to make hardware and software development fast, efficient and productive. With our high-speed CRT, high-level language programming and powerful software, things happen fast – sometimes instantaneously. Now available with highly block structured PASCAL compilers, our system can cut your programming time by 50% or more.

WE DELIVER THE MOST COST-EFFECTIVE SOLUTION

Lower initial cost, universality and expandability make our system a prudent, long-term investment. Any of our systems can be upgraded to network status. By sharing costly and under-utilized resources (disks, printers, emulators, analyzers and even software) you can stop paying your designers to stand in line. Networking can lower your cost-per-station by 20% or more.

WE'RE HERE TO STAY

There is no finish in the smart-product race. To stay ahead you're going to need flexible, productive, expandable development systems and a supplier with staying power capable of giving you in-depth, after-sale service and support. Ask for a demonstration of the 2300 Series Advanced Development System. Sales and service offices in major cities.

GenRad futuredata

GenRad/Futuredata
5730 Buckingham Parkway
Culver City, CA 90230
(213) 641-7200. TWX: 910-328-7202.

GenRad/Futuredata universal development systems – expanding your world of microprocessor-based design.

CIRCLE NO. 33 ON INQUIRY CARD

Electro '80 Booths 1208 - 1210 - 1307 - 1309

not easy—there is a technology gap and a credibility gap. "We've had difficulties getting U.S. vendors to believe us," he says. "There have been so many Chinese dog and pony shows over here, suppliers are conditioned to believe that nothing will come of all the talk." For that reason, he stresses, payment for the hardware will come from Cuyler, not China.

Dynabyte's Smith says that's the only way to do business with the Mainland. "I want my money up front," he declares. "The numbers of systems and dollars that are casually tossed around by the Chinese and some of their representatives scare me to death." Dynabyte, he says facetiously, wants to keep its growth rate down to 8 percent a month. "But on the other hand, if they come up with the hard cash, then I'm interested in talking to them."

And that's another problem. China is not overloaded with hard foreign exchange and is burdened with a nonconvertible currency. In short, American computer vendors require payment in American dollars—or some equivalent, universally accepted money. Until recently, says one U.S. banker, any hard currency generated by China has been controlled by a number of "trading companies"—governmental agencies overseeing imports and exports. Now, however, says Mark Tse, an executive with the China Group of The First National Bank of Chicago, universities and municipalities have been given the leeway to deal directly with vendors or purchasing agents, such as Cuyler, for the hardware they need. They use the trading companies simply as import/export agents. This move has streamlined trade procedures somewhat, notes Tse, but the process still can be ponderous.

One prime difficulty facing U.S. vendors, he explains, is payment for goods received. "Typically, the Bank of China will pay when all documentation attesting to the shipment of the goods has been presented at a local bank—in China," he says. "We send those documents over by courier; they send back authorization to us, as corresponding bank to release funds, by first class mail."

Such an arrangement can string out the exporter, he notes, and can be altered only by a specific clause in the sales contract. "For example, we can set up an arrangement for telegraphic transfer if they'll agree to it," he notes. "That can save 10 days." Better yet is a deal whereby the corresponding bank pays the exporter if all the papers are in order. "This type of arrangement is very rare, however," he warns.

Also standing in the way of potential vendors, says one trade observer, is the administrative hurdle of U.S. government licensing and the lack of an adequate distribution network within China. "The question of how large volumes of low-cost hardware are to be moved about has yet to be answered," he cautions.

Another problem: the Chinese aversion to middlemen. "They automatically ask, 'What's his commission?'" the observer explains. "Once they understand who the players are and where things are at, they seek to go direct."

Despite these obstacles, however, the Chinese view micro-driven systems as essential to their program to modernize the country. But that does not mean China is a pot of gold at the end of a rainbow for U.S. vendors. "A lot of problems have yet to be ironed out," he warns. China "is not the place for someone looking to turn a fast dollar."

—John Trifari

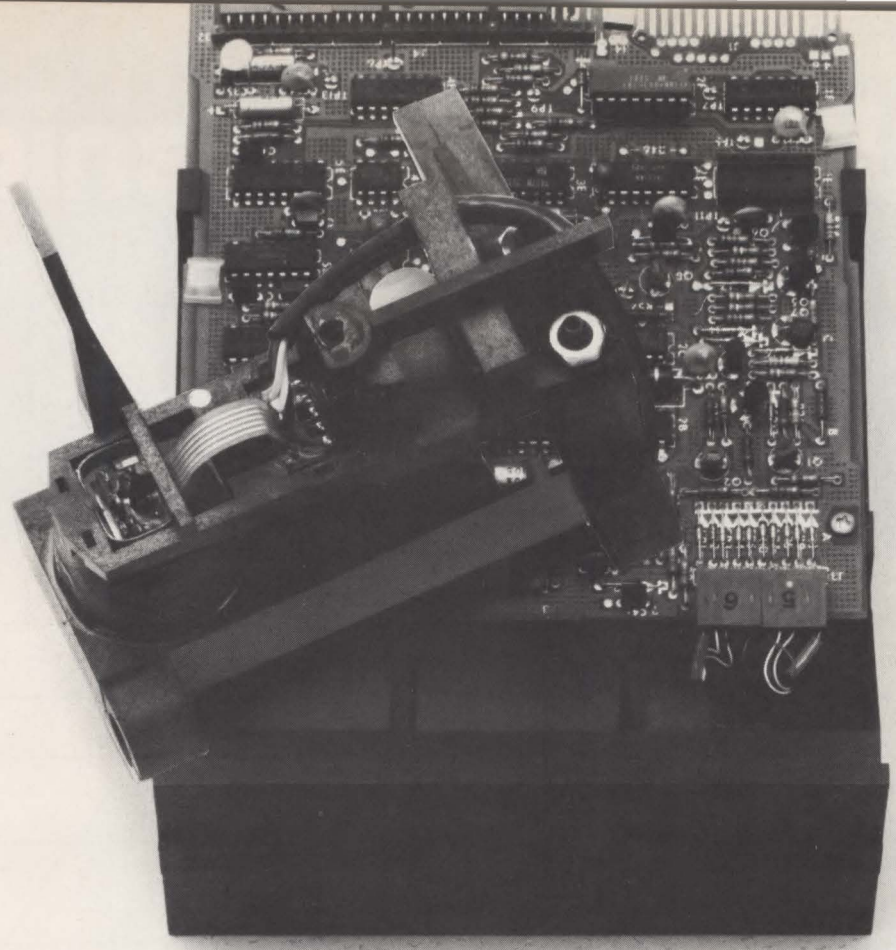
INDEPENDENT PROGRAMMERS TAKE A NEW MARKETING TACK

Independent programmers writing software for personal computers, many of whom are amateurs working out of their basements or garages and selling software through classified ads, are spawning entrepreneurial ventures in marketing that software. Although most independent software developers do not have substantial financial backing to produce and sell a product, there are three main marketing routes open to them: selling on their own, going through a new market outlet—the software publisher—or going to a traditional publisher.

In the software business, *the end product must work. If not, "it can have serious consequences on people's businesses," says John Fall, president of Computer Software Development Co.*

Although an independent writer will see a greater percentage of return by selling his own software, with no middleman dipping into profits, there are many risks in this approach for those with little marketing experience. With the market wide open for small business-oriented personal software, programmers are faced with increasing demands for better software and support.

"Businessmen are more sophisticated than they were in the mid-sixties and want better products," explains Steven A. Epner, president of International Computer Consultants Association, St. Louis, most of whose members are third-party software companies. "The (amateurs) will disappear



Tandon Drives. Heads above the Rest

For years, Tandon Corporation has been designing and manufacturing read/write heads for most major flexible disk drive manufacturers. Their heads are currently in over 1,000,000 field operable units, and deliver a standard of reliability that is positively unmatched.

Tandon now introduces their own mini-floppy disk drive. The TM-100 family consists of four models, and offers the widest range and the highest storage capacities of any 5¼" mini-floppy. What's high? Try 250K to 1000K bytes of storage. With a track-to-track access time of 3 to 5 ms. And a price that is lower than any other comparable unit.

The TM-100 series design is based on Tandon's patented head design and superior head technology. This guarantees 20,000 hours of wear in media contact, and at least 4×10^6 passes per track. Tandon's unique head finish eliminates the need for a head load solenoid. The heads needn't be unloaded even if not reading or writing!

But that's just the beginning, and we'd like to tell you more. So call us at (213) 993-6644. And take the Tandon challenge. Compare our price, performance and reliability. Then you'll discover what 50,000 floppy disk users already know. We're better.

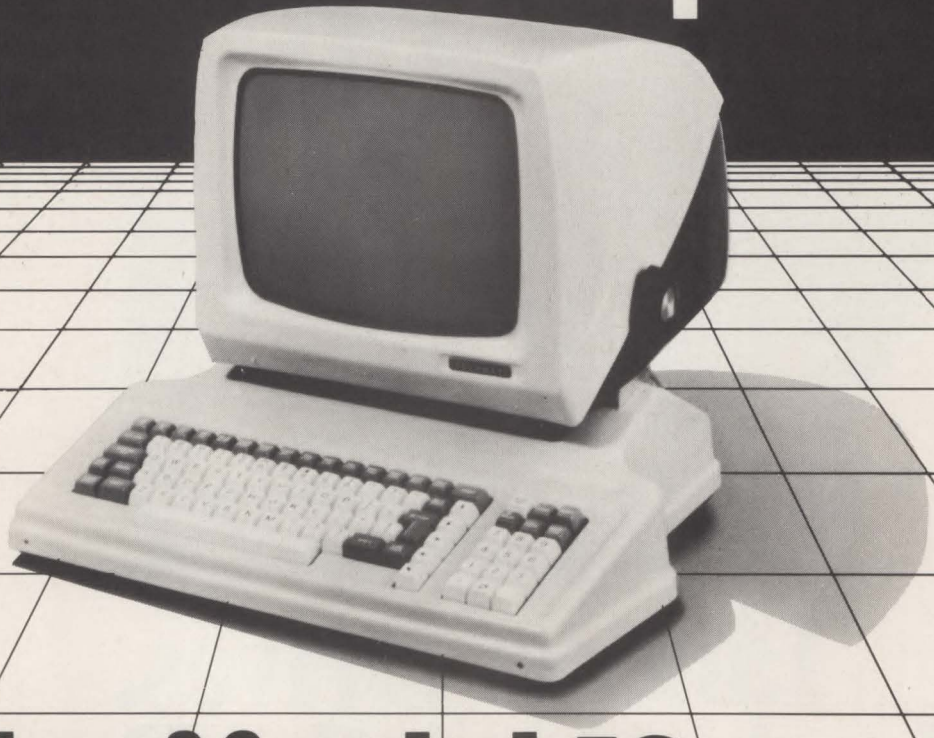
Tandon

9333 Oso Avenue
Chatsworth, California 91311
(213) 993-6644

Heads above the rest in disk technology.

CIRCLE NO. 34 ON INQUIRY CARD

Look What's Happening at Teleray!



the Model 12...

"memory machine"

The Model 12 is affordable and convenient. Virtually every performance feature — editing and text handling, mode selection and display format, data rates and peripheral control — is at your fingertips. Consider these Model 12 highlights:

- 48 lines (two full pages) of scrollable display.
- 7500 character memory for functions (such as forms and control sequences) or additional "working" memory (transferrable to display).
- Choice of styles and colors — molded or metal enclosure, integral or detached keyboard, free-standing or rack mount versions.
- Instant snap-out service — no tools!

Model 12 — a wise and economical choice today, with reliability and expandability for tomorrow. We'd like to tell you more about it. Call your nearest distributor for information.

TELERAY DIVISION OF **RESEARCH INC**

BOX 24064 MINNEAPOLIS, MINNESOTA USA 55424
PHONE (612) 941-3300

For Dealer or Other Information

Teleray response line **800-328-6179**

CIRCLE NO. 35 ON INQUIRY CARD

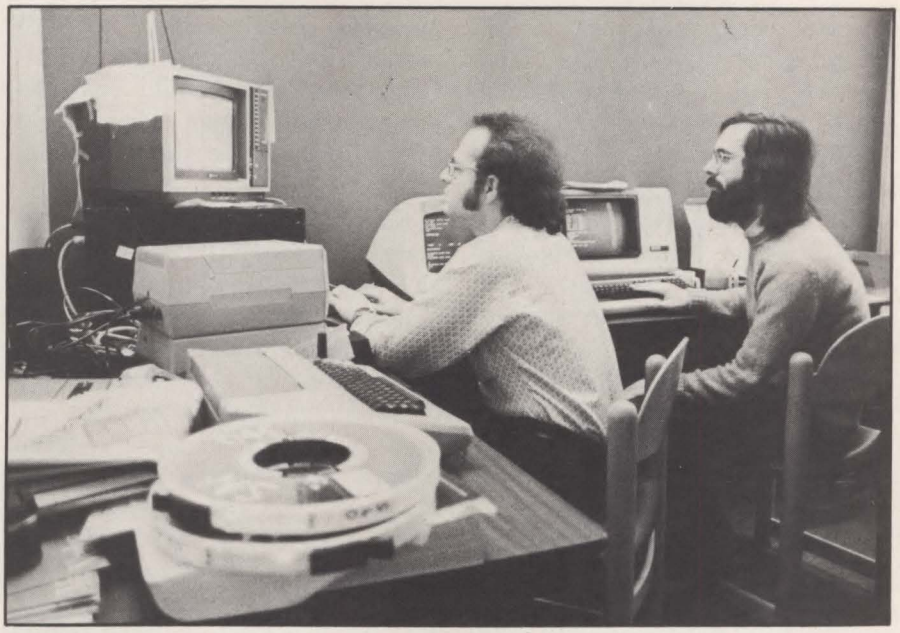
except for writing games." Epner stresses the importance of knowing the more professional marketplace.

John R. Fall, president of Computer Software Development Co., San Diego, a consulting firm for software writers, agrees and explains that in the software business, the end product must work. If it doesn't, "it can have serious consequences on people's businesses," he says.

"Many software developers have a great ability to make software work and can conceptualize the need," he adds, "but do not know the marketplace or how to address it. Sometimes there is a difference between what they think and what the product really does." Both Fall and Epner point out that if an independent writer does sell the software, the first sale is very important and can serve as a reference for future sales.

Although returns can be high once a software writer breaks into the business, one writer warns that it is not a get-rich-quick scheme.

"We took enormous risks for high returns," explains Dan Bricklin, vice president of Software Arts, Inc., Cambridge, Mass., a company that produces independent software. "We had to mortgage ourselves to get into the business. But once you're in, it can be profitable."



Software Arts president *Bob Frankston, left, and vice president Daniel Bricklin turned to a specialized software publishing house for assistance in marketing their independently produced programs.*

Although Bricklin is setting his sights on selling $1 million, or about 8000 to 9000 copies, of his small business-oriented VisiCalc software package for personal computers, he had a long, year-and-a-half road from product conception to positive cash flow. He spent more than $100,000 in software development costs for computer and staff, including six months of almost continual man-hour time using a Prime timesharing computer.

Bricklin admits he could get higher returns if he marketed the software himself, but he chose to turn to a new software marketing alternative, the specialized software publishing house, for assistance. His choice—Personal Computer Software, Inc. (PSI), of Sunnyvale, Calif.

Bricklin points out that PSI offered him the marketing resources he lacked in-house—product credibility that comes from selling through an established software vendor, marketing exper-

PROTECTING MICROCOMPUTER SOFTWARE FROM PIRATES

Protecting software for small computers is more difficult for independent software writers. That's because large system users typically sign agreements preventing piracy and software copying, according to Steven Epner, president of Independent Computer Consultants Association. Epner points out that software can be stolen more easily on the microcomputer level, and it is hard to do anything about it.

A major deterrent to piracy, Epner emphasizes, is ensuring that the software is only a part of the total program involved, with long manuals that are expensive to reproduce. Technical deterrents can also be used. These include such methods as developing software on interdependent ROM chips and diskettes, so that one is undecipherable without the other.

"A good systems person can get around that security," Epner says, adding that writers should seek reputable vendors.

Dan Bricklin, vice president of Software Arts, Inc., agrees about the importance of reputation. He points out the author/publisher relationship is built on trust, with both parties taking risks.

Bricklin's publisher, Daniel Fylstra, president of Personal Software, Inc., indicates that technical measures, such as anticopying in the disk, are the best long-range protection.

Another technique, he explains, is to give pricing motivations for buying rather than stealing software. All PSI software is protected by copyright.

Software writer Dr. Adam Osborne relies heavily on copyrighting to protect his software. Osborne, whose company Osborne and Associates in Berkeley, Calif., was acquired by McGraw-Hill, publishes the source code and documentation in copyrighted books. He prefaces each book by saying that users can modify and sell programs if they buy a documentation book. "People can't steal what is being given to them," he explains.

tise for pricing the product and polishing a product for mass marketing through personal computer stores and stereo outlets.

Bricklin looks back to his first attempts at pricing VisiCalc at $35 a copy—using the rationale of the same price for Texas Instruments' business analyst calculator that performed a similar function—as naive.

After market research with PSI, he noted the product had to be sold for $150 a copy, since it was expensive to support.

Support is a key issue in large-volume software marketing. PSI president Daniel Fylstra, who says his market is the 300,000 to 400,000 Apples, TRS-80s and PETs to be installed by year-end, says maintenance and support must be minimized by increasing education of dealers.

"We must make the software good enough so there are not too many questions, and so we can sell thousands of copies with limited support," he says, adding that, with increased support, prices also increase.

And making that software good enough is Fylstra's specialty. PSI functions much like a traditional publishing house in selecting, improving and selling software. It holds exclusive rights to the software, including versions that are rewritten for several different computers, original versions, improved versions and options on future work. Software Arts and other independent software writers receive royalties of 10 to 30 percent of product wholesale.

Fylstra prides himself on the selectivity PSI uses in obtaining software, and says he has developed a good reputation with dealers due to products like VisiCalc. VisiCalc started a move by PSI away from publishing personal computer games toward software aimed at high-level professionals using computers in desk-top applications.

Two other business-oriented packages recently added to PSI's product line, VisiPlot and TrendCalc, were produced by independent Mitchell Kapor, president of Micro Finance Systems, Wellesley, Mass.

Kapor, who went with PSI after marketing some software himself, says PSI provides him with greater exposure than he could get on his own, offering a national outlet and some international outlets through its reputation and distribution.

Although Kapor sees a trend toward more houses like PSI and Microsoft, he also points to the increasing trend of traditional publishers toward software publishing. They may even acquire some of the "smaller fish" on the market, Kapor says.

But, Fylstra points out, selling in the computer market requires strong sales and demonstration efforts.

"You can't sell a $150 item like a book," he emphasizes. "Most traditional publishers do not have the marketing or product skills required."

Kapor agrees, but he adds that if traditional publishers like McGraw-Hill prove to be good businessmen, they will learn to sell in the software market.

As an example, he points to Radio Shack, which before the introduction of the TRS-80,was not known for selling computers.

"Everyone laughed at Radio Shack, and now they're laughing all the way to the bank."

McGraw-Hill has a feasibility study under way to study the use of home computers and has developed prototype software, as well. Study director Ferd Smilari says he is aware that selling software is different from selling books, and his company must learn to develop and sell software.

According to Smilari, publishing houses will have a major impact in software marketing in the next three to five years, with developed or acquired expertise and extensive marketing networks. He sees initial thrusts in the education market, where personal computers are used in some schools.

"The major publishers will have a major part of the market, since they have a marketing network in place now," he says, pointing to McGraw-Hill's pipeline to schools with educational material.

He explains that some publishers are already turning toward software marketing. Houghton-Mifflin Co., he says, has a technological division with in-house programmers and analysts who work with vendors to develop software.

His own company has acquired Osborne and Associates, which markets software in book form under copyright protection, including source code and documentation.

Smilari does not consider PSI and smaller publishers like Hayden as competition, because they do not have extensive sales networks. But, he adds, companies like Hayden have the advantage of being smaller and being able to move more quickly.

That is an advantage Wayne Green, editor and publisher of *Kilobaud*, is banking on. Green has been publishing software for two years now, selling it through computer stores and internationally, and paying independent writers 20 percent gross sales royalties. He feels that time will be his best ally in pursuing success.

"I'm trying to get as much of a head start as possible," he says, explaining he has a decided advantage over specialists like PSI because he can solicit and promote software to more than 300,000 of his magazine's readers through ads.

One key to his success has been more than $1 million invested in a staff of 50, as well as 60 in-house microcomputers to evaluate and produce good software.

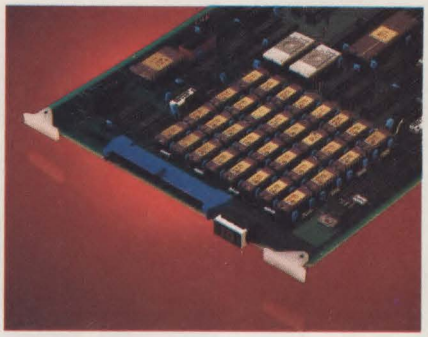
"We want to turn out five programs a day by the end of 1980, and we are now at a one-per-day rate." **—Lori Valigra**

Match with MSC custom memories

...and microcomputers too. Standard off-the-shelf systems may not match up to your special needs. MSC can design and produce a memory system using the best technology, parts, and form factors available to meet your specific operating requirements. Our custom engineering capabilities also extend to microcomputers designed to an industry standard bus.

Multiple Sourcing MSC custom products utilize components from a wide range of industry sources, resulting in less delays in production, replacement, and delivery.

Full Spec Components We use only full specification components, and test stringently to assure reliability and remove defective elements.

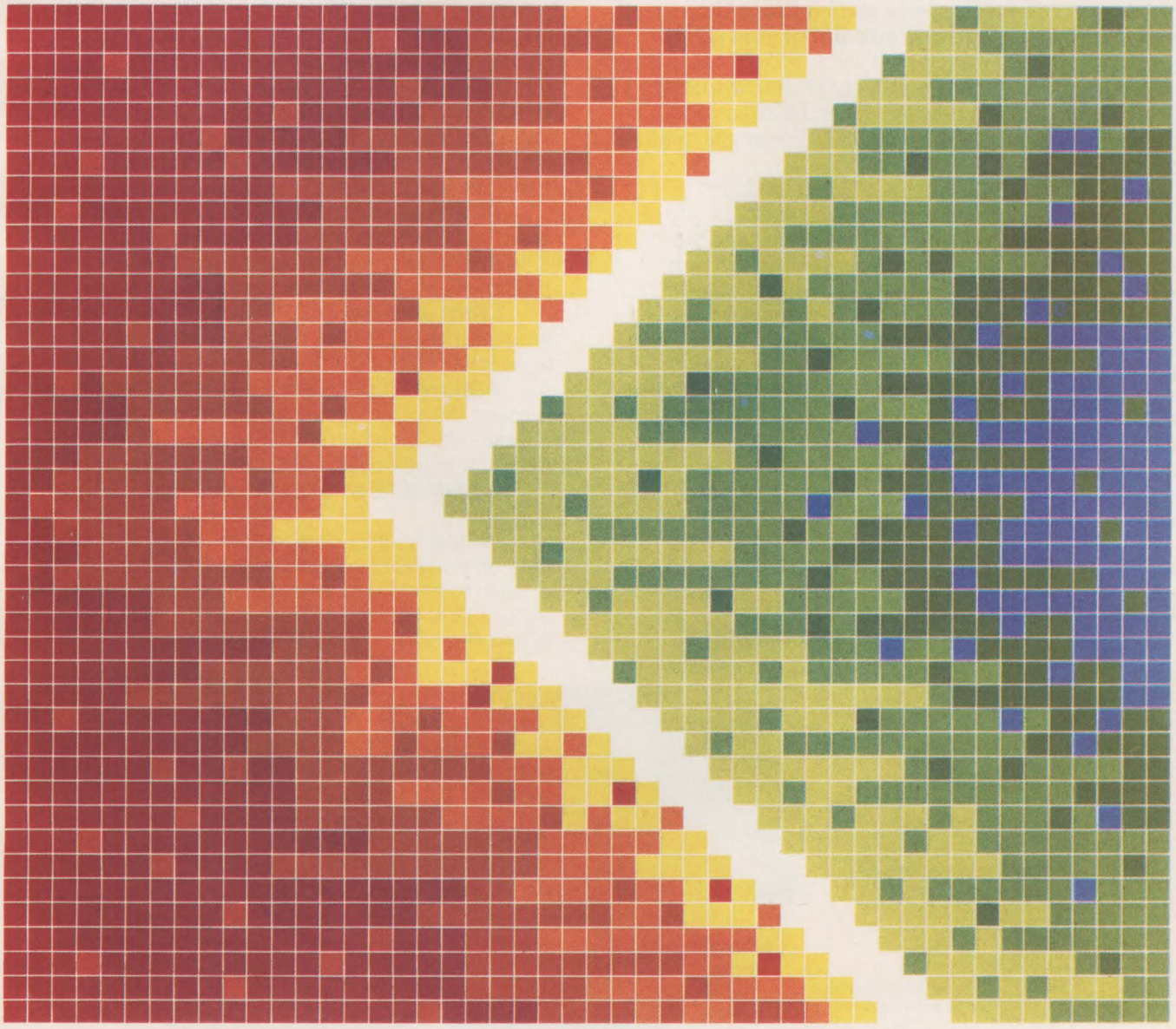


Monolithic Systems corp

Design Time Savings Our custom products relieve you of unnecessary design and engineering time, allowing you to direct your resources toward other important areas.

Cost Savings The security of a fixed-price contract protects against cost overruns, while MSC experience assures best-value component selection. For more information on MSC custom products and other Monolithic Systems Corp. products and systems, please contact us at 14 Inverness Drive East, Englewood, Colorado 80112. (303) 770-7400. Telex: 45-4498.

Extending the limits of information.



MSC Regional Sales Offices: **Eastern Region** 1101-B9 State Road, Princeton, NJ 08540, (609) 921-2240, **Central Region** 7200 East Dry Creek Road, Suite #B203, Englewood, CO 80112, (303) 773-1060, **Western Region** 49 South Baldwin, Suite D, Sierra Madre, CA 91024, (213) 351-8717

CIRCLE NO. 36 ON INQUIRY CARD

DILOG CONTROLS DEC 11*

disc and magnetic tape with single quad board controllers for LSI-11*, 11/2, 11/23, and PDP11*. Each reduces your power, space and interface time . . . they simply plug into one bus slot of your CPU . . . and at a low cost too.

Dilog (Distributed Logic Corp.) is now the **only** firm offering you all these intelligent hard disc and magnetic tape products for your CPU on single quad size boards.

COMMON FEATURES of Dilog products include • single quad size board • no external power or chassis . . . just a cable to connect to the drive—you don't need anything else! The low cost simple designs employ proprietary sophisticated bipolar μPs so you benefit with • increased reliability • automatic self-test including data base protect feature and indicator.

NEW LSI-11 DUAL DENSITY MAGNETIC TAPE COUPLER, Model DQ130 interfaces dual density (NRZI/PE) imbedded formatter tape drives • handles up to eight drives • emulates TM-11* • handles new drive innovations, such as "streamer" mode • RT-11/RSX-11* compatible • 800 CPI NRZI or 1,600 CPI PE formats • speeds 12.5 to 125 ips • transfers data via DMA facility at rates to 200,000 characters per second • buffers data and status transfers between units.

LSI-11 μP TAPE CONTROLLER, MODEL DQ120 emulates the TM-11*/TU10* and interfaces industry standard drives including both 7 and 9 tract NRZI ½-inch tape drives with 7, 8½ or 10½" reels at speeds up to 112.5 ips.

PDP-11 μP TAPE CONTROLLER, Model DU120 emulates TM-11*/TU10* and offers you 30-50% saving when used with industry standard drives.

NEW LSI-11SMD/ WINCHESTER/CMD DISC CONTROLLER, Model DQ200 interfaces any two removable media or Winchester drives with SMD interface • cost savings over 40% and up to 50% savings on power and space • soft sector format offers 20% more disc storage • on-board bootstrap loader provides automatic startup • controls industry standard Winchester, SMD (pack), CMD (cartridge) drives • mix drive types • drive capacities to 300 MB.

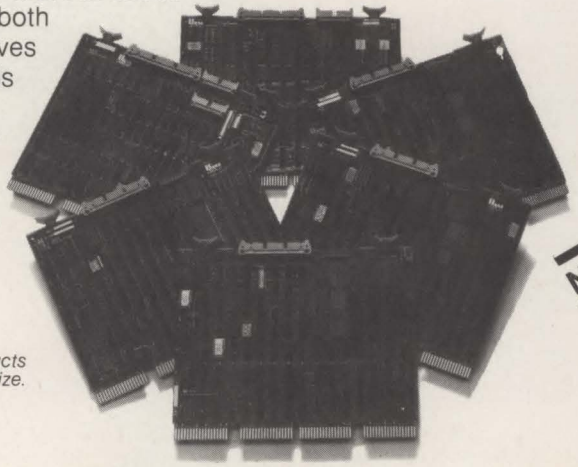
PDP-11 μP DISC CONTROLLER, Model DU100 is an RK-11*/RK05* emulator that supports all 2.5, 5, 10 and 20 MB industry standard cartridge class disc drives • expanded addressability to 40 MB.

LSI-11 μP DISC CONTROLLER, Model DQ100 emulates RKV11*/RK05* and offers the same benefits as DU100.

PRICING for Dilog controllers is competitive or lower than any product you'll find on the market . . . either individually or in OEM qtys. Fast delivery from stock to 30 days A.R.O. and solid warranty.

COMPLETE SYSTEMS including drives also available.

Write or call for detailed product performance data on these 6 Low Power, quad DEC-11 products, or soon to come new products. Distributed Logic Corp. 12800-G Garden Grove Blvd. Garden Grove, CA 92643 Phone (714) 534-8950



All Dilog μP Products are Low Power, Quad Size.

DISTRIBUTED LOGIC CORP.
DILOG

NEW

- LSI-11 Shugart SA4000 Winchester Controller
- PDP-11 Magnetic Tape Coupler
- PDP-11 SMD Controller
- 8" Winchester Controllers

*Trademark DIGITAL EQUIPMENT CORP

NCC ANAHEIM BOOTH 3110

CIRCLE NO. 37 ON INQUIRY CARD

308 DATA ANALYZER

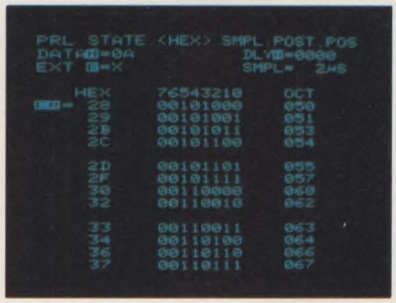
Easily acquire the data you need.

1. Select parallel state, parallel timing, serial, or signature operation. Simply press the appropriate key.

2. Choose synchronous or asynchronous sampling. Use the clock of the system under test or the 308's own internal clock. In either case, sampling rates up to 20 MHz are possible.

3. Enter the word you want to use as a trigger to acquire data. Other keys let you select an external trigger and trigger delay.

4. Press "start" and you're done. Now, you can view the acquired data in the format you want. Or, store the data in the reference memory by pressing the "store" key. Other function keys allow you to acquire new data and compare it with the reference memory.



In each data acquisition mode, all measurement parameters are displayed for your convenience.

Minimum keystroking with the new 308 Data Analyzer from Tektronix.

Of course, the 308 Data Analyzer can do a lot more than we've shown here. For example, there's a self-test routine at power-up, plus seven diagnostics, to ensure accurate results. And the 308 weighs only 8 pounds (3.6 kg), for easy portability.

For the full story, contact your local Tektronix Field Office, or write us.

Tektronix, Inc.
U.S. Marketing
P.O. Box 1700
Beaverton, Oregon
97075
Phone:
(503) 644-0161
Telex: 910-467-8708
Cable: TEKTRONIX

Tektronix
International, Inc.
European Marketing
Centre
Postbox 827
1180 AV Amstelveen
The Netherlands

Tektronix®
COMMITTED TO EXCELLENCE

For immediate action, dial our toll free automatic answering service 1-800-547-1512

CORPORATE & FINANCIAL

FORMATION BRANCHES OUT WITH IBM-COMPATIBLE MINIS

Engineers, like artists, typically derive more satisfaction from creating new products than from producing and marketing them. This may be the reason behind the low-key market approach taken by Formation, Inc., Mt. Laurel, N.J., over the past 10 years.

The relatively unknown, privately held company, now with $20 million in annual sales, was formed in 1970 by four former RCA engineers as a consulting firm to large mainframe users such as ITT, ICL of England and Honeywell. It later branched into developing custom interfaces for RCA and DEC PDP-11 equipment, and then concentrated most of its efforts on former RCA customers, which to date have comprised 80 to 90 percent of its business. Now Formation is aiming to change its RCA-oriented image with the recent introduction of the Formation 4000, a bit/slice processor-based small business minicomputer that can run IBM 370 software, and which is aimed at IBM systems houses and end users. OEM versions are scheduled for delivery in November, and an end-user version will be introduced in the fall. A typical configuration, consisting of a 512K-byte processor, two 70M-byte Winchester disk drives, three CRTs and a printer, will sell for $75,000 to $92,000.

Although the IBM 4300 is a major competitor, the 4000 is not aimed at replacing the 4331, which Formation considers an end-user product, according to Ralph Mele, vice president for marketing business systems. Instead, the 4000 will be targeted at the thousands of systems and software houses selling IBM proprietary software, Mele says, 80 percent of which are not in the hardware business now. The 4000 will offer these vendors a vehicle around which to build systems with minimum cost and change.

The Formation 4000, *a bit/slice processor-based small business minicomputer that can run IBM 370 software, is aimed at the OEM market.*

"The 4000 will allow users to convert from IBM to the minicomputer arena, which normally is expensive and difficult," Mele maintains.

Formation president and founder Arthur Beard says the end-user version, including some application software, will find a home in vertical businesses in the $5-million to $50-million range. "We will pick certain vertical segments and attempt to be a dominant factor therein, with at least 30 percent of the market share," he explains. "But that vertical market will be a small percent of the total small business system market." He says he has prospects for both OEM and end-user versions.

Entering the OEM market is a new venture for Formation and its engineering-oriented managers. Formation's success under Beard surprises one market observer, who says the company's marketing know-how must have been acquired along the way.

Beard, who was chief engineer of the RCA Computer Systems Division from 1962 to 1970, is described by a source close to RCA as an "engineer's engineer, a do-it-yourselfer" who is not as good at managing as at engineering.

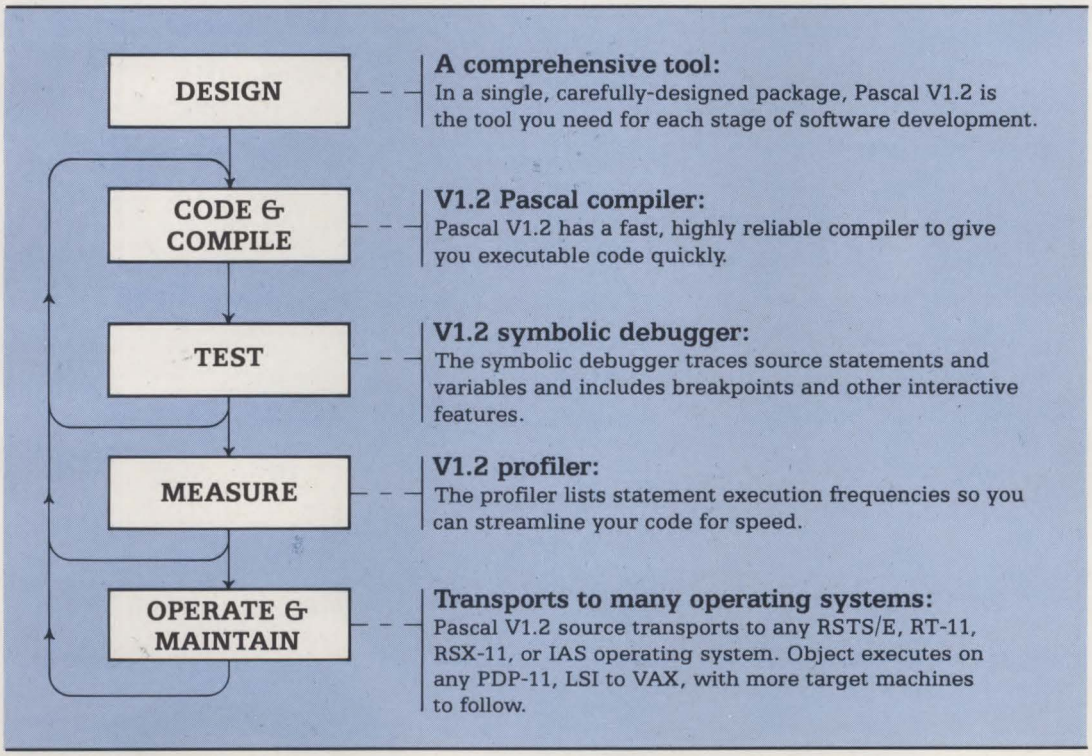
Beard says his decision to leave RCA came at a convenient time in the engineering completion of the Spectra product and in his professional life, since he wanted to start his own company anyway. But the source points to a different reason: Beard's demotion from managing several hundred engineers to being put on special assignment after failing to develop, within three to four years, a credible fourth-generation product to serve as RCA's response to the IBM 370 introduction. Beard denies this, saying there was talk of departmental reorganization, which indicated he might not have the same top responsibilities, but that did not happen until after he left. He adds that RCA offered him other opportunities, but he decided to leave and form his own company.

The source adds that Beard was respected for his technical ability. Four months after leaving RCA, he

The Pascal Software Tool

OMSI PASCAL V1.2™

We at Oregon Software are pleased to announce that V1.2, our improved version of Pascal-1, is now available. The value of Pascal in computer software design is becoming widely recognized, and our V1.2 version contains significant enhancements in ease of operation and reliability.



A comprehensive tool:
In a single, carefully-designed package, Pascal V1.2 is the tool you need for each stage of software development.

V1.2 Pascal compiler:
Pascal V1.2 has a fast, highly reliable compiler to give you executable code quickly.

V1.2 symbolic debugger:
The symbolic debugger traces source statements and variables and includes breakpoints and other interactive features.

V1.2 profiler:
The profiler lists statement execution frequencies so you can streamline your code for speed.

Transports to many operating systems:
Pascal V1.2 source transports to any RSTS/E, RT-11, RSX-11, or IAS operating system. Object executes on any PDP-11, LSI to VAX, with more target machines to follow.

Oregon Software guarantees the performance of Pascal V1.2. We also include in the purchase price our technical support during the first year of operation.

Write or call for more details about Pascal V1.2. Ask to see our user manuals, example programs, and benchmarks.

PDP, RSTS/E, RSX, VAX, and IAS are trademarks of Digital Equipment Corporation.

Oregon Software

2340 S.W. Canyon Road • Portland, Oregon 97201 • (503) 226-7760 • TWX: 910-464-4779

INTERNATIONAL DISTRIBUTORS

Australia: Sydney;
Network Computer Services
390-3677

Canada: Vancouver;
Valley Software
(604) 291-0651

England: Stafford;
Hourds Computing Ltd.
0785-44221

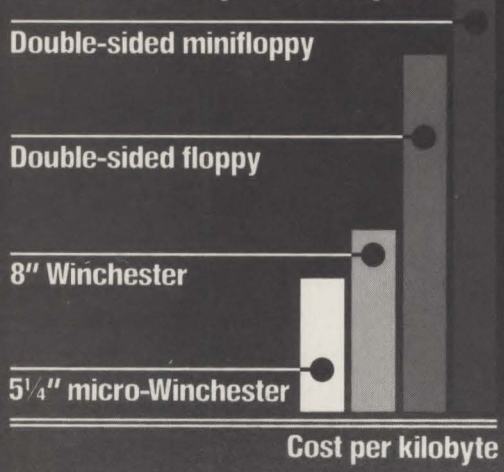
Japan: Tokyo;
Rikei Corporation
03-345-1411

CIRCLE NO. 38 ON INQUIRY CARD

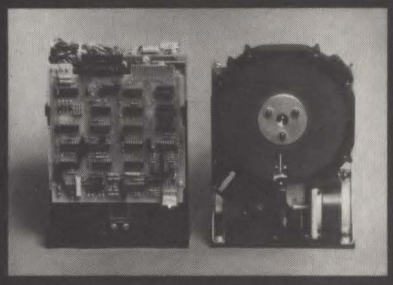
Al Shugart delivers the first 5 1/4-inch micro-Winchester

The developer of the original OEM floppy has done it again. He has packaged the performance, capacity and reliability of Winchester technology in a 5¼-inch drive. Offering 6.38 megabytes of storage capacity (unformatted) in a minifloppy-sized package, the micro-Winchester delivers 15 times the capacity of a double-sided minifloppy at less than three times the cost.

Lowest cost per kilobyte



The perfect marriage– Minifloppy and micro-Winchester



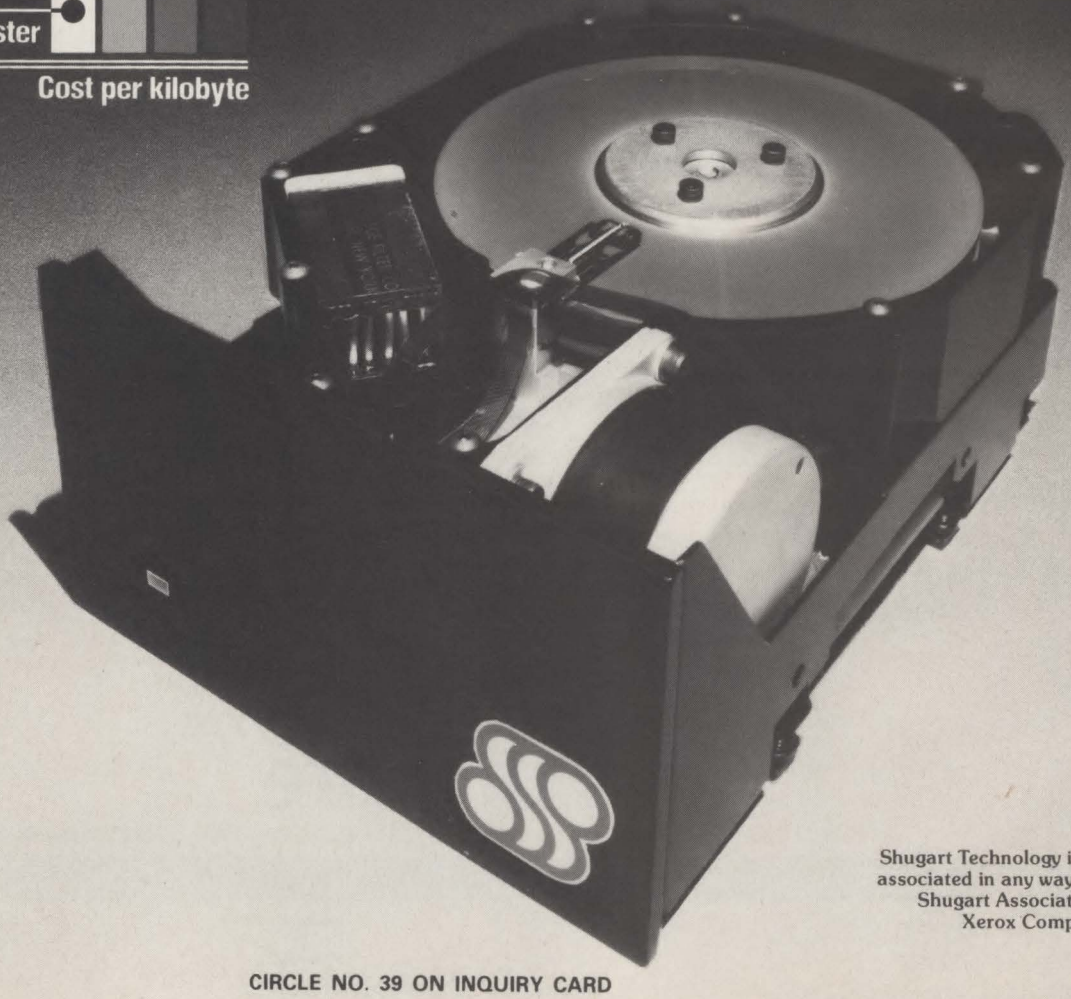
Use micro-Winchester with a minifloppy. Get Winchester's faster access time and data rate. Average access time is 170 milliseconds, almost twice as fast as the minifloppy's 298 milliseconds. Data rate? In one second, the micro-Winchester transfers five megabits compared to the minifloppy's ¼ of a megabit. Save your minifloppy for low-cost backup and system I/O.

It's easy to integrate micro-Winchester with your existing minifloppy-based system. Like the minifloppy, the micro-Winchester has dimensions of 5¾" by 3¼" by 8". It uses the same voltages (+12 and +5) and requires no A.C. power.

The micro-Winchester is real. You can see hard-tooled production models while at NCC. For an invitation and a comprehensive technical brochure, check our readers' service number or call Finis Conner.

Shugart Technology

340 El Pueblo Road,
Scotts Valley,California
95066
(408) 438-6550



Shugart Technology is not associated in any way with Shugart Associates, a Xerox Company.

CIRCLE NO. 39 ON INQUIRY CARD

was joined by three other RCA engineers who became co-founders of Formation.

The company had a few positive boosts before becoming profitable in 1975. The first took place in September, 1971, when RCA's Computer Division went belly-up. That allowed Formation to gain some key RCA technical people, as well as access to RCA's customer base, estimated at that time to have some 550 customers and 1000 computers.

The company also got a financial assist in 1972 and 1973, when three venture capital companies—EN Warburg Pincus and Co., New Court Securities and DSV Associates—infused the company with $2 million in debentures and equity.

But the big turnaround for Formation came in 1975, with a large order from Southern Bell Telephone Co. for the Formation 9903, an RCA 3301 upgrade system. Formation won the contract over Univac and IBM and received an initial order for 12 machines, costing $1 million each, according to Mele. That order stimulated company growth, and it accounts for most revenues to date.

Although this part of Formation's business, which it calls its responsive system business, brought the company $1.1 million in net profits last year alone, Beard realizes that that market will level off and no longer support a 20- to 30-percent a year growth rate. There are no other orders for the 9903, but the company does have back-orders for another 12 to 13 months, with maintenance contracts extending out to five years.

Beard was able to build his company on fourth-generation RCA peripherals, channeling 19 to 22 percent of annual revenues into R & D, and coming up with a product that can run IBM 370 software.

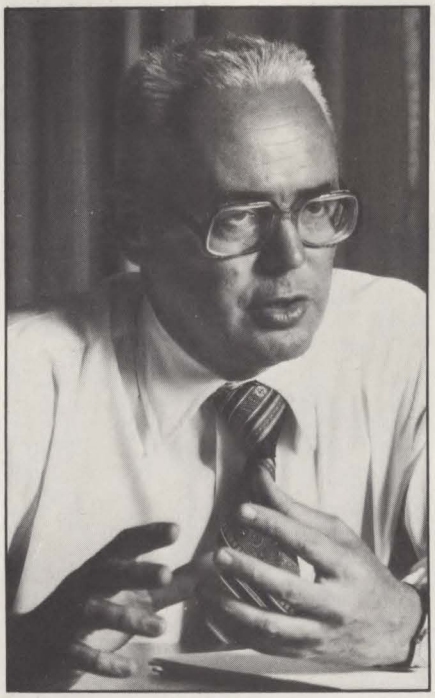
Beard expects to hold his response business steady at $20 million and plans a conservative growth rate for the Formation 4000, with anticipated sales of $20 million to $50 million in four to five years.

But it remains to be seen whether this company, which parlayed its engineering expertise into a $20-million custom business, has the marketing and management skills needed to survive in the fiercely competitive minicomputer market.

—Lori Valigra

HIGHER COSTS FUEL BOOM IN THIRD-PARTY MAINTENANCE

The costs of computer maintenance, like everything else, are constantly rising, and the higher costs are affecting both vendors and users. Many computer vendors are feeling the pinch in drained profits. Data General Corp., for one, reported lower fourth-quarter earnings, due partially to the buildup of its service organization (MMS, March, 1980, p. 84). And users complain that, despite higher prices, the quality of service has deteriorated. They cite slow response time and "green" engineers who don't know the equipment or fail to have the necessary parts.



Sorbus president Keane: *"You have to have service equal to IBM and for less money."*

This situation has opened up new opportunities for independent service vendors, which are trying to offer users an alternative: faster service and 15 to 20 percent lower maintenance costs. These vendors, such as Sorbus, Inc., are also appealing to users with multivendor hardware who are required to hold separate service contracts for each peripheral. These factors will spur third-party maintenance market growth to $380 million by 1982, compared to an expected $250 million this year, say Sorbus market researchers.

Sorbus, based in King of Prussia, Pa., is the leader in the independent maintenance field, with 10,000 customers, 160 offices and a 1200-person field service force. It is one of several operating companies that form Management Assistance Inc. (MAI). Others include Basic Four, Wordstream and Genesis, which manufacture data- and word-processing equipment.

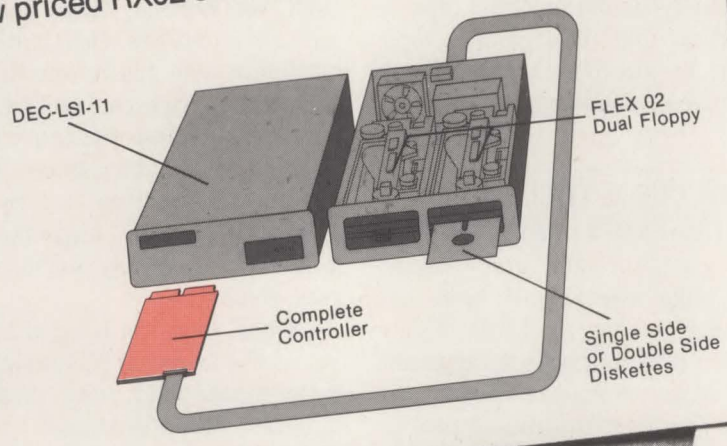
Last year, Sorbus reported $71.4 million in revenues, of which 40 percent was derived from maintaining Basic Four systems and other MAI products. Approximately 42 percent came from servicing IBM equipment—from record-keeping equipment to 370 mainframes. The remaining 18 percent was from servicing the equipment of 60 different vendors, including Ampex, EM&M and Intel add-on memories, Xerox computer systems and Diablo printers and disk drives.

"To service these accounts you have to have service equal to IBM and for less money," says Stephen Keane, Sorbus president. One new way to speed parts to a customer site is by using mobile service vans. The firm recently established repair depots in 12 cities nationwide to help cut the firm's service time on digital printed circuit boards and other computer components. Each depot has a radio-dispatched van that carries replacement parts. "This way if our technician finds that he needs a special part after

FOUR NEW CARDS FOR YOUR DEC...

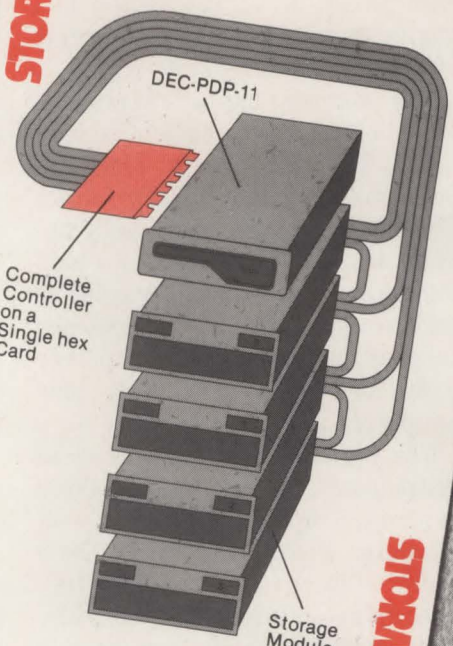
Low priced RX02 emulator

FLEX02



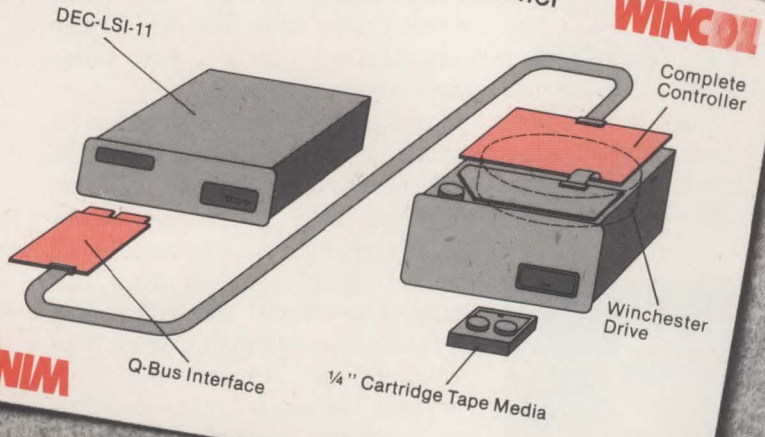
Single card RM02 emulator

STORM02



RL01 compatible Winchester controller

WINC01

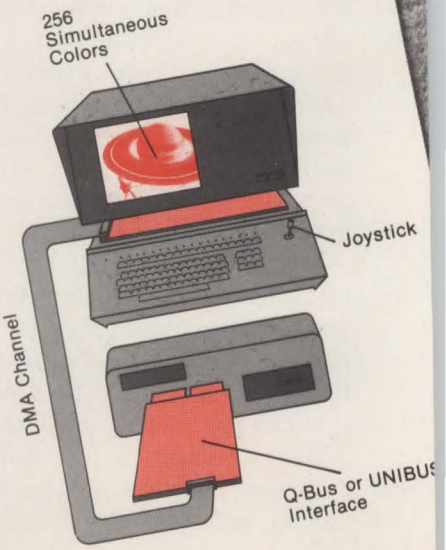


FROM AED

Our three new low-cost emulator controllers provide OEMs with greater flexibility, improved reliability and better thruput for their LSI-11 and PDP-11 based systems. At a price/performance ratio that aces out all the competition! Add to this the AED512, our full-color graphics imaging system, and you'll see why AED has all the cards you need.

Full color imaging system

AED512



Controller features

FLEX 02...complete RX02 emulation on a dual-width card that plugs directly into any LSI-11, media compatibility, uses DEC-provided software, available with DEC look-alike 2-drive cabinet, runs RX02 diagnostics, compatible with Q-Bus® and comes with single or dual-head drives.

WINC 01...controller card mounts directly onto Winchester drive, dual-width interface card plugs into any LSI-11 computer, runs RL01 diagnostics, fixed media reliability, microprocessor based, built-in error correction, compatible with Q-Bus® and comes with 15 MB cartridge tape drive for data transportability.

STORM 02...full RM02 emulation on single hex card for a PDP-11, runs RM02 driver software unaltered, has pack interchangeability with DEC, compatible with Ampex, Ball, Century Data or CDC storage module drives and provides data transfer at 1.209 MBs/sec. @ 3600 rpm.

* Reg. trademark of Digital Equipment Corp.

ADVANCED ELECTRONICS DESIGN, INC.
COMPUTER PERIPHERALS DIVISION
440 Potrero Avenue, Sunnyvale, CA 94086 Phone 408-733-3555, Boston 617-275-6400

CIRCLE NO. 40 ON INQUIRY CARD

responding to a service call, he simply calls for the van to bring him the parts he needs," says Keane. Before, the technician would leave the site to get the required part. The faulty boards are now returned to the company's regional factory depots for repair.

Another way of attracting customers is by lowering their maintenance costs. The company claims it can save IBM users 15 to 20 percent in service costs. Marvin Venable, vice president, claims Sorbus can save a customer as much as $11,800 a year on a typical System 370, model 14J configuration. For smaller systems, it charges $512 a month for maintenance on a System/3 model 10, compared to IBM's $640 fee—a $128 monthly savings.

Keane insists his service is as good as IBM's, noting that he uses IBM components. He also claims that the company's profitable operation results from its dedication to service, unlike computer vendors which have limited budgets for service and hope only to break even.

Keane also maintains that he has few problems attracting—and keeping—skilled technicians. "Each field manager has profit and loss responsibility and has 15 to 25 technicians under him," says Keane. "He works closely with his group, and thus we avoid the high turnover in most companies."

To attract technicians, the company employs a full-time recruiter, who visits technical schools, high schools and college campuses. Beginning technicians average $210 a week and spend eight weeks learning at company headquarters. They then work with engineers under an apprenticeship, learning Sorbus' varied product lines.

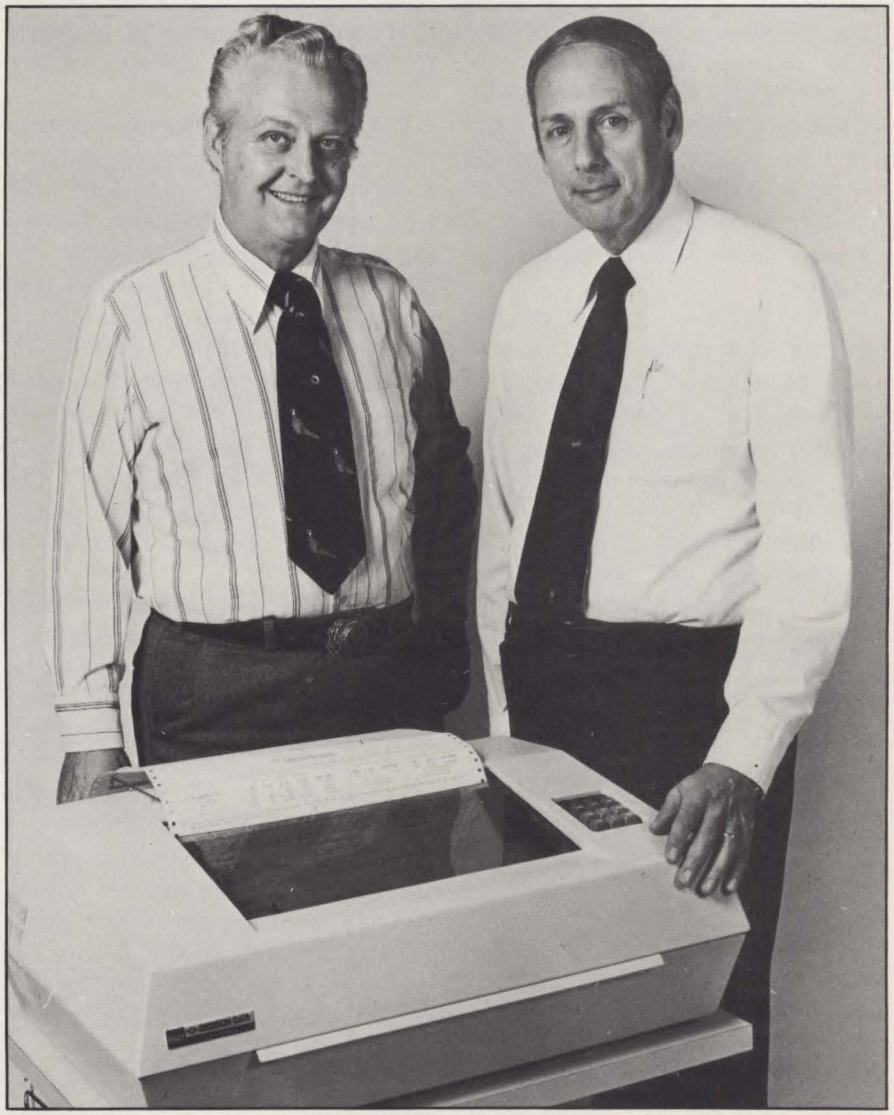
Looking to the future, Keane says he expects Sorbus to grow 15 to 20 percent annually, with a major chunk of business coming from IBM mainframes and plug-compatible systems. Sorbus also has targeted 1500 370 systems in 23 cities for servicing. **—Ronald Rosenberg**

PUNCH CARD MAKER STRIVES TO ENTER PRINTER MARKET

Consider a computer peripherals manufacturer with $40 million in revenue, of which 25 percent is derived from the sale, lease and servicing of card-punch equipment—a very mature product line. The company prides itself on being the only vendor building new (and very profitable) 80-column card peripherals. Yet it also has nearly $14 million in bank debt and recently sold its lease base of 96-column card punch devices to raise cash for that debt. Still, this firm is confident it can compete against Wang Laboratories and IBM in new arenas, notably the non-impact electrophotographic printer market—provided it can line up a major OEM vendor as a partner.

The company is Decision Data Computer Corp. of Horsham, Pa., which has been without a full-time president for nearly two fiscal quarters, since the departure last October of Louis H. Benzing after three years. But Decision Data's problems began long before he took office.

A major supplier of 80- and 96-column card punch peripherals since its inception in 1971, the company grew financially until 1975, when IBM introduced the floppy disk as the replacement for punch cards.



Kenneth R. Whitehouse (left), *vice president of corporate business development, and Richard L. Schwab, vice president of marketing, plan to push Decision Data deeper into printer and terminal markets, starting with this 150-cps printer.*

The new technology prompted Burroughs Corp.—Decision Data's largest 96-column card equipment customer with more than half its punch card revenue and production—to stop buying. Stuck with huge inventories, plus a dearth of orders from smaller customers who postponed buying during the 1975 recession, Decision Data hit rock bottom. It posted an $8.4 million loss on sales of $39.6 million.

The red ink on Decision Data's balance sheet led to the withdrawal of bank credit lines, massive layoffs and the resignation from active management by the four company founders. And stockholder equity plummetted to $4.3 million. (It has since rebounded to more than $10 million in fiscal 1979.)

Looking back, Decision Data officials acknowledge that the company was too dependent on a single customer—Burroughs—and didn't diversify fast enough into new markets and state-of-the-art technology products.

Today, Decision Data is still recovering from its setbacks. It continues to refurbish about 400 of its 80-column card readers while building 1000 new ones, selling them to OEM customers, such as Hewlett-Packard Co., in relatively small quantities. "Twenty-five units is a big order for us," says Richard Schwab, marketing vice president, noting that the company continues to provide maintenance for all its products in 70 domestic offices.

To lower its debt, once as high as $28 million, the company sold its 3500-customer lease base of 96-column punch card equipment to North American Corp., a New York City-based third-party leasing firm, for $7.7 million, of which $7.2 million was applied to lowering long-term bank notes. The transaction in mid-1978 has helped bring the firm's debt to a more reasonable level.

With a new but restricted $14 million line of credit, Decision Data, under Benzing, looked to new technologies and chose to become a printer and controller manufacturer and reseller. It sells more than 500 Dataproducts Corp. 200- to 1500-lpm printers annually, primarily to IBM mainframe, System 34, System 38 and System 3 users, as well as to Digital Equipment Corp., Data General Corp. and Hewlett-Packard customers.

"The System 34 had a difficult controller and interface, unlike the easier System 3 (interface), and we devoted a lot of time and money to it," says Kenneth R. Whitehouse, vice president of corporate business development. "Now we know the System 34 interface channel." Whitehouse says market studies show the current base of 20,000 System 34s will swell to between 70,000 and 80,000 systems in the next several years.

Decision Data's 150-cps printer, with its Zilog Z80 controller and 9 × 7 dot-matrix head, is sold for use with IBM's 3270 information display system. The plug-compatible replacement printer, introduced last year, is expected to account for 5 percent of the firm's revenues in fiscal 1980, Schwab says. He notes that it will also contain interfaces and controllers for use with the IBM System 34. Whitehouse says the System 34 model will be priced $1500 to $2000 below IBM's comparable printer.

While Decision Data officials maintain they are zeroing in on IBM System 34 and 38 users, as well as IBM mainframe customers who plan to lease most of their printers, they are aware of the recent Dataproducts contract to supply IBM with 200- and 340-cps dot-matrix printers. "We recognize this as a potential threat, but we are not overly worried about it," says Whitehouse. He claims Dataproducts' first deliveries are at least nine months off, while Decision Data is about ready to start delivering.

For the future, he sees the company pursuing IBM plug-compatible work stations and the low-speed page printer market. He says the company has designed a 24-page-per-minute electrophotographic printer that can store nine fixed and six variable-sized fonts, using a floppy disk. The company, however, is still looking for an OEM partner. "I want to be assured of the final interface specification and a real commitment," he says, adding that a financial partner will help the firm's cash flow.

The new printer will be positioned between Wang Laboratories' 18-ppm image printer (priced at about $32,000) and IBM's 36-ppm device, which sells for about $75,000.

Another possible venture may be into peripheral equipment maintenance. With 70 domestic offices and 275 technicians, Decision Data wants to enter the third-party maintenance market, as did nearby Sorbus, a King of Prussia, Pa.-based independent service firm. Currently, Decision Data service revenues account for $6 million to $8 million, says Schwab, and the company can better employ its field service force by expanding it to service other vendors' peripherals.

Much of Decision Data's success in field service, new printers and other projects will hang on its ability to manage its debt. The company's financing floats with the prime interest rate, and so far it has not missed an interest payment. "We're committed to terminal and printer markets, and we'll stick to what we know best," assures Whitehouse.

—Ronald Rosenberg

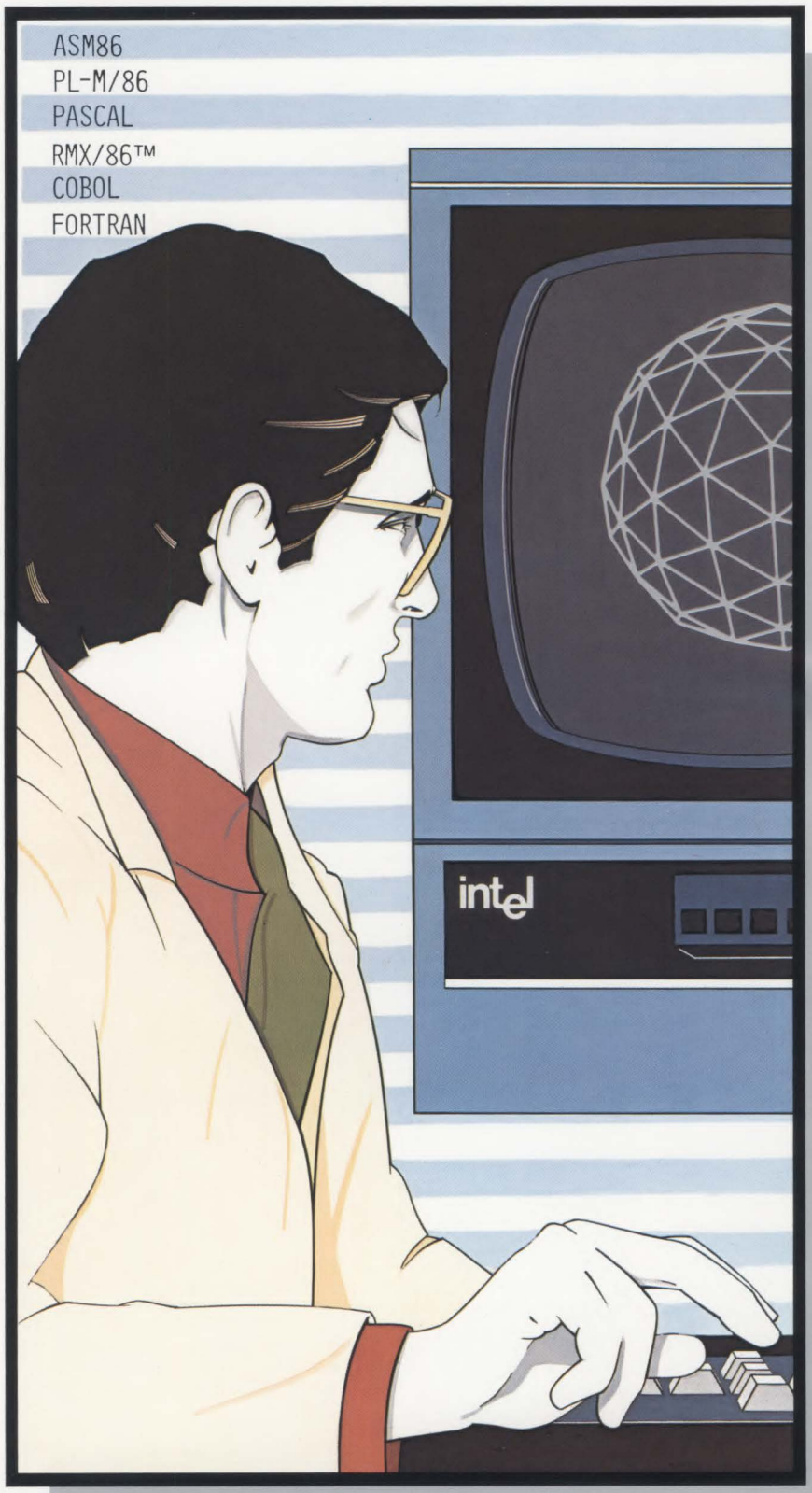
WHAT'S COMING IN MAY:

- NCC preview
- Intelligent peripherals
- Data communications III
- Multilingual software

There is only one high performance VLSI computer solution.

Intel delivers it.

Tools to solve the



How Intel delivers the key to productivity in the '80s.

As we move into the '80s, the increasing demand for complex computer programs, the critical shortage of programmers, and the seemingly unstoppable rise in software development costs will reach crisis proportions. To understand how to bring this situation under control, we have to understand its cause.

In the 1970s, the microcomputer was used successfully to lower the cost of hardware engineering. Each new microcomputer generation integrated more and more of the system, lowering the cost of design and making it easier to put electronic intelligence anywhere and everywhere. As hardware cost dropped, rising software costs became increasingly visible.

So, today, as costs climb, management puts everyone under increasing pressure to deliver projects on time and on budget. Yet, the cost of programming is still outpacing productivity. Software development and integration still lag the system hardware. The software crisis of the '80s rages on.

Tools for structured solutions

Once a problem grows beyond a certain point, the most efficient way to solve it is with a top down approach. You break the problem into units, program and debug each one, and combine the units into a unified solution.

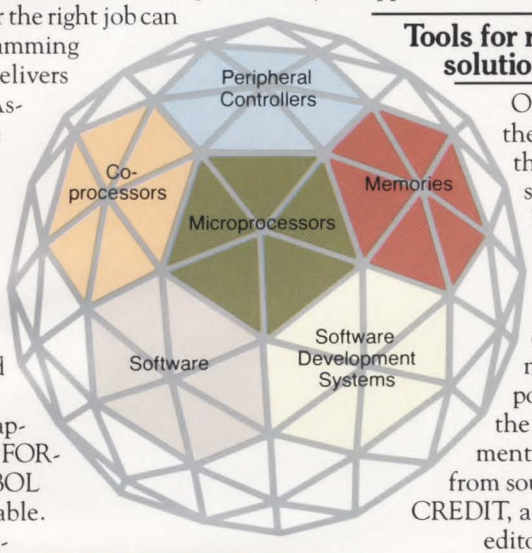
That's the concept. But you can't stop there. In the '80s, bridging the gap between a conceptual solution and a working one will require tools as efficient as the top down method. New tools, like a CPU with a dramatically different architecture. An architecture uniquely suited to a world of higher level languages and structured programming. Tools like a modular operating system, of a kind never before available on a 16-bit microprocessor. Tools like the

software crisis.

only complete family of programming languages, because no one language is right all the time.

Different languages have different strengths and weaknesses, and using the right language for the right job can make your programming easier. So, Intel delivers ASM86 Macro Assembly Language for space and speed sensitive modules. Our PL-M/86 systems programming language and PASCAL support structured programming at the systems and applications levels. FORTRAN and COBOL will also be available.

With Intel's relocation and linkage tools, modules written in the different languages are combined, with library utilities and operating system routines, into one, complete solution, automatically. Using this modular approach, and the right language for the right job, your finished product is clean, reliable, maintainable, and understandable.



Intel Structured System

The critical module

Since complex software requires sophisticated operating systems support, the operating system is the most critical module in your solution. It is the foundation upon which your application is built. It is also available, off the shelf, from Intel.

Today, Intel delivers the RMX/86™ operating system. RMX/86 is new, and it's the first modular, real-time, multitasking operating system for 16-bit microcomputers. File manipulation, task scheduling, and interrupt control are configured by you, according to the needs of your application. There's no unnecessary burden.

Intel's investment in the development of RMX/86 is substantial. Depending upon the features you select, you save from two to forty man years of programming effort. That's an additional two to forty man years you can devote to your application.

Tools for realizing your solution

Of course, having the foundation and the concept of your solution doesn't help if you can't write the programs to implement it. So, Intel delivers development tools to support you through the entire development cycle. Support from source entry, with CREDIT, a CRT based text editor, through compiling and debugging, with an Intellec® development system and ICE™ hardware/software debugging system. Intel's tools work with you. They shorten development time and support the structured approach you've taken.

But debugging software on a development system is not the same as testing it on the actual hardware. The ICE modules help here, too. During development, these tools let you trace through your software and debug it, symbolically, at the source language level. Now, these In-Circuit Emulators replace your prototype hardware's CPU to speed hardware/software integration.

If your hardware is built from components, ICE Modules will help you separate the hardware and software bugs, so you don't spend your time fixing engineering problems. If your hardware is built around an Intel iSBC 86/12A™ Single Board Computer, you'll already have a known, working hardware environment for program testing. You can use ICE Modules to concentrate your efforts on debugging your software.

Either way, the same software, operating system support and debugging tools are available to help you bring your application to life.

Synergy for high performance

In the '60s and '70s, programs were used to instruct computers. Applications of the '80s require programs to be the solutions to problems. High performance solutions will be the result of synergy between the hardware and the software.

To create this synergy today, Intel delivers the 8086 processor. The 8086 processor is unique. Instead of a linear, or flat architecture, the 8086 is the only microprocessor optimized to work with high level languages and the structured solutions they implement.

For the specialized needs of the '80s, the 8086/87 and 8086/89 co-processing systems will set the standard of performance for mathematical processing and I/O bound applications.

And Intel peripheral controllers contribute to your system throughput by freeing processors for more computation.

Your software design may be revolutionary. And with help from an architecture designed to support your structured solution, its performance can be revolutionary, too.

Intel's software tools let you concentrate your planning on the payoff—getting to market today with a superior product. To take your first step to higher productivity, fill out and mail the coupon on the other side of this page. It's a productive use of your time.

intel® delivers solutions.

Europe: Intel International, Brussels, Belgium.
Japan: Intel Japan, Tokyo. United States and Canadian distributors: Alliance, Almac/Stroum, Arrow Electronics, Avnet Electronics, Component Specialties, Hamilton/Avnet, Hamilton/Electro Sales, Harvey, Industrial Components, Pioneer, L.A. Varah, Wyle Distribution Group, Zentronics.

Your first step toward productivity

How to get more information on solving the software crisis of the '80s.

To find out more about our solutions, fill out the information requested below and send it to Intel Corporation, Literature Department, 3065 Bowers Avenue, Santa Clara, CA 95051. Indicate what your particular interests are, including workshops, and we'll make sure you get the appropriate material. If you don't have a pair of scissors handy, give us a call at 408/734-8102 (Literature Department) and we'll rush the material out to you. Or call your local Intel distributor.

Intel wants to help you solve the software crisis of the '80s. It all starts right here.

Name_____

Title_____

Company_____

Division_____

Address_____

City, State, ZIP_____

___ I have an immediate requirement, please telephone me at ( ) _____

___ I need additional information.

Please put the letter corresponding to your yearly requirements in the line to the left of those products of interest.

W for 1-10 per year
X for 11-99 per year
Y for 99-999 per year
Z for over 1,000 per year

___ A 16-bit Microprocessors
___ B 8-bit Microprocessors
___ C Single-Chip Microcontrollers
___ D Peripheral Controllers
___ E RAMS
___ F EPROMS
___ G Bubbles
___ H Single Board Computers
___ I Development Systems
___ J Debug Tools
___ K High-Level Languages (_____) Indicate languages
___ L Macroassembler
___ M Operating Systems (RMX/86™)
___ N Telecom Products
___ O Military Products
___ P Workshops

01234

Circle No. 26 for information.

PRODUCT FOCUS

'LARK' DISK DRIVE OFFERS SMD/CMD COMPATIBILITY

Control Data Corp.'s long-awaited "Lark" disk drive—the first 8-in. device to offer compatibility with larger storage module (SMD) and cartridge module (CMD) drives, and the first to combine a fixed, sealed Winchester platter and a removable disk cartridge for file backup—may be ready by June. There are unofficial reports circulating that it will debut at next month's National Computer Conference.

Now under development at Magnetic Peripherals, Inc., the Control Data subsidiary in Oklahoma City, the 16M-byte drive (8M bytes fixed, 8 removable) should be welcomed by systems designers contemplating lower-capacity Winchesters and plagued by doubts about existing file backup hardware—despite the steadily growing market for tape cartridge drives. "CDC's new hardware will be greeted enthusiastically," says Jim Porter, Mountain View, Calif., consultant and publisher of *Disk/Trend Report*. "There is a big latent market for these drives."

Behind the push for small Winchesters with disk cartridges, Porter says, is the popularity among OEMs for 14-in. cartridge module drives based on older IBM 3330 technology. "A lot of systems designers are oriented to this hardware, and a lot of them will stay with the concept of removable media when it comes to selecting 8-in. drives," he says.

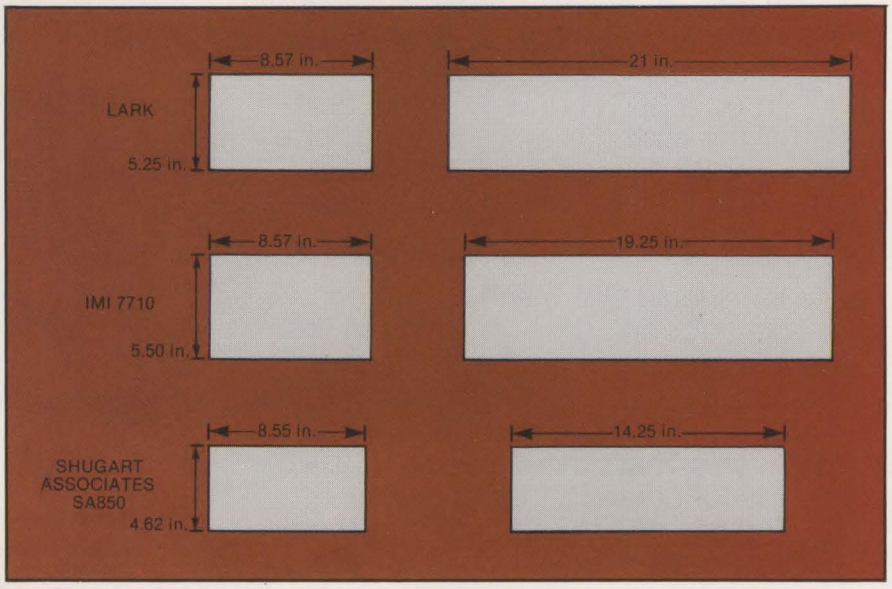
The Lark's SMD and CMD compatibility will also attract these users. According to one report, the new hardware will operate at 20,672 bytes per track—the same as CDC's larger-capacity 14-in. hardware. That will position the Lark within the company's existing line of OEM disk products, notes Ray Freeman, Santa Barbara, Calif., consultant and publisher of the *Freeman Report* on 8-in. Winchesters. "Users will be able to easily map data from larger devices onto the Lark," he points out.

But this very compatibility feature is also raising some eyebrows. To achieve an SMD/CMD byte per track density, the Lark will operate at 10,161 bits per inch, notes one source, a density significantly higher than the 6400 bpi common to 3550-technology 8-in. Winchesters. While many industry observers agree that the drive's fixed, sealed disk will be standard oxide-coated, lubricated Winchester media, they point out that the cartridge may be something else again. "There is no way you can remove a Winchester disk and maintain a contamination-free environment," points out Andy Roman, a Newark, Calif., consultant. "I expect that the cartridge itself will be based on advanced 3330 technology."

But even if nonlubricated media, such as that used on 3330-technology drives, finds its way into the Lark, users contemplating the new 8-in. device still will have to concern themselves with contamination within the cartridge. As a result, the Lark will probably require a 30- to 60-sec. purge cycle to clean out the cartridge before the heads are loaded. This cycle also will create a positive air flow, which will keep dirt out of the cartridge during operation, and which will be maintained by impellers. However, the Lark will probably require a fan to get the purge process started.

An advanced encoding scheme may be part of the new hardware, also. According to Roman, even double-density 3350 Winchester heads cannot operate at speeds of 10,000 bpi or greater. Unless Control Data introduces a drive incorporating thin-film heads, the Lark will be equipped with an encoding scheme capable of generating more than one bit of information per flux reversal. Such a code—dubbed 2,9—reportedly will be used in the Lark in place of the MFM and GCR codes common in other 8-in. Winchesters.

Also to be incorporated into the Lark will be an embedded servo system with track positioning data prerecorded into each track of both the sealed disk and the removable cartridge. Most other 8-in. devices have servo data recorded onto one side of the fixed disk. But while embedded servo data obviates the



Envelope dimensions *of CDC's "Lark" 8-in. Winchester are compared to those of International Memories, Inc.'s 7710 Winchester and Shugart Associates' SA850 floppy disk drives. Several suppliers of 8-in. Winchesters have opted for the 850's dimensions to speed incorporation of the larger-capacity hardware into small-business systems.*

WHY CAN'T MICROPOLIS DO THINGS LIKE EVERYONE ELSE?

To be honest, we could. But our customers have come to expect a lot more from us.

They've come to appreciate our role as a problem solver and a leader in technology responsible for the highest capacity and best performance drives in the industry.

96 TPI is nothing new for us.

Consider the current hubbub about "new" 96 TPI disk drives. You should know that what may be new to our competition is anything but new to us.

After all, we brought the 100 TPI MegaFloppy™ disk drive to the marketplace more than two years ago. And we've delivered more than 50,000 drives already.

To us, a 96 TPI drive is no big deal. So for the customer who's looking for a double track drive offering compatibility with 48 TPI drives, Micropolis can deliver.

Think of us as double headquarters.

We should also mention that our double track disk drives give you all the storage capacity of an 8-inch floppy in the body of a 5¼-inch floppy. And with our double head version, you get up to 1.2 megabytes. That's more than ten times the capacity of other 5¼-inch floppies.

But our innovations don't stop there. Over the years, many of our ideas have gone on to become industry standards. And many more will.

Things like stainless steel, precision-ground lead screws instead of cheaper, less reliable plastic positioners.

We also developed a special disk centering mechanism that is the most accurate in the industry.

And who do you think successfully adapted Group Code Recording technology to the floppy disk drive industry? None other than Micropolis.

Remarkable as our technical achievements may be, some people still wonder how we got to be number two so rapidly in such a fiercely competitive business.

Obviously, we did it by design.

MICROPOLIS™

Where the 5¼-inch OEM drive grew up.

Micropolis Corporation, 21329 Nordhoff Street, Chatsworth, CA 91311. For the telephone number of your nearest OEM rep, call (213) 709-3300.

See us at NCC Booths #1260-1262.

CIRCLE NO. 42 ON INQUIRY CARD

'FINCH' DISK DRIVE ALSO SET TO FLY

Further details concerning Control Data Corp.'s second 8-in. hard-disk entry, a low-end 8- and 24M-byte Winchester originally code-named "Meadowlark" and now reportedly going by the name "Finch," are also surfacing.

The Finch will take a more conventional approach to Winchester design and will not be equipped with a removable disk cartridge. It will not offer SMD/CMD compatibility, but it will be based on the same envelope dimensions as Shugart Associates' 1M-byte SA850 floppy-disk drive. It will also incorporate a separate servo surface rather than the embedded servo found in the Lark.

The Finch will incorporate a rotary actuator, will provide a 50-msec. access time and will operate at 6800-bpi, 526 tpi. The drive will use conventional MFM recording and will come with a floppy-disk drive interface. First models are scheduled to be shipped during the fourth quarter.

need to give up a data surface, it also means that servo data must be embedded at the factory. That fact may be incidental in a sealed environment, but in a removable environment, use of an embedded servo allows users to buy additional disk cartridges only from Control Data Corp. But this may not be a problem for long, says Rod Crisp, distribution marketing manager at Verbatim Corp., Sunnyvale, Calif. "There'll be plenty of sources for this media once the Lark is fully understood—and if it's successful."

The Lark's low track density is also of interest to OEMs. The initial specifications for tracks per inch is 237—far below the densities common to 3350 drives, and one easily within reach of stepper-motor driven actuators. The Lark, however, will incorporate a linear voice coil motor, leading several observers to speculate that the low tpi figure represents a move to test a piece of hardware under conservative conditions.

"They have to prove the field reliability of this system," one observer notes, adding that if and when the reliability of the device comes up to spec, storage capacities will be quickly doubled. "The second year out, they'll bring track densities up to 3350 levels," he says, "and boom, they'll have a 32M-byte drive with a 16M-byte cartridge with no changes in the interface." Another observer has another idea about the low track densities of the Lark, however. "Low track densities are needed to insure data integrity if the cartridge does not center properly," he claims.

In whatever form, however, the Lark seems destined to cost more than "standard" 8-in. Winchester hardware, although no one is ready to make anything but a ball-park estimate on what the Lark will cost. Some observers estimate that the drive, scheduled for quantity deliveries during the third quarter of 1981, will sell for about $1000 higher than equal-capacity Winchesters without cartridges.

Further affecting the cost of the drive could be the unspecified price of the cartridges themselves. Conventional 14-in. cartridges based on 2314 and 3330 technology sell for about $150 each in quantity. Many observers discount any question of pricing premiums for the Lark. They point out that "standard" Winchesters also require backup hardware and additional controllers, which could bring their total system price well within the Lark's competitive range.

But that's today's pricing, others note. The Lark is not scheduled to be available in production quantities until the third quarter of next year, and a lot can happen in the next 18 months. "There's obviously a ready market for this hardware among users comfortable with drives based on SMD and CMD interfaces," says Sam Thompson, vice president of marketing at Data Electronics, Inc. (DEI), San Diego, the largest supplier of ¼-in. tape cartridge drives for Winchester backup applications. "These people probably won't shift over to something else."

But, Thompson points out, CDC is only one of a large number of companies that have discussed 8-in. Winchesters or are delivering them in quantity, and the drive will probably not affect designers already using other disk/backup combinations. "The Lark will be one of the last drives to be available to small systems designers," Thompson adds. "As a result, we feel it will not set an industry standard, and users who have chosen tape cartridge drives to back up their systems will not shift."

A spokesman for Control Data confirms only that the Lark will be introduced by mid-1980. Beyond that, he says, it would be inappropriate for the company to comment on unannounced products.

—John Trifari

IBM UNVEILS 5120—ITS LOWEST-PRICED SYSTEM YET

Continuing to stalk the computer-shy first-time user, IBM Corp. has introduced the model 5120 desk-top computer, its lowest-priced system to date. At the same time, IBM's General Systems division has announced new business software packages for the 5120 and the opening of an installation support center in Atlanta to handle telephone inquiries from 5120 customers.

Although similar to its forerunner, a 5110 desk-top computer, the new system offers enhancements intended to make it more attractive to small businesses—its target market. For one, it incorporates a larger CRT display than the system it replaces—9 in. diagonal vs. 5 in. in the 5110. This reduces eyestrain in prolonged use—an important

consideration in business applications.

With two integral floppies, the 5120 is also more compact than its predecessor, which had separately packaged disks.

But perhaps most important to the small businessman, the new system is significantly less expensive than the 5110. For example, a representative system that includes 32K bytes of memory, 2.4M bytes of floppy-disk storage, a 120-cps printer and the BASIC programming language sells for $13,320—about $3000 less than a comparable 5110 system, according to Lee Bowman, vice president of sales at IBM's General Systems division in Atlanta. Bowman attributes the price differential to the use of an unspecified new diskette technology.

Bowman defines very small businesses as companies with fewer than 10 employees. To reach this market, IBM plans to sell the system in a retail fashion through its 50 business computer centers as well as through its branch offices. Bowman says the centers have been selling 5110s off-the-shelf since last summer—a policy that will be continued with the 5120.

Although the 5120 is IBM's lowest-priced system to date, it remains expensive compared to competitive systems. Among IBM's minicomputer competitors, for example, Data General Corp. offers a more powerful Winchester-disk-based system, the MP/100, for $12,350. DG recently began marketing the system through independent computer stores and office-equipment dealers.

Digital Equipment Corp. also sells a less expensive system, the DECsystem 308, through its chain of 21 company-owned computer stores. However, the DEC system, which retails for about $11,500, contains significantly less main memory (16K bytes) and floppy-disk storage capacity (512K bytes) than the 5120.

When compared to offerings from personal computer companies, the 5120 price differential appears even more dramatic. For example, a Radio Shack TRS-80 II system that includes 1.5M bytes of floppy storage and a 120-cps printer sells for $8000—or more than $5000 less than a comparable 5120 system. The Radio Shack system is available through the company's 53 Tandy computer centers as well as through selected Radio Shack electronics stores.

In addition to the new hardware, IBM also introduced six new business applications packages: general ledger, accounts payable, payroll, billing, inventory and accounts receivable. The packages are interrelated in that they pass transaction data among themsleves via diskettes. The packages carry a $60-a-month license charge, which is paid up after 24 months.

To assist customers in installing the 5120 system and the application packages, IBM's Atlanta-based installation support center is equipped with a toll-free "hot-line" number. —**Paul Kinnucan**

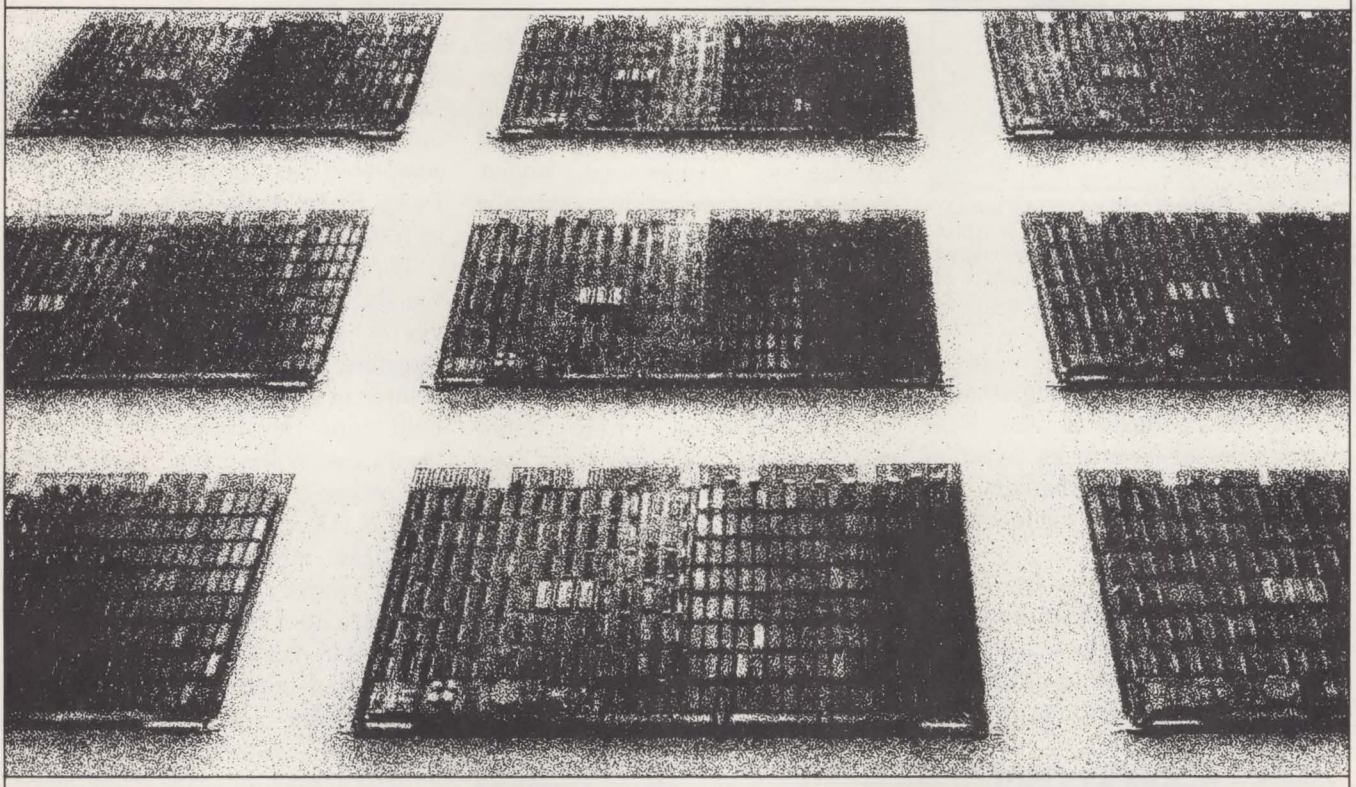
IBM's 5120 desk-top computer *is aimed at the small-business market, but it faces stiff competition from other computer suppliers.*

SMART INTERFACE HANDLES WORD-PROCESSING CHORES

Many small business computer system vendors, eager for fast access to word-processing sites, are hesitating, intimidated by the high cost of developing the software drivers needed to control letter-quality daisy-wheel printers. But these vendors may soon be able to gain entry into this lucrative market using a newly developed intelligent interface.

Called the Daisy Brain, the new device is the work of Len Wilker and a company he incorporated in Hayward, Calif., last September

National helps DEC® users improve their memories.



Contrary to popular belief, all memories are not created equal. And if you're a DEC user, you should know that National's boards actually operate faster than DEC's. In fact, they run at UNIBUS® cache memory speed.

The truth is, National Semiconductor offers the highest quality add-in memories available for all QBUS and UNIBUS systems, including the newly-announced PDP-11/44. That's because National's boards offer faster throughput by making basic decisions earlier in the memory access cycle.

Exclusive Products. Exclusive features.

National's UNIBUS product line features the fastest, densest production card around, not to mention the only ECC memory available for PDP-11s.

The high-speed NS11L memory offers 128K x 18 bits, including the parity controller. The NS11E memory corrects single-bit memory errors on the fly, and still runs faster than DEC. (Double bit errors are reported as parity errors.) And both cards require only +5V power and function with any PDP-11 modified, standard, or special bus.

The NS23P card boasts the same feature density and reliability in a half-size format for QBUS® processors, supplying up to 64KB of parity memory per card for the LSI-11/2 and the new LSI-11/23.

And there's no need to wait.

National doesn't just make better memories, however. They make them for less, and deliver them faster because every one is readily available from stock. National also provides a one-year warranty on every board they make. Could you expect anything less from a billion dollar corporation responsible for much of today's latest technology?

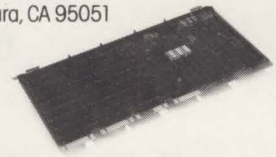
So if you're looking for memories, talk to your local rep. Or fill out the coupon below and send it to National Semiconductor. Or call them at (800) 538-8510. In California, call (408) 737-5894.

They'll be happy to give you complete information on the best memories money can buy.

DEC, UNIBUS, and QBUS are registered trademarks of Digital Equipment Corporation.

National Semiconductor
2900 Semiconductor Drive
Mail Stop MS7C265
Santa Clara, CA 95051

MMS480



Yes, National, I want to improve my memories. Please send me the information I have checked below.

☐ UNIBUS products
☐ Q-BUS products
☐ Other_____

Name_____

Title_____

Company_____

Address_____

City_____

State_____ Zip_____

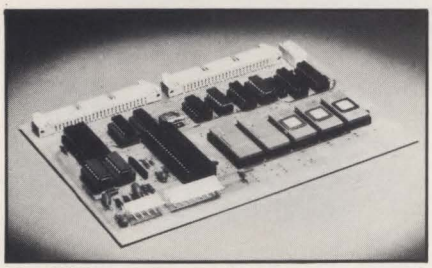
Telephone_____ Ext_____

Union Grove, AL 205/498-3380 • Glendale, AZ 602/269-2649 • Inglewood, CA 213/673-4300 • San Diego, CA 714/278-8021 • Santa Clara, CA 408/727-1800 • Southberry, CT 203/264-9494 • Casselberry, FL 305/339-0978 Ft. Lauderdale, FL 305/791-2488 • Largo, FL 813/596-5331 • Atlanta, GA 404/252-6609 • Chicago, IL 312/775-7594 • Indianapolis, IN 317/253-4606 • Overland Park, KS 913/649-6996 • Needham, MA 617/444-2366 Bethesda, MD 301/656-4535 • Farmington Hills, MI 313/553-9111 • Bloomington, MN 612/881-3300 • St. Louis, MO 314/569-1406 • Greensboro, NC 919/294-4783 • Fairlawn, NJ 201/797-5560 • Jericho, NY 516/935-6600 Columbus, OH 614/885-6682 • Beaverton, OR 503/644-9164 • San Juan, P.R. 809/762-2688 • Dallas, TX 214/661-9633 • Houston, TX 713/681-0200 • Richmond, VA 804/264-2341 • Bellevue, WA 206/455-4922 Richardland, WA 509/942-1264

National Semiconductor

The Practical Wizards of Silicon Valley.

CIRCLE NO. 43 ON INQUIRY CARD



The Wilker Daisy Brain *enables "dumb" daisy wheel printers designed for word-processing applications to be interfaced to small business computers in place of dot-matrix devices with minimal software modification.*

called Wilker, Inc. The single-board device incorporates a Z80 8-bit microprocessor tied to 2K bytes of random access buffer memory and 3K bytes of read-only memory for program storage.

According to Wilker, the Brain will enable systems designers, OEMs and terminal distributors to connect "dumb" daisy-wheel printers to low-cost business systems in place of the dot-matrix hardware now commonly used. The result, he says, is an instant word-processing system that does not require the writing of complex control algorithms for the printer to carry out functions such as right-hand justification, wraparound, underscoring and overstriking, and the insertion of sub- and superscripts.

"Writing the drivers to carry out these chores is not a trivial task," claims the former sales manager at Qume, Inc., one of the largest suppliers of daisy-wheel printers. "A small business system vendor thinking of selling into the word-processing market could spend $300,000 to $400,000 writing the software he'd need to operate the printer."

Use of the Daisy Brain can get the designer around this cost, Wilker claims. "Control algorithms are stored in ROM," he explains, noting that, in operation, text is keyed into the system along with printer control characters. "The operating system of the host processor treats these characters as text," he adds, "as if a dot-matrix printer were still hooked on." But when the completed text is printed out, the Daisy Brain reads these characters as instructions.

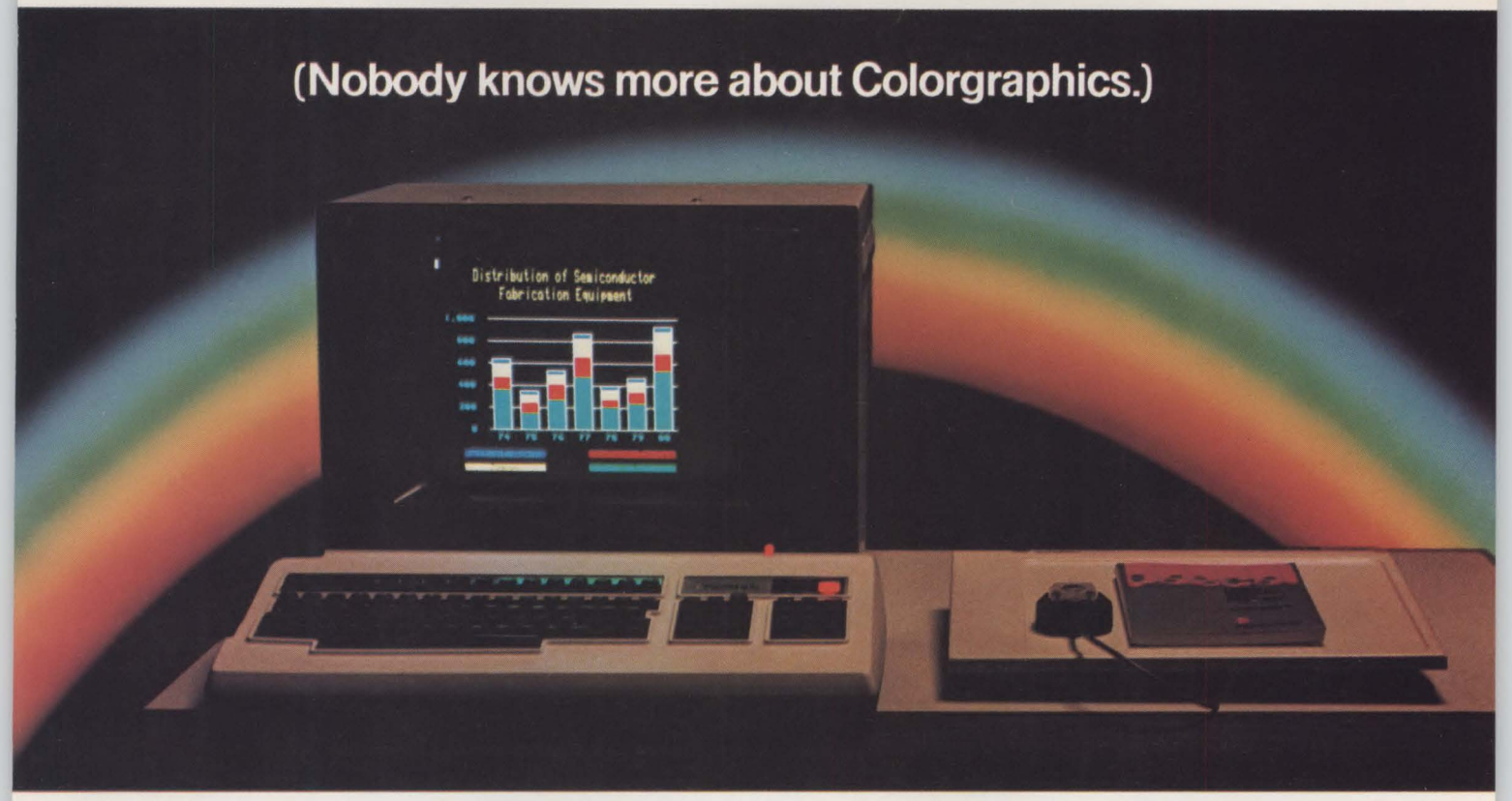
The physical connection between the Daisy Brain and the computer is via an RS 232C serial port. The interface between the Brain and the printer is through the parallel ports built into the Qume and Diablo hardware. Wilker, Inc., supplies all the cables for the two connections, plus a third cable to hook the intelligent interface to the printer's power supply. The single-board interface fits into a spare slot within the Diablo daisy-wheel printer, and is mounted inside the cover of the Qume device.

Wilker feels his intelligent interface may become even more attractive to OEMs when Diablo's and Qume's low-cost daisy-wheel printers, reportedly under development for the last eight months, hit the market later this year (MMS, November, 1979, p. 15). "In quantity, these devices should break the $1000 barrier," he says. But a number of other sources point out that users will have to trade off some speed to get lower prices. "Daisy wheel printers now on the market are in the $1500 range and run at 50 characters per second," reports one observer. "The lower-priced printers from Diablo and Qume will operate at 25 cps."

Wilker has no plans to wait for the low-priced printers and offer them with the Daisy Brain as intelligent peripherals. Instead, he stresses that the company will stick with board-level products. Evaluation quantities of the Daisy Brain are already on the market, Wilker reports. Production models pegged at $600 in 1000-lot quantities are scheduled for shipment later this quarter. **—John Trifari**

Ask Ramtek.

(Nobody knows more about Colorgraphics.)



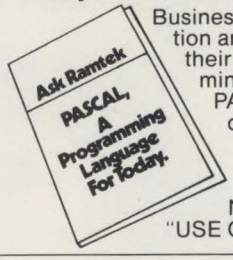
Isn't one clear, colorful picture worth a thousand lines of print-out?

Get the picture fast with Ramtek's 6114 Colorgraphic Computer. Operating alone or with your host computer, the 6114 not only provides you with state-of-the-art tools for graphically and colorfully displaying your data, it also gives you PASCAL, the modern, interactive computer language that speeds up manipulating and formatting that data.

The 6114 is just one of five color and black and white graphic computers that you can choose from in Ramtek's 6000 Series. Designed with the information management needs for business, education and industry in mind, the Ramtek 6000 Series is designed to make data retrieval faster and more effective. Hardware options permit you to choose the resolution and graphics manipulation features that fit your needs. One time-saving software option provides a basic package of graphics and text routines that simplify applications programming.

For complete information on the Ramtek 6114 Colorgraphic Computer and the entire Ramtek 6000 Series, write: Ramtek, 2211 Lawson Lane, Santa Clara, CA 95050. Or, call your nearest Ramtek office.

Why is PASCAL better for business?



Business, industry and education are turning to PASCAL for their interactive programming needs. To find out what PASCAL offers and how it can benefit you, request "PASCAL, A Programming Language For Today." It's Issue Number 1 of Ramtek's "USE OUR EXPERIENCE" series.

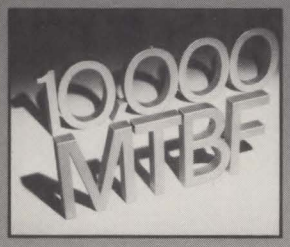
Ramtek
Our Experience Shows.

See us in Booth #1127 at NCC

REGIONAL OFFICES: Santa Clara, CA (408) 988-2211, Newport Beach, CA (714) 979-5351, Seattle, WA (206) 838-5196, Albuquerque, NM (505) 298-2200, Dallas, TX (214) 422-2200, Maitland, FL (305) 645-0780, Huntsville, AL (205) 837-7000, Chicago, IL (312) 956-8265, Cleveland, OH (216) 464-4053, Dayton, OH (513) 278-9461, Washington, DC (301) 656-0350, Metropolitan NY (201) 238-2090, Boston, MA (617) 862-7720, Netherlands 31 2968 5837.

CIRCLE NO. 46 ON INQUIRY CARD

RELIABILITY. IT'S WHAT MAKES FUJITSU THE WORLD'S LARGEST MANUFACTURER OF OEM WINCHESTERS.



That's right! Fujitsu produces more Winchester technology disk drives for the OEM market than any other manufacturer in the industry. The reason for this success is the unequalled reliability of Fujitsu products.

For instance, Fujitsu's M228X Winchester drive delivers more than 10,000 MTBF power on hours of high performance. That's 40% better than the industry standard. And the M228X is fast: 6ms track-to-track (27 ms average) access time. With this kind of performance, up to 169 megabytes of unformatted storage, and Fujitsu's competitive pricing—there is no other choice! Optional head-per-track capacity of 655 kilobytes also available with this series.

80 and 50 MB cartridge drives with SMD interfacing

Fujitsu's advanced technology does not stop at Winchesters! The two front-loading cartridge drives with SMD capability shown here, have statistics only Fujitsu could guarantee. Like access times of 6ms track-to-track (30 ms average), and a reliability factor of over 6,000 poh MTBF. That's 50% better than the industry standard.

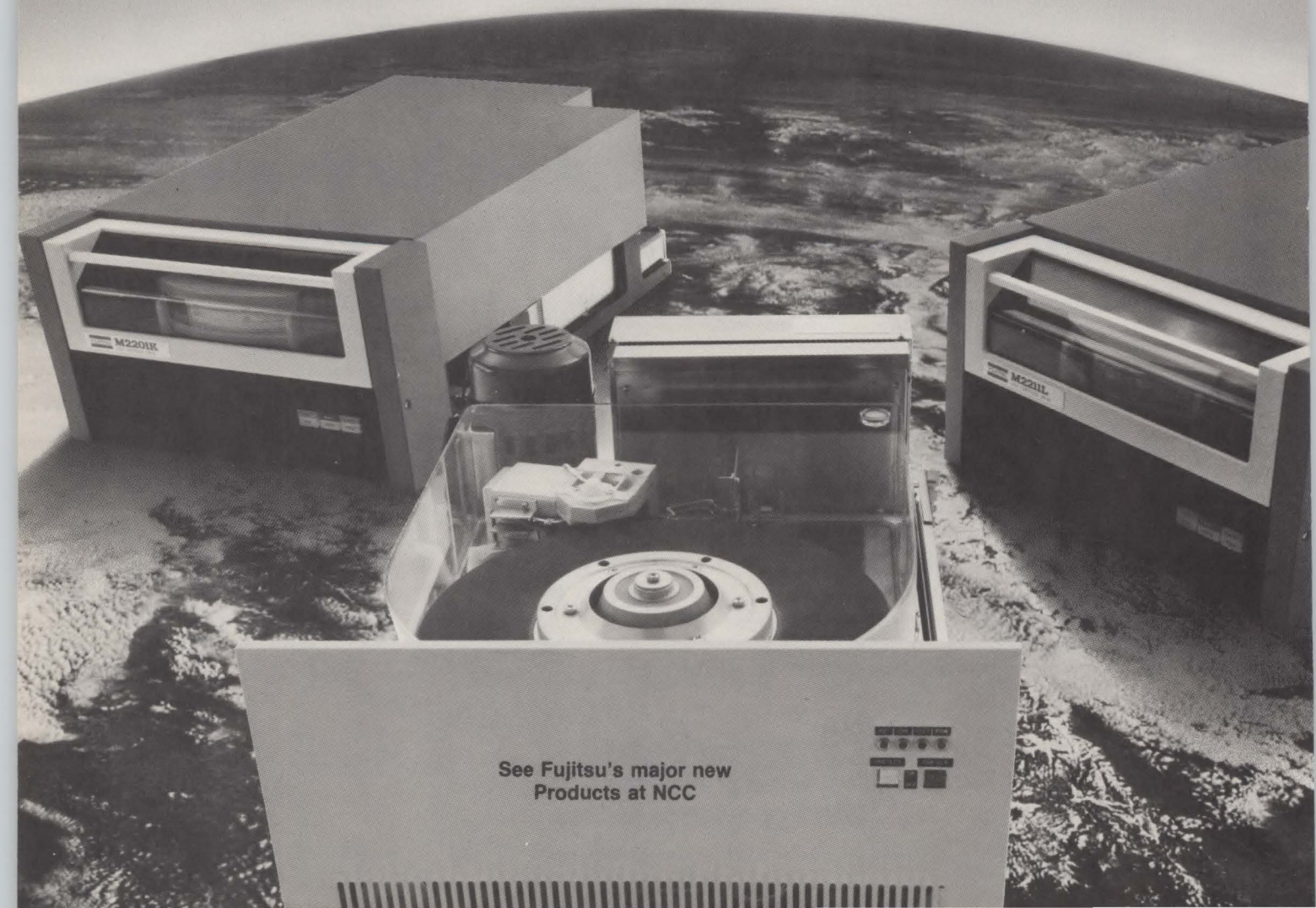
And whether you order the M2211 (80 MB) or the M2201 (50 MB) drive you can say goodbye to data staging. Plus you get a servo/track record system that assures the cartridge interchangeability you need. With features like these it's no wonder Fujitsu's got the world on a platter.

For technical information, (outside California only) phone toll-free 800-538-8175. For sales and service, or evaluation unit, contact: Fujitsu America, Inc., 2945 Oakmead Village Court, Santa Clara, CA 95051. Phone 408-985-2300, Telex 357-402, TWX 910-338-0047.

FUJITSU

The first word in reliability.
The last word in performance.

CIRCLE NO. 47 ON INQUIRY CARD



For Data General data storage, the name of the game is Ball

BALL 1: CONTROLLERS. Ball has *intelligent single-board disk controllers* supporting up to four Storage Module, Winchester or 3300-type disk drives in any mix of capacities, *controllers* for *cartridge-type disk* and *magnetic tape* (phase encoded and/or NRZI), and *custom designed controllers* for a perfect computer/data storage interface.

BALL 2: DISK DRIVES. Ball has rack-mountable and pedestal-based Storage Module-type disk drives in 50, 80, 100, and 160 megabyte capacities... interface and media-compatible with Trident and Storage Module Drives.

BALL 3: INTEGRATED DISK & TAPE SYSTEMS. Fully integrated data storage subsystems for Nova,® Eclipse® and Data General-compatible computers prevent system integration headaches. They cut your inventory cost while improving factory throughput and quality.

BALL 4: CUSTOM SYSTEMS. Using a special bus structure or operating system... Ball can develop and support custom data storage configurations to match special needs.

Ball Computer Products Division

Computer Products Division
860 East Arques Avenue
Sunnyvale, California 94086
(408) 733-6700

Ball . . . Where Quality Has Been A Tradition for 100 Years.

CIRCLE NO. 48 ON INQUIRY CARD

® Nova and Eclipse are trademarks of Data General Corporation

"WHAT WOULD YOU SAY TO BIG COMPUTER PERFORMANCE FROM YOUR MICROCOMPUTER?"

"YOU'RE TALKING OUR LANGUAGE: PL/I-80™."

New PL/I-80 from Digital Research Brings Big Computer Programming Power to Microcomputer Systems.

PL/I-80 is the biggest news for small system users and OEMs since we introduced CP/M® and MP/M. PL/I-80 is ANSI's General Purpose Subset of full PL/I, tailored into a language for 8080, 8085 and Z80 users who expect the software revolution they've seen in hardware —better results at lower cost. PL/I-80 works harder than any other general-purpose language for business, science, research and education.

The PL/I-80 software package includes a native code compiler, comprehensive subroutine library, linkage editor and relocating macro assembler. And it's backed by our CP/M and MP/M operating systems.

Best of all, **the complete PL/I-80 system diskette and documentation costs just $500.**

PL/I-80: There's no better way to get big-machine results from your 8-bit processor.

Single-and Multi-User Operating Systems That Set Industry Standards.

CP/M is the industry standard operating system for small machines. With thousands of users throughout the world, it's the most popular and widely used. It's the original, hardware-independent 'bus' for users working with a broad array of languages, word-processing and applications software available from scores of suppliers at affordable prices.

Now we've made a great CP/M even better. CP/M 2.2 is the latest release of the efficient, reliable system that's truly universal, able to manage virtually any 8080, 8085 or Z80 micro and its floppy or hard-disk subsystems. Named to the 1979 Datapro Software Honor Roll, CP/M comes on a diskette with its own operating manual, **for just $150 in unit quantity.**

MP/M provides big-computer power at small-computer cost. It provides multi-terminal access with multi-programming at each terminal. And it's CP/M compatible, so you can run many programming languages, applications packages and development software on your system.

Check these advanced capabilities. Run editors, translators, word processors and background print spoolers simultaneously. Use MP/M's real-time facilities to monitor an assembly line and schedule programs automatically, or control a network of micros. Even write your own system processes for operation under MP/M. The possibilities are endless, **yet MP/M costs just $300 (unit price for diskette and manual).**

Utilities That Work For You.

Use our utilities. Thousands do. They're designed to make your small system work extra hard, yet they cost surprisingly little.:

- MAC™ (Macro Assembler)—$90.
- SID™ (Symbolic Instruction Debugger)—$75.
- ZSID™ (Z80 Symbolic Instruction Debugger)—$100.
- TEX (Text Formatter)—$75.
- DESPOOL™ (Background Print Utility)—$50.

All are supplied on a diskette, with operating manual.

Digital Research
P.O. Box 579
801 Lighthouse Avenue
Pacific Grove, CA 93950
408 649-3896
TWX 910 360 5001

DIGITAL RESEARCH®

CIRCLE NO. 49 ON INQUIRY CARD

Introducing the micro-Winchester

FINIS F. CONNER, Shugart Technology

Hard-tooled versions of Shugart Technology's ST500, the first 5¼-in. Winchester drive, will be operating at NCC next month

Designers of microcomputer-based systems looking for lower-cost, more reliable storage than 8-in. Winchester disk drives offer, now have a favorable alternative to the industry standard 5¼-in.-diameter minifloppy. It's the 5¼-in. ST500 "micro-Winchester" from Shugart Technology, and while the drive is the same size and uses the same DC voltages as the standard minifloppy, it offers higher performance, greater storage capacity and better reliability.

The improvements should be welcomed by designers of small-business, desk-top computer and word-processing systems, who have seen their storage needs surpass the capacities of minifloppy-disk drives. But a number of such users, especially those with single-station systems, can benefit from a combination of micro-Winchesters and minifloppy-disk drives. Micro-Winchesters give the system more capacity and higher performance than the minifloppy alone, and the minifloppy provides backup and system input/output.

The ST500, the first in a series of micro-Winchesters from Shugart Technology, in Scotts Valley, Calif., offers 6.38M bytes of unformatted storage in a 5¾- × 3¼- × 8-in. package—the same size as the industry standard minifloppy drive. It uses the same DC voltages (+12, +5) and requires no AC power, making it easily integrated into any system that accommodates a standard minifloppy drive. Moreover, at less than $1000 in quantities of 500, the new drive provides about 15 times the capacity of a double-sided minifloppy at less than three times the price. This attractive capacity/cost ratio delivers a cost per kilobyte of 14¢ vs. the double-sided minifloppy's 74¢ and the standard double-sided floppy's 37¢. It is also less than the lowest-cost 8-in. Winchester drive's cost per kilobyte of 19¢.

In constrast to the minifloppy, however, the 5¼-in. Winchester has a faster access time and data rate. Average access time is 170 msec., about twice as fast as the minifloppy's 298 msec. The difference in data rate is even more impressive. The micro-Winchester transfers 5M bits per sec. compared to the minifloppy's 250K bps.

Officials at Shugart Technology also regard the ST500 as competition for low-end entries in the 8-in.

SMALL SYSTEM DISK STORAGE ALTERNATIVES

	Capacity Mbytes	Unit Cost 500 Qty	Cost/ Kbytes	Avg. Access	Data Rate Mbits/sec.	AC Required	Voltages Required	Physical Size	Power Dissipation
Micro Winchester (ST500)*	6.38	$925	.144¢	170m sec.	5.0	no	+12 +5	5¾ × 3¼ × 8	30W
Double-sided minifloppy (SA450)**	.437	$325	.744¢	298m sec.	.25	no	+12 +5	5¾ × 3¼ × 8	14.5W
8-inch Winchester (SA1000)**	5.33	$995	.187¢	70m sec.	4.34	yes	+24 +5 −5	4.62 × 8.55 × 14.25	150W
Double-sided floppy (SA851)**	1.60	$590	.368¢	91m sec.	.5	yes	+24 +5 −5	4.62 × 8.55 × 14.25	57W

*Shugart Technology
**Shugart Associates

The 6M-byte drive can be easily integrated into systems designed for minifloppy disk units.

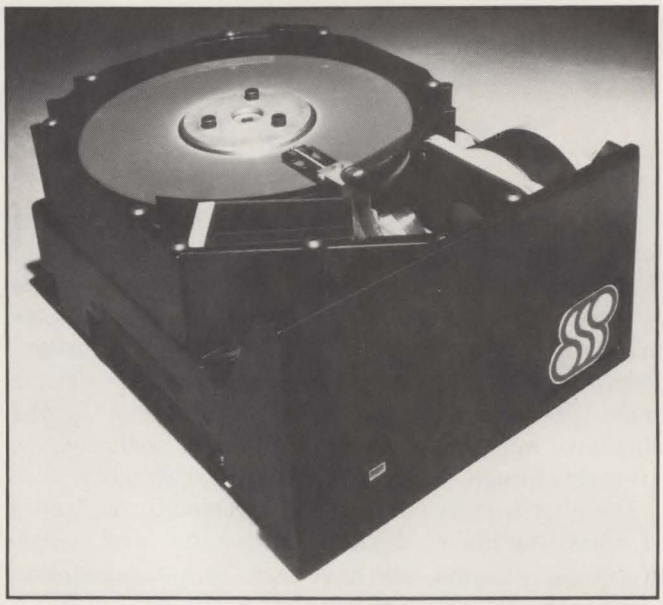
Winchester-disk drive market. It offers 20 percent greater capacity than its closest-priced 8-in. competitor, the SA1000, although the ST500's average access time is slower (Fig. 1). And while larger Winchester drives are suitable for many applications, they present severe integration problems for smaller systems that now use a single floppy or two minifloppy drives. A 14-in. drive is too cumbersome to be integrated into many existing systems. It is five times wider and almost three times deeper than a minifloppy, and it can weigh 35 lbs. or more. It also requires a more sophisticated interface and AC and DC power supplies. Equally important, the 14-in. drive costs at least $1250. With aggressive price competition in the small systems market, the designer may find this too expensive.

The 8-in. Winchester drive offers a more affordable choice than 14-in. units, but it is no panacea. Although the 8-in. Winchester is about the same size as a floppy, it is too large for some systems, because most systems require both flexible and fixed media.

If the existing system has been designed for one floppy or two minifloppies, there may not be room for both fixed and removable disk drives. Also, the floppy may be an inadequate backup. Eight-inch Winchester drives have capacities of 4M to 35M bytes. Attempts to back up that much storage on floppies are awkward and impractical. And although tape cartridges have been proposed for backup, they lack the random access, reliability and serviceability of disk storage.

Some 8-in. Winchester drives require AC power, which usually dictates use of a belt-and-pulley drive arrangement that would have to be altered, along with the motor, to be sold in Europe. They also dissipate 150W or more of power, compared to just 30W for the ST500. In some systems, this produces heat problems that require an additional cooling fan or a larger fan, with accompanying increases in size and cost.

Reliability, however, may be Winchester technology's most important advantage over diskettes. Sealed, nonremovable, contaminant-free Winchester drives are far less susceptible to head crashes and other failures, which lower mean time between failure (MTBF) for



The ST500's standard read/write heads, *disks and stepper motors are intended to make the micro-Winchester easy to assemble.*

WHY A MICRO-WINCHESTER?

It's clear that there's a big market for 8-in. Winchester disk drives; consultant Andrew Roman, president of Roman Associates International, Newark, Calif., forecasts that shipments of the units will grow at more than 100 percent annually, reaching a level of $1.72 billion in 1984 (MMS, February, p. 82). But it's also clear that the market is still in its formative stages, with projections of 1980 shipments in the 100,000 range.

But with the 8-in. drive just poised for takeoff, why would anyone think there's a broad need for a 5¼-in. Winchester drive? Finis Conner, executive vice president and a co-founder, along with Alan Shugart, of Shugart Technology, believes one of the reasons his company can be successful with the ST500 is precisely that the 8-in drives haven't been shipped in large quantities. A second major factor that Conner is counting on to give the ST500 early impetus has been the inability of suppliers of 5¼-in. double-sided floppy-disk drives to meet the demand for those units created by manufacturers of small computer and word-processing systems.

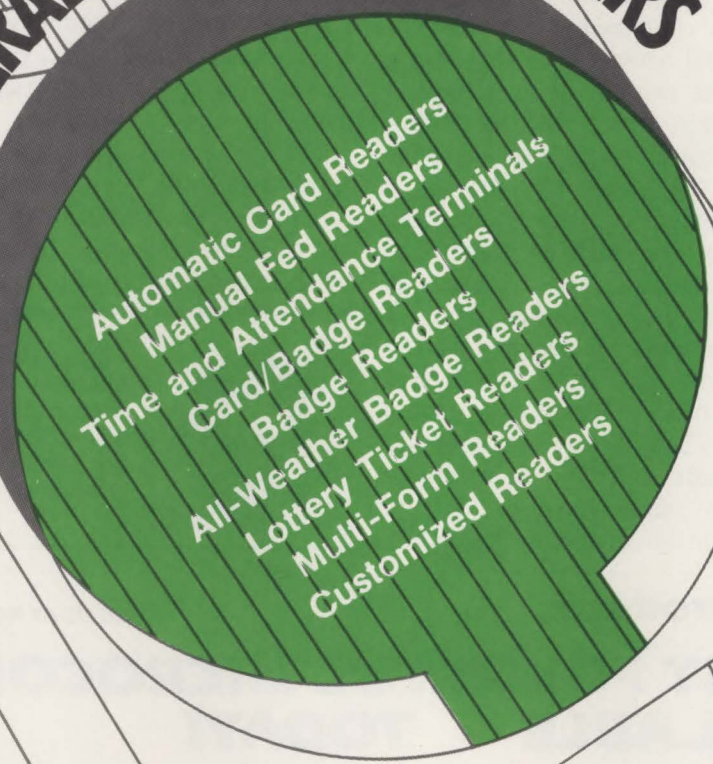
That's the market window that Shugart and Conner see for the ST500. Both men helped found Shugart Associates, but neither has any affiliation with the latter firm. "We saw an opportunity to be the first company to take advantage of a market need if we could get to the market first, fast and in substantial volume," says Conner, "because customers for the minifloppy weren't getting sufficient quantities, and the ones they were getting were memory bound." Maximum storage with a minifloppy is about 1M bytes.

Shugart Technology's strategy included the need for the micro-Winchester to exactly match the package size and DC voltages of the minifloppy so that system designers would find it easy to upgrade to a Winchester, and to offer a minimum of 5M bytes of formatted data storage. Further, the company wanted to be able to ship in production quantities within three months of formal product announcement. The hardware goals have been met, and preproduction versions of the ST500 are operating. Conner is confident that production units will be shipped in volume in the third quarter.

In order to avoid the proliferation of package and platter sizes, types of interfaces and varying storage capacities that Conner believes has precluded the 8-in. Winchester from getting broader early acceptance, Shugart Technology has standardized on the minifloppy package dimensions, and has worked with Dysan Corp. to come up with a platter size that Conner hopes will become standard, as well. The disks have an outside diameter of 130 millimeters, and an inside diameter of 40mm.

—Lawrence J. Curran

GET A GREAT START ON SYSTEM PERFORMANCE WITH PERIPHERAL DYNAMICS READERS



Get off to a great start at the NCC. Visit PDI in Booth 2547-49.

Information processing — no matter what the application — starts with data, and how that data gets into the system plays an important part in how well that system is going to perform. And how profitable it's going to be, whether you're an OEM or systems house.

Peripheral Dynamics makes that start a confident one for you, with a family of card, badge and forms readers that have been proven in thousands of systems in countless applications throughout the world.

Readers like our Ultra-Quiet 600 CPM Card Reader, that's practically maintenance free; our all-weather badge reader, that provides the highest level of security and safety in automated (hazardous environment) bulk terminal systems; our broad spectrum read head, that handles almost any mark sense challenge you can find; and our forms readers that can read everything from newsprint thinness to badge thickness, from 22 columns to 3½ feet, and on a range of colored stock that practically spans the rainbow.

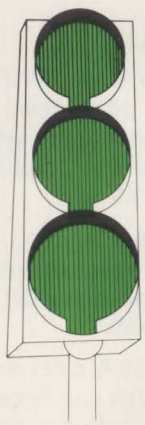
With reading ability like that, it's no wonder we say that Peripheral Dynamics helps give you a great start on system performance...and profits.

Just like we've been doing — reliably and responsively — for OEMs and system houses for more than a decade.

Peripheral Dynamics. We sell great starts.

PERIPHERAL DYNAMICS INC.
Whitpain Campus • 1730 Walton Road • Blue Bell, PA 19422
(215) 277-8484 • TWX 510-660-8028

START ME OFF with more information on your readers.



I am interested in

☐ Automatic Card Readers ☐ Manual Fed Readers
☐ Card/Badge Readers ☐ Time & Attendance Terminals ☐ My special reader need is _____

_____

Name _____

Title _____

Company _____

Address _____

City _____ State ___ Zip _____

Phone _____

PDI • 1730 Walton Road • Blue Bell, PA 19422

CIRCLE NO. 50 ON INQUIRY CARD

New Winchester drive incorporates standard stepper motors, standard heads and a standardized disk platter.

minifloppies. The ST500 will easily improve the minimum MTBF rating of 8000 "power-on" hours of 8-in. Winchesters.

In contrast, some users report that minifloppy disks can't take heavy use because the disk is handled repeatedly and the head is in direct contact with the disk during reading and writing, thus shortening disk life. But a micro-Winchester combined with a minifloppy limits the latter to I/O and backup roles, extending diskette life. If a system has two minifloppy drives, a designer can simply replace one with the micro-Winchester. The voltage requirements are the same for both and a single controller can handle both drives.

Besides being easily backed up, the ST500 uses standard available hardware as much as possible to make it simpler to manufacture, and to make it available as soon as possible. Shugart Technology buys standard heads, disks and stepper motors, and it's the company's function to assemble and test the drives. Drive mechanics are broken into two motor assemblies—a stepper and a spindle—a head assembly with four Winchester heads and a disk assembly containing two disks. The disks have an outside diameter of 130mm and an inside diameter of 40mm.

The stepper motor uses a steel band to position the heads over 153 tracks. Track-to-track access time is 3 msec., with a 15-msec. settling time on the last step, providing an average access time, including settling, of 170 msec. and maximum access time of less than ½-sec. The spindle is driven by a DC brushless motor that spins the disks at 3600 rpm.

The motor controls the speed at ±1 percent to ensure data integrity, and the unit comes up to speed within 15 sec. An integral brake stops disk rotation within 15 sec.

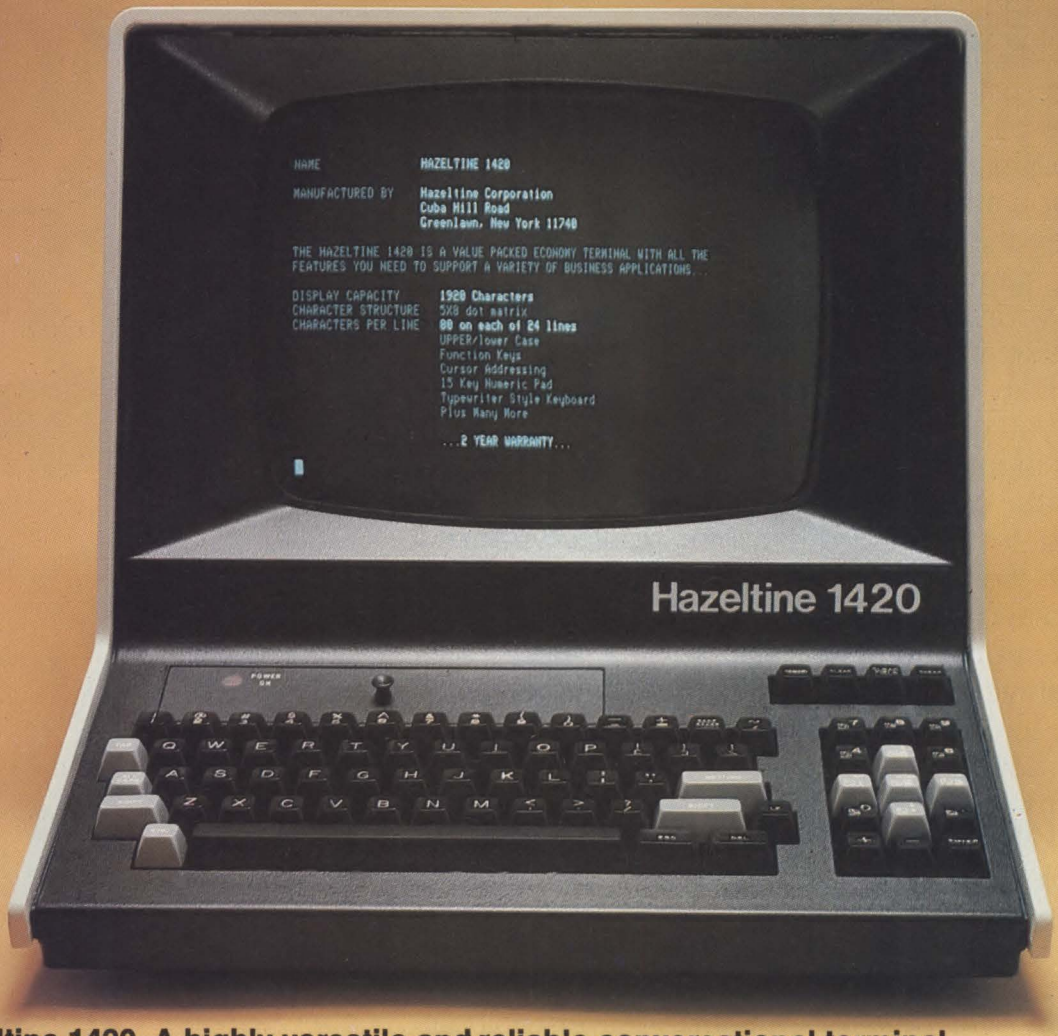
Shugart Technology designers chose an open-loop stepper motor for the ST500 because of its low cost and very high reliability, although enhanced versions that might follow could offer greater track density and higher capacity by incorporating a closed-loop stepper motor or voice-coil actuator.

The ST500 will sell for $925 each in quantities of 500. Hard-tooled units will be operating at the National Computer Conference in Anaheim, Calif., May 19-22, and schedules call for shipping in production quantities by the third quarter of this year. ■

Finis Conner is co-founder and executive vice president of Shugart Technology. Along with Alan Shugart, he also helped found Shugart Associates, but neither man now has any affiliation with the latter company.

Hazeltine

builds more performance into a low cost terminal



Hazeltine 1420. A highly versatile and reliable conversational terminal.

If you're interested in low-cost conversational terminals, then you should know about the Hazeltine 1420 which offers more performance and reliability than any other terminal in its price class. With the Hazeltine 1420 you get a full range of operator convenience features: a separate enhanced numeric pad, a familiar typewriter keyboard and cursor control keys. You also get upper and lower case, variable intensity and blinking fields, features you'd expect only on higher priced systems.

Best of all, the Hazeltine 1420 is backed by our exclusive two-year warranty which gives you immediate replacement of circuit boards at absolutely no charge. Ask for details.

Why settle for less, when the best conversational terminal costs no more than all the others?

Hazeltine Corporation, Computer Terminal Equipment,
Greenlawn, NY 11740 (516) 549-8800
Hazeltine and the Pursuit of Excellence

New York (212) 586-1970 • New Jersey (201) 584-4661 • Chicago (312) 986-1414
San Francisco (415) 342-6070 • Atlanta (404) 952-8444 • Arlington (703) 979-5500
Orlando (305) 628-0132 • Dallas (214) 980-9825 • Los Angeles (213) 553-1811
Columbus (614) 889-6510 • England 01-948-3111 Telex (851) 928572

Hazeltine **Answers for the eighties**

CIRCLE NO. 51 ON INQUIRY CARD

If you're an OEM or system builder, no doubt you've been subjected to the 8-inch Winchester hustle.

Well, Century Data thinks it's time to rack up the facts and lay them on the table.

First off, the 14-inch Winchester is rebounding. Just as predicted. And Century's new Marksman disk is the perfect example.

Sure 8-inch drives will be available some day. But can you afford to wait?

Today, the need for more storage and less cost is forcing many companies to go Winchester. And we think your best shot is our Marksman drive.

Marksman is the no-risk disk with enormous expandability and optional built-in intelligence. It's also one you can get today.

Built-in intelligence means you won't get behind your competition by spending months designing, testing and debugging your own disk controller. We've already done most of the work. You're up and running in days, not months.

Built-in growth means you won't have to start over when your applications increase. Marksman comes in 10, 20, and 40 MB models, and a lot more to come soon.

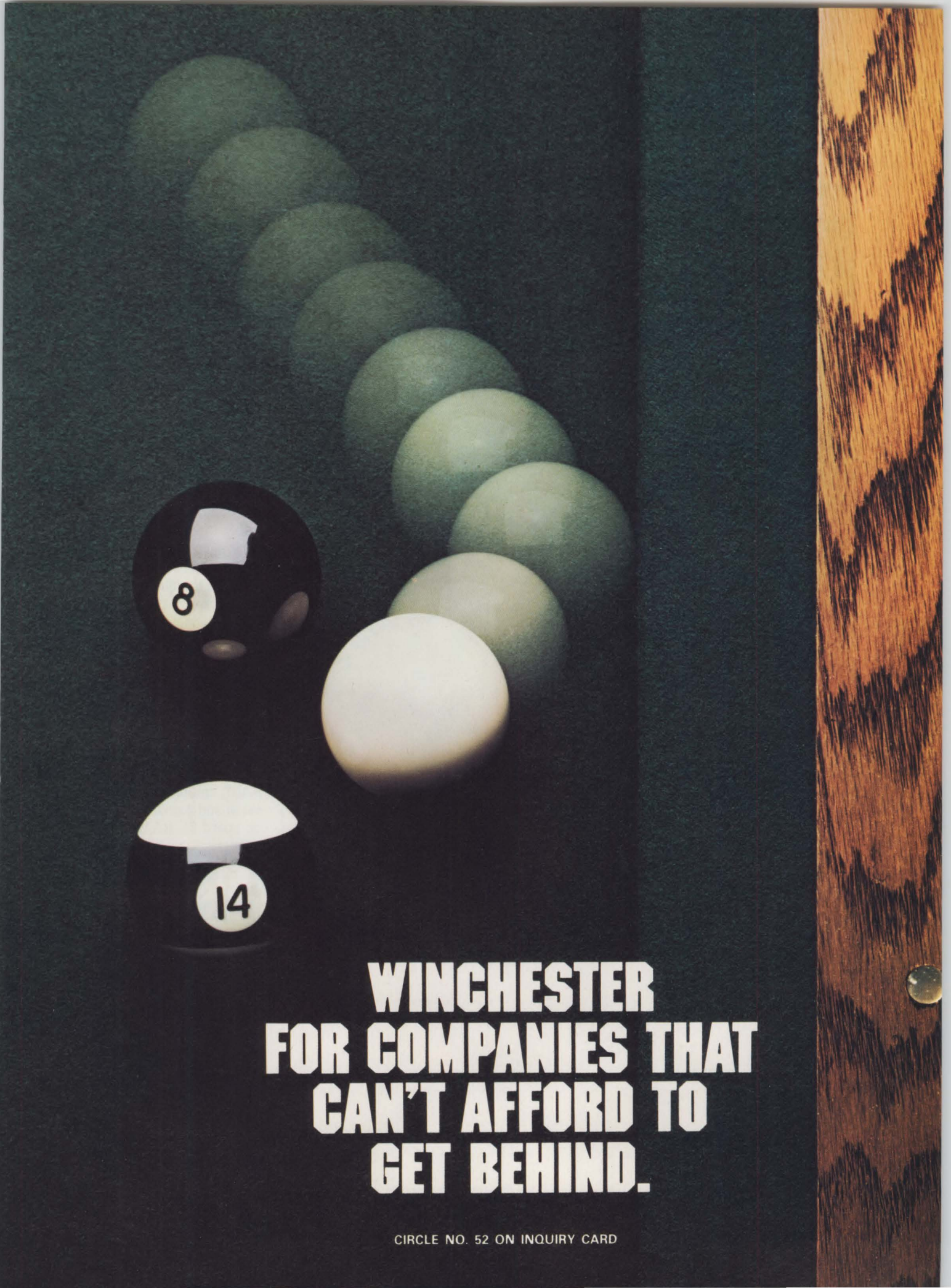
For more flexibility, Century offers everything from a 2½ MB Diablo cartridge disk to the 600 MB removable-pack Trident — with lots of mixed and fixed storage in between.

So if you can't afford to get behind, call Century Data, a Xerox Company specializing in mass storage for over 11 years. Our early delivery will put you ahead. Our advanced technology will keep you there.

Century Data Systems,
1270 North Kraemer Blvd.
Anaheim, CA 92806
Phone: (714) 632-7500

Century Data Systems
A Xerox Company

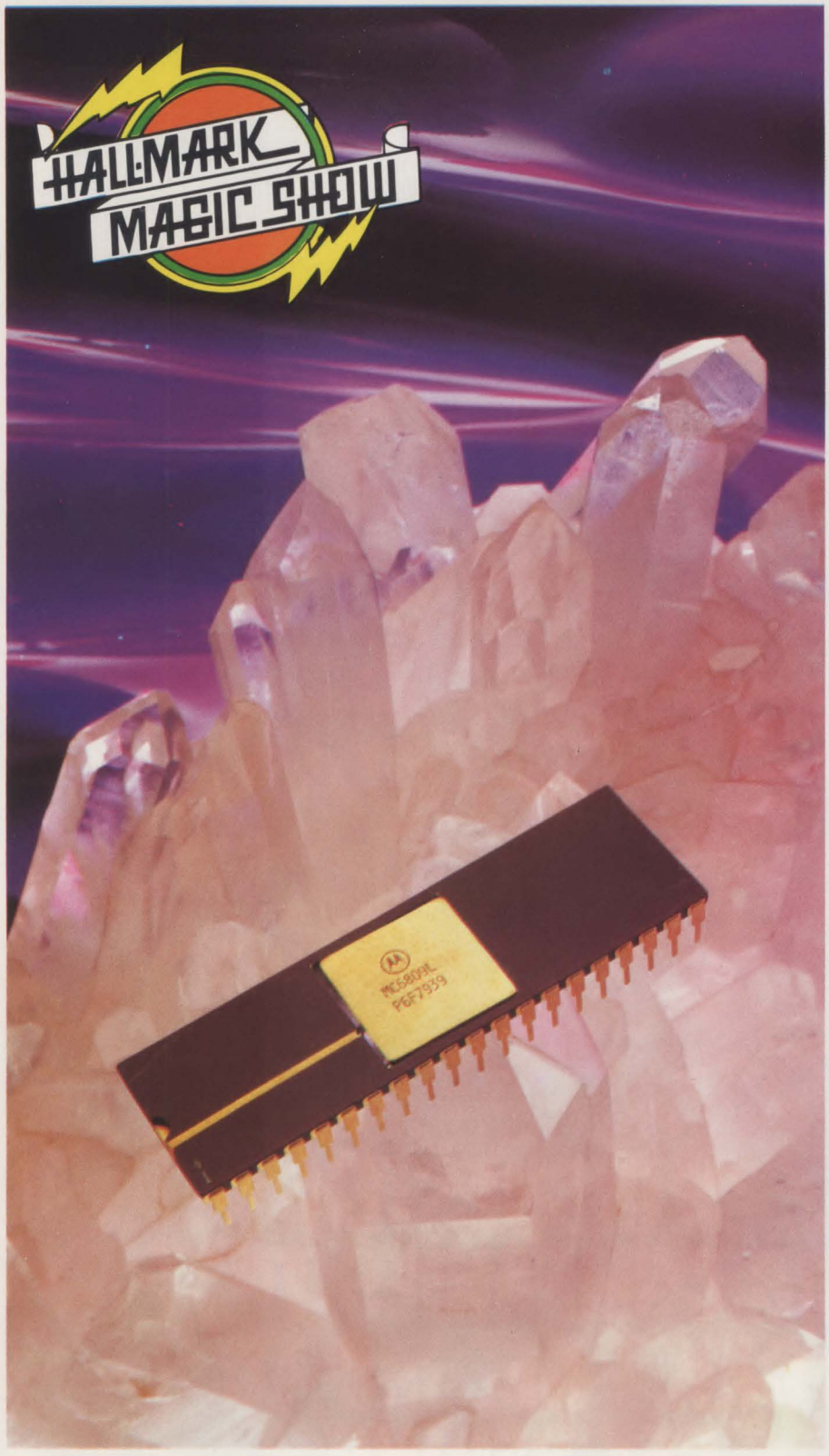
CIRCLE NO. 52 ON INQUIRY CARD



WINCHESTER FOR COMPANIES THAT CAN'T AFFORD TO GET BEHIND.

CIRCLE NO. 52 ON INQUIRY CARD

THE MOTOROLA

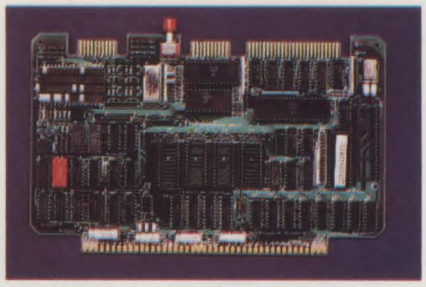


The Third Generation MC6809 Group Is Here!

Motorola's MC6809 Microprocessor offers you up to 5 times the performance of the MC6800. Additional 16-bit registers, plus two 8-bit accumulators linked together to form one 16-bit accumulator, provide 16-bit operation. Add a position-independent or relocatable code, 19 addressing modes and a 1468 instruction set and you have one of today's most versatile and powerful 8-bit microprocessors. Software development is relatively economical because the 6809 is upward compatible from the 6800, and is programmable with high-level languages such as Pascal.

The M68MM19 Monoboard Microcomputer Module uses the 6809, and offers you state-of-the-art processing capability. The M68MM19 a stand-alone system that can be easily expanded. It contains four sockets for ROM, PROM or RAM, and features programmable serial and parallel interfaces and on-board 2K RAM.

For more flexibility add Motorola's M68MM09, a 4K static

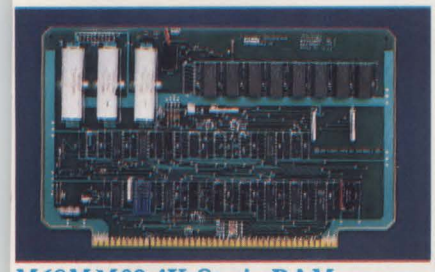


M68MM19 Monoboard Microcomputer Micromodule 19

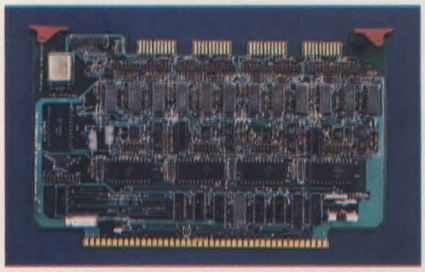
MPU TRICK

Hall-Mark's Motorola Systems Demonstration Center

RAM module with battery backup. Put a M68MM07 quad communications micromodule on the line and get cost-effective interface with 4 serial ports and 21 hardware/software selectable baud rates ranging from 75 to 115K.



M68MM09 4K Static RAM Module Micromodule 9



M68MM07 Quad Communications Module Micromodule 7

Incidently, the MC6809 is hardware/software compatable with the 6800 family. So if you would like to bring your EXORciser to a 6809 capability you can do it. Just ask Hall-Mark about the MEX6809KT upgrade kit.

MEX6809KT Upgrade Kit

In fact, ask us about any of the Motorola products like the 6809 group. We have the hardware to fill your order, and the Hall-Mark Systems Demonstration Center gives you a hands-on opportunity to test, analyze and refine your systems requirements. Processing or control, our specialists have helped many a project get started on the right road. We have a unique overview of the products on today's market, their capabilities and limitations.

When it comes to Microprocessing, come to Motorola at Hall-Mark It's the best show in town.

MOTOROLA

I would like more information on Motorola's MPU products. Please send me the literature items I've checked.

- ☐ M68MM07 Quad Communications Module
- ☐ M68MM09 4K Static RAM Module
- ☐ M68MM19 Monoboard Micromodule Microcomputer
- ☐ MC6809 Microprocessor
- ☐ Other _____

Name _____

Company _____

Address _____

City _____

State _____ Zip _____

Phone _____

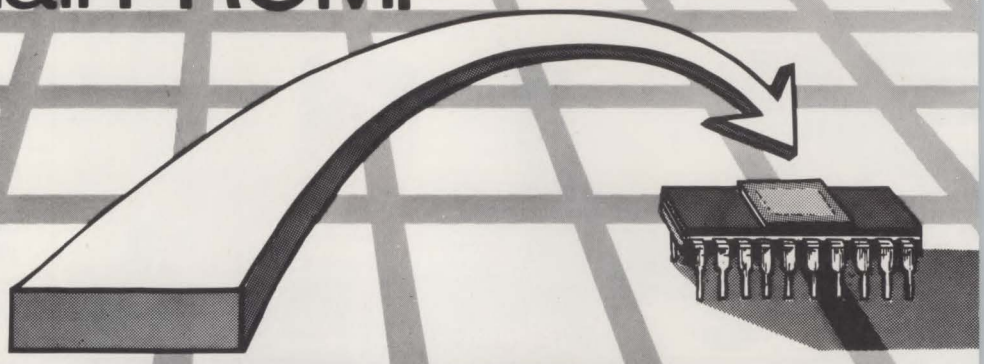
Jim Burnett
Hall-Mark Electronics Corp.
Box 222035
Dallas, Texas 75222

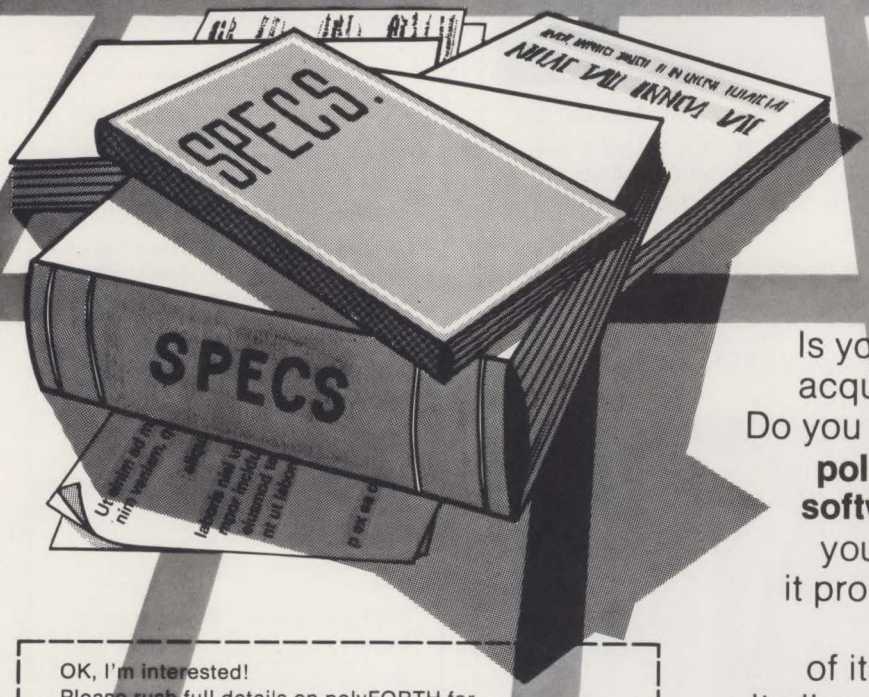
HM3580

HALL-MARK

HALL-MARK ELECTRONICS CORP. ATLANTA 800-633-2918 AUSTIN 512-837-2814 BALTIMORE 301-796-9300 CEDAR RAPIDS 800-323-0558 CHICAGO 312-860-3800 CINCINNATI 800-282-6933 CLEVELAND 216-473-2907 COLUMBUS 614-846-1882 DALLAS 214-341-1147 DAYTON 800-282-6933 HOUSTON 713-781-6100 HUNTSVILLE 205-837-8700 KANSAS CITY 913-888-4747 KNOXVILLE 800-633-2918 LAWRENCEVILLE 800-633-2918 MIAMI 305-971-9280 MILWAUKEE 414-761-3000 MINNEAPOLIS 612-884-9056 OMAHA 800-255-6946 ORLANDO 305-855-4020 PHILADELPHIA 215-355-7300 RALEIGH 919-832-4465 ST. LOUIS 314-291-5350 TAMPA 800-432-0564 TULSA 918-835-8458 WICHITA 800-332-4375 FOR SALES & SERVICE IN THE 11 WESTERN STATES: 800-527-3272 NEW ENGLAND AREA 800-523-6288 NEW YORK AREA 800-523-6288

polyFORTH™
shrinks your big problem into a small PROM.





Do you use an 8080, 8086, 1802, 9900 or LSI-11? Is your field process control, data acquisition or automated testing? Do you have a real time application? **polyFORTH will help solve your software problems.** It will reduce your development time because it promotes interactive debugging. It saves memory because of its unique dictionary structure. It allows control of run time because it is a true multilevel language. It insures transportability because it is a virtual computer. And if your final program resides in PROM, polyFORTH's Target Compiler™ will produce exceptionally compact code. Let us tell you more. Send the coupon, attend a free seminar but first give us a call at: **213/372-8493**

OK, I'm interested!
Please rush full details on polyFORTH for
_____ microprocessors
_____ minicomputers

☐ Contact us for immediate requirements
Tel: ( ) _____

☐ Send dates and locations for your polyFORTH Seminars.

Name _____

Title _____

Attach coupon to company letterhead, and return to:
FORTH INC., 2309 Pacific Coast Highway,
Hermosa Beach, CA 90254. Or call (213) 372-8493.

FORTH, Inc.

CIRCLE NO. 54 ON INQUIRY CARD

Product Profile

High-level languages for microcomputers

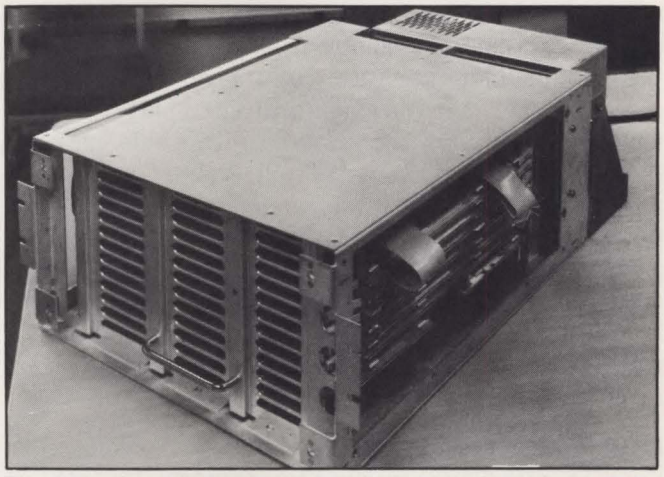
MOKURAI CHERLIN, APL Business Consultants, Inc.

Most popular high-level languages can now be run on microprocessors

The attraction of high-level languages is the same now for microcomputers as it was when such languages were first introduced in the fifties for what were huge machines—the saving of programming time and effort by letting the computer do some of the work. The microprocessors that are now appearing are actually superior in almost every way to computers such as the IBM 704, for which FORTRAN, COBOL and LISP were originally written. The economics of computer languages have remained essentially unchanged. When a large project requires a small amount of code executing as fast as possible, assembly language is still used; as the number of copies of a program or its total execution time falls relative to the expense of writing, debugging, modifying and improving it over time, intermediate and higher level languages become more attractive.

When microprocessors first appeared in 1972, there was no choice: assemblers, cross-assemblers and, later, PL/M were the only tools available. BASIC was first offered for the 8080 in 1975, and a subset of FORTRAN IV in 1976. For most of the last five years, since microcomputers began to be sold in kit form, their system software has been written in assembly language and application programs in BASIC. More recently, however, it has become possible to buy applications off-the-shelf in FORTRAN, COBOL, Pascal, FORTH and several other languages for a wide range of both 8- and 16-bit processors.

System software is also being written in high-level languages. The University of California at San Diego has a Pascal system including a Pascal compiler, a BASIC compiler, an editor, an operating system and more, written entirely in Pascal except for the run-time interpreter for the intermediate compiled code and a few I/O routines. Similarly, FORTH systems are written mostly in FORTH. The UNIX operating system, written in C, will soon be available on the Onyx Z8000-based system, and other variants of UNIX have appeared for the 8080 and the 6800. Concurrent Pascal has been implemented at UCSD, but not yet released; it will enable structured programming of portable multitasking operating systems.



The Aydin Controls 5216 *color graphics computer uses a version of FORTH as its operating system, running on an 8086 microprocessor.*

Fred Brooks, manager of the original OS/360 development project, recommends coding operating system functions in APL first to get the algorithm right, then translating to PL/I to match the machine environment. This approach has recently become possible using Telecompute's full APL and Digital Research's PL/I subset.

Pascal and FORTH are the main languages on a growing number of microprocessor development systems, and are used in control systems ranging from single-board computers to multiterminal, multiprocessor systems for factories. It is possible to use FORTH on a single-chip microcomputer, and a FORTH microprocessor is in the research stage.

Direct execution of high-level code, without recourse to conventional machine language, ranks among the most significant developments in microcomputers. Besides the FORTH device just mentioned, research is

Most currently available compilers and interpreters are for 8-bit processors, especially the Z80.

being done on APL and LISP microprocessors, and there is already the Western Digital Pascal MICROENGINE, a microprogrammed processor whose "machine language" is Pascal p-code. Sorrento Valley Associates claims that the MICROENGINE, which uses the same chip set as the LSI-11 and AM-100, but a different microprogram, executes Pascal programs faster than an LSI-11 executes hand-tuned machine code for the same operations.

Coverage

The dividing line between microcomputers and minicomputers is hazy, and complete coverage of all existing processors is not possible. The rule followed here is to include language implementations for all microprocessors (except single-chip versions of minicomputers) that are available from the manufacturer at the chip (or, more accurately, DIP) level or are sold by someone other than the manufacturer on plug-in boards for computers using the S-100 bus. This rule excludes the microNOVA and LSI-11, as well as many proprietary processors used in desk-top computers and intelligent terminals. As far as possible, every language that runs on any of these processors is listed in our product table, with the exception of BASIC, which is already well-known, PL/M and its numerous relatives, which are middle-level languages, and a number of single-vendor languages.

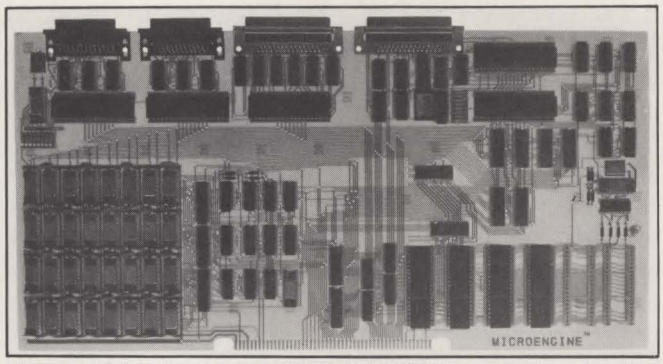
Configurations

Most currently available compilers and interpreters are for 8-bit processors, the Z80 especially dominant (reflecting the fact that there are more than 300,000 Z80-based microcomputer systems in the field—more than for all other microprocessors together). Of the 16-bit processors, the Zilog Z8000 and Motorola 68000 are attracting the most attention from language implementors, partly because of their 32-bit internal architectures.

An 8-bit processor can directly address 64K bytes of memory using 16 address lines, or as much as 1M byte with bank select. The memory-addressing capabilities of 16-bit processors vary from 256K bytes (20 lines) to 2.0 gigabytes (31 lines). Similarly, most 8-bit processors can manage 256 I/O ports with 8-bit addresses, while many 16-bit machines have 64K bits of I/O space. The most recent 16-bit microprocessors are faster and have greatly expanded register space and instruction sets compared either to their 8-bit predecessors or to earlier 16-bit devices. Their performance puts them in the midrange of minicomputer CPUs. Hardware floating-point and I/O-channel processor chips make even more powerful configurations possible.

Most 8-bit systems are configured for a single user and a single task, but several operating systems support four users, and a few of the compilers listed in the table provide position-independent or reentrant code (compiler, object code or both) to enable swapping or sharing on such systems. The 8-bit processors lack many of the features that facilitate such operation: no relative or indirect addressing in many cases, and at most, one stack pointer. The 16-bit units provide a variety of addressing modes and in some cases the ability to use any register as a stack pointer. On these processors, full compiler support for multiprocess systems will be the norm, and 16-user operating systems will become commonplace.

The configuration of a computer system using a high-level language can vary enormously. At one extreme, FORTH can be stripped down to a minimum run-time system of about 500 bytes and used on a single-board, or even a single-chip, microcomputer for process-control and data-acquisition. And several compilers for other languages can produce object-code modules of 2K bytes or less, including run-time support.



Western Digital's Pascal *MICROENGINE incorporates the first high-level language microprocessor, which directly executes Pascal p-code.*

At the other end of the scale, a micro can be equipped with several megabytes of main memory, several hundred megabytes of hard-disk storage, a dozen or more terminals, printers, plotters and other peripherals, plus a variety of languages, for less money than a similar minicomputer system. A more typical system comprises 32K to 64K bytes of main memory, two floppy-disk drives, a CRT terminal, a printer and perhaps a 10M-byte, 8-in. hard-disk drive.

Languages vary considerably in their requirements for main memory and mass storage. Most need one or two floppy disks, but some can manage with cassette I/O. The only general rule is that compilers need more space than the resulting object code; the table lists compiling requirements wherever possible. Cross-compilers are occasionally very large, requiring an IBM 370 with a hard disk in some cases. The best compilers enable segmenting and linking of programs, so that huge programs can be compiled and run even on small machines.

Translation methods

Most programmers are familiar with both compilers and interpreters, but there are other variants, as well,

TOREN/GAYNOR

Parliamo molte lingue.

(We speak many languages)

Over 15,000 Ontel intelligent systems are used worldwide with many languages—English, Italian, German, French, Spanish and Hebrew. Our software languages include—PASCAL, BASIC, FORTRAN and OP/L. Ontel provides everything for successful OEM installations...data processing...word processing...communications...delivery...customer support ...operating systems. And certainly not least—highly attractive pricing. Contact me today. You'll find we speak your language.

Edward J. Heinze
Vice President Marketing
Ontel Corporation
250 Crossways Park Drive
Woodbury, NY 11797
(516) 364-2121

Ontel

CIRCLE NO. 55 ON INQUIRY CARD

TABLE OF MICROCOMPUTER HIGH-LEVEL LANGUAGE SUPPLIERS

The following table is provided as a guide to vendors of high-level languages for microcomputers. The table was prepared by the staff of Mini-Micro Systems from its own sources. Some suppliers may not be included, either because they did not respond to our survey questionnaire or responded too late to be included.

SOURCE	NAME	PROCESSORS	OPERATING SYSTEMS	NUMBER OF USERS	TYPE OF TRANSLATOR	CONFORMANCE TO STANDARD
Advanced Micro Computers	COBOL	8080				ANSI 1974 Level 1, plus some Level 2
	FORTRAN	8080	CP/M	one	compiler	ANSI 1966 with extensions
	Pascal	8080, Z80, Z8000	CP/M, Z8000 monitor	one	cross-compiler, compiler-interpreter	UCSD 1.4
Algorithmics, Inc.	FORTRAN IV	8080, Z80	CP/M	one	compiler	ANSI 1966
Alpha Micro Systems	ALPHALISP	AM-100	AMOS	several	interpreter	LISP 1.5
	Pascal	AM-100	included	several	compiler-interpreter	UCSD
AM-100 User's Group	FORTH	AM-100	included		interpreter, compiler-interpreter	
American Microsystems, Inc.	Pascal	6800	included	one	compiler-interpreter	UCSD
Apple Computer, Inc.	Apple Pascal	6502	included	one	compiler-interpreter	UCSD with strings, color graphics
Avocet Systems	STOIC-II	8080, Z80	CP/M	one	interpreter, compiler-interpreter, compiler	
Aydin Controls	AYDOS (version of FORTH)	8086	is an operating system	several	interpreter, compiler-interpreter	color graphics extensions
	FORTRAN	8086	AYDOS	several	compiler	
BD Software	C	8080, Z80	CP/M	one	compiler	UNIX C subset
The Boston Systems Office, Inc.	BSO/Pascal	6800, 8080, 8086			cross-compiler (PDP-11, DECsystem 10, DECsystem 20, NOVA, ECLIPSE)	Wirth, interface extensions
California Software	SUPER-PILOT	8080, Z80	Northstar DOS, CP/M	one	compiler-interpreter	
CAP-CPP, Inc.	MicroCOBOL	8080, Z80, 6800, 9900, 8086, PDP-11, Series/1	BOS (included)	several	compiler	ANSI 1974 subset with many extensions
Cap'n Software	fig-FORTH	6502	included	one	interpreter, compiler-interpreter	FORTH-79
CETEC Corp., DMC Division	Pascal	8080		one		
Computerware	PILOT	6800				
Compu/Think	FIFTH (version of FORTH)	hybrid 6502		one		
Control Systems, Inc.	UCSD Pascal	6800, 6809, 68000	included	one	compiler-interpreter	UCSD version 2.0 (4.0 in the future)
Cook's Computer Company	PILOT	6502	Apple DOS 3.2 (included), Applesoft BASIC	one	interpreter	core instructions plus graphics and sound extensions

COMPUTER SYSTEMS WITH THIS VERSION	MINIMUM MAIN MEMORY (bytes)	MINIMUM MASS STORAGE	COMPILING SPEED (lpm)	PRICE	SOURCE CODE AVAILABILITY AND PRICE	COMMENTS
AMC					no	Z8000 version under development
AMC	64K			$950	from Microsoft	Z8000 version under development.
AMC AmSYS 8/8	64K	one floppy disk	180	$1450	no	
Algorithmics, Inc.	48K			$500	no	
Alpha Micro, Khalsa				bundled	no	
Alpha Micro				bundled	no	
none						
AMI MDC-100					no	microprocessor development system
Apple	48K	one minifloppy disk		$495	no	sold only with Apple Language System (16K RAM and autostart ROM card, two BASICs)
	48K	one floppy disk	600	$2000	$4000	enhanced FORTH, with a file system and more error checking
Aydin 5216 Color Graphics Computer				bundled	no	also available in PROM without disk-handling, editor and files
Aydin 5216 color graphics computer					no	AYDOS is a version of FORTH
none	24K		200	$110	not yet	sold by Lifeboat Associates
BSO UMDS-40	64K words to compile	5M-byte disk			no	microprocessor development system
none	16K			$49.95	no	
CAP-CPP				$595 to $745	no	BOS is processor independent; microCOBOL provides structured pogramming and interactive test and debugging facilities
Cap'n Software	16K	one floppy disk			included	
DMC CommFile 130	44K	two floppy disks		bundled	no	
				$24.95	no	
Compu/Think Minimax						processor is partially user-microprogrammable
SWTPC, Smoke Signal Broadcasting, Control Systems	56K	one floppy disk	300	$250 to $419	no	ROMable code; p-code interpreter available in ROM (2716 or 2708); used in very large-scale control applications, such as grain elevators
	32K	one floppy disk		$25	included	

SOURCE	NAME	PROCESSORS	OPERATING SYSTEMS	NUMBER OF USERS	TYPE OF TRANSLATOR	CONFORMANCE TO STANDARD
Creative Solutions	MULTI-FORTH	8080, Z80, 68000	CP/M, included	10	interpreter, compiler-interpreter, compiler	FORTH-79
Cromemco, Inc.	RATFOR	Z80	CDOS	one	pre-compiler	*Software Tools* by Kernighan & Plauger
The Digital Group	CONVERS (version of FORTH)	Z80	PHIMON	one	interpreter, compiler-interpreter	no
Digital Marketing	Pascal/M	8080, Z80	CP/M, MP/M, CDOS	one	compiler-interpreter	draft ISO standard, slight changes
Digital Research	PL/I-80	8080, Z80	CP/M, MP/M	one, eight	compiler	proposed ANSI subset "G"
Dynasoft Systems	Dynasoft Pascal	6800	MIKBUG, SWTBUG	one	compiler-interpreter	restricted subset
Ellis Computing	Nevada COBOL	8080, Z80	CP/M	one	compiler	ANSI 1974 strict subset
Extensys Corp.	COBOL	8085	EMOS	several	compiler	
	FORTRAN	8085	EMOS	several	compiler	
FMG Corp.	COBOL	Z80	TRSDOS, CP/M	one	compiler	
	FORTRAN	Z80	TRSDOS	one	compiler	ANSI 1966 except complex numbers
	Pascal	Z80	TRSDOS, CP/M	one	compiler-interpreter	UCSD
FORTH, Inc.	polyFORTH	8080, 6800, 1800, 9900, 8086, LSI-11	included	several	interpreter, compiler-interpreter, compiler	is standard
FORTH Interest Group	fig-FORTH	8080, 6800, 6502, PACE, PDP-11	included	one	interpreter, compiler-interpreter	FORTH-79
Forthright Enterprises	fig-FORTH	8080	included	one	interpreter, compiler-interpreter	FORTH-79
GenRad/Futuredata	Pascal	8080, 8085, Z80, 6800, 6802, 8086	RDOS	eight	compiler-interpreter	
	Pascal	8086, Z8000, 68000	RDOS	eight	cross-compiler	
GNAT Computers, Inc.	FORTRAN-80	8080	ANAIO.COM	one	compiler	ANSI 1966 except complex numbers
Dave Gomberg	PILOT	6502	Commodore PET, CBM	one	interpreter	close to PILOT-73
Patrick Greussay, University of Paris (France)	VLISP	Z80			interpreter, compiler	
Hewlett-Packard Co.	Pascal	8080, Z80, 6800, 6809		one	cross-compiler (HP-64000A)	subset

COMPUTER SYSTEMS WITH THIS VERSION	MINIMUM MAIN MEMORY (bytes)	MINIMUM MASS STORAGE	COMPILING SPEED (lpm)	PRICE	SOURCE CODE AVAILABILITY AND PRICE	COMMENTS
Creative Solutions	8K	one floppy disk	1200	$1000 to $2500	included	
Cromemco				$195	published in *Software Tools*	structured programming preprocessor for FORTRAN, with control structures from C; object code is standard FORTRAN, which is then compiled
The Digital Group	26K	two digital cassettes		$25		
Altos, Micromation, Godbout Electronics	56K	one floppy disk	450 (4MHz Z80)	$350	OEMs, $85,000	
none	48K	one floppy disk	200		no	code is not reentrant; hard disk supported; CP/M and MP/M are products of Digital Research
none	12K	one cassette drive		$38	included	6809 version in preparation
	20K	one floppy disk	700	$99.95	compiler $10,000, run-time package $500	
Extensys					no	
Extensys						
none					no	
none	48K	two floppy disks		$150	no	
FORTH, Inc.	16K	two floppy disks		$4000	included	company founded by the originators of FORTH
Cap'n Software	16K	one floppy disk		$10, listing only	included	not a toy, in spite of price; vendor is a noncommercial group
	16K	one floppy disk			included	
Genrad 2300 development systems	64K	one floppy disk	100	$1500	no	
Genrad 2300 development systems	64K	one floppy disk	100	$2000	no	
GNAT DAS-512				$350	no	Microsoft FORTRAN-80 modified to use one to four AMD 9511 32-bit floating-point processors on a separate board in a data-acquisition system
	8K	two cassette drives		$25	included	versions differ slightly — differences fully documented
						optimizing compiler with recursion elimination
HP-64000A development system		one floppy disk			no	

SOURCE	NAME	PROCESSORS	OPERATING SYSTEMS	NUMBER OF USERS	TYPE OF TRANSLATOR	CONFORMANCE TO STANDARD
InfoSoft Systems, Inc.	Pascal	8080, Z80	TSA/OS, CP/M		compiler	subset of ISO proposal Pascal
Institut für Theoretische Informatik	Pascal	Z80	Compucorp Zebra PB00	one	cross-compiler (IBM 370, Siemens 7000)	Wirth with some restrictions
Intel Corp.	FORTRAN-80	8080, 8085	ISIS-II, RMX-80	one	compiler	ANSI 1978 with extensions and omissions
	iCIS COBOL	8080, 8085	ISIS II		compiler-interpreter	ANSI 1974 Level 1
	Pascal 80	8080, 8085	ISIS II		compiler-interpreter	Jensen & Wirth with extensions similar to UCSD
Ithaca Intersystems, Inc.	Pascal/Z	Z80	CP/M, Ithaca K2	one	compiler	Wirth
Language Resources, Inc.	Pascal	8080, 8085, Z80, 8086, 8088	ISIS-II, RMX-80, MTOS		compiler, cross-compiler	Jensen/Wirth, as clarified by Draft Proposed ISO Standard
The LISP Company	TLC-LISP	Z80	CP/M, Cromemco CDOS	one	interpreter	subset of MIT LISP machine, without arrays and unlimited precision arithmetic
Lucidata, Pascal Division	Pascal	6800		one		
Mad Hatter Software	PILOT	Z80		one		
Marinchip Systems	Sequential Pascal	9900	Marinchip Disk Executive, Marinchip Network OS	one	compiler-interpreter	Brinch Hansen's Sequential Pascal
Micro Focus, Inc	CIS COBOL	8080, 8085, Z80, PDP-11, LSI-11	CP/M (or any CP/M-compatible OS), RT-11, CDOS		compiler-interpreter	ANSI 1974 Level 1, with Level 2 extensions
Micro Focus Ltd.	CIS-COBOL	8080	ISIS-II, CP/M	one	compiler	ANSI 1974 Level 1, plus part of Level 2
Micropi	Common PILOT	8080, Z80, 6800, 6809, 6502, AM100, LSI-11, IBM	CP/M, HELIOS, North Star, TRSDOS, FLEX, AMOS, UCSD Pascal, Terak	one or four (6809)	interpreter	is the standard
Microsoft	COBOL-80	8080, Z80	CP/M, ISIS-II, TRSDOS	one	compiler	ANSI 1974 Level 1, plus most of Level 2
	FORTRAN-80	8080, Z80	CP/M, ISIS-II, TEKDOS	one	compiler	ANSI 1966 except no complex numbers
Microware Systems Corp.	LISP	6800		one	interpreter	
Miller Microcomputer Services	MMSFORTH	Z80	included	one	interpreter, compiler-interpreter, compiler	microFORTH of FORTH, Inc.
Mostek Corp.	FORTRAN IV	Z80	FLP-80DOS V2.1	one	compiler	ANSI 66
Motorola, Inc.	COBOL	6800	MDOS	one	compiler	ANSI 1974 Level 1, plus extensions
	FORTRAN	6800, 6809	MDOS	one	compiler	FORTRAN 1966, plus extensions
	Pascal	6809	MDOS	one	compiler-interpreter	extended
	Pascal	68000	Motorola	one	cross-compiler (IBM 370)	extended

COMPUTER SYSTEMS WITH THIS VERSION	MINIMUM MAIN MEMORY (bytes)	MINIMUM MASS STORAGE	COMPILING SPEED (lpm)	PRICE	SOURCE CODE AVAILABILITY AND PRICE	COMMENTS
	32K	disk	100	$250	yes	
Electronic Büromaschinen KG (Frankfurt)	56K	two floppy disks	85			
Intel				$1750	no	structured programming, no complex numbers, other deviations from standard
Intel MDS-800, Intellec Series II	64K	two floppy disks		$1300	no	
Intel Intellec	64K	two floppy disks		$975	no	
Ithaca Intersystems DPS-1	56K	one floppy disk	200	$395	yes	optimizing compiler
	64K	one floppy disk		$3000	yes	
Cromemco	48K	one floppy disk		$150	no	arrays, compiler, 16-bit processor version under development
none				$14.95		
Marinchip M9900	56K	two floppy disks		$150	no	M9900 is an S-100 CPU board
	48K	two floppy disks	100 (8080) to 250 (PDP-11/34)	$850 (CP/M), $1200 (RT-11)	to OEMs only	
Intel	32K	one floppy disk	200	$995	no	sold by Lifeboat Associates; has passed U.S. Navy COBOL validation test
Micropi, SWTPC	32K	one floppy disk		$250	$950	matrices, floating point, string and pattern matching, graphics; programs execute from disk, no size limit; main memory is used for data
Cromemco, Altos, Pertec, SORD, Billings, Ricoh, AMC, AI, Cascade Data, Findex, ICL, ISC, OSI, Rair, SST, TEI	44K	100K-byte floppy disk	200	$750	to OEMs, $10,000	the most widely distributed version, with more than 1000 users.
many	25K		1000	$500	to OEMs, $60,000	10,000 users; sold by Cromemco for $95.
				$75	no	
MMS (TRS-80)		cassette	1000	$44.95 (cassette), $64.95 (floppy disk)	included	microFORTH is the predecessor of polyFORTH; MMSFORTH runs on TRS-80 model I level II and can use Corvus' 10M-byte hard disk
Mostek Matrix development system	48K				no	
Motorola EXORciser	32K	two floppy disks		$1195	no	
Motorola EXORciser	24K	one floppy disk		$550 to $750	no	
Motorola	56K	one floppy disk		$1500	no	
Motorola				$3300	compiler only, $3300	native compiler under development

SOURCE	NAME	PROCESSORS	OPERATING SYSTEMS	NUMBER OF USERS	TYPE OF TRANSLATOR	CONFORMANCE TO STANDARD
MT Microsystems (formerly MetaTech)	Pascal	8080, Z80	CP/M, TRSDOS	one	compiler	Wirth without SET type, but with several extensions
MUSE	APPILOT	6502	Apple	one	interpreter	
National Semiconductor Corp.	FORTRAN	8080	STARPLEX DOS	one	compiler	ANSI 1966
	Pascal	SC/MP-II		one		
North Star Computers	Pascal	Z80, 8080	included	one	compiler-interpreter	UCSD
Northwest Microcomputer Systems	Pascal	8085	included	one	compiler-interpreter	UCSD
Novar Associates	Pascal	Z80, 8080, 8085	included	one	compiler-interpreter	UCSD
John D. Owens Associates, Inc.	FORTH	9900	included		interpreter, compiler-interpreter	
Pascal Development Company	Pascal	8080, Z80, 6800	PASDOS included	several	compiler-interpreter	UCSD
Process Computer Systems, Inc.	FORTRAN	8080, Z80	SPDS	one	compiler	ANSI 1966 X3.9 with extensions, but without complex data type
	Industrial Pascal	Z80		one	compiler-interpreter	UCSD
Programma International, Inc.	FORTH	6502, 6800, 8080, Z80	included	one	interpreter, compiler-interpreter	follows original version
	Clarity Pascal	6502	included	one	compiler-interpreter, compiler	restricted subset — Chung & Yuen's Tiny Pascal with machine-dependent extensions
Queue Corp.	Pascal/Q	8080, Z80	included	one	compiler-interpreter	UCSD, plus QSAM structured files
Real Time Intelligence Corp.	FORTRAN	6800	SWTPC	one	compiler	ANSI 1966 with extensions and omissions
Research Machines	RML ALGOL 60	Z80, PDP-8, PDP-11	CP/M	one	compiler-interpreter	ALGOL 60 with some omissions and extensions
Rochester Area Microcomputer Society	fig-FORTH	8080, Z80	included	one	interpreter, compiler-interpreter	FORTH-79
Ryan-McFarland	RM/COBOL	Z80, 9900	OASIS, CP/M, COS 990	one	compiler, compiler-interpreter, cross-compiler	ANSI 1974 Level 1, plus some Level 2
Smoke Signal Broadcasting	FORCE-1	6800	DOS-68	one	compiler	
	UCSD Pascal	6809	Smoke Signal DOS68 Version 5.1 and DOS69 Version 1.0		compiler-interpreter	UCSD
	FORTRAN	6800	Smoke Signal DOS68 Version 5.1 and DOS69 Version 1.0		compiler	
	MICROCOBOL	6800	Smoke Signal DOS68 Version 5.1 and DOS69 Version 1.0		compiler	

COMPUTER SYSTEMS WITH THIS VERSION	MINIMUM MAIN MEMORY (bytes)	MINIMUM MASS STORAGE	COMPILING SPEED (lpm)	PRICE	SOURCE CODE AVAILABILITY AND PRICE	COMMENTS
	32K	one minifloppy disk	600 to 1000	$250	to OEMs, $5000	ROMable code; can use hardware floating point (AMD9511)
none	32K	one floppy disk		$49.95		
National Semiconductor	64K		300	bundled	no	sold with STARPLEX development system
National Semiconductor					no	
North Star	56K	one floppy disk		$49	no	
Northwest Microcomputer Systems			725	$225	no	
	56K	one floppy disk	50	$450		
				$200		
Tektronix 8002 Microprocessor Development Lab	48K			$1500	no	permits Pascal or machine-language interrupt routines with a Pascal program
PCS development systems			400 to 700	bundled	no	
PCS development systems			300 to 500	bundled	no	
none	8K	cassette		$35 (cassette), $50 (floppy disk)	yes	for Apple, PET, KIM, TRS-80, CP/M
none	16K	one cassette drive		$49.95	to OEMs	
				$300	no	update service $19/month
Real-Time Intelligence FORTRAN Processor Board				$125 and up	no	on-board microcomputer with compiler in ROM, processes in parallel with 6800; SS-50 bus compatible
	21K	one minifloppy disk	150	$199	no	runs slightly faster on Z80 than on PDP-8; compiler written in ALGOL; also sold by Lifeboat Associates
	16K	one floppy disk				for TRS-80
Onyx C8000, TI 990/10, Zilog MCZ	48K	one floppy disk	150 to 200	$10,000, plus $250/copy (OEM)	no	versions for 8086 and Onyx Z8000 system with UNIX under development
Smoke Signal Broadcasting	24K			$99	no	
	48K			$250	no	
	32K			$100	no	
	48K			$3000	no	

SOURCE	NAME	PROCESSORS	OPERATING SYSTEMS	NUMBER OF USERS	TYPE OF TRANSLATOR	CONFORMANCE TO STANDARD
The Soft Warehouse	muLISP	8080, Z80	CP/M, CDOS, TRSDOS	one	interpreter	LISP 1.5 extended
Softape	FORTH	6502	included	one	interpreter, compiler-interpreter	
Softech Microsystems, Inc.	UCSD Pascal	8080, 8085, Z80, 6502, 6800, 9900, PDP-11, LSI-11, GA 16, Western Digital MICROENGINE	included, compatible with CP/M and CDOS 1.07		cross-compiler, compiler-interpreter	UCSD
Softronics	μAPL	8080, Z80	CP/M	one	interpreter	subset
Software Consulting Services	SCOBOL	any with COBOL	any		pre-compiler	adds structured programming to any COBOL
	SFORTRAN	any with FORTRAN	any	one	pre-compiler	extends FORTRAN with structured programming
The Software Farm	tinyFORTH 2.1	Z80	included	one	interpreter, compiler-interpreter, compiler	FORTH-79
Sorrento Valley Associates	Micro Pascal	8080, Z80, LSI-11	UCSD Pascal OS	one	compiler	UCSD subset
Southwest Technical Products Co.	Pascal	6809	Flex9	several		
	PILOT	6809	SWTPC	several	interpreter	
Dr. E. Strassbourger, TECHNION (Israel)	MUMPS	6800			interpreter	ANSI X11.1 - 1977
Supersoft	Tiny Pascal	8080, Z80	CP/M, TRSDOS	one	compiler-interpreter, compiler	restricted subset (Tiny Pascal by Chung & Yuen)
Technico, Inc.	FORTRAN IV	9900	Technico TAS OS	six	complier	ANSI 1966 level H with ISA extensions
Telecompute Integrated Systems, Inc.	TIS-APL	Z80	included	one	interpreter	full APL; extended system functions in the manner of STSC and Sharp APL
Texas Instruments Inc.	COBOL	9900	DX10	eight	compiler-interpreter	ANSI 1974 Level 1 nucleus, plus table handling and sequential I/O
	FORTRAN	9900	TXS, DX10	one, eight	compiler	ANSI 1966 with extensions
	Microprocessor Pascal	9900	TXDS, DX10	one, eight	compiler-interpreter, compiler	ISO plus concurrency
	RPG-II	9900				
TICOM Systems, Inc.	Pascal	9900, FS990/4, FS990/10, DS990	included, TI DX10 for multi-user systems	16	compiler-interpreter	UCSD Version II.0
tiny c associates	tiny-c	8080, Z80, 6502, PDP-11	CP/M, OMNIX, Northstar DOS, ZDOS, CDOS, HDOS, TRSDOS, RT-11, RSTS	one	interpreter, compiler-interpreter	subset
TSA Software, Inc.	ASP (version of Pascal)	8080, Z80	CP/M, TSA/OS	one	compiler	subset
	PILOT	8080		one	interpreter	

COMPUTER SYSTEMS WITH THIS VERSION	MINIMUM MAIN MEMORY (bytes)	MINIMUM MASS STORAGE	COMPILING SPEED (lpm)	PRICE	SOURCE CODE AVAILABILITY AND PRICE	COMMENTS
none	20K	one floppy disk		$190	no	also muMATH symbolic mathematics package
				$49.95		for Apple
	48K	175K bytes	300 to 1500	$300	yes, $2000	Softech now handles all licensing of UCSD Pascal; 8080, Z80 and PDP-11 versions are completely configured; others require user-supplied I/O routines and bootstrap loader
none	48K	one floppy disk		$350	no	all unimplemented primitive functions are provided as defined functions; optimizing interpreter using Abram's descriptor calculus.
				$1400	included	developed by Volvo Flygmotor (Sweden); will run on any system on which it can be compiled
none				$1400	included	developed by Volvo Flygmotor (Sweden); will run on any system on which it can be compiled
	16K	one cassette drive	less than one sec per screen	$29.95 (cassette), $49.94 (disk)	no	for TRS-80 model I level II; graphics included; disk version can be upgraded for multiple users
none	56K	two floppy disks	1000 cps	$500	no	ROMable code, optimizing compiler
SWTPC S/09						
SWTPC					no	
none						
none	24K		500		yes	
Technico	34K	two floppy disks		$990	no	optimizing compiler
TIS, Altos	28K	one floppy disk		$700	no	supports hard disk and communication with other computers
TI					no	
Texas Instruments				$750	no	
TI	56K	one floppy disk	150	$2479	yes	not Concurrent Pascal
TI					no	
	48K	one single-density floppy disk	200 to 500	$700 to $2000	no	
tiny c associates Program Preparation System	16K		100 lpm	$75	included	
	32K	one floppy disk	230 lpm to 8080 macroassembler		yes	test distribution only
none				$50		

SOURCE	NAME	PROCESSORS	OPERATING SYSTEMS	NUMBER OF USERS	TYPE OF TRANSLATOR	CONFORMANCE TO STANDARD
Unified Technologies	FORT//80	8080	CP/M, others	one	compiler	ANSI 1966 with extensions and omissions
University of California, San Diego Institute for Information Systems	Concurrent Pascal	most	included	several	compiler-interpreter	Brinch Hansen's Concurrent Pascal modified for compatibility with UCSD Pascal
University of California School of Medicine, Department of Community Health (Davis)	MUMPS	8080	CP/M	one	interpreter	ANSI X11.1 - 1977 single user
University of Colorado, Pascal Distribution	Concurrent Pascal	machine-independent	SOLO	several	complier-interpreter	Brinch Hansen's Concurrent Pascal
Uppsala University (Sweden)	LISP 1.5	FORTRAN		one	interpreter	LISP 1.5
Vanguard Systems Corp.	APL/DTC	Z80	CP/M	one	interpreter	subset, with extended file system
Virtual Systems, Inc.	FORTRAN-77	8086		eight	cross-compiler (PDP-11, LSI-11)	ANSI 1978 official subset level
Western Digital	UCSD Pascal	Western Digital Pascal MICROENGINE	included	one	compiler	UCSD
Whitesmiths Ltd.	C	8080, Z80, LSI-11, PDP-11, VAX 11/780	ISIS, CP/M, CDOS, UNIX, IAS, RSTS-E, RSX-11D, RSX-11M, RT-11		cross-compiler (DEC to 8080), compiler (DEC)	Kernighan & Ritchie
Wintek Corp.	C	6800	Wizrd	one	compiler	Kernighan & Ritchie
	Pascal	6800	Wizrd	several	compiler-interpreter	UCSD
Zendex Corp.	SBC-FORTH	8080, 8085	included	one	interpreter, compiler-interpreter, compiler	similar to FORTH-79
Zilog, Inc.	COBOL	Z80	Zilog RIO	one	compiler-interpreter	ANSI 1974 Level 1, with many Level 2 features
	FORTRAN	Z80	Zilog RIO	one	compiler	ANSI 1966 without complex variables
	Pascal	Z80	Zilog RIO	one	compiler-interpreter	Wirth

COMPUTER SYSTEMS WITH THIS VERSION	MINIMUM MAIN MEMORY (bytes)	MINIMUM MASS STORAGE	COMPILING SPEED (lpm)	PRICE	SOURCE CODE AVAILABILITY AND PRICE	COMMENTS
Arkansas Systems, Inc., Ramsey Electronics, Realistic Controls, others	32K	two floppy disks		$99.95	no	
					to OEMs	working, but not yet released; will be licensed by Softech
none	56K	two floppy disks		$25	included	
none				$60	included	requires several months to reprogram kernal for a new processor; SOLO is written in Concurrent Pascal
none					yes	will run on any system that can compile the source code
Vanguard, Vector Graphic, Altos	48K	one floppy disk		$500	no	all unimplemented primitive functions provided as defined functions; Z8000 version under development
no			200 to 800	$5500	no	run-time library source code $1250.
Western Digital, Cutting Edge of Technology, Inc., Digicomp Research Corp. (S-100 board), Pertec, others	64K	one floppy disk	1700	bundled	no	MICROENGINE machine language is Pascal p-code; same chips as LSI-11 with different microprogram
	64K		100 lpm	$500 to $900	$5000 to $9000	
Wintek Sprint 68				$495	no	
Wintek Sprint 68				$495		
			200	$450	included	sold in EPROM for Intel SBC 80/10, 80/20 and 80/30; can run on single-board computer
Zilog MCZ	48K	two floppy disks		$950	no	a single program can poll five terminals
Zilog MCZ	48K	one floppy disk		$750	no	
Zilog MCZ	60K	one floppy disk		$950	no	

Yes, Tally is the best teleprinter!

Witness the Quick Tear that saves money by saving forms!

The Quick Tear option stops wasted forms, wasted money. It saves throughput time, operator time and customer time. Now you can remove a completed form after printing without wasting the next form. And for batch work, you can by-pass the quick tear assembly for continuous print runs.

Unique to Tally alone, the quick tear can accommodate variable width forms from 4 to 15 inches wide. The pin-feed tractors are adjustable from either side of the carriage. Print an original plus five sharp carbon copies. And Tally teleprinter operators give testimony to quieter operation, better key action and heftier construction.

The Quick Tear is only one of many valuable options available with the T-1612 printer terminal Contact your local Tally dealer for all the details.

Tally Corporation, 8301 So. 180th St., Kent, WA 98031. (206) 251-5524.

TALLY®
PRINTERS
WORLDWIDE

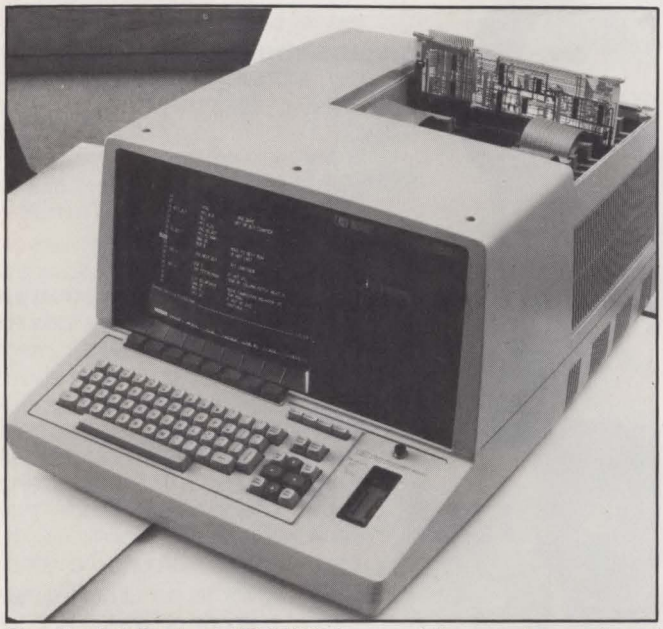
Tally Corporation is a member of the Mannesmann Group.

CIRCLE NO. 56 ON INQUIRY CARD

A few vendors have announced plans to put compatible versions of a language on every popular microprocessor.

and some unfamiliar combinations. It is not universally known, for example, that LISP can be compiled as well as interpreted; The LISP Company is working on a compiler for the Z80 now, and in France, Patrick Greussay has a compiler that transforms many recursive programs into more efficient iterative ones. C and PILOT are also available in both forms.

The most common translation method for Pascal compiles code for a processor called the p-machine, which the actual processor simulates (except in the case of the Western Digital Pascal MICROENGINE, which is a microprogrammed p-machine). This combination is usually called a compiler-interpreter, because simulating a p-machine is the same as interpreting p-code. (There are also several Pascal compilers that produce machine code directly.) The method of compiling intermediate code, which is then interpreted, is sometimes used for COBOL and ALGOL, also.



The Hewlett-Packard HP-64000 *is one of the growing number of microprocessor development systems that support Pascal.*

FORTH uses a different organization, known as threaded code. The basic unit in FORTH, called a word, is either an assembly language routine or a sequence of FORTH words in structured reverse Polish notation (RPN). When a word is defined, it is compiled into a sequence of addresses of words. It can then be executed by an interpreter perhaps 50 bytes long, which jumps from word to word, stacking all continuations at each level of definition down to executable code and returning when the stack is empty. Commands can be entered from a terminal keyboard and interpreted, each word being looked up in the dictionary when it is to be executed.

Most of the languages listed in the table include some means of practicing structured programming at least in the narrow sense of using properly nested IF and iteration statements without GOTOs. This and other structuring facilities are essential elements of Pascal, which was designed for teaching programming methodology. In various ways, ALGOL, PL/I, FORTH, LISP, FORTRAN 77 and C also achieve this level of structure. A language that doesn't can still be used for structured programming if the user writes his code in a structured version of the language and then translates it either by hand or by means of a preprocessor to the standard version of the language. Several FORTRAN and COBOL preprocessors are available, and one version of COBOL, MicroCOBOL from CAP-CPP, Inc., has structured programming forms built in.

Availability of particular structuring facilities—procedures, recursion, concurrency, separate compilation and so forth—varies. Each is available in some programming languages, but not all, and may take different forms in different languages, or even in different dialects of the same language. For example, Texas Instruments Inc. offers a Pascal with concurrency, but it is not Concurrent Pascal. Some operating systems, such as UNIX, offer facilities that enable a program in a sequential language to create concurrent processes by means of interprocess communication. The variations in all these features are too numerous to describe, or even list. It is important for a prospective user of a language to make sure that the version he wants to use and the operating system he wants to use it with provide the facilities he needs.

The same situation exists with regard to data structures, except that the variability is even greater. Some languages have specific structures built in, together with appropriate operations: arrays in APL, data base in MUMPS, lists in LISP, records in COBOL and the stack in FORTH (as well as other structures in each case). Within the structures available, it may be convenient to synthesize or simulate others. Binary trees, for example, are difficult to implement in COBOL, but multilevel records are easy in any LISP that does not provide them, because they are just lists with fixed forms and properties. LISP may provide arrays, records and unlimited precision arithmetic; other languages are usually more tightly constrained. Of the languages listed in the table, Pascal has the most elaborate facilities for defining data types. Unfortunately, however, many implementations omit some base types or structuring methods. On the other hand, there are some examples of careful adherence to standards. Telecompute Integrated Systems provides not only all the APL primitive functions, but also the system functions for file handling and data formatting included in the leading timeshared APLs.

Compatibility and portability

Most FORTRANs and COBOLs listed in the table exhibit the same general degree of compatibility as any languages that follow some standard reasonably

"Let me send you my newest recommendations on how to PUT AN END TO POWER-RELATED COMPUTER PROBLEMS"

Says Emil Rechsteiner, President of Frequency Technology, Inc., Makers of ISOREG™ Computer Power Modules.

UNSTABLE AND ELECTRICALLY "NOISY" POWER LINES CAN MAKE A SHAMBLE OF YOUR COMPUTER OPERATIONS!

Voltage Spikes (very high over-voltages lasting milliseconds or less) can scramble your computations, wipe out stored data, alter programs and even destroy computer circuits. *Brown-Outs* can wipe out stored data, turn your computer runs into disasters and can paralyze your equipment—perhaps even your business, maybe at the worst possible moment! *"High" Line Voltages* can overheat and quickly burn out your computer circuits, causing bothersome interruptions and costly repairs.

Sounds like a nightmare? Indeed, unstable and electrically noisy power lines *are* nightmares to all who depend on computers!

What to do?

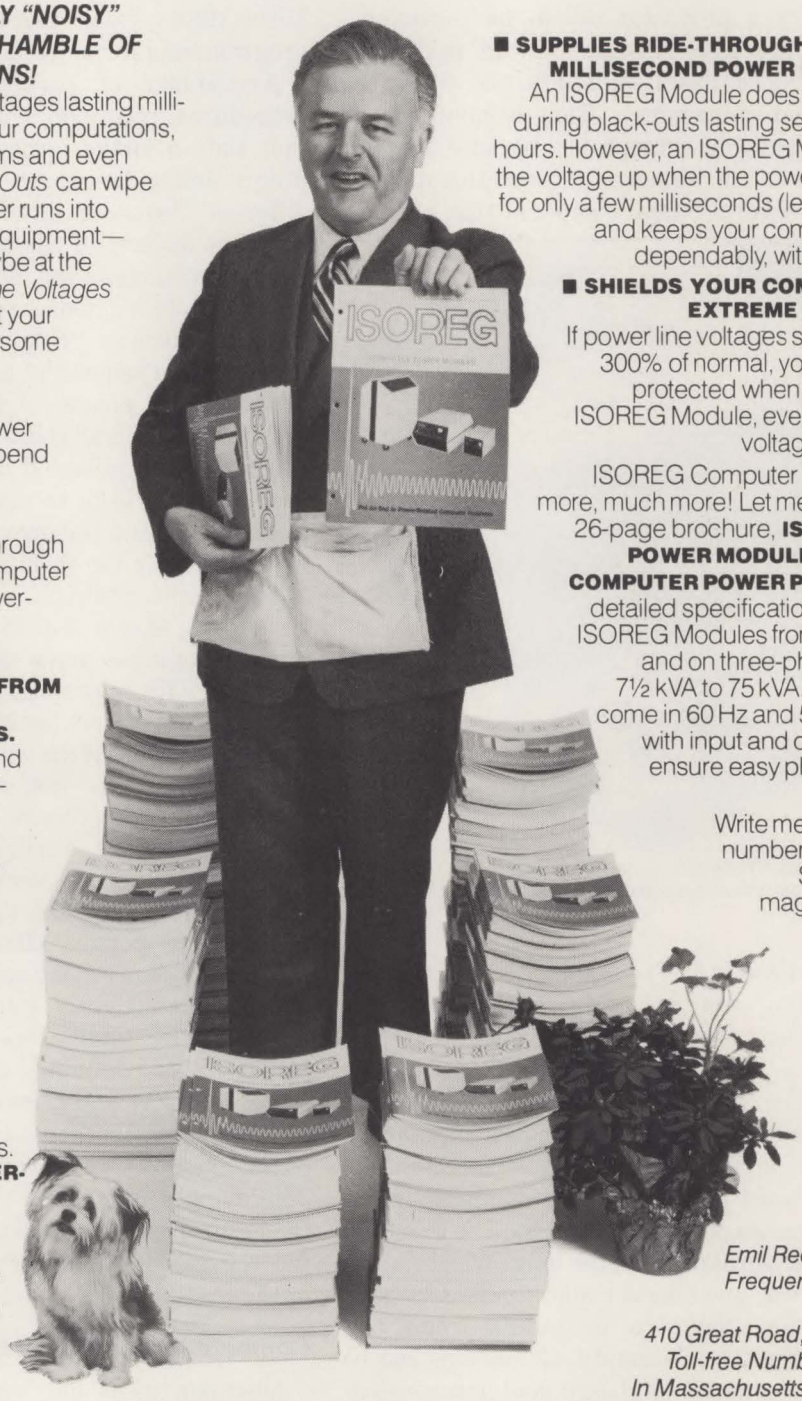
Supply power to your computer through an ISOREG Module. ISOREG Computer Power Modules put an end to power-related computer problems!

An ISOREG Computer Power Module:

■ **ISOLATES YOUR COMPUTER FROM UTILITY POWER AND SCREENS OUT VOLTAGE SPIKES AND DIPS.** Even spikes of a thousand volts and more are cut down to levels imperceptible to the computer.

■ **REGULATES COMPUTER VOLTAGES WITHIN TIGHT ±½% LIMITS EVEN WHEN LINE VOLTAGES DROOP TO 75% OR SURGE TO 115% OF NORMAL.** If utility voltages fluctuate between "too low" and "too high," an ISOREG Module *automatically* supplies the correct voltage to your computer. You make no adjustments whatever; the ISOREG Module operates unattended, dependably, for years.

■ **KEEPS YOUR COMPUTER OPERATING DURING BROWN-OUTS** If your utility voltage stays 25% below normal for minutes, hours or even days, an ISOREG Module *automatically* raises the voltage to the correct level and keeps your computer operating dependably, even when you cannot depend on your utility power.



■ **SUPPLIES RIDE-THROUGH POWER DURING MILLISECOND POWER INTERRUPTIONS.** An ISOREG Module does *not* supply power during black-outs lasting seconds, minutes or hours. However, an ISOREG Module *does* keep the voltage up when the power line goes "dead" for only a few milliseconds (less than a full cycle) and keeps your computer operating—dependably, without missed digits.

■ **SHIELDS YOUR COMPUTER AGAINST EXTREME OVER-VOLTAGES.** If power line voltages shoot up to 200% or 300% of normal, your computer is fully protected when it is powered by an ISOREG Module, even if such excessive voltages last for minutes.

ISOREG Computer Power Modules do more, much more! Let me send you our new 26-page brochure, **ISOREG COMPUTER POWER MODULES PUT AN END TO COMPUTER POWER PROBLEMS.** It offers detailed specifications on single phase ISOREG Modules from 250 VA to 25 kVA and on three-phase Modules from 7½ kVA to 75 kVA. ISOREG Modules come in 60 Hz and 50 Hz versions and with input and output voltages that ensure easy plug-in convenience around the world!

Write me, or call our toll-free number, or use the Reader Service Card of this magazine to obtain our new brochure, free.

Emil Rechsteiner, President
Frequency Technology, Inc.
TDC Division
410 Great Road, Littleton, MA 01460
Toll-free Number: 1-800-225-5078
In Massachusetts Call: 617-486-3539
TWX 710-347-6974

CIRCLE NO. 57 ON INQUIRY CARD

For many applications, the cost of memory and CPU time, which in the past outstripped all other expenses, is no longer the primary concern.

closely, but for several languages there are translators that offer complete or nearly complete source-code compatibility on a number of micros and on other computers as well. A few vendors have announced plans to put compatible versions of a language on every popular microprocessor. Considerable progress has been made in this direction for FORTH (by FORTH, Inc., Programma International and the FORTH Interest Group), Pascal (by UCSD) and PILOT (by Micropi). Micropi has extended PILOT to include floating-point arithmetic and matrices. This version now exists for seven microprocessors. They also have a version written in Pascal, which will run on any processor that supports that language.

Efficiency

Although efficiency is sometimes overemphasized, it is a genuine concern. Unfortunately, there is very little reliable information on the relative speeds of any of the versions of any of the languages covered in this survey. It is not even clear how to rate the speeds of the processors they run on. General (and conditional) comparisons are possible, but definite information can be acquired only by testing.

For example, it is often said that compilers are 10 to 200 times faster than interpreters and that machine-language programs can be made to run several times faster than any compiler-generated code. And certain languages are said to be more efficient in memory space or speed than others. But it isn't always so.

On large machines, compiled LISP has beaten compiled FORTRAN in both space and speed. And interpreted APL has beaten compiled FORTRAN on problems involving moderately large arrays, for which interpretation overhead is negligible.

For many applications, the cost of memory and CPU time, which in the past outstripped all other expenses, is no longer the primary concern. A commercial user has reported a case in which an APL program cost more to run than a COBOL program for the same task, but the program would have to be used for three years without modification to lose the saving in development cost.

A multi-user COBOL *is available with Zilog's MCZ-1/70 microcomputer system.*

A QUICK LOOK AT THE LANGUAGES

ALGOL: A block-structured algebraic language—among the first with recursion and structured-programming primitives. Widely used in Europe and for publication of algorithms.

APL: Designed primarily for efficient handling of n-dimensional arrays. Very powerful and concise. Used in engineering, business, mathematics instruction and digital hardware design.

C: A structured language designed to give efficient control of machine resources while enabling device-independent programming. Used for the UNIX operating system.

COBOL: Designed for business use. Supports files of multilevel records.

Concurrent Pascal: Pascal with program and data structures for verifiably correct concurrent process control. Used for operating systems.

FORTH: An extendable, stack-oriented, threaded language, developed for data acquisition and radio telescope orientation at an astronomical observatory. All system software except a kernel of low-level routines is written in FORTH.

FORTRAN: An algebraic language with static arrays. The first widely successful high-level language.

LISP: Data and programs are represented as list structures using Church's lambda calculus—extended with a variety of program and data structures to a general-purpose language. Used widely in artificial intelligence research, symbolic mathematics and computing theory.

MUMPS: A text-oriented language with built-in data base facilities and string and pattern matching. Used in hospitals and other large organizations for unified accounting.

Pascal: Designed for teaching programming methodology, with a variety of programming and data structures. Block-structured like ALGOL.

PILOT: Created for computer-aided instruction (CAI). Has basic facilities for interactive input and output, pattern matching and conditional branching. Extended with various data types and structures.

PL/I: A very large, general-purpose programming language, often used in systems programming.

RPG-II: A limited and inconvenient report generator with some arithmetic and file-handling capabilities. Many word processors are more competent at all of its functions. One of the most widely used languages.

Some higher-priced languages (in the $100 to $1000 range) offer extensions or special emphases, such as speed, portability, structure, interactivity.

Language processors fall roughly into four categories of price and performance, with considerable overlap and some exceptions (e.g., versions offered by nonprofit groups often have very low prices relative to their quality). At the bottom of the scale are the toy versions, mainly of interest to hobbyists. Many of them are not listed here, especially ones with only printed

REFERENCE LITERATURE

For more information on the high-level languages surveyed in this article, use the reader circle numbers below.

Company	Circle No.
Advanced Micro Computers, Sunnyvale, Calif.	360
Algorithmics, Inc., Wellesley, Mass.	361
Alpha Micro Systems, Irvine, Calif.	362
AM-100 User's Group, Rochester, N.Y.	363
American Microsystems, Inc., Santa Clara, Calif.	364
Apple Computer, Inc., Cupertino, Calif.	365
Avocet Systems, Dover, Del.	366
Aydin Controls, Ft. Washington, Pa.	367
BD Software, Cambridge, Mass.	368
The Boston Systems Office, Inc., Waltham, Mass.	369
California Software, El Cerrito, Calif.	370
CAP-CPP, Inc., Palo Alto, Calif.	371
Cap'n Software, San Francisco, Calif.	372
CETEC Corp., DMC Division, Santa Clara, Calif.	373
Computerware, Encinitas, Calif.	374
Compu/Think, Menlo Park, Calif.	375
Control Systems, Inc., Kansas City, Kan.	376
Cook's Computer Company, Marshalltown, Iowa	377
Creative Solutions, Silver Spring, Md.	378
Cromemco, Inc., Mountain View, Calif.	379
The Digital Group, Denver, Colo.	380
Digital Marketing, Walnut Creek, Calif.	381
Digital Research, Pacific Grove, Calif.	382
Dynasoft Systems, Windsor Junction, Nova Scotia, Canada	383
Ellis Computing, San Francisco, Calif.	384
Extensys Corp., Mountain View, Calif.	385
FMG Corp., Fort Worth, Texas	386
FORTH, Inc., Manhattan Beach, Calif.	387
FORTH Interest Group, San Carlos, Calif.	388
Forthright Enterprises, Palo Alto, Calif.	389
GenRad/Futuredata, Culver City, Calif.	390
GNAT Computers, Inc., San Diego, Calif.	391
Dave Gomberg, San Francisco, Calif.	392
Patrick Greussay, University of Paris, Paris, France	393
Hewlett-Packard Co., Colorado Springs, Colo.	394
Infosoft Systems, Inc., Westport, Conn.	395
Institut fur Theoretische Informatik, Darmstadt, West Germany	396
Intel Corp., Santa Clara, Calif.	397
Ithaca Intersystems, Inc., Ithaca, N.Y.	398
Language Resources, Inc., Sunnyvale, Calif.	399
The Lisp Co., Los Gatos, Calif.	400
Lucidata, Pascal Division, Voorburg, The Netherlands	401
Mad Hatter Software, Dracut, Mass.	402
Marinchip Systems, Mill Valley, Calif.	403
Micro Focus, Inc., Santa Clara, Calif.	404
Micro Focus Ltd., London, England	405
Micropi, Lummi Island, Wash.	406
Microsoft, Bellevue, Wash.	407
Microware Systems Corp., Des Moines, Iowa	408
Miller Microcomputer Services, Natick, Mass.	409
Mostek Corp., Carrollton, Texas	410
Motorola, Inc., Phoenix, Ariz.	411
MT Microsystems, La Jolla, Calif.	412
MUSE, Baltimore, Md.	413
National Semiconductor Corp., Santa Clara, Calif.	414
North Star Computers, Berkeley, Calif.	415
Northwest Microcomputer Systems, Eugene, Ore.	416
Novar Associates, Wallingford, Pa.	417
John D. Owens Associates, Inc., Staten Island, N.Y.	418
Pascal Development Co., Cupertino, Calif.	419
Process Computer Systems, Inc., Saline, Miss.	420
Programma International, Inc., Los Angeles, Calif.	421
Queue Corp., Berkeley, Calif.	422
Real Time Intelligence Corp., Rochester, N.Y.	423
Research Machines, Oxford, England	424
Rochester Area Microcomputer Society, Rochester, N.Y.	425
Ryan-McFarland, Inc., Round Rock, Texas	426
Smoke Signal Broadcasting, Westlake Village, Calif.	427
The Soft Warehouse, Honolulu, Hawaii	428
Softape, North Hollywood, Calif.	429
Softech Microsystems, Inc., San Diego, Calif.	430
Softronics, Roosevelt, N.J.	431
Software Consulting Services, Allentown, Pa.	432
The Software Farm, Reston, Va.	433
Sorrento Valley Associates, San Diego, Calif.	434
Southwest Technical Products Corp., San Antonio, Texas	435
Dr. E. Strassbourger, TECHNION, Haifa, Israel	436
Supersoft, Champaign, Ill.	437
Technico, Inc., Columbia, Md.	438
Telecompute Integrated Systems, Inc., Toronto, Ontario, Canada	439
Texas Instruments Inc., Houston, Texas	440
TICOM Systems, Inc., Los Angeles, Calif.	441
tiny c associates, Holmdel, N.J.	442
TSA Software, Inc., Monroe, Conn.	443
Unified Technologies, Islington, Ontario, Canada	444
University of California, San Diego Institute for Information Systems, San Diego, Calif.	445
University of California School of Medicine, Dept. of Community Health, Davis, Calif.	446
University of Colorado, Pascal Distribution, Boulder, Colo.	447
Uppsala University, Uppsala, Sweden	448
Vanguard Systems Corp., San Antonio, Texas	449
Virtual Systems, Inc., Walnut Creek, Calif.	450
Western Digital, Newport Beach, Calif.	451
Whitesmiths Ltd., New York, N.Y.	452
Wintek Corp., Lafayette, Ind.	453
Zendex Corp., Dublin, Calif.	454
Zilog, Inc., Cupertino, Calif.	455

THE GREAT HP WAND TRICK

The world's first digital bar code reader is faster than keyboard or pushbutton entry. It's in stock now at Hall-Mark.

HP's HEDS-3000 Wand scans black and white bar codes and converts them to microprocessor-recognizable digital output: it speeds data entry while improving accuracy. And *that's* a wand worth waving.

The reader is housed in a rugged, molded plastic case that can be manufactured in custom colors and imprinted with your company logo. The wand has a push-to-read switch and comes with attached cord and connector for fixed or portable use.

To get complete specs and prototype or production units, call Hall-Mark for HP. It's the best show in town!

HEWLETT PACKARD

I want more information on the great HP Wand Trick. Please send me:

- ☐ Data Sheet on the HEDS-3000 Wand
- ☐ HP Catalog
- ☐ Other _____

Name _____
Company _____
Address _____
City _____
State _____ Zip _____
Phone _____

Jim Burnett
Hall-Mark Electronics Corp.
Box 222035
Dallas, Texas 75222

HM3680

HALL-MARK

HALL-MARK ELECTRONICS CORP. ATLANTA 800-633-2918 AUSTIN 512-837-2814 BALTIMORE 301-796-9300 CEDAR RAPIDS 800-323-0558 CHICAGO 312-860-3800 CINCINNATI 800-282-6933 CLEVELAND 216-473-2907 COLUMBUS 614-846-1882 DALLAS 214-341-1147 DAYTON 800-282-6933 HOUSTON 713-781-6100 HUNTSVILLE 205-837-8700 KANSAS CITY 913-888-4747 KNOXVILLE 800-633-2918 LAWRENCEVILLE 800-633-2918 MIAMI 305-971-9280 MILWAUKEE 414-761-3000 MINNEAPOLIS 612-884-9056 OMAHA 800-255-6946 ORLANDO 305-855-4020 PHILADELPHIA 215-355-7300 RALEIGH 919-832-4465 ST. LOUIS 314-291-5350 TAMPA 800-432-0564 TULSA 918-835-8458 WICHITA 800-332-4375 FOR SALES & SERVICE IN THE 11 WESTERN STATES: 800-527-3272 NEW ENGLAND AREA 800-523-6288 NEW YORK AREA 800-523-6288

CIRCLE NO. 58 ON INQUIRY CARD

A wide selection of the most popular languages are now available in microcomputer versions — many for no more than the cost of recompiling it.

source code or object code available. Most are inadequate subsets of languages, written for minimum space by omitting major characteristics and largely ignoring execution efficiency. They are often not supported in any way and cost $50 or less, although some are free. The next category includes language subsets with many omissions, but reasonable capability, at fairly low prices ($35 to $500). Some users may want to try one of these as a learning tool, with the understanding that full versions offer more capability and often considerably higher speed.

At higher prices ($100 to $1000), there are a number of translators that approach the standards for their languages. Some offer extensions or special emphases, such as speed, portability, structure, interactivity, multi-user support and so on. Optimizing compilers and interpreters are available for several languages, and more of everything is coming.

The highest-priced ($700 to $5500) versions of languages for microcomputers include those that were developed originally for some minicomputer and maintain source-code compatibility, crosscompilers from larger machines and some particularly high-powered implementations. These overlap into the price range of minicomputer languages, sometimes offering extra, as in the case of the FORTRAN-77 compilers from Intel and Virtual Systems. Those that provide multi-user support, such as FORTH, Inc.'s polyFORTH, are sometimes cheaper to use than much less expensive single-user versions, because of the hardware savings.

A wide selection of the most popular languages are now available in microcomputer versions. Each language has certain unique virtues, and each has been used for enormous quantities of application software. Much of that software can now be made available for microcomputers for no more than the cost of recompiling it (about $5 an hour on a typical microcomputer system). For this to happen, organizations with software that would be useful on a micro must discover profits that can be made, perhaps by licensing others to distribute their programs in this new market at appropriately lower prices, as now is happening with the UNIX operating system. ■

Mokurai Cherlin is director of micro systems development for APL Business Consultants, Inc., of Newark, N.J.

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

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

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

A true 100% duty cycle printer

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

Engineered to stay on the job.

From top to bottom, the compact TermiNet 340 line printer is engineered with long-life components designed to keep the printer on-line. And businesses on schedule.

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

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

Fewer service problems keep it working longer

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

Find out for yourself. Mail the coupon today and see why so many companies have chosen the more productive TermiNet 340 line printer to get their work done.

Quality that will make a lasting impression

GENERAL ELECTRIC

Mail today to:
J. Walsh,
General Electric Company,
TermiNet 794-43,
Waynesboro, VA. 22980
Telephone: (703) 949-1474.

☐ Send me more information about the TermiNet 340 line printer.

☐ Have a sales representative contact me.

☐ I'm also interested in a TermiNet 340 line printer demonstration.

Name _____

Title _____

Company _____

Address _____

City _____ State _____ Zip _____

Telephone _____

CIRCLE NO. 60 ON INQUIRY CARD

WHEN IT COMES TO PUTTING IT ALL ON DISPLAY, THE ORION-60 STANDS ALONE.

A display terminal that won't stand alone can't be as versatile or as adaptable as the Orion-60, the modular plasma display system that stands by itself or interfaces with existing hardware to let you create your own programs.

To begin with, the Orion-60 is an easy touch: besides offering full alphanumeric, floppy disc and rear-projection capabilities, it lets you create displays and enter data simply by touching the screen with your finger.

That means you can project a slide onto the screen coordinates and plot your own course over it. You can program your own character sets. You can generate vectors of any length to absolute screen coordinates. In short, you'll have a flexible terminal that will keep up with your needs today—and grow with your operations tomorrow.

Of course, since Magnavox was a leader in the development of plasma terminals, you can be sure your Orion-60 will have a bright, high-contrast display free from jitter and distortion.

There's a lot more you should know about the ways this remarkable terminal can help you get more out of graphic displays. For a demonstration, call or write Tyler Hunt at Magnavox Display Systems, 2131 S. Coliseum Blvd., Ft. Wayne, IN 46803, (219) 482-4411.

Magnavox
DISPLAY SYSTEMS

CIRCLE NO. 61 ON INQUIRY CARD

DEC® RX02 COMPATIBILITY DOUBLE SIDED FLOPPY IBM DOUBLE DENSITY WINCHESTER DISK SUPPORT

Available Soon with Winchester Drives

CAPABILITY . . .

Double your LSI-11® floppy disk storage (up to 1.25M bytes per diskette) with the SMS FWT0127. It is hardware, software, and media compatible with DEC RX02 systems. Software selectable IBM 3740, 2/2D formats provide diskette interchange with IBM and other non-DEC systems. On-board bootstrap loads and runs your software automatically at power up. All this plus resident diagnostics in a low profile 5-1/4" package.

AND PERFORMANCE . . .

Double head drives give you 33% faster average access than RX02. Extended mode (using IBM 2D format) operation reduces data transfer time by over 40% when compared to RX02, and the FWT0127 runs fill and empty buffer operations over 34% faster than RX02.

PLUS GROWTH.

The newest 8" and 14" Winchester disk technology (up to 26M bytes) is supported for growing storage requirements. A single LSI-11 "Flinchester" controller (resident in the FWT0127) supports both floppy and Winchester drive technology to minimize future software efforts.

AND FURTHERMORE . . .

SMS announces the DSX0127 Disk System 11 incorporating a LSI-11 Q-Bus backplane with double head drives and the same FWT0127 features above in an attractive 10-1/2" package. Plug any configuration of LSI-11 modules (including LSI-11/23) into the 8-slot Q-Bus backplane. Enough power is provided for up to (13) dual height cards and the SMS "Flinchester" controller.

® *Trademark of Digital Equipment Corporation*

CIRCLE NO. 62 ON INQUIRY CARD

Scientific Micro Systems
777 East Middlefield Road
Mountain View, CA 94043
(415) 964-5700 TWX: 910-379-6577

WESTERN REGIONAL SALES
(602) 978-6621

EASTERN REGIONAL SALES
(617) 246-2540

DATA
COMMUNICATIONS: PART II

Reducing communication line costs with multiplexors

ROGER L. EVANS, Micom Systems, Inc.

These 'black boxes' enable a number of terminals to share the same phone line

This article is the second in a three-part series on data communication, taken from the notes for Micom's new seminar, "Data Communications for Minicomputer Users." Part I (MMS, March, 1980) discussed the types of data terminals, the terminal-to-computer connection, communication protocols and modems.

A computer system supporting multiple remote terminals does not have to be very large for the cost of telephone lines and modems to exceed that of the computer and terminal equipment. Even in small systems, the user will want to reduce telephone costs by putting more than one terminal on each line.

As discussed in the first part of this series (MMS, March, 1980, p. 96), terminals supporting one of the established communication protocols can be multidropped and polled on a shared telephone line, but the protocol-less dumb terminals used with most minicomputers cannot. The only way several dumb terminals can share one telephone line is by multiplexing.

A multiplexor system provides a transparent connection between modems or terminals and the computer ports to which they normally would be directly attached. In Fig. 1, a multiplexor system enables eight terminals in Denver to share a single telephone circuit to a computer center in Los Angeles. Multiplexors are used at both ends of the shared telephone line, so the eight channels multiplexed at one end can be demultiplexed back into eight channels at the other. That provides the necessary transparent connection between each of the eight computer ports and each of the eight terminals.

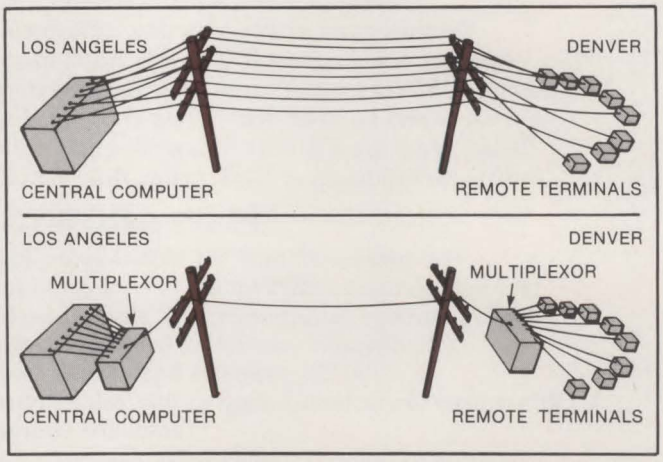


Fig. 1. A typical multiplexor application. *Installation of multiplexors reduces the number of lines required to connect remote terminals in Denver to a computer in Los Angeles from eight (top) to one (bottom).*

"Transparent" means that the multiplexor system does not interrupt the flow of data and interface signals across the cable between the computer port and the attached modem or terminal. Thus, when the multiplexors are installed, the computer, modems and terminals remain unaware that the multiplexor system is being used (Fig. 2). As a result, neither terminal equipment nor computer software has to be changed when a multiplexor system is installed.

Multiplexing techniques

Of the three basic multiplexing techniques—frequency-division multiplexing (FDM), time-division

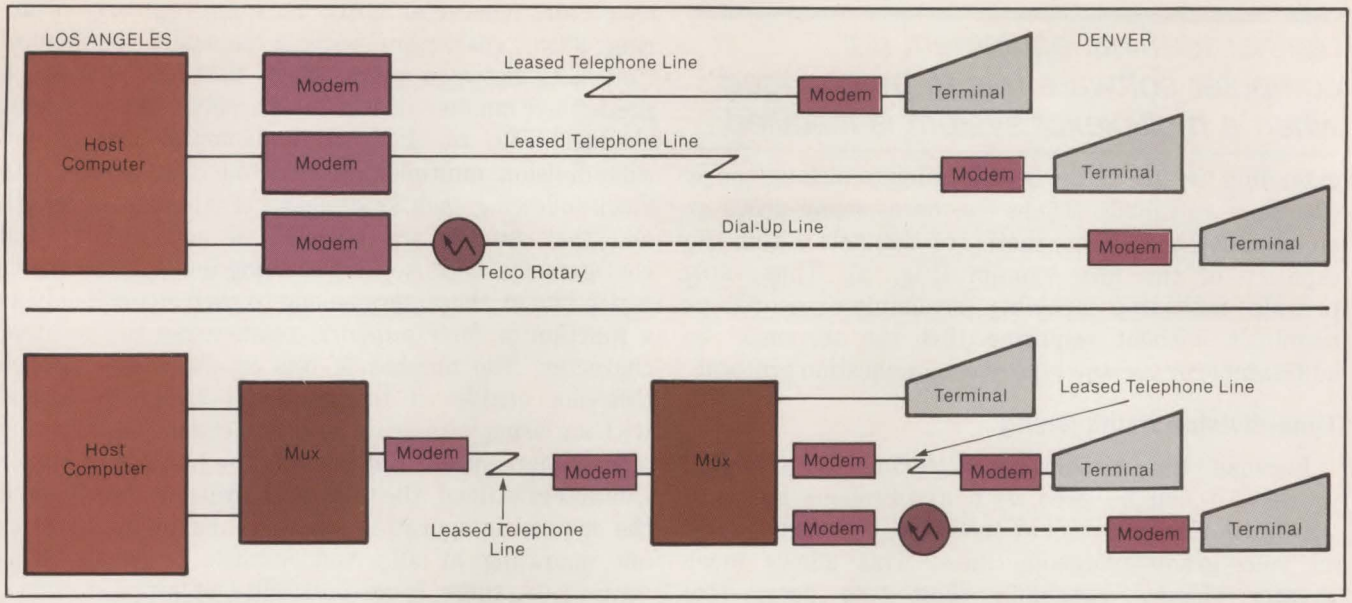


Fig. 2. A detailed illustration *of how several lines (top) are consolidated into one by means of multiplexors (bottom). The multiplexors are completely transparent to the computer, the terminals and the users.*

multiplexing (TDM) and statistical multiplexing—the oldest is frequency-division multiplexing.

Bell 103 modems, which use FSK modulation, splitting a telephone line into two subchannels to provide a simultaneous transmit and receive path, were discussed last month. A frequency-division multiplexor is a group of FSK modems sharing a single telephone line. Each modem operates on its own channel—a frequency band separated from adjacent channels by guard bands, which are unused portions of the available telephone bandwidth. FDM takes advantage of the fact that the 3-kHz bandwidth of a voice-grade telephone line is significantly greater than is required for a low-speed data channel; by using a different frequency band for each channel, several can share the same line without interfering with each other.

Time-division multiplexing is a digital technique that interleaves bits (bit TDM) or characters (character TDM), one from each attached channel, and transmits them down a telephone line equipped with high-speed synchronous modems. At the other end, a second multiplexor demultiplexes the "bit train" or "character frame," presenting one bit or character to each low-speed channel, just as they originated.

Statistical multiplexing, sometimes referred to as intelligent time-division multiplexing (ITDM) or data concentration, is a relatively new technique. Like TDM, it is a digital system, but instead of sampling each channel at a fixed rate, it dynamically allocates time on the line to the various channels according to their relative activity. When a channel is inactive, the statistical multiplexor ignores it entirely, making idle bits or characters unnecessary. And when many channels are highly active at the same time, the multiplexor stores data in memory until it can be transmitted without overloading the line.

Frequency-division multiplexing

By Fig. 3's comparison criteria, frequency-division multiplexing does not rate high scores, because it is not a digital technique. It is inefficient because the channels have to be separated across the band to prevent crosstalk, and this wastes bandwidth. For example, a 300-baud channel requires a 480-Hz bandwidth to provide the recommended channel spacing. Channel capacity is limited by the telephone line's 3-kHz bandwidth, resulting in a capacity of only six channels at 300 bps. Because an FDM cannot multiplex even two channels at 1200 bps, it scores very badly in its ability to handle high-speed channels. In addition, an FDM cannot perform automatic retransmission-on-error.

One strong point of FDM, however, is that it enables individual channels to be dropped and inserted at different points along the same telephone line, because each channel uses a different frequency. This enables multiplexing one or two terminals in one location and

COMPARISON FACTOR	FDM	TDM	STATMUX
Efficiency	Poor	Good	Excellent
Channel Capacity	Poor	Good	Excellent
High-Speed Channels	Very Poor	Poor	Excellent
Flexibility	Poor	Good	Excellent
Ease of Installation	Poor	Poor	Excellent
Retransmission-on-Error	N/A	N/A	Automatic
Multidrop Capability	Good	N/A	Possible

Fig. 3. Multiplexing techniques. *"Flexibility" is a measure of how difficult it is to change the number or speed of channels in the system.*

Neither terminal equipment nor computer software has to be changed when a multiplexor system is installed.

extending the line to the next location to pick up one or two more terminals. There can be as many drops or points along the line as there are channels within the capacity of the FDM system (Fig. 4). Thus, FDM provides multidrop capability for simple asynchronous terminals without requiring that the terminals be addressable or use any type of communication protocol.

Time-division multiplexing

Because time-division multiplexing is a digital process, it can be used with synchronous modems, which can transmit data at speeds as high as 9600 bps on voice-grade telephone lines. This allows much greater channel capability than FDM does. TDM

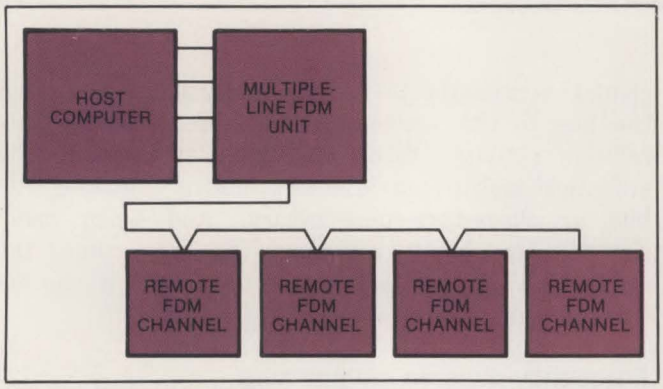


Fig. 4. Frequency-division *multiplexing lends itself easily to multidropping. Each terminal's modem is assigned a band of frequencies on the line and cannot respond to data transmitted at other frequencies.*

multiplexors also provide considerable flexibility to change the number or speed of channels as the requirements of the data network change. This, too, is possible because a TDM is a digital system independent of the data modem attaching it to the high-speed line.

Character TDM offers greater efficiency than FDM, because it buffers a complete character before transmitting it. As a result, it is possible to remove the start and stop bits from each asynchronous character before transmission, adding them back during demultiplexing at the other end. Thus, in the case of a Teletype, it is necessary to transmit only eight bits for every 11 bits (including one start and two stop) received.

The simplicity of the TDM technique results from the fact that the multiplexors communicate with each other by transmitting a constant stream of bits (bit TDM) or characters (character TDM), including regularly recurring SYNC characters with a constant number of time-slots between them. Each time-slot contains a predefined number of bits or characters for a specific channel (Fig. 5). It is a fundamental principle of time-division multiplexing that the frame (the data block following each SYNC character) is fixed in length and that frames are transmitted continuously and contiguously, because the receiving multiplexor knows which bits or characters belong to each channel only as a function of their temporal relationship to the SYNC character. The number of bits or characters in each time-slot enables it to handle its assigned channel without losing data, even when the channel is operating at maximum speed. But because the number of bits or characters is fixed, the TDM must transmit them even if the channel is operating below its maximum speed or not operating at all. And because transmission is continuous, there is no possibility of retransmission, even if the receiving multiplexor does detect errors.

The idle character used to fill a time-slot when no data character is ready for transmission often carries channel interface condition information, the break condition, remote loopback commands, diagnostic status information and terminal speed and code information needed to support adaptive-speed multiplexor configurations, which establish multiplexor channel speed by analyzing the first character received from a dial-up terminal. Idle characters are, therefore, not totally redundant, but the frequency of change in the control information is normally low enough that a large amount of redundant information is transmitted.

Fig. 5 shows a TDM configuration that employs fixed sequential scanning for interleaving bytes into the high-speed serial stream. Fixed scanning samples a bit or a character from each channel in order: channel 1, then 2, 3 and so on. This method results in all channels occupying the same bandwidth on the line. If the fastest terminal attached to the multiplexor runs at 300 bps, all channel allocations will be at 300 bps, regardless of the terminal speed.

Most TDMs now on the market use variable-channel address scanning. A variable-scan multiplexor can sample data at a rate proportional to the transmission speed. For example, it samples each 300-bps line three times for every time it samples a 110-bps line or every two times it samples a 134.5-bps line. Thus, it makes much more efficient use of a high-speed transmission line. But, with or without variable-channel scanning, each channel's time-slot is fixed and capable of supporting the channel continuously at maximum speed.

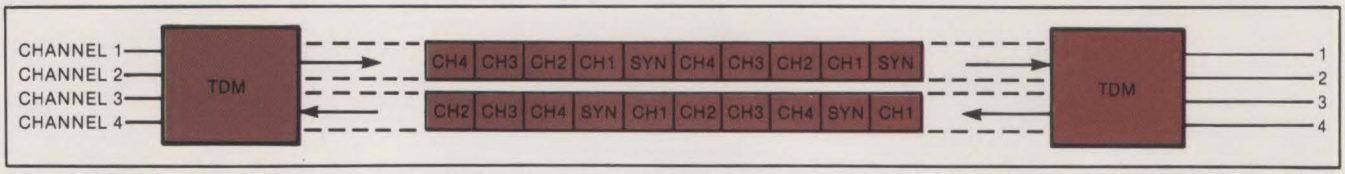
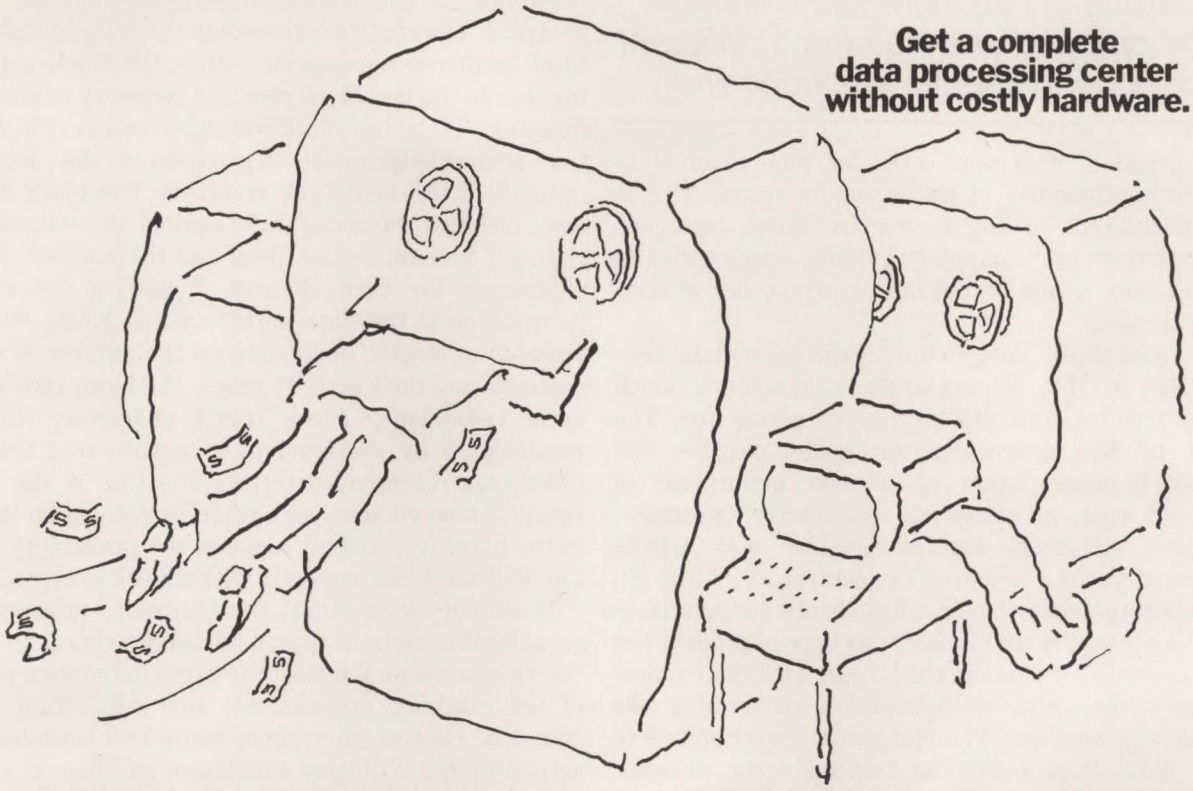


Fig. 5. A fixed sequential scanning TDM protocol. *The multiplexor samples a bit or character from each channel in sequence. If no data is available from a channel, the multiplexor inserts an idle bit or character. In this example, the multiplexor inserts a SYNC bit or character each time it finishes scanning all four channels.*

Get a complete data processing center without costly hardware.



Now there's a software package that can turn a minicomputer into a small-scale data processing center with from 5 to 40 terminals. The UNIX™ System.

UNIX Systems are time-sharing operating systems that are easy to program and maintain. So easy, in fact, that more than 800 systems are already in use outside the Bell System.

UNIX Systems give fast and efficient data processing. They feature more than 100 user utilities.

UNIX System, Seventh Edition, and UNIX/32V System. The new UNIX System, Seventh Edition, offers greatly enhanced capabilities, including a larger file system and inter-machine communications. The Seventh Edition is designed for PDP-11 minicomputers. For those needing its capabilities on a larger machine, the UNIX/32V System is available for the VAX-11/780. The Seventh Edition's improved portability features allow users to adapt it more easily to other computers.

Both the UNIX System, Seventh Edition, and the UNIX/32V System can support up to 40 users with FORTRAN 77 and high-level "C" languages.

Programmer's Workbench. For large software design projects, the PWB/UNIX System (Programmer's Workbench) allows up to 48 programmers to simultaneously create and maintain software for many computer applications. The PWB/UNIX System features a unique, flexible set of tools, including a Source Code Control System and a remote job entry capability for the System/370.

Developed for our own use, UNIX Systems are available under license from Western Electric and come "as is". With no maintenance agreements, no technical support.

For more information about UNIX Systems or other Bell System software, complete the coupon and mail to Bell System Software, P.O. Box 25000, Greensboro, N.C. 27420. Or call 919-697-6530.

UNIX is a Trademark of Bell Laboratories.

MMSS/10

To: Bell System Software,
P.O. Box 25000, Greensboro, N.C. 27420

Please send me more information about Bell System software packages.

☐ **UNIX Systems.** ☐ **Other Bell System software packages.**

Name_____

Title_____ Company_____

Address_____

City_____ State_____ Zip_____

Telephone_____ Hardware_____

CIRCLE NO. 63 ON INQUIRY CARD

One strong point of frequency-division multiplexing is that individual channels can be dropped and inserted at different points along the same telephone line.

In practice, it is very rare for any terminal to transmit continuously at its maximum speed. This is particularly true of the interactive dumb terminals used with most minicomputer systems, which typically transmit only a line or perhaps a screen-full of data before pausing.

Any multiplexor design intelligent enough to take advantage of this characteristic will achieve much greater terminal capacity on a given phone line. The advent of the microcomputer made possible the low-cost implementation of a new generation of intelligent TDM, or statistical multiplexor (statmux).

Micom's statistical multiplexors are called Data Concentrators or Computer Concentrators. Although these microprocessor-based multiplexors are relatively new, the concept is not. In fact, this type of product has been in service for years in the largest data communication networks, with minicomputers performing the multiplexing function. The statmux is programmed to buffer data from individual terminals, to transmit variable-length data blocks according to the loading on individual channels and to check data blocks received on the high-speed line and request retransmission in the event of errors. Without a computer, such functions are complex to implement.

Fig. 6 shows a typical statmux protocol. Each block starts with a start-of-header character marking the beginning of the control information for the block contents. The control information typically contains the block sequence number as well as the block sequence number of the last block received correctly in the other direction. If the last block was received in error, a NAK (non-acknowledgement) flag replaces the sequence number of the last block received. The block header also includes mapping information to indicate the channels present in the block and the number of data characters for each channel. Following the control information is the data portion of the block, which is variable in length, depending on the number of active channels and their activity rates. The block ends with a cyclic redundancy check (CRC) character, which is recalculated by the receiver to ensure that the data block was received correctly. The CRC is the 16-bit result of a polynomial calculation performed on the bits in the block, giving only a one in 10^{12} probability that a CRC will check out correctly with a block in error.

It would seem that the statmux protocol has considerably more overhead (non-data) characters than the TDM protocol, but the characters in the data portion of the statmux protocol are real data from active channels. On the other hand, many TDM time-slots are actually filled with pad characters or idles. It is true that if every channel were to operate continuously at its maximum speed, filling all the TDM time-slots with real data, the TDM protocol would be more efficient, but this point is of only academic interest.

The transmission of variable-length data blocks

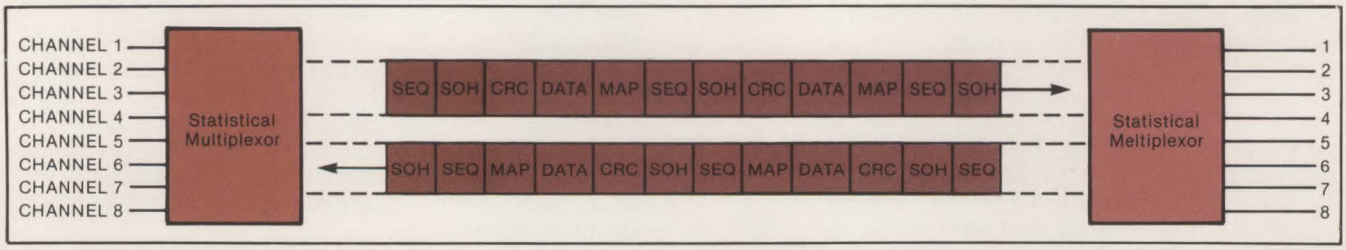


Fig. 6. A typical statmux line protocol. *Each data block begins with a start-of-header character (SOH), followed by the sequence numbers (SEQ) of the current block and of the last block correctly received. Then comes "mapping" information (MAP) that tells which channels are represented in the block and the number of data characters for each. The actual data (DATA) follows the map, and is in turn followed by a cyclic redundancy check (CRC) character.*

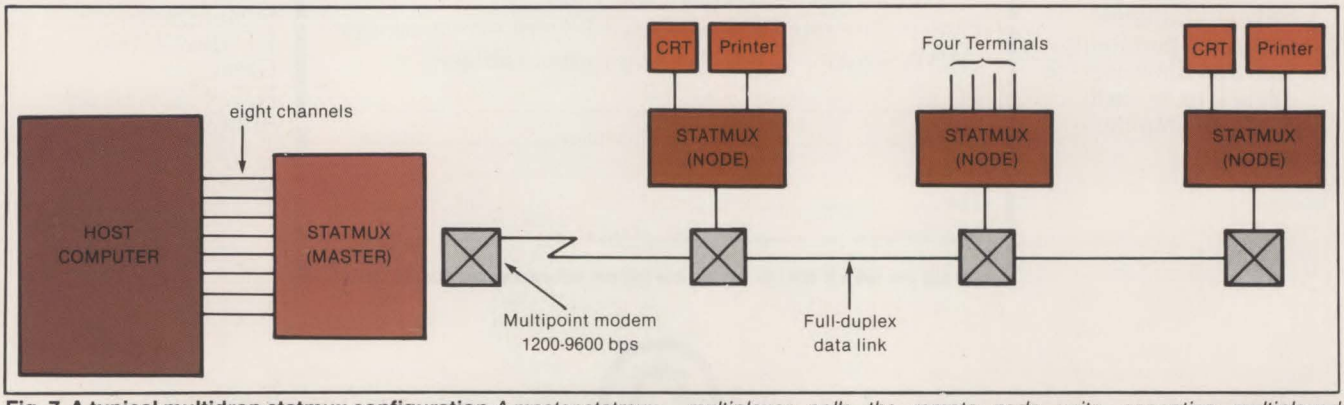
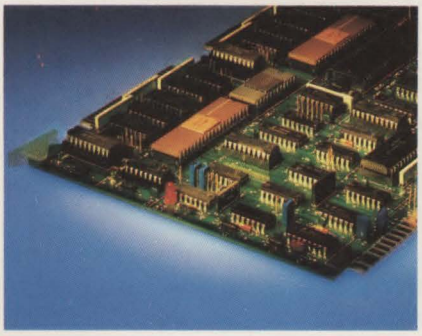


Fig. 7. A typical multidrop statmux configuration. *A master statmux at the computer site carries eight channels, each of which gives the computer an apparently point-to-point transparent connection to a terminal in one of the regional offices. Regional offices have node statmux units, which support two or four channels. The master multiplexor polls the remote node units, accepting multiplexed inbound data from terminals at each site and delivering multiplexed outbound data addressed to individual terminals at each site. The communication protocol is programmed into the multiplexors, enabling the use of asynchronous dumb terminals.*

Expand with the MSC 8001

The MSC 8001 is a MULTIBUS™ compatible single board computer designed to provide new dimensions in function and versatility. Built around the powerful eight-bit Z80™ CPU, the MSC 8001 provides a flexible memory addressing scheme and extensive input/output capabilities at prices well below competing single board computer products. Using the MSC 8001 as a master module, you can select I/O and special feature modules to configure a system of virtually any complexity or refinement.

Expand SBC 80 systems Upgrade existing SBC 80 systems that are being slowed down by limited memory size or restricted execution cycles. All existing I/O boards and memory expansion cards will operate with the MSC 8001.



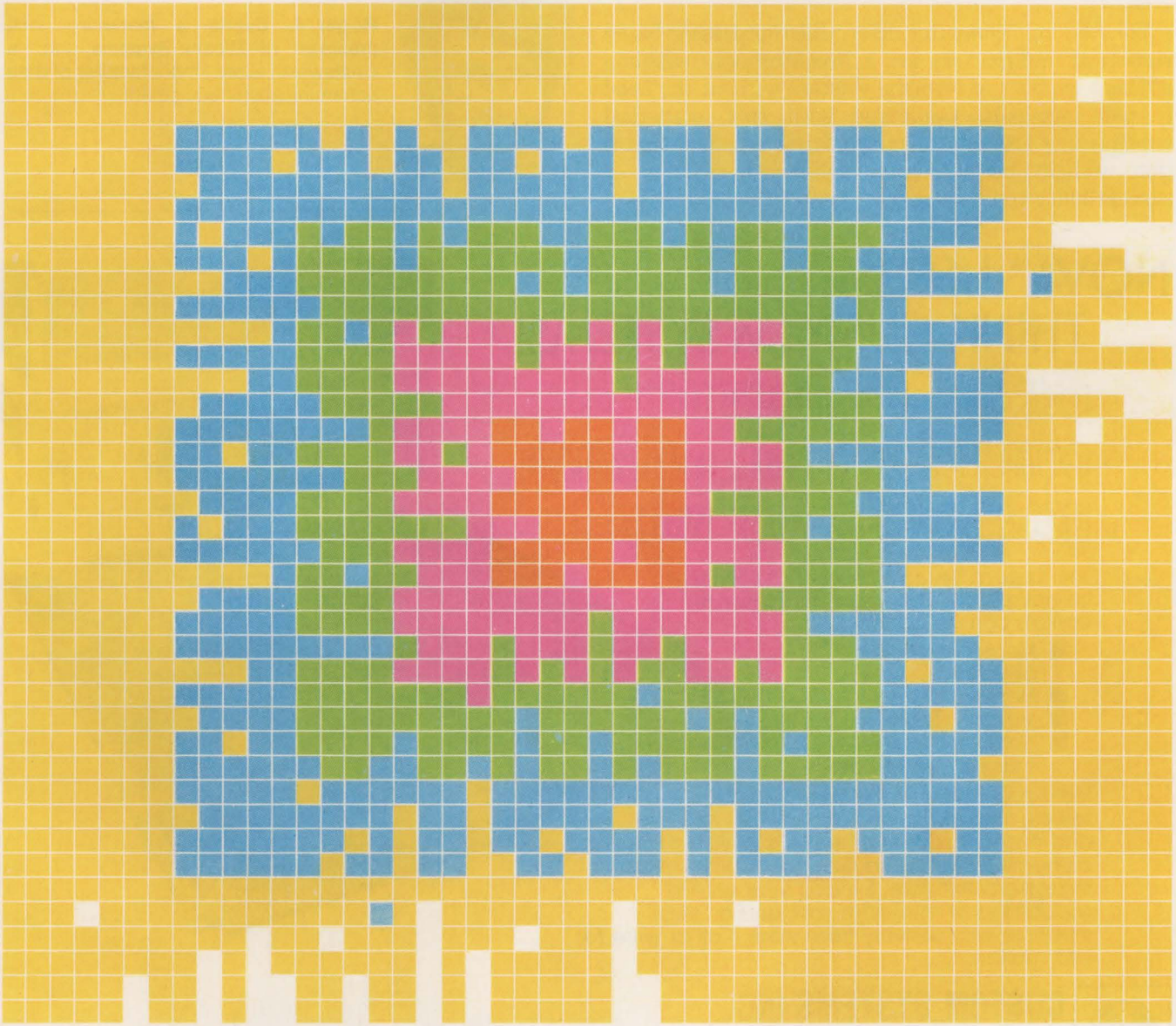
Monolithic Systems corp.

Expand to meet future needs The MSC 8001 is designed to accommodate a wide range of versatile configurations. Almost any combination of memory, inferface complement, and other options can be configured to meet your specific requirements without hardware modification. For additional information on the MSC 8001 and our other 41 Monolithic Systems Corp. products and systems, please contact us at 14 Inverness Drive East, Englewood, Colorado 80112. (303) 770-7400. Telex: 45-4498.

MULTIBUS is a trademark of Intel Corp.

Z80A is a trademark of Zilog, Inc.

Extending the limits of information.



MSC Regional Sales Offices: **Eastern Region** 1101-B9 State Road, Princeton, NJ 08540, (609) 921-2240; **Central Region** 7200 East Dry Creek Road, Suite #B203, Englewood, CO 80112, (303) 773-1060; **Western Region** 49 South Baldwin, Suite D, Sierra Madre, CA 91024, (213) 351-8717

CIRCLE NO. 64 ON INQUIRY CARD

The advent of the microcomputer made possible a new generation of low-cost data concentrators, or statistical multiplexors, whose concept came from large networks.

according to the loading on individual channels enables statistical multiplexors to avoid wasting high-speed line time with inactive channels. In addition, the transmission line needs to be capable of dealing only with average traffic loading, because the statmux can use its buffer storage to accommodate temporary peak loading on individual channels or groups of channels. The concentration achieved by the statistical multiplexor's transmission scheme and backup buffer storage means that its channel capacity and efficiency are superior to that of TDM. The further the total throughput of the channels is below their maximum data rate, the greater is the superiority of statistical multiplexing relative to TDM.

For the minicomputer user, microprocessor-based statistical multiplexors are a breakthrough, enabling efficient support of terminal clusters without the need to poll terminals. Compared with TDM, statistical multiplexing also enables much faster terminal operation without use of very high-speed modems or susceptibility to line errors.

Another advantage of statistical multiplexors is that they can be designed for use in multidrop configurations. A central master multiplexor can be programmed to poll multiple remote node multiplexors (Fig. 7). The polling is automatic and transparent to the terminals and host computer. In this configuration, the "multidrop multiplexor" serves the same function as an FDM, while enabling operation with much higher-speed dumb terminals.

A point-to-point statmux enables support of terminal clusters without a polling protocol in the computer and terminals; a multipoint, multidrop statmux enables support of multidropped terminals or terminal clusters, also without any requirement for a polling protocol. Both products are black boxes that provide an "add-on protocol" for the dumb terminals commonly used with minicomputers. Next month we will discuss how other black boxes can be used to optimize access to the computer and to reduce port costs. ■

Roger L. Evans is marketing vice president of Micom Systems, Inc., a Chatsworth, Calif., manufacturer of data communications equipment.

Beehive's family of custom OEM terminals

proven hardware!

plug-in software!

MODULAR CONSTRUCTION

Model DM1A
EXPANDED CONVERSATIONAL
14 Key Numeric Pad, Line Drawing,
21 Video Attributes,
128 ASCII Character Set

Model DM20
EDITING
Full Editing Features,
Buffer Transmission Modes,
Logical Attibutes,
Protected Fields,
16 Function Keys

Model DM30
ADDITIONAL MEMORY
All features of the DM20,
Multiple Page Capability,
Parallel Printer Port,
Scrolling

Call for applications assistance and delivery

TOLL FREE USA **(800) 453-9454**

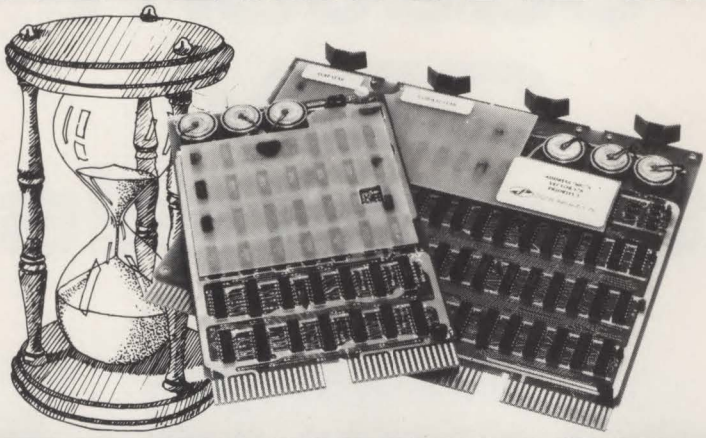
CALIFORNIA Costa Mesa *(714) 540-8404 TWX 910-595-2572* • Sunnyvale *(408) 738-1560*
FLORIDA Altamonte Springs *(305) 830-4666* **ILLINOIS** Arlington Heights *(312) 593-1565*
MASSACHUSETTS Woburn *(617) 933-0202* **NEW YORK** New York *(212) 682-2760* **UTAH** Salt Lake City *(801) 355-6000*
WASHINGTON, D.C. (VA) Falls Church *(703) 356-5133*
EUROPE The Netherlands *Phone 020-451522*

BEEHIVE INTERNATIONAL

"A proven competitive manufacturer of smart terminals"

CIRCLE NO. 65 ON INQUIRY CARD

TIME after TIME



BATTERY SUPPORTED CALENDAR CLOCKS

PDP-11*
TCU-100 • $495
- Provides month, day, hour, minute and second.
- Can interrupt on date/time, or periodic intervals.

TCU-150 • $460
- Provides year, month, day, hour, minute and second.
- Automatic leap year.
- Patches for RSX-11M, RT-11 FB/SJ VO2, VO3 and UNIX.

LSI-11/2*
TCU-50D • $325
- Provides month, day, hour, minute and second.
- Dual size board.
- Patches for RT-11 SJ/FB VO2, VO3B.

Lockheed SUE
TCU-200 • $550
- Provides year, month, day, hour, minute, second and milli-second.
- Interval interrupts between 1/1024 seconds and 64 seconds.

Computer Automation (Naked Mini)
TCU-310 • $385
- Provides year, month, day, hour, minute and second.

Multi-Bus**
TCU-410 • $325
- Provides year, month, day, hour, minute and second.
- SBC/BLC compatible.

HP 2100
TCU-2100 • $395
- Correct time restored after power failure.
- Compatible with the HP TBG card.

Serial Clock (RS 232 or 20 mA)
SLC-1 • $640
- Connects between any terminal and host computer.
- Provides date, time and more!

All Digital Pathways TCUs have on board NICAD batteries to maintain time and date during power down. Timing is provided by a crystal controlled oscillator. Prices are U.S. domestic single piece. Quantity discounts available.

For more information on these products, contact:
Digital Pathways Inc.
4151 Middlefield Road
Palo Alto, CA 94306
Phone: (415) 493-5544

*Trademark of Digital Equipment Corporation

**Trademark of Intel Corporation
***Trademark of Computer Automation Incorporated

DIGITAL PATHWAYS

CIRCLE NO. 66 ON INQUIRY CARD

The 8086 family: a second wave

JEFFREY KATZ, Intel Corp.

They add a multiprocessing capability to Intel's 16-bit microcomputer

The recent expansion of Intel Corp.'s 8086 family of 16-bit microcomputer components, embodied in the addition of three new parts, shows that Intel regards the family as one of the most ambitious product lines of its kind. The 16-bit instructions enable the microcomputer to attain performance an order of magnitude greater than that of medium-range 8080-type units.

The new products are:

- The 8088 microprocessor. This HMOS microprocessor is almost identical to the 8086 with its 16-bit internal architecture, 1M-byte addressing capability, 8086 software compatibility, and powerful register structure. The major change is that the bus interface unit provides an 8-bit data bus.
- The 8089 I/O processor. This second addition brings a mainframe concept to microcomputers. In addition to allowing easy interfacing between the Intel 8086 and 8088 microprocessors and 8/16-bit

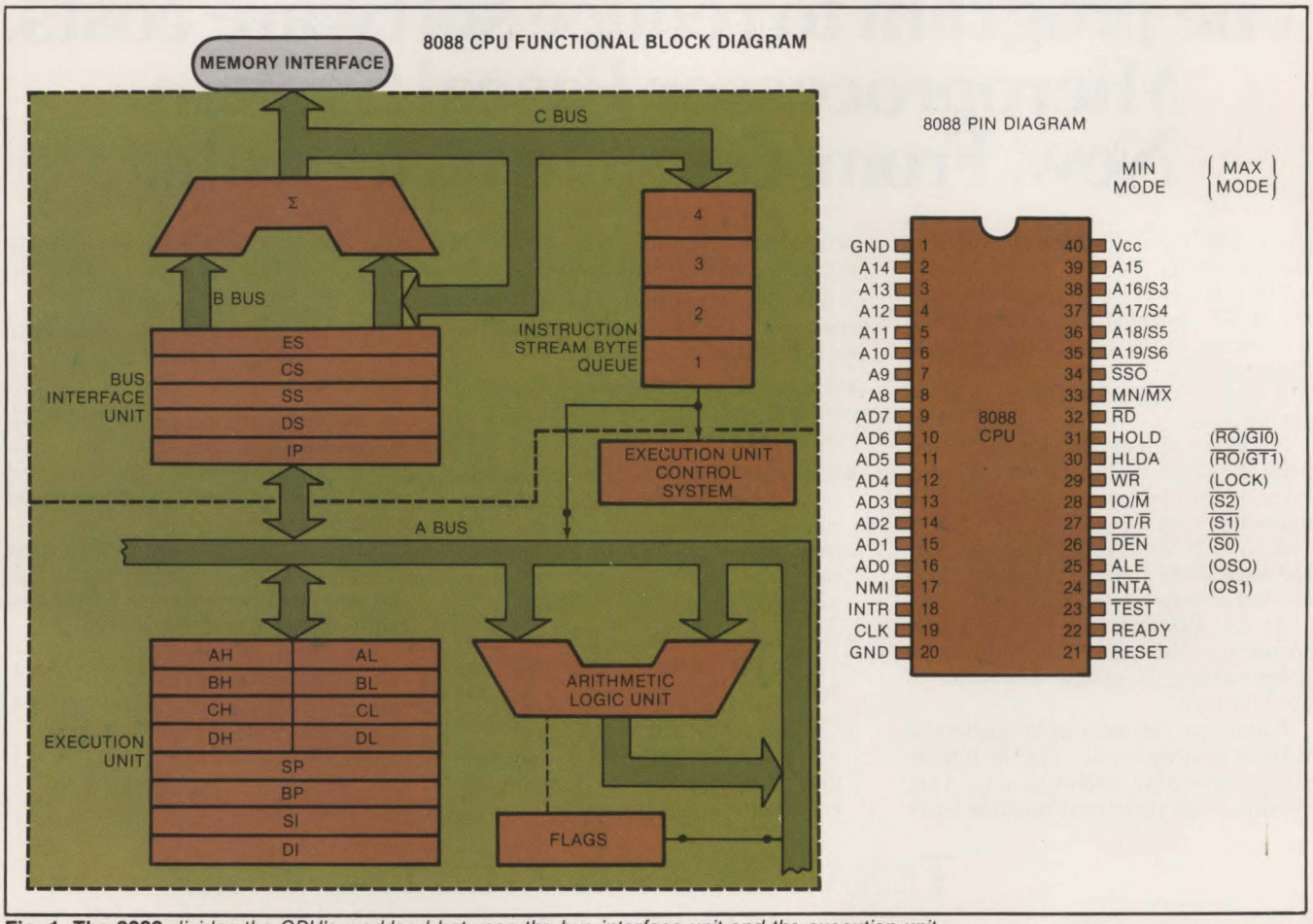
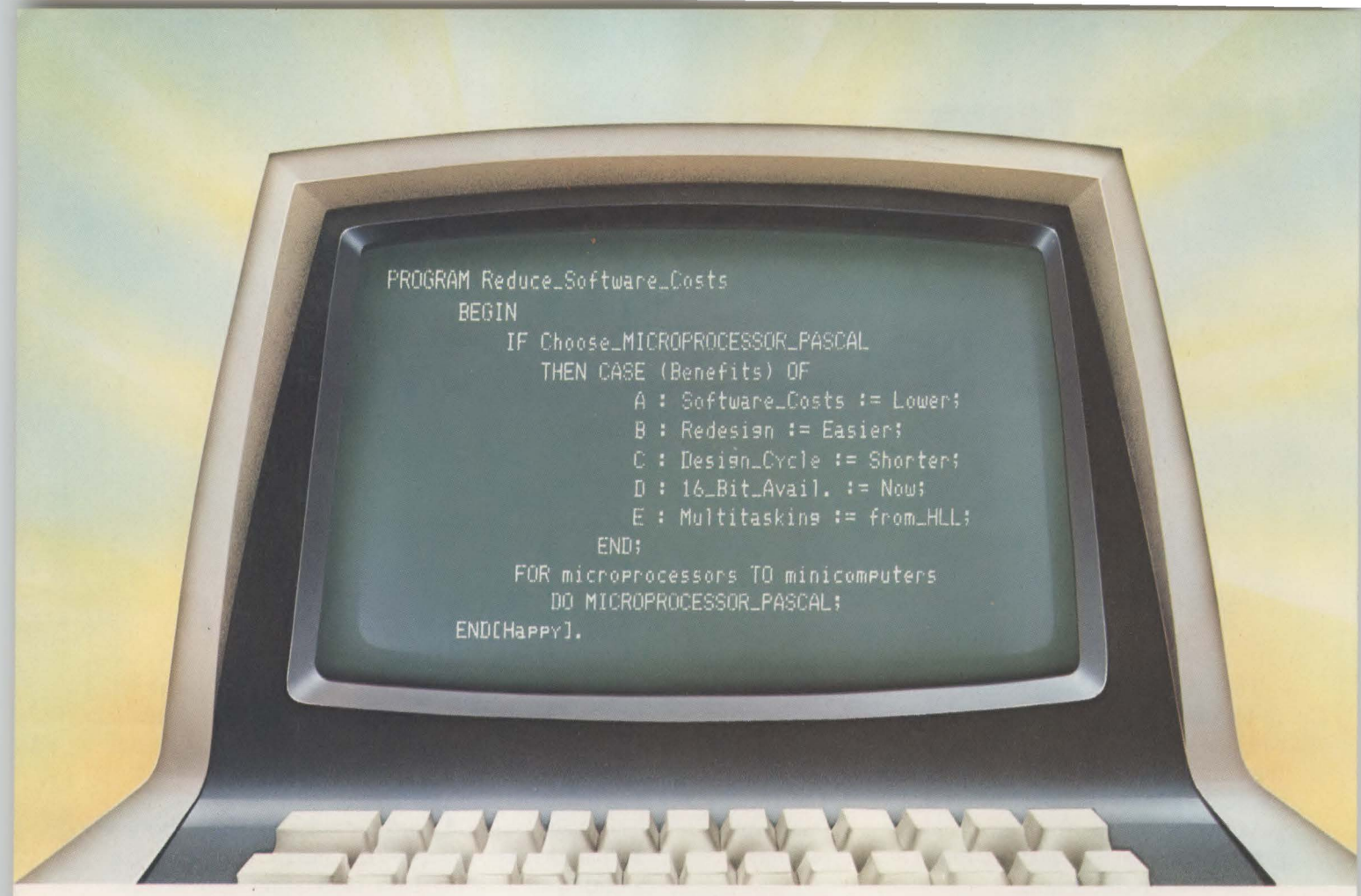


Fig. 1. The 8088 *divides the CPU's workload between the bus interface unit and the execution unit.*



The program to reduce software costs. Microprocessor Pascal System. New. From Texas Instruments.

Learnability. Transportability. Maintainability.

The features of Pascal, plus the benefits of TI's learning curve experience, are offered in the new Microprocessor Pascal system.

A system designed for microprocessor applications.

A system developed for the 16-bit 9900 Family, including the TM990 microcomputer modules, and 990 minicomputers.

A system to effectively lower your software costs today. And keep them low tomorrow.

At TI, Pascal is the first and only corporate-wide approved high-level programming language. For a lot of good reasons.

Pascal lets you solve your application without getting involved in the intricacies of machine architecture. And, Pascal's block structure results in fewer programming errors, because the code is easier to write, read and modify.

TI's Microprocessor Pascal system consists of six parts and provides the most Pascal capability ever offered:

- Source Editor — specifically designed to create/edit Pascal programs and check program syntax.
- Compiler—compiles conventional Pascal programs as well as TI's Pascal concurrent extensions into interpretive code, which can then be executed directly, or converted into 9900 native machine code.
- Host Debugger — over fifteen options for tracing variables and modifying data.
- Configurator—enables the target system to retain only the parts of the runtime support necessary for program execution.
- Native-Code Generator — converts Pascal interpretive code into 9900 native machine code.
- Run-Time Support—both interpretive and native-code execution provide a speed/memory trade-off.

TI's continuing commitment to innovative, cost-effective 16-bit microprocessor software means an increased applications capability and decreased development time for you.

Find out how you can reduce your present and future software costs. Put the new TI Microprocessor Pascal system to work for you, today.

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

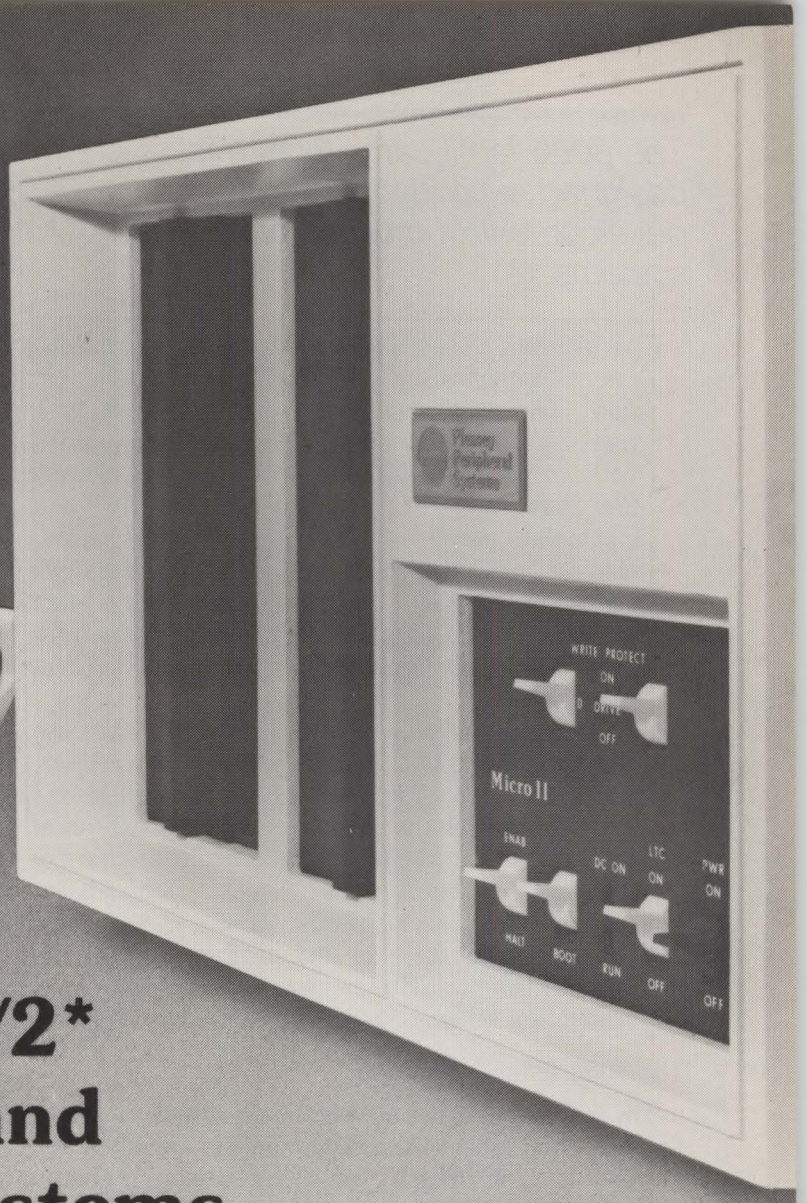
Fifty Years of Innovation

TEXAS INSTRUMENTS
INCORPORATED

85582B

CIRCLE NO. 67 ON INQUIRY CARD

SYST-2VX



Plessey's LSI-11/2* Microcomputer and Floppy Based Systems

Series SYST-2VX is Plessey's new high-performance, general purpose microcomputer system designed for small system applications. Based on the LSI-11/2, the SYST-2VX series is an ideal entry-level floppy system with additional backplane slots available for expansion to large data base applications — AND the versatile instruction set of the PDP-II/34 to support the extensive software associated with hard disc storage. When used in conjunction with an optional terminal, the features of the SYST-2VX surpass those of DEC's* non-expandable PDT-11 programmable data terminals.

Plessey's new SYST-2VX microcomputer systems include:

- 64 Kbytes of random access memory (RAM)
- dual density floppy disc subsystem with one or two drives for up to 1 Mbyte of storage
- either a 1-channel EIA/20mA or a 4-channel EIA serial line interface
- line time clock
- bootstrap ROM and terminator
- either tabletop cabinet or rack-mount chassis with front panel operator console

Plessey anticipated your future needs and designed the Series SYST-2VX so that you can upgrade with an upward compatible LSI-11/23* and related memory increase.

Plessey's reputation for quality, service, delivery, reasonable prices, and worldwide support, has made us the largest independent producer of DEC-compatible equipment. Our product line includes add-in/add-on, core, and semiconductor memories; cartridge, disc pack, floppy, mag tape controllers and subsystems; mini/microcomputer systems; DEC-compatible software; and a wide variety of backplanes, expansion chassis and other accessories. All Plessey products include applicable hardware and software documentation, plus warranty with maintenance/installation options.

Contact your nearest regional sales office for more information on the Series SYST-2VX or any Plessey product.

Plessey Peripheral Systems

17466 Daimler Avenue
Irvine, CA 92714
(714) 540-9945
TWX 910 595 1796

*Registered trademark of Digital Equipment Corp.

A REPUTATION TAKES TIME TO ACQUIRE

Waltham MA (617) 890-2654 • Dallas TX (214) 387-0229 • Minneapolis MN (612) 881-0190 • Santa Ana CA (714) 972-8966

See us at NCC Booths 3118, 3120 and 3122

CIRCLE NO. 68 ON INQUIRY CARD

The 8086 family architecture is designed explicitly to simplify development of multiple processor systems.

peripherals, the 8089 offloads I/O overhead from the CPU, communicating with the CPU only as necessary. The 8089 also acts as an intelligent DMA controller, and may operate completely in parallel with a CPU. With its on-board processing power, the 8089 can translate data "on the fly" and manipulate peripheral controllers, leaving the CPU free for computing chores. The 8089 provides two I/O channels, each capable of supporting data transfer rates as high as 2M bytes/sec., dramatically improving performance in I/O-intensive applications.

- The 8289 bus arbiter. This device referees bus use in systems with multiple bus masters. The arbiter, which operates with the 8288 bus controller, is a key to exploiting the multiprocessing capabilities of the 8086 family. The processor is totally unaware of the 8289's existence and issues commands as though it had exclusive use of the system bus. Depending on the size and configuration of the system, the bus aribiter provides straightforward arbitration schemes to prevent bus contention.

The 8086 family processor

The expansion of the 8086 family offers a set of flexible, compatible processors, support elements and peripherals. The designer can choose the configuration that best meets product requirements while maintaining compatibility for future upgrades. The 8086 family architecture is explicitly designed to simplify development of multiple processor systems by providing complementary processors and facilities for coordinating their interaction. Through the use of a common set of bus control and support circuits, designers can tailor systems to meet specific applications.

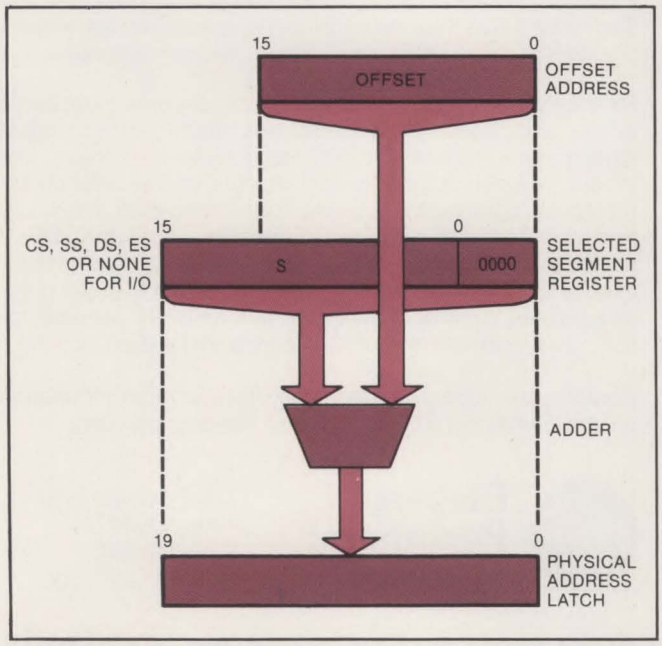


Fig. 2. The 8080's *20-bit memory address is computed by adding a 16-bit offset to the appropriate segment register, which has been shifted left four positions.*

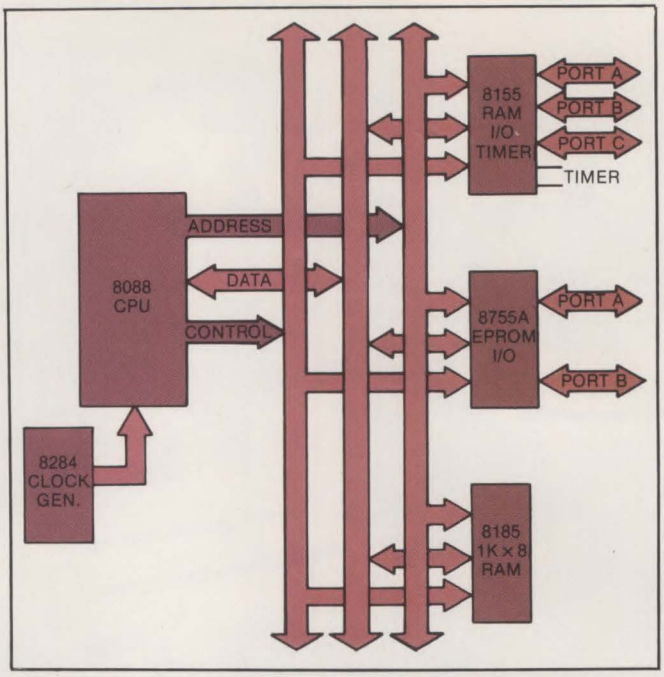


Fig. 3. The 8088's *minimum configuration mode enables several multiplexed components to be connected directly to the CPU.*

The 8086 is best applied to highest-throughput designs, such as high-speed communication links and hard-disk systems. The 8088 is the prime component for byte-oriented systems. Such 8-bit systems would include intelligent terminals, word processors and telecommunications processors. With the HMOS technology, both processors offer high performance, while the common architecture provides faster, easier design with identical development tools and complete software portability. A designer can write software in assembly language or PL/M for both family CPUs and be assured of its portability. In addition, system upgrades from earlier processors, such as the Intel 8080A and 8085A, can be made easily, because the 8088 bus structure is compatible with their 8-bit bus interface.

The third processor of the family, the 8089, provides for modular systems development, allowing the I/O system to be designed and implemented in parallel with the rest of the system. With modular I/O and application/operating systems, the useful life of software is increased. Changes can be made to one without greatly affecting the other. I/O specialists can work without a detailed knowledge of the application; conversely, the application and operating system teams do not need to have expertise in I/O device operations. The I/O processor's simple CPU interface is also designed to be compatible with future Intel CPUs.

Combining the raw speed and responsiveness of a traditional DMA controller, an I/O-oriented instruction set and a flexible bus organization, the 8089 IOP is a very versatile I/O system. Applications with demanding

I/O requirements, previously beyond the abilities of microcomputer systems, can be undertaken with the IOP. Such I/O-intensive applications include:

- systems that employ high-bandwidth, low-latency devices, such as hard disks and graphics terminals;
- systems with many devices requiring asynchronous service; and
- systems with high-overhead peripherals, such as intelligent CRTs and graphics terminals.

In addition, virtually every application that performs a moderate amount of I/O can benefit from the design philosophy embodied in the IOP—system functions should be distributed among special-purpose processors. IOP channel programs are likely to be both faster and smaller than the equivalent function implemented with a general-purpose CPU. Programming also is more straightforward with the IOP's specialized instruction set.

Multiprocessing benefits

The availability of a family of compatible processors enables the benefits of multiprocessing design to be realized in medium-to-large systems. Instead of a centralized approach, which relies on a "super" CPU and extremely fast memory, multiple processor advantages include:

- Allocating tasks to special-purpose processors that perform the functions more simply and efficiently;
- Parallel processing for very high levels of performance;
- Systems function isolation, which insures that failures or errors in one part of the system have limited effect on the rest of the system; and
- Natural system partitioning, which promotes parallel development of subsystems, breaks the overall application into smaller, more manageable tasks and helps isolate the effects of system modifications.

With the addition of the 8289 bus arbiter, the 8086 family architecture provides a built-in solution to the classical multi-processing coordination problems of bus arbitration and mutual exclusion.

The 8088 processor

The 8088 brings the advantage of 16-bit CPU performance to existing 8-bit systems. The advantages include faster arithmetic and logic operations, greater data-handling capacity and improved memory and I/O addressing techniques. The 8088's internal architecture allows efficient operations on 8- and 16-bit data, including strings and blocks. With an instruction set identical to the 8086's, the new processor delivers twice the performance of the 5-MHz 8085A and five times the performance of the 2-MHz 8080A. Yet, it is able to use roughly the same speed memories as those devices, and performs without wait states.

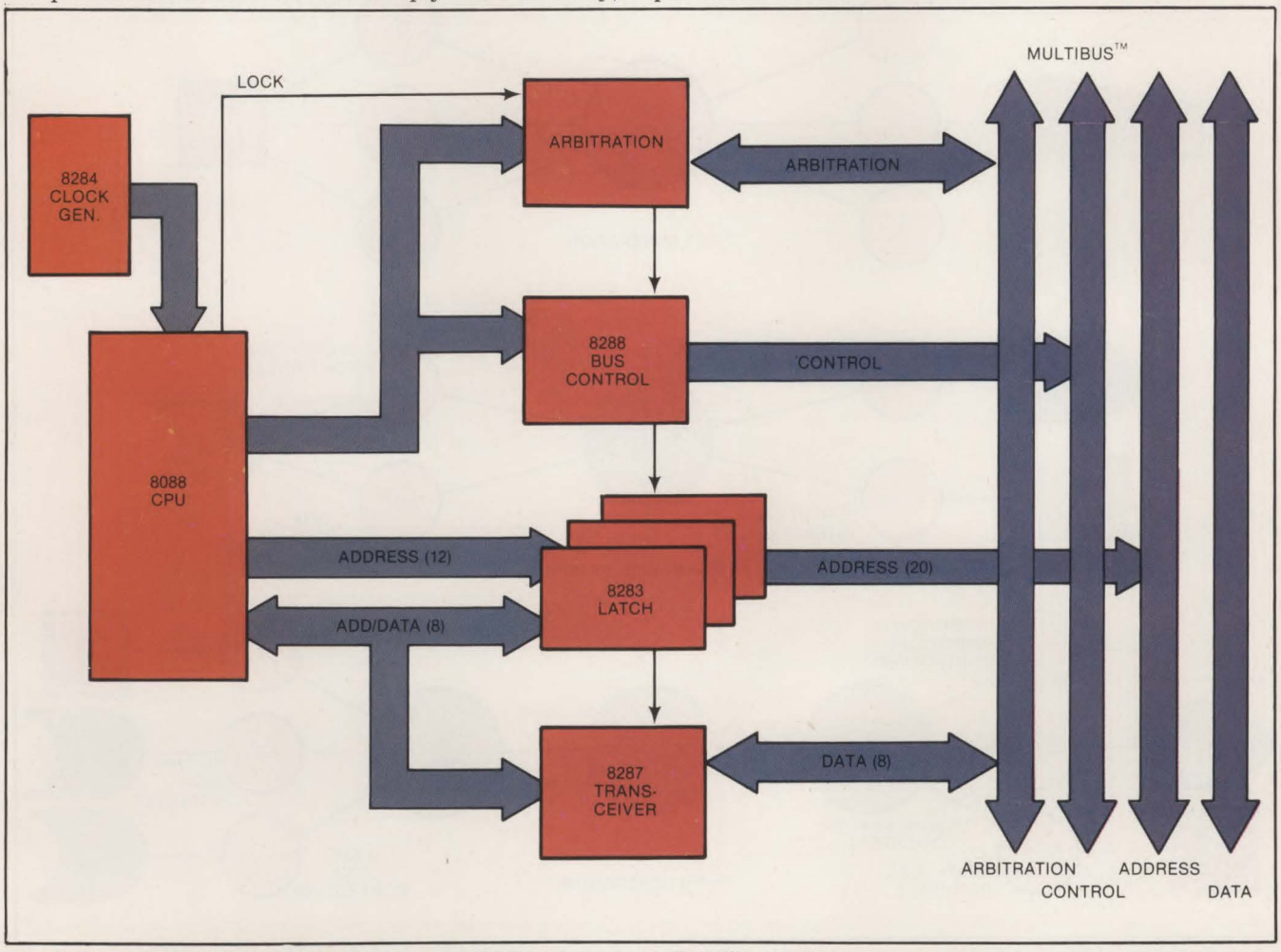


Fig. 4. A multiprocessing system *that uses the 8088's maximum configuration mode.*

The 8089 I/O processor brings a mainframe concept to microcomputers.

Essentially, the 8088 is two processors encapsulated in a single 40-pin package (Fig. 1). The bus interface unit (BIU) pre-fetches instructions required by the execution unit (EU) and buffers as many as 4 bytes in a queue. This maximizes bus bandwidth use. The BIU also handles operand fetch and store, address-relocation and bus-control functions. The EU performs the basic processsing functions. By splitting the CPU workload into separate but concurrent tasks, the 8088 architecture enables processor functions to be pipelined for improved performance. Although it has an 8-bit external interface, the 8088 retains the 8086's 16-bit width for all internal registers and data paths. The 16-bit manipulation is implemented for all arithmetic, logical data and I/O operations.

The processor contains nine 1-bit flags and four sets of four 16-bit registers: general, pointer, index and segment. The general registers may be used freely in 8088 arithmetic and logical operations. Some general registers may also be used in special operations, such as string-transfer operations. The pointer and index registers also participate in 16-bit arithmetic and logical operations. In addition, they are used to compute addresses within a segment. The four segment registers, called the code-, data-, stack- and extra-segment registers, respectively, are used in all memory address computation.

The 8088 has a 1M-byte memory space. To locate a byte in this space, the processor must generate a 20-bit memory address. This is accomplished by dividing the 8088's memory space into 64K-byte segments and using one of the segment registers as a base pointer with a 16-bit offset (Fig. 2). For example, the offset in an instruction fetch is the 16-bit value of the instruction pointer. This value is added automatically to the code segment register (with four low-order zero bits appended) to form the required 20-bit address. In a data transfer, memory is addressed relative to the base address contained in the data-segment or extra-segment register. The stack-segment register is similarly used in stack operations.

Program relocation is simple

Program segments can be relocated dynamically anywhere in the 8088's 1M-byte address space simply by moving the code and updating the code-segment register. However, the program segment to be relocated must not contain absolute branch instructions

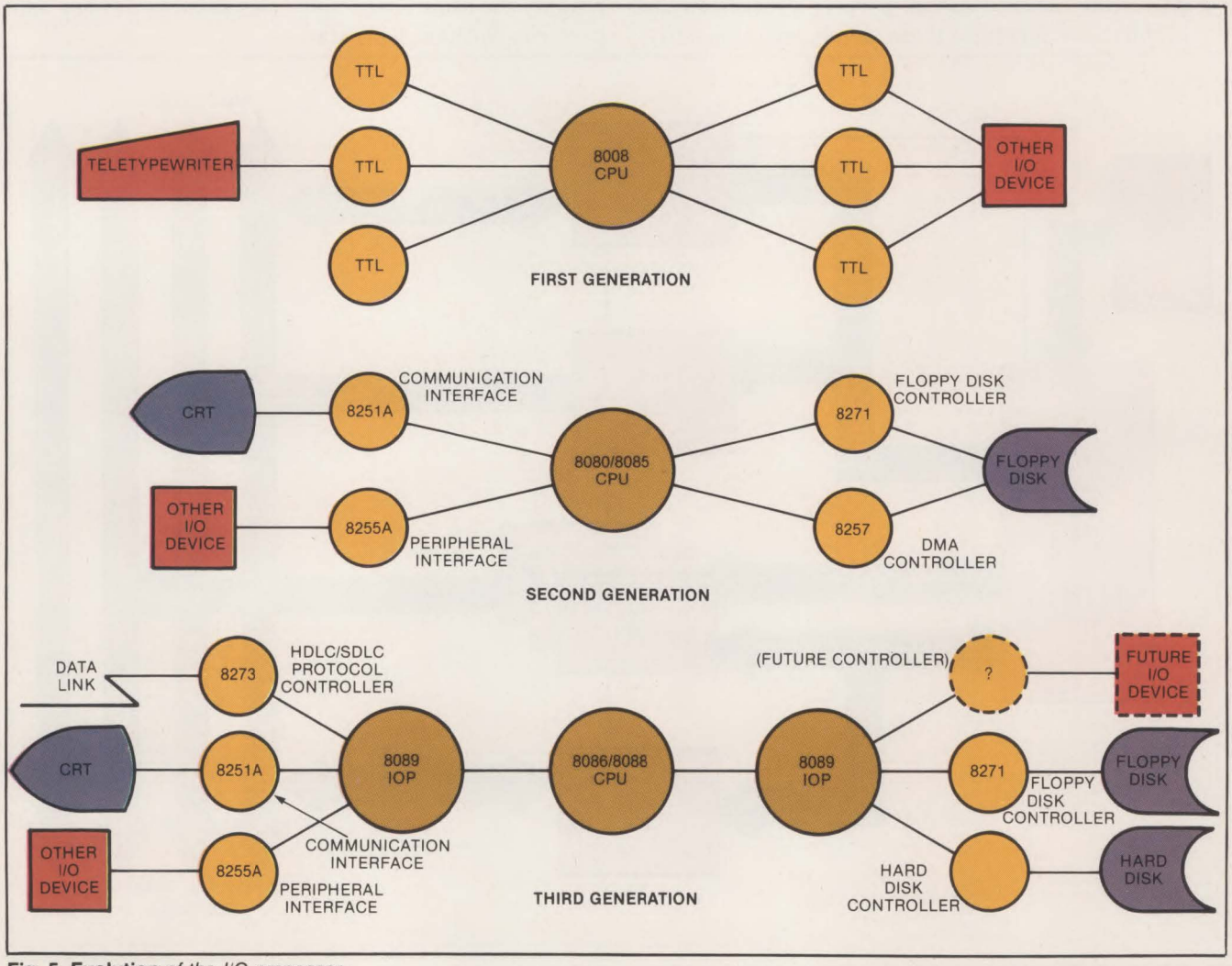


Fig. 5. Evolution *of the I/O processor.*

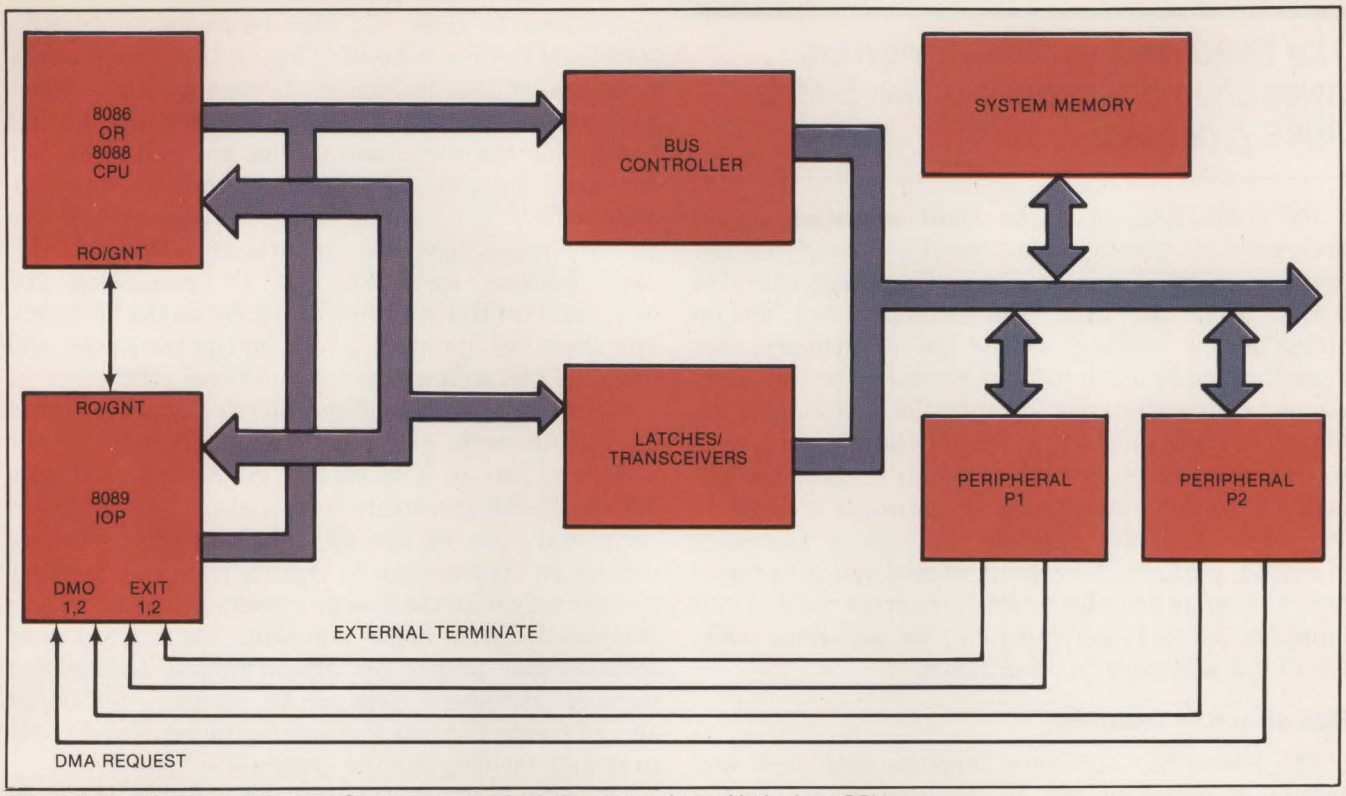


Fig. 6. Local mode *enables the I/O processor to share the system bus with the host CPU.*

and must not modify the value of the code-segment register.

The 8088's 8-bit data bus structure maintains compatibility with existing 8-bit hardware. The 8-bit interface requires fewer components and connections, leading to minimum layouts. For example, it interfaces to the 8085 family's multifunction components, which reduce the number of packages needed to implement a system.

With such design simplification, the 8088 covers a broad range of applications from component count-sensitive systems to high-performance multiprocessing systems. The 8088 can operate in either a minimum or maximum hardware mode, which is strap-selectable. In the minimum mode, the 8088 can be used with either a multiplexed or demultiplexed bus (Fig. 3). The multiplexed bus structure allows implementation of a minimum chip-count system. For example, it supports high-density multifunction 8085A peripherals, such as the 8155 RAM/IO/TIMER, 8755A EPROM I/O, 8185 1K × 8 static RAM and others. The demultiplexed mode requires from one to three latches to extract the address bus fully. Fully implemented, the demultiplexed mode provides a standard bus structure, with heavy bus buffering, relaxed bus timing requirements and full 1M-byte addressability.

The maximum mode uses the 8288 bus controller and 8289 bus arbiter to remove control signals from the CPU. This frees the CPU to provide more CPU status information and such advanced features as hardware lock, queue status and two request/grant direct memory access interfaces. These features allow local and remote bus configurations, multimaster bus arbitration and compatibility with 8086 family co-processors. Fig. 4, for example, shows one method of implementing the 8088 in a multiprocessing environment with minimal hardware.

Evolution of the I/O processor

Traditionally, in an I/O-intensive system, the CPU's computational efficiency is reduced. This occurs because peripherals tie up the system bus and require concurrent attention from the CPU. As microprocessors become more powerful and complex, the consequences of becoming I/O-bound increase in severity.

Increased processor performance and greater I/O throughput requirements of magnetic media have led designers to distributed processing solutions (Fig. 5). First-generation CPUs were forced to deal directly with substantial numbers of TTL components, often performing transfers at the bit level. As a result, they could support only a limited number of relatively slow devices. Second-generation processors were introduced with single-chip interface controllers that removed the lowest level of device control from the CPU and let the CPU transfer whole bytes at once. With the introduction of DMA controllers, high-speed devices could be added to a system, and whole blocks of data could be transferred without CPU intervention. Second-generation I/O devices and DMA controllers allowed microprocessors to tackle problems that required a moderate number of medium-speed I/O devices. The controllers themselves, however, still required a considerable amount of attention from the CPU. In many cases, for example, the CPU had to respond to an interrupt with every byte read or written. In addition, the CPU had to stop while DMA transfers were performed.

The 8088 microprocessor delivers twice the performance of the 5-MHz 8085 processor.

The 8089 introduces the third genration of I/O processing. It continues the trend of simplifying the CPU's "view" of I/O devices by removing another level of control from the CPU. The CPU performs an I/O operation by building a message in memory that describes the function to be performed; the IOP reads the message, carries out the operation and notifies the CPU when it has finished. To the CPU, I/O devices appear to transmit and receive whole blocks of data; the IOP makes both byte- and word-level transfers invisible to the CPU. The IOP assumes all device controller overhead, performs both programmed and DMA transfers, and can recover from "soft" I/O errors without CPU intervention; these activities may be performed while the CPU is attending to other tasks.

Bus structure features

The 8089's bus structure supports both local and remote operation modes. In the local mode, the IOP shares the 8086/8088 bus. This allows the 8086 or the 8088 to address peripherals located on the system bus. Essentially, this configuration provides intelligent DMA for small systems (Fig. 6). In the remote mode, the IOP's local bus is physically separated from the system bus to allow the 8089 to communicate with peripheral devices without tying up the system bus, a configuration that maximizes throughput. Direct communication between the 8086 or 8088 and a peripheral residing on the IOP's local I/O bus is not possible—or desirable. Instead, as necessary, the CPU and IOP communicate by storing messages in a shared system memory space. The IOP supports an additional "private" address space so that I/O processing and peripheral control may be transparent to the host CPU. This frees the system bus to eliminate contention and frees the CPU to increase computational efficiency.

Fig. 7 shows an I/O configuration that uses 8089 IOP in its remote mode. Resident memory exists on the peripheral bus to hold canned I/O routines and data buffers. Resident memory is treated as an I/O processor peripheral. Use of the I/O peripheral bus interface enables an I/O processor to execute from local memory concurrently with the host processor operation. When a peripheral device needs servicing, the I/O processor accesses the proper I/O driver routine in resident memory. Peripheral data can be stored in the buffer area of resident memory or can be transmitted directly to system memory via the system bus.

The 8089 contains two register-oriented channels, each executing both user-written channel programs and hard-wired block transfers. The user-written program sets up the registers for the block transfer, then starts the transfer and suspends its own operation. The channel program resumes execution

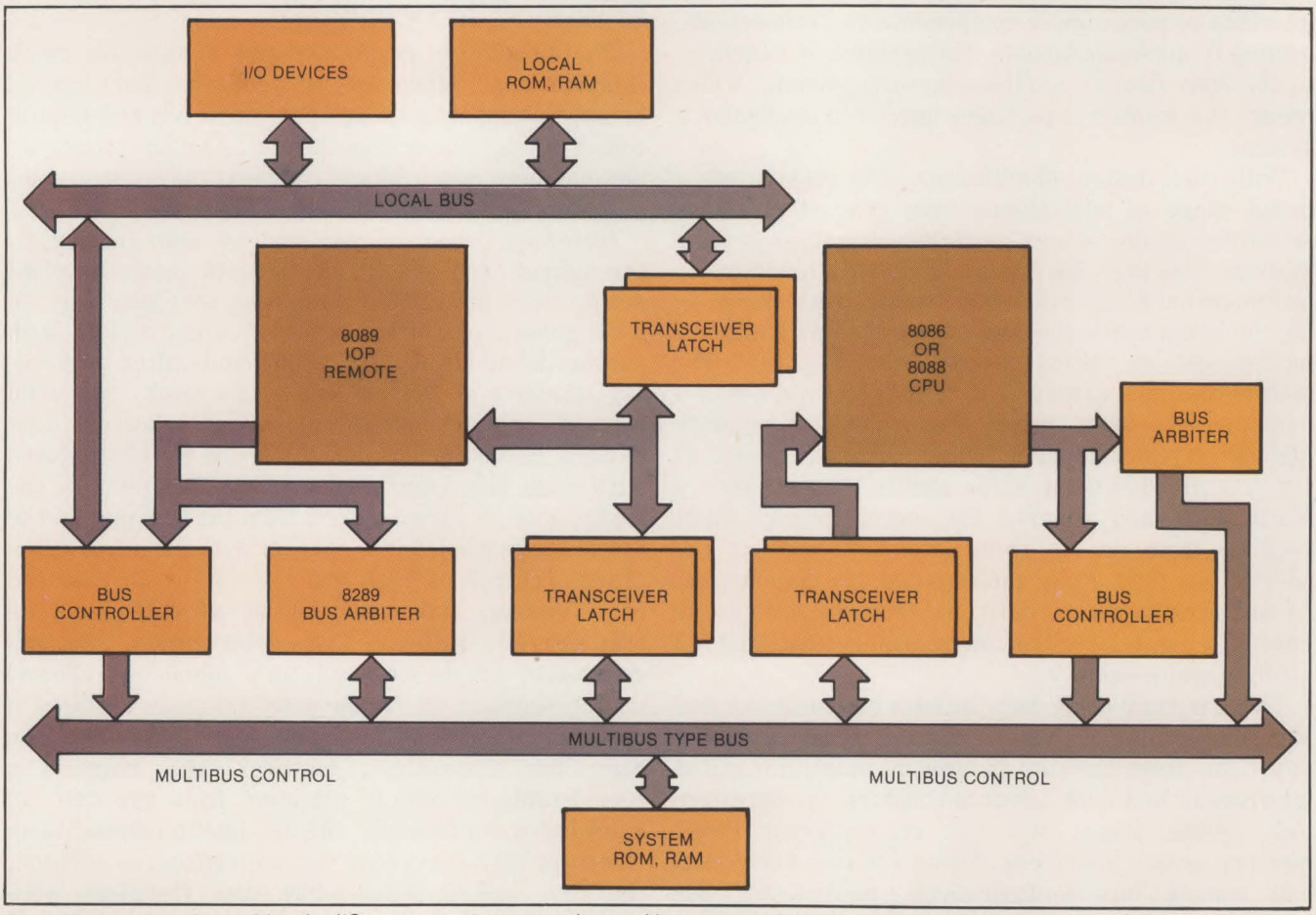


Fig. 7. Remote mode *enables the I/O processor to communicate with system peripherals over a local bus.*

SIEMENS

The little floppy disk drive with the big performance record.

What really counts in a disk drive is performance. And that's where the Maxi-Mini™ shines. For more than 3 years, it has consistently met every performance standard. You might say the Maxi-Mini is the "old reliable" of the mini-floppy market.

Siemens quality and engineering excellence make the dependable difference. Metal lead screws, for instance, are used to assure the utmost precision in head positioning.

Siemens Maxi-Mini disk drives are available with single or double head, single or double density. And they are plug-to-plug industry compatible.

To find out more about the Maxi-Mini, contact:

Siemens Corporation
OEM Data Products Division
240 East Palais Road
Anaheim, California 92805
(714) 991-9700

District Offices:
Boston, MA (617) 449-3450
Iselin, NJ (201) 494-1000
Chicago, IL (312) 671-2810
Dallas, TX (817) 461-1673

Siemens. The technology to do more.

CIRCLE NO. 69 ON INQUIRY CARD

The 8289 bus arbiter provides a built-in solution to the classical multiprocessing coordination problem.

when the block transfer is complete. The system CPU may issue a channel command to halt a channel program or start another.

The block transfer function is a microcoded sequence executed by the IOP that allows high-speed transfer between a source and destination address as defined by a user program. Where source/destination data widths differ, the microcode automatically compensates for word alignment and bus width, making most efficient use of the available bus bandwidth. The block transfer function supports three synchronization options: free running, source synch and destination synch. In addition, it supports four transfer modes: port-to-port, buffer-to-port, port-to-buffer and buffer-to-buffer.

The 8089's versatility

The IOP is a general-purpose device. Some of the situations where it can be used to advantage include:

- **String processing.** The IOP can perform a memory move, translate, scan-for-match or scan-for-nonmatch operation much faster than the equivalent instructions in an 8086 or 8088. Translate and scan operations can be set up so that source and destination addresses refer to the same location to permit the string to be manipulated in place.
- **Spooling.** The IOP can be used to store data from low-speed devices, such as terminals and paper tape readers, in memory or on disk until the transmission is complete. The IOP can then transfer the data at high speed when it is needed by an application program. Conversely, output data ultimately destined for a low-speed device, such as a printer, can be temporarily spooled to disk and then printed later. This permits batches of data to be gathered or distributed by low-priority programs that run in the background, essentially using up "spare" CPU and IOP cycles. Applications programs that use or produce the data can execute faster because they are not bound by the low-speed devices.
- **Multitasking operating systems.** The IOP allows an operating system to dispatch I/O tasks to channels with an absolute minimum of overhead. Because a remote channel can run in parallel with the CPU, the operating system's capacity for servicing application tasks can increase dramatically, as can its ability to handle more, and faster, I/O devices. If both channels of an IOP are active concurrently, the IOP automatically gives preference to the high-priority activity (e.g., DMA normally preempts channel program execution). The operating system can adjust the priority mechanism and also can halt to suspend a channel to take care of a critical asynchronous event.
- **Disk systems.** The IOP meets the speed and latency requirements of hard disks. It can be used to implement high-level, file-oriented systems, which appear to application programs as simple commands, such as OPEN, READ and WRITE. The IOP can search and update disk directories and maintain free space maps. "Hierarchical memory" systems that automatically transfer data between memory, high-speed disks and low-speed disks based on

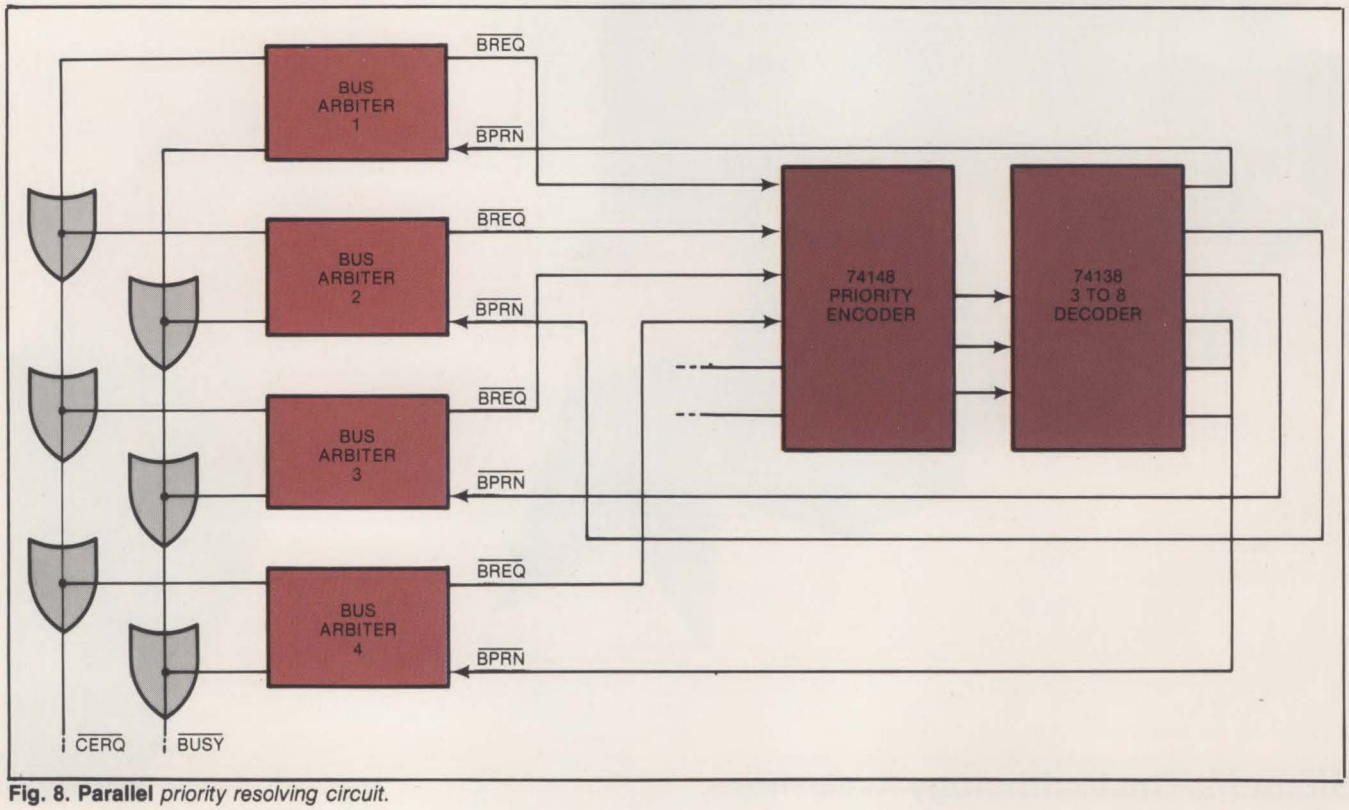


Fig. 8. Parallel *priority resolving circuit.*

frequency of use can be built around IOPs. Complex data base searches (reading data directly or following pointer chains) can appear to programs as simple commands and can execute in parallel with applications programs if an IOP is configured remotely.

- **Display terminals.** The IOP can be used to handle the DMA requirements of CRT controllers. The IOP's transfer bandwidth is high enough to support both alphanumeric and graphics displays. The 8089 can assume responsibility for refreshing the display from memory data; in the remote configuration, the refresh overhead can be removed from the system bus entirely. Linked-list display algorithms may be programmed to implement sophisticated display modes. Each time it performs a refresh operation, the IOP can scan a keyboard for input, and translate the key's row-and-column format into an ASCII or EBCDIC character. The 8089 can buffer the characters, scanning the stream until an end-of-message character (e.g., carriage return) is detected, and then interrupt the CPU. A single IOP can typically support an alphanumeric CRT and keyboard on one channel and a concurrently operating floppy disk on the other channel. In the remote configuration, an IOP can be coupled with 8086 or 8088 to provide scaling, rotating and other display transformations.

8289 bus arbiter

The 8289 is a 20-pin, bipolar component intended for use with medium-to-large 8086/8088 multimaster/multiprocessing systems. It provides distributed bus arbitration for systems with multiple bus masters, such as the 8086 CPU with the 8089 I/O processor in remote mode, while providing bipolar buffering and drive capability.

When used in a multimaster bus system, the bus arbiter allows each MCS-86 family processor to operate as if it has exclusive use of the system bus. Each processor has its own bus arbiter. The arbiter prevents the bus controller, data tranceivers and address latches from accessing the system if the arbiter does not have use of the system bus. The system bus appears as "not ready," and the processors enter a wait state. Once the higher-priority data transfer is complete, a transfer acknowledge is returned to the processor to indicate "ready." The processor then completes its transfer cycle. In this manner, the bus arbiter serves to multiplex a processor or bus master onto the multimaster system bus and prevents bus contention.

Priority resolving techniques

In a multimaster bus system, priority resolving techniques are required to arbitrate use of the system bus. The three techniques available when using the 8289 are:

- **Parallel priority.** This technique uses a priority encoder-decoder arrangement shown in Fig. 8. The arrangement is fairly simple: A separate bus request line ($\overline{\text{BREQ}}$) from each arbiter feeds into the encoder, which generates a binary address for the highest priority line. The address is then decoded to select a predesignated highest-priority requesting arbiter via its bus priority in line ($\overline{\text{BPRN}}$). When the system bus becomes idle, the selected arbiter allows its master to access the bus. While this technique requires external logic, the logic is simple to implement and can be used effectively where many arbiters are present on the system bus.
- **Rotating priority.** This technique, also used for large systems, is similar to the parallel technique but uses a different approach to arbitration: Priority is assigned dynamically. Rather than returning priority to a predesignated highest-priority requesting arbiter, priority is rotated among the requesting arbiters. Immediately following the use of the bus, the arbiter for that master is assigned the lowest priority. While requiring the use of more external logic, the technique assures that each bus master, over time, receives an equal chance to use the system bus.
- **Serial priority.** This technique, used for medium-sized systems, eliminates the need for external encoder-decoder logic. Instead, priority is established by daisy-chaining the bus arbiters together: the highest-priority arbiter's bus priority output ($\overline{\text{BPRO}}$) is connected to the $\overline{\text{BPRN}}$ of the next highest priority, and so on. The number of arbiters that can be chained together is a function of the bus system clock and the propagation delay from arbiter to arbiter. Normally, at a 10-MHz bus clock frequency, only three arbiters can be daisy-chained.

Flexible modes of operation

The 8289 has four modes of operation, which are strap-selectable. These include a multimaster bus mode and a multiple multimaster bus mode. In addition, there are two other modes of operation: I/O peripheral bus mode and a resident bus mode. The I/O peripheral bus mode is the basic mode for the 8089 I/O processor. In this mode, the IOP communicates with peripherals over a separate peripheral bus. When the I/O processor needs to communicate with system memory, it does so over the system memory bus. When the 8089 tries to transfer information to the system bus, the 8289 serves to arbitrate the system. The resident bus mode, used mainly with an 8086 or 8088 CPU, allows a processor to have peripheral and memory resources on a private or "resident" bus, which it uses without contention with other processors on the system bus. This frees up the system bus, thereby increasing system throughput. ■

Jeffrey Katz is microprocessor marketing manager at Intel Corp. in Santa Clara, Calif.

Full DEC*

Introducing the Mostek VAX Add-In. Now we have all the cards.

With the addition of our 256K byte add-in memory for the VAX-11/780, we now have a full line of add-in, add-on memories for DEC minicomputers. Your advantage? All the inherent advantages of dealing with a reliable single source supplier.

The new Mostek VAX incorporates the same quality found in all our memory systems: Total hardware and software compatibility. High density for maximum capacity in a minimum number of card slots. Burn-in and stress tests at the component level. Pre-burn, burn and post-burn tests at the system level. Standard and optional system features for greater system flexibility and significant cost savings. And a full one-year warranty on all memory boards.

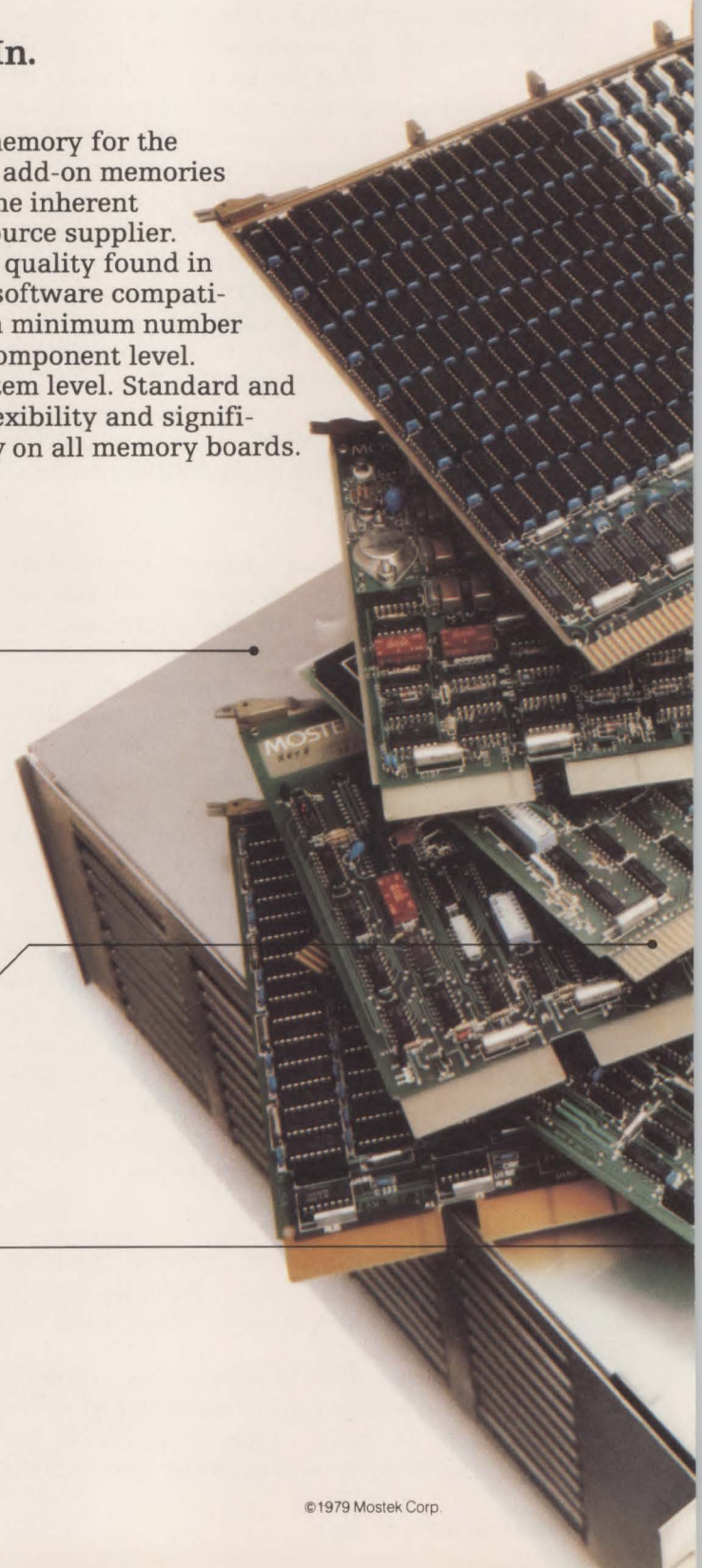
PDP-11/70*

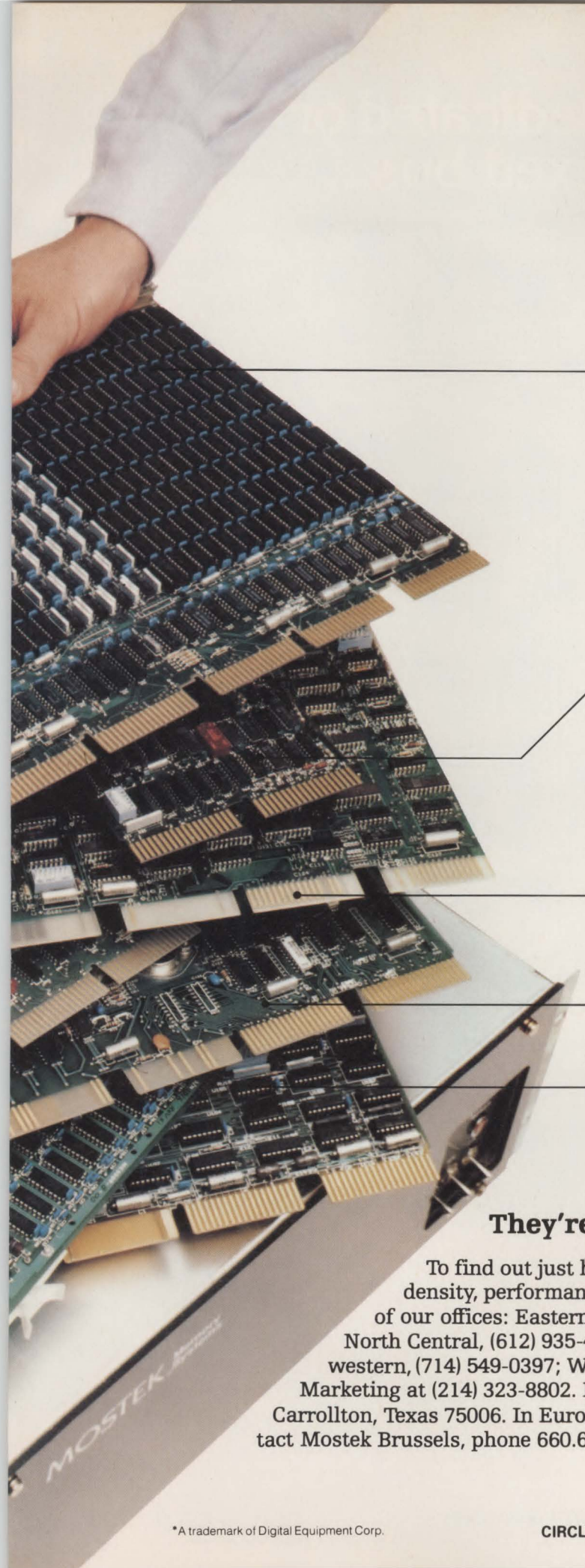
MK 8601
Total capacity of two megabytes in a 7" chassis. 256KB or 512KB increments with ECC standard. Can operate in the serial and interleave modes simultaneously. Maintenance program available.

PDP-8*

MK 8009 A1"X" (PDP-8A)
16K, 32K, 48K, or 64K words x 12 bits. Compatible with DEC memory management to extend total capacity to 128K x 12 with just two cards.

MK 8009 A0"X" (PDP-8E,F,M)
16K or 32K words x 12 bits. Single +5V supply with synchronous "hidden" refresh control.





VAX-11/780*

MK 8016
256KB single board capacity (32K words x 72 bits with 64 bits data and 8 bits ECC). Totally hardware and software compatible.

LSI-11/2* or LSI-11/23*

MK 8005 (PDP-11/03,* 23)
8K, 16K, or 32K words x 18 bits with optional byte parity generation and checking.

PDP-11/04* through 60

MK 8011
16K, 32K, or 64K words x 18 bits with on-board parity generation and checking.

MK 8001
16K, 32K or 64K words x 18 bits with parity standard.

MK 8012
64K x 18, 96K x 18, or 128K words x 18 bits with parity standard.

They're available out of stock.

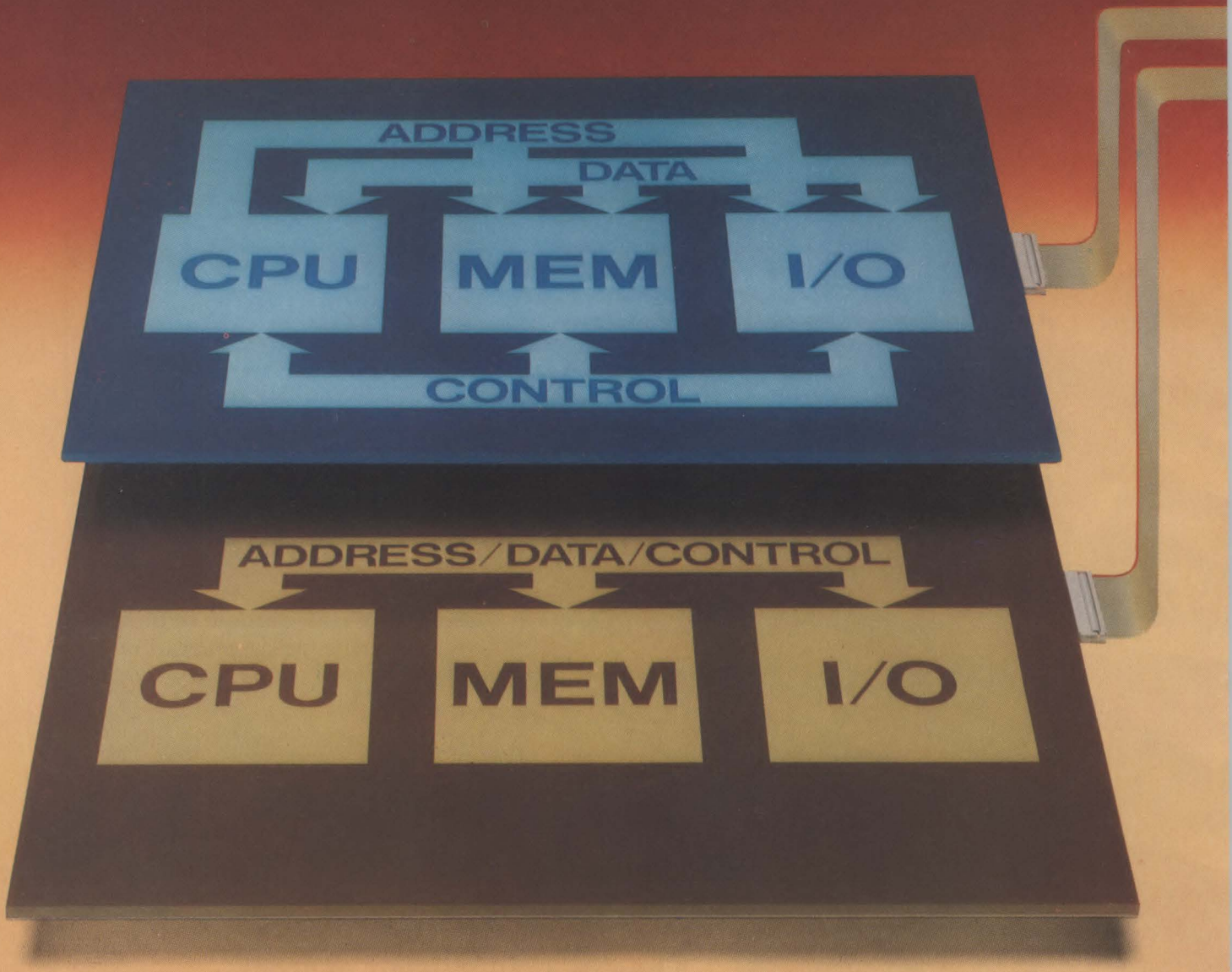
To find out just how well Mostek Memory Systems stack up in density, performance, reliability, availability and price, call one of our offices: Eastern, (201) 842-5100; Northeastern, (617) 256-1500; North Central, (612) 935-4020; South Central, (214) 386-9141; Southwestern, (714) 549-0397; Western, (408) 287-5081; or Memory Systems Marketing at (214) 323-8802. Mostek Corporation, 1215 West Crosby Road, Carrollton, Texas 75006. In Europe, contact Mostek Brussels, phone 660.69.24.

MOSTEK Memory Systems

*A trademark of Digital Equipment Corp.

CIRCLE NO. 70 ON INQUIRY CARD

Catch a dedicated or multiplexed bus...



HP—When you depend on logic

CIRCLE NO. 71 ON INQUIRY CARD

and leave the analyzing to HP's 1610B.

If you're working with mini- or micro-based systems, you'll find that HP's 1610B is a very efficient dedicated-bus logic state analyzer.

But unlike other analyzers, the HP 1610B can also handle multiplexed-bus analysis just as effectively. The reason? Because with multiplexed buses, addresses and data appear at different times on the same lines. And first-generation logic analyzers, with their single-clock design, simply cannot demultiplex these correctly.

One popular solution to this problem has been to build a two-clock sequential acquisition system into a single package. While this approach will separate out address and read/write functions, it is still inferior to the 1610B. Why? Because this is still not true demultiplexing, in that this technique cannot correct for the real-time differential between the capture of address information and the capture of read/write data.

This means address and data information can be interleaved in the display. It requires the operator to interpret read or write functions. And it means that triggering may occur on false address/data combinations. In other words, it complicates analysis and may lead to false conclusions.

In comparison, the HP 1610B incorporates not two — but three clocks — plus a buffered memory to deliver true demultiplexing. In short, the 1610B can independently monitor addresses, plus read and write data, to demultiplex in real time for efficient and accurate analysis.

So with the 1610B, addresses and corresponding data are displayed as a single line of information, for easy comparison with your original programs. And you're sure that if you trigger on an address-data combination, the data is present at that address at that specific point in the program.

Other important capabilities.
In addition, the HP 1610B delivers other capabilities required for efficient state flow analysis of both bus structures. It will store information on a qualified basis, to permit selective editing. Which means you don't have to sort through unnecessary data. And it makes functional measurements, such as time interval analysis, on the state flow, which speeds analysis and troubleshooting.

Flexibility for the future.
Because the 1610B is a 32-bit analyzer with user-selected parameters, and a variety of options, you can use it with both mini and micro based systems, including 8-bit microprocessors such as the Motorola 6800 and the Intel 8085, as well as the newer 16-bit microprocessors such as the Z8000. And, of course, it includes HP's popular menu program format that speeds set-ups and analysis.

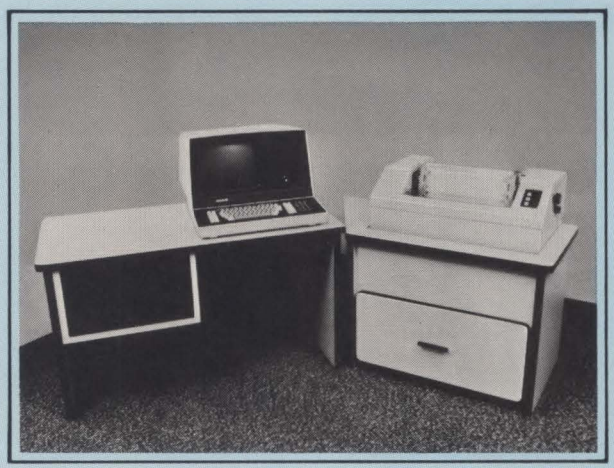
An economical solution to microprocessor-based systems analysis.
Another good answer to the problem of microprocessor demultiplexing is the 1611A Logic State Analyzer, with HP's general-purpose module. This module incorporates a seven-clock system that allows multiplexed information on common bus structures to be latched into 1611A inputs at the appropriate time for display. If you're already using an HP 1611A, you'll find this module to be both an effective and cost-efficient solution.

For complete details.
The HP 1610B is priced at $12,500,* while the 1611A (including the general-purpose module) is $6,000.* For more information on these, and for an application note on state analysis of multiplexed microprocessors, write: Hewlett-Packard, 1507 Page Mill Road, Palo Alto, CA 94304. Or call the HP regional office nearest you: East (201) 265-5000, West (213) 970-7500, Midwest (312) 255-9800, South (404) 944-1500, Canada (416) 678-9430.

*Domestic U.S.A. price only

HEWLETT PACKARD

089/15



We want additional dealers. And the sooner you get started with Astrocom, the sooner you start making money. Talk to Tom Frahm from Astrocom. He'll tell you about the total support he provides his dealers.

When you need us, we'll be there.

astrocom corporation

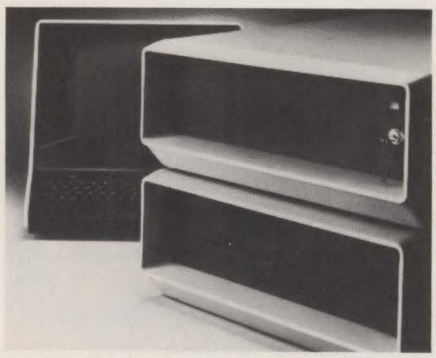
120 West Plato Boulevard
St. Paul, MN 55107
(612) 227-8651 Telex: 297421

See the Astrocom 760 at NCC Booth #426 in Disneyland Hotel Garage May 19-22

CIRCLE NO. 72 ON INQUIRY CARD

SMALL BUSINESS SYSTEM. The CS/50 small business system supports as many as nine interactive DASHER terminals, as much as 760M bytes of disk storage, and 600- and 900-lpm printers. The system can also include 12.5M- and 25M-byte Winchester-disk drives with integral 126M-byte backup floppy drives. The CS/50 supports interactive operations, such as order entry or customer inquiry, with concurrent activities supporting data communications, file maintenance or program development. For users with distributed sites, the CS/50 supports RJE 80 (2780/3780) and HASP II communications. **Data General Corp.,** Westboro, Mass. **Circle No 200**

HARD-DISK SYSTEM. Using a double-sized printed circuit board, the ACS8000-6 computer system incorporates all the logic needed to control as many as four 14.5M-byte Shugart Winchester disks. The ACS8000-6 includes I/O control to support two serial and two parallel ports, in addition to four serial ports to which users' terminals are connected. Features include DMA operation, firmware address checking, a high-speed FIFO buffer and intelligent sequencing. **Altos Computer Systems,** Santa Clara, Calif. **Circle No 201**



8-BIT MICROCOMPUTER. The Centurion microcomputer system, which can process data for small-business applications at a rate of 7 MHZ, is said to run about six times faster than competing models. Built around Intel's 8085A-2 microprocessor, the system uses a floating-point math chip to handle number-crunching calculations. The system operates with a CRT terminal and as many as four single-sided, double-density floppy-disk drives and is compatible with any printer with an RS232 interface. Prices in single-unit quantities ranges from $8025 to $10,925, depending on configuration. **Artec Electronics, Inc.,** San Carlos, Calif. **Circle No 202**

WORD PROCESSOR/COMMUNICATIONS WORK STATION. The 700/RTE work station is geared to applications that require both stand-alone word-processing and data-processing communications with a central computer. The system includes dual minifloppy drives, with a total capacity of 160K bytes, and a 55-cps daisy-wheel printer. In the word-processing mode, the system uses an 8 × 12 dot matrix and displays 20 80-character lines. In the communications mode, the 700/RTE switches to a 7 × 9 dot matrix and a 24 × 80 display. Price is $8000. **Megadata Corp.,** Bohemia, N.Y. **Circle No 203**

HIGH-SPEED DIGITAL TYPESETTER. The APS-Micro 4, a compact CRT typesetter that can set 1250 lines per minute, is aimed at small- to medium-sized newspapers, commercial printers, typographers, in-plant operations and publishers. The system, which has a 200-typeface storage capacity and resolution as high as 3600 lpi, is available in 45-, 57- and 70-pica line widths. Typesetting features include point-size scaling in 1/10-point increments and dynamic leading. **Autologic, Inc.,** Newbury Park, Calif. **Circle No 204**

MICROCOMPUTER SYSTEM. The Cluster-shared Cluster/One model A enables as many as 64 independent Apple II computers to be tied together in a local network to share data. Each model A includes a dual 8-in. floppy-disk drive; a 16.5M- or 33M-byte Winchester-disk drive is optional. Prices start at $6000 for the basic system with 1.26M bytes of storage. The optional 16.5M- and 33M-byte systems cost $8000 and $10,000, respectively. A $400 ClusterBus communication card is required for each user station in the network. Apple II computer costs are separate. **Nestar Systems, Inc.,** Palo Alto, Calif. **Circle No 205**

MEDIUM-SCALE COMPUTER. The Level 64/DPS-330 medium-scale computer provides architectural support for development of on-line data bases, telecommunications networks and transaction-oriented and distributed-processing environments. The DPS-330 includes microprogramming, integrated mass storage and unit record processors, a communications controller for greater central processor efficiency and directly addressable LSI MOS main memory that can be expanded from 512K to 2M bytes. The computer can serve as a host to a network of as many as 15 Honeywell Level 6 computers. **Honeywell Information Systems, Inc.,** Waltham, Mass. **Circle No 206**

MICROCOMPUTER SYSTEM. The Series 2000 microcomputer is a desk-top system with minifloppy-disk drives and controller, two high-speed microprocessors, 64K bytes of dynamic RAM, boot ROM, a 12-in. CRT, a commercial keyboard with function keys and a numeric pad, two serial ports and provisions for attaching a Winchester disk. Including a UCSD Pascal software package, the system costs $3450. **Wave Mate, Inc.,** Carson, Calif. **Circle No 207**

LAW OFFICE COMPUTER. The Alpha System 7 microcomputer for law firms comprises an 8080 microprocessor with 64K of RAM and as many as three 8-in. floppy-disk drives capable of storing more than 125 pages of text each, a CRT terminal and a letter-quality printer. The system supports word-processing, client-billing, accounting and calendar-control functions. Prices begin at $14,000, with leasing available. **Alpha Professional Systems,** Beverly Hills, Calif. **Circle No 208**

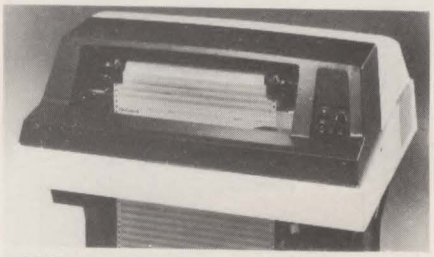
printers

MATRIX PRINTER. The M-120 impact printer uses an operator-replaceable seven-wire print head. The unit produces standard or expanded characters bidirectionally at 180 cps, in a 7 × 7 half-dot matrix. Throughput ranges from 75 lpm for 132-character lines to 200 lpm for 40-character lines. Prices start at $1350 in OEM quantities. **Dataproducts Corp.,** Woodland Hills, Calif. **Circle No 209**

LOW-PRICED PRINTERS. The 3365 teleprinter, available in either RO or KSR versions, incorporates LSI circuitry and a matrix printhead. The unit operates at 10 or 30 cps in half- or full-duplex mode. The 3450 solid-font band printer, which produces as many as six copies at 300 or 600 lpm, includes microprocessor-based electronics, friction-free hammers, custom IC hammer drivers and a built-in diagnostic display. An electronic vertical format unit (EVFU) gives program-control of forms length and line skips. Prices start at $10,750 for the 3450, $2075 for the 3365. **General Automation, Inc.,** Anaheim, Calif. **Circle No 210**

ALPHANUMERIC PRINTER. The model 0533 alphanumeric printer prints 21 columns on standard 3 7/16-in.-wide plain paper tape. The printer uses a bar matrix impact print mechanism and produces multiple copies in two colors. Continuous print speed is 90 lpm, with a rapid line feed control that slews paper as fast as 10 lps. Price is $495 in single-unit quantities, with OEM discounts available. **SODECO Division, Landis & Gyr, Inc.,** Elmsford, N.Y. **Circle No 211**

RO SERIAL PRINTER. The model 877 receive-only serial printer, which prints bidirectionally in a 9 × 7 dot matrix, includes a heavy gauge, hardened metal chassis, a stainless steel drive screw and a cartridge ribbon that eliminates ribbon reversing mechanisms and insures first-impression print quality. The microprocessor-controlled unit prints a 95-character ASCII set at 120 cps on an 8½-in. roll of paper. Price is $999 in single-unit quantities, $830 in 100-unit quantities. **Printer Terminal Communications Corp.,** Ramona, Calif. **Circle No 212**



BAND PRINTERS. These 300-lpm band printers and printer subsystems use friction-free hammer actuators, a minimum number of mechanical parts, high-energy magnets and custom IC hammer drivers. All models print 132 columns of fully formed characters suitable for report generation. **Data General Corp.,** Westboro, Mass. **Circle No 213**

New Products

accessories and supplies

DATA CASSETTE. The 520 DEC cassette, intended for use in Digital Equipment Corp. computers, employs large-diameter hubs that keep surface speed constant, eliminating mechanical jitter. The unit comes with heavy-duty, one-mil computer tape, said to be twice as strong as other tape. Designed for harsh mechanical applications, the cassettes are tested for torque and running smoothness. **Magnetic Information Systems, Inc.,** Shelton, Conn. **Circle No 214**

DISKETTE HEAD-CLEANER. The CCL 140 diskette head-cleaner, which can be inserted into a drive in the same way as a floppy disk, cleans read/write heads in 30 sec. The cleaner uses a lamination technique, employing presaturated polyamid fiber, which is nonabrasive, lint-free and static-resistant. Diskette head-cleaners, sold in mailers of three diskettes each, are available in four versions: the CCL 140 for 8-in. single-sided drives, the CCL 140-1 for 8-in. double-sided drives, the CCL 1400 for 5¼-in. single-sided drives and the CCL 1400-1 for 5¼-in. double-sided drives. **Computer Resources, Inc.,** Cleveland, Ohio. **Circle No 215**

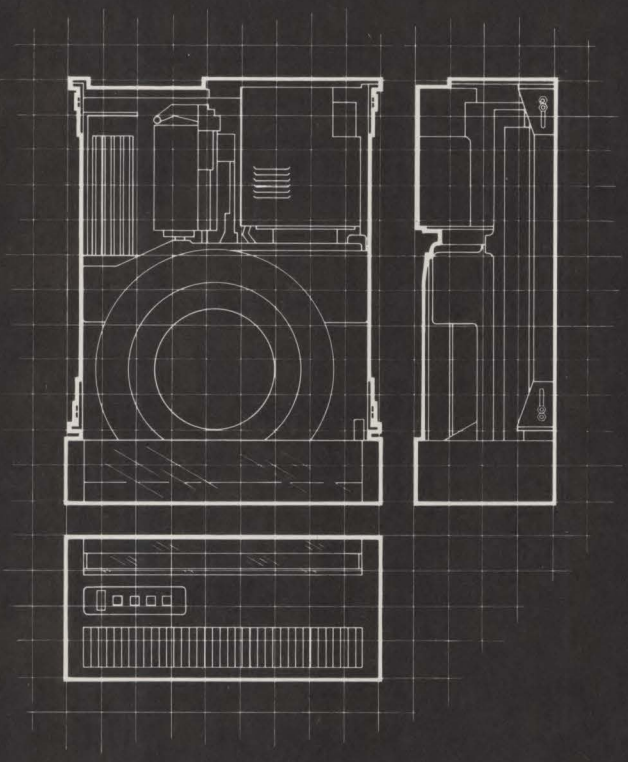
TERMINAL STANDS. The Terminal Mate stand for data entry terminals can support as much as 350 lbs. The stand has an interlocking system that enables it to be assembled without tools. Terminal Mates come in 30-, 36- or 45-in. widths. **Monarch Computer Products,** New Windsor, N.Y. **Circle No 216**

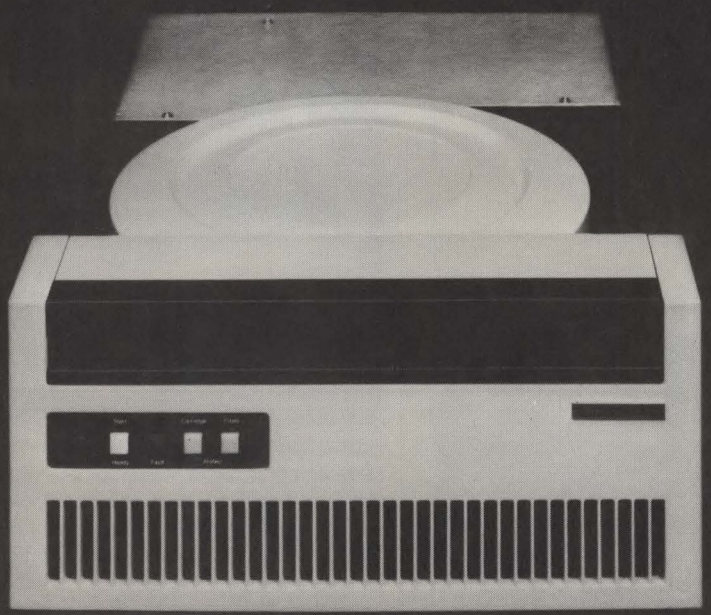
PRINT WHEELS. These print wheels, intended for use with the vendor's daisy-wheel printers and data terminals, include Cubic and Essay type styles and seven foreign-language versions of the vendor's proportional-space print wheel family. The languages include Deutschland Themel, Deutschland/WPS Boldface and Boldface Italic, England/WPS Boldface and Boldface Italic, Bilingual/WPS Arcadia and Modern. Monospace print wheels include Danmark/Norge Light Italic 12, Danmark/Norge 2 Courier 10, England Orator 90% 10, Portugal Pica 10, Portugal Prestige Elite 12 and Metric Letter Gothic 12. The print wheels have 96-character sets and are fully interchangeable. **Qume Corp.,** San Jose, Calif. **Circle No 217**

PRINTOUT BINDERS. This fold-over binder, which fits into briefcases, holds computer reports as wide as 14⅞ in. A similar binder, with a hanging rod and a touch fastener, condenses printouts to fit in letter-size suspension file drawers. Both binders hold as many as 200 pages of burst printout on thin-line metal rings with open/close boosters. **Devoke Co.,** Palo Alto, Calif. **Circle No 218**

PACKAGING SYSTEMS. The TMS-BOX and the TMS-CAGE packaging systems are compatible with Texas Instruments' TM 990 module series. The TMS-BOX includes power supplies, a card cage, a front panel and room for two Shugart SA801R floppy drives. The TMS-CAGE contains eight slots on .600 centers and a front-panel interface for reset and load. The unit can accommodate on-board regulators to provide +12V and −12V from +15V and −15V for analog applications. In quantities of one to four, the TMS-BOX sells for $1295; the TMS-CAGE costs $225. **Technical Micro Systems,** Irvine, Calif. **Circle No 219**

Perkin-Elmer presents a complete rethinking of the cartridge disk drive.





Introducing VANGUARD I. Simple. Reliable. Economical.

To create better back up storage for the office systems of tomorrow, we rethought the role of the cartridge disk drive.

We wanted a totally new cartridge drive that would satisfy systems requirements for backup store and audit trails.

That would meet the needs for working and archival storage in small business systems.

That would offer the compactness needed for desk-mounted peripherals.

That would provide a high speed single storage system at a price that would give systems designers something to think about.

The result was the cartridge drive for the systems of the 80's—VANGUARD I.

We built VANGUARD I 24 inches deep for in-desk or rack mounting. We gave it a capacity of up to 20 megabytes and a standard cartridge disk interface for industry-wide compatibility.

To make VANGUARD I easy to maintain and service, we built it in simple modules. That makes maintenance a matter of minutes instead of hours. (VANGUARD I can be broken down into subassemblies in less than seven minutes, reassembled quickly with minimum tools.)

And to reduce the need for maintenance we gave it an air moving system designed for maximum cleanliness and minimum temperature rise in the media chamber.

VANGUARD I is everything we think a cartridge disk drive should be. Simple. Reliable. Fast. Universally compatible.

Call or write today for a preview look. And let us know what you think about our rethinking. Perkin-Elmer, Memory Products Division, 7301 Orangewood Avenue, Garden Grove, CA 92641. **Call toll free 800-631-2154. In California, call (714) 891-3711.**

PERKIN-ELMER

CIRCLE NO. 77 ON INQUIRY CARD

New Products

data entry

SPEECH RECOGNITION SYSTEM. The Quiktalk voice data entry system reduces the pause time required between spoken words. This improvement enables the system to achieve 99 percent accuracy at entry rates of 180 wpm—said to be twice the rate of previous equipment. **Threshold Technology, Inc.,** Delran, N.J. **Circle No 220**

INDUSTRIAL DATA COLLECTION SYSTEM. The IMP interactive manufacturing planning system employs shop-floor data-collection stations to track jobs in real time, using magnetic cards to identify workers and jobs. IMP's software includes modules for material requirements planning, inventory control, job cost accounting, WIP monitoring, shop loading, shop-floor control, pegging, automated purchasing and a bill-of-materials processor. The turnkey system automatically produces material requisitions and picking lists, shop orders, operation routing lists and shortage and pegging reports. **Williams & Associates,** San Luis Obispo, Calif. **Circle No 221**

REAL-TIME CARD READER. The DEP-80 real-time card reader reads as many as 48 bits of data from standard paper stock. The information can be preprinted or written on the paper with a pencil. Designed for applications that require simple entry with easy visual review, the desk-top unit can be used in various applications, including inventory control, programmable industrial control, maintenance scheduling, time management and electronic games. **Turnex International,** Newport Beach, Calif. **Circle No 222**

OCR-A READER. The model 7887 hand-held OCR reader includes a pistol grip reading unit attached by a 10-ft. cord to a microprocessor-based control unit. The system, which reads NRMA OCR-A characters, is compatible with NCR 250, 280, 255, 2552, 2140 and 2150 POS terminals, as well as the NCR 2950 general-purpose terminal. Users can make limited format modifications, such as field length changes, by passing the reader over special programming symbols. The unit also has check-digit verification capability. Price is $995 including cable and installation charges. **NCR Corp.,** Dayton, Ohio. **Circle No 223**

disk/tape

NCR-COMPATIBLE TAPE READER. The ICS 3802-NCR-2 cassette reader for use with NCR 250 and 2140 cash registers can operate at speeds ranging from 110 to 19,200 baud. The device is designed as a read-only buffered terminal capable of storing data formatted in 440-byte blocks and can be remotely controlled via ASCII commands. The reader costs $2050. **Interdyne Co.,** Van Nuys, Calif. **Circle No 224**

How to condition problem power.

Line voltage is subject to fluctuations. Fluctuations which decrease the efficiency and reliability of such sensitive and costly equipment as computers and peripherals, medical diagnostic and monitoring devices, and sophisticated broadcast equipment.

Condition your power with Superior Electric's power conditioning team. STABILINE® Automatic Voltage Regulators, Shielded Isolation Transformers, Transient Voltage Suppressors, and Computer Regulators. In series or individually (depending on your particular needs), they intercept and virtually eliminate unexpected fluctuations before they damage components, cause erratic operation or reduce equipment life.

Use our simple chart to identify the power problems you are facing. Superior's power conditioning team can provide you with a safe, economical solution.

For product literature or technical assistance, contact your nearest Superior Electric representative. Or, call us direct. (203) 582-9561. The Superior Electric Company, Bristol, CT 06010.

Power problems and solutions

Problem	Impulse	Sag/Surge	Drop-out	Hi/Low Line	Common-mode Noise
Description	Short duration transient in voltage	Multi-cycle variation for voltage amplitude	Total loss of voltage for part of the sinewave	Voltage amplitude long-term average variation	Voltage signal occurring between either line and ground where no signal is expected
Typical Causes	SCR's firing, welders, ignitors, switching for load or power factor correction, fault clearing...	Load switching on/off such as air conditioners, machine shops, transformers, ovens...	Momentary line fault, utility switching operations...	Brownouts and other power cutbacks due to shortages, daily demand fluctuations, long line regulation problem...	Lightning, impulse noise, grounding faults, poor grounding practices, radio transmitters...
Solutions	Transient Voltage Suppressor	Voltage Regulator	Computer Regulator	Voltage Regulator	Shielded Isolation Transformer

Superior Electric
We want you to know.

The Superior Electric Company • POWERSTAT® Variable Transformers • SLO-SYN® Motors and Controls • 5-WAY® Binding Posts

CIRCLE NO. 79 ON INQUIRY CARD

New Products

STREAMING TAPE DRIVE. The 6809 Data Streamer tape transport is intended for file backup and archival storage for multiplatter 8- and 14-in. Winchester disk drives. The ½-in. reel-to-reel unit operates at 100 ips using IBM- and ANSI-compatible 1600 bpi phase-encoding techniques. In the streaming mode, the transport stores or restores 12M bytes of data in 75 sec. and 40M bytes in 250 sec. Total unformatted capacity is 46M bytes on a 10.5-in. reel. The unit also operates at 12.5 ips in a start/stop mode to accommodate conventionally recorded tapes. The drive with formatter costs $2500 in OEM quantities. **Kennedy Co.,** Monrovia, Calif.
Circle No 225

277M-BYTE DISK DRIVE. The model 6122 DG disk storage subsystem provides on-line disk-pack capacity of 277M bytes per drive and more than 1G byte per subsystem when tied to an Eclipse S/250, C/350 or M/600 equipped with a burst multiplexer channel. The drives are fully supported by DG's AOS, for simultaneous control of time-sharing, multiple-batch job streams and real-time environments, and by RDOS. The Model 6122 costs $38,500; model 6122-A add-on drives cost $33,500. **Data General Corp.,** Westboro, Mass. **Circle No 226**

96-TPI FLOPPY DISK DRIVES. Models 91 and 92 minifloppy disk drives read and write 96 tpi, which is said to yield twice the data capacity of other 5¼-in. drives now in quantity production. The unit stores nearly 1M byte of data using components that are the same as those found in the company's current single- and double-sided, double-density models. The drives are plug-compatible with existing systems and can accommodate FM, MFM or M2FM encoding. Prices are $450 for the single-sided, 480K-byte model 91 and $550 for the double-sided, 1M-byte model 92. **Micro Peripherals, Inc.,** Chatsworth, Calif.
Circle No 227

IEEE-488 ½-IN. TAPE SYSTEMS. The model 2102 ½-in. magnetic tape system is said to have the fastest data transfer rate (100K bytes per sec.) and highest buffering capacity (16K bytes) in the industry. The system, which can store more than 30M bytes of data on a single drive, transfers data between any computer and a GPIB IEEE-488 controller through a Z80A microprocessor that manages bus-interface, formatter and tape-transport functions within the system. Both IBM- and ANSI-compatible tapes can be used. Prices start at $7995. **Dylon Corp.,** San Diego, Calif.
Circle No 228

FLOPPY-DISK SYSTEM. The ZX-710/720 floppy-disk drive system is Multibus-compatible and can be used with hardware and software compatible with Intel's MDS-800 and Series II computers. The system, which operates with single- or double-density recording formats, uses a Shugart SA801 single-sided drive housed horizontally in a 19-in. rack-mountable chassis. Price is $3900 in evaluation quantities. **Zendex Corp.,** Dublin, Calif. **Circle No 229**

TAPE DRIVES FOR NOVAS. The TFS-706 magnetic tape system for Nova and Eclipse computers can read or write data at 1600 bpi in phase-encoded formats or at 6250 bpi in GCR formats on IBM-compatible tape. The system operates at 45, 75 or 125 ips and can store more than 150M bytes on one reel of tape. The system includes a formatter, a single-slot controller and cabling. Prices start at $29,200. **Aviv Corp.,** Woburn, Mass.
Circle No 230

10M-BYTE CARTRIDGE-DISK SYSTEM. This cartridge-disk system, which interfaces to DEC PDP-11s and LSI-11s, Data General Novas and Interdata minicomputers, incorporates a 10M-byte Series 6000 Western Dynex cartridge-disk drive with an imbedded controller. The system can replace or add the equivalent of four DEC RK-11 drives. **Datrex, Inc.,** Phoenix, Ariz. **Circle No 231**

DISK SUBSYSTEMS FOR CLASSIC COMPUTER. Two moving-head disk subsystems for CLASSIC computer systems incorporate removable media, a controller capable of handling three additional drives, enclosures and all cabling. The disk devices have an average access time of 30 msec., an average latency of 8.3 msec. and a transfer rate of 1.2M bytes per sec. The 67M-byte 4174-1-67A subsystem costs $26,000; the 256M-byte 4174-256A subsystem costs $39,000. **Modular Computer Systems, Inc.,** Fort Lauderdale, Fla. **Circle No 232**

Craftsmen Create Masterpieces

If Antonio Stradivarius had created violins the way many companies today make their products, and had he expanded to make tubas and bassoons, his name would be as obscure as the other unknown manufacturers of the 18th century. But, his objective was never to produce the greatest variety at the lowest possible cost. His was craftsmanship. And specialization. Antonio Stradivarius stuck to what he did best.

At Data Printer—the world's leading manufacturer of high speed horizontal font line printers, the Company's objectives of product excellence and specialization may seem to some as belonging to an era long past. Instead, the results of Data Printer's singleminded quality objectives are as readily recognized and sought after today as then. By adhering to its high standards of quality, craftsmanship and care in every individual line printer it makes, Data Printer has become the leading force in a marketplace which knows the value of an enduring product.

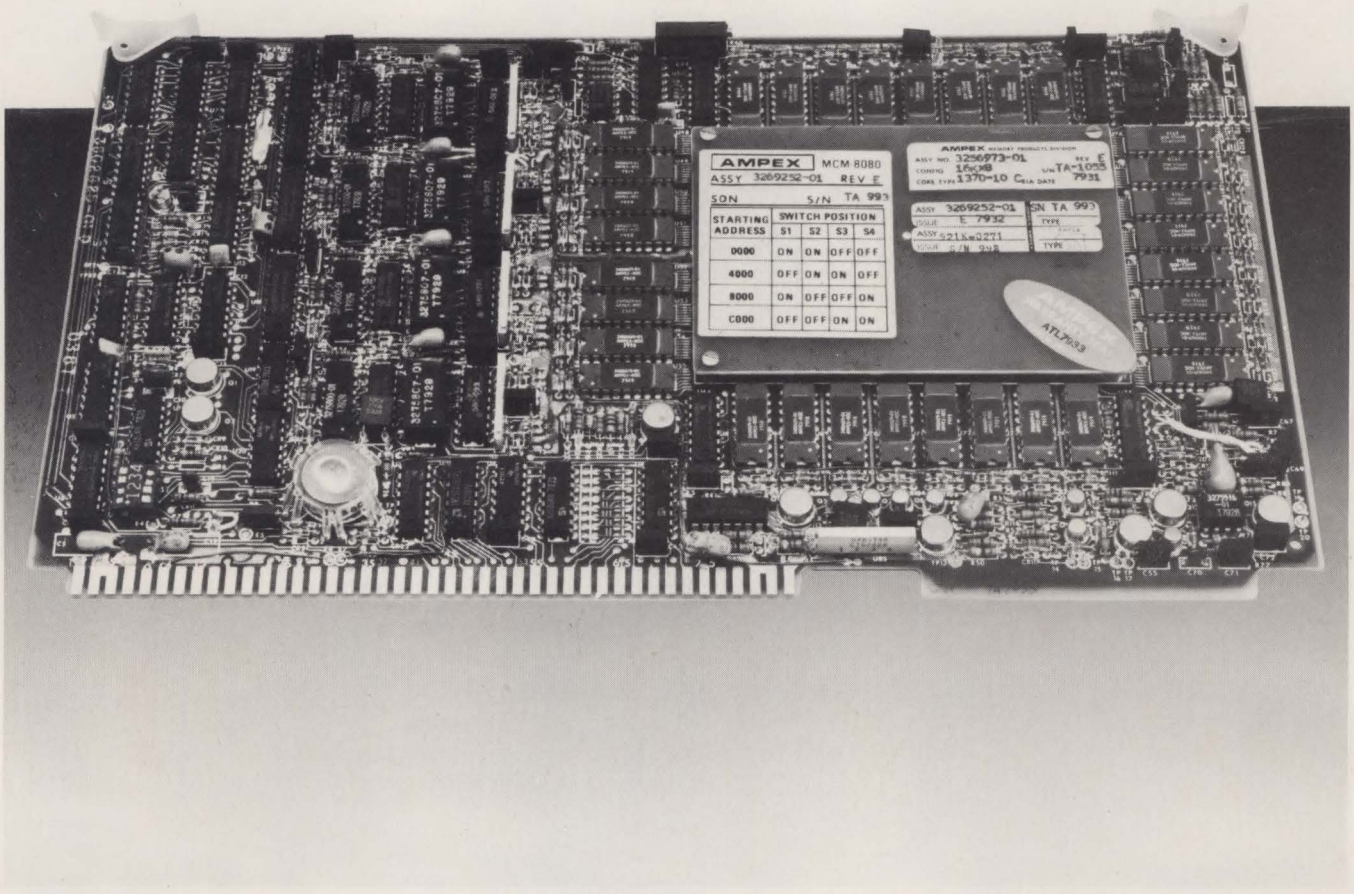
Data Printer makes only line printers. And, they only make line printers of quality. Consequently, the Company's 1200 Series of ChainTrain line printers with speeds of 600 to 1500 lines per minute and their 3000 Series of 150 to 750 lines per minute band printers are obvious examples of technological mastery. And, like Stradivarius' lasting example of an enduring commitment to quality, Data Printer's product quality will remain as true tomorrow as today.

Data Printer Corporation, 99 Middlesex Street, Malden, MA 02148 Telephone: (617) 321-2400 TWX: 710-348-0794

Data Printer The Craftsmen.

CIRCLE NO. 81 ON INQUIRY CARD

NON-VOLATILE RAM FOR 8080. AMPEX MAKES IT. AND MORE.



For many applications, a microprocessor is unexcelled in price/performance. But volatile memory can erase the advantage in a hurry.

With the Ampex MCM-8080, your microcomputer will never forget the data. Even in the event of a power failure. It uses reliable, non-volatile cores. All in the same card size, with the same performance, and the same plug-compatible connections as Intel RAM for SBC 80/05, 80/10 and 80/20, the MDS-800 and the 888 System Development Center.

Ampex MCM-8080 RAM provides 16K bytes of non-volatile memory, is Multibus compatible, and occupies only one card slot. And all at a price that will make you smile: $885.

8080 RAM. It's just one of the surprising Ampex line of digital systems products. From plug-compatible memories for nearly any CPU you can name, through a wide range of disk and tape peripherals. Even intelligent controllers, our own minicomputer, and completely packaged, all-Ampex minicomputer systems.

Steve Welker will provide more details on our infallible memory and the full Ampex product line. Call him now at 213/640-0150. Or write him at Ampex Memory Products, 200 North Nash Street, El Segundo, California 90245.

AMPEX MAKES IT EASY

Multibus is a trademark of Intel Corporation

CIRCLE NO. 93 ON INQUIRY CARD

Guard your margins while you ring up sales.

Employees can press the right register keys and still end up with costly mistakes. That's because common electrical power disturbances can trick electronic cash registers into accepting false data, misunderstanding real data, or forgetting all data.

These problems result from momentary surges and dips in power line voltage, low-energy/high-frequency interference known as "noise", and the all-too-familiar brownout. Now they can be solved easily with Sola's Micro/Minicomputer Regulator ... a portable, plug-in, UL-approved device that stabilizes voltage, provides ultra-isolation to block out noise, and offers the near-pure AC sine wave that electronic cash registers and back-room data processors crave. A choice of sizes lets you match your power needs economically.

Learn about all of the protective features of Sola's Micro/Minicomputer Regulator. For free literature, contact Sola Electric, 1717 Busse Road, Elk Grove Village, IL 60007. Phone (312) 439-2800.

A UNIT OF GENERAL SIGNAL GS

The Power Protectors

SOLA

50 YEARS 1930–1980

CIRCLE NO. 83 ON INQUIRY CARD

New Products

interactive terminals

DEC VT-103 TERMINAL. The VT-103 terminal, an expandable version of the VT-100 video-display terminal, incorporates an LSI-11 microcomputer backplane and a 140W power supply that is switch selectable from 115V to 230V operation. The basic model, the VT103-AA, sells for $2900. The VT103-BA, with a dual-drive DECtape II cartridge subsystem, sells for $3890. **Digital Equipment Corp.,** Maynard, Mass. **Circle No 233**

VIDEO DISPLAY TERMINALS. The Dasher D100 and D200 video display terminals, designed for use in applications requiring high-speed, interactive communication, can display as many as 1920 alphanumeric characters in 24 lines of 80 characters each. Each terminal incorporates a 96-character upper- and lower-case ASCII keyboard, a 7 × 11 dot-matrix character cell and a 12-in. screen. Intended for use with the vendor's Eclipse, Nova, microNova and commercial systems computers, the D100 and D200 support FORTRAN IV and 5, RPG-II, Extended BASIC, DG/L, PL/I and ALGOL. The terminals operate asynchronously at speeds as high as 9600 bps and use 20-mA current loop or RS232C interfaces. Prices start at $1750 for the D/100, $1950 for the D/200, in single-unit quantities. **Data General Corp.,** Westboro. Mass. **Circle No 234**

MAILGRAM TERMINAL. The Mark IV page mailgram terminal, produced for use by Western Union, enables users to enter and store as many as seven pages (13,440 characters) in the mailgram mode and as many as eight pages (16,000 characters) in the general-purpose mode. The terminal, which includes editing, scrolling and paging capabilities, displays any page or segment of stored text. The Mark IV can also be used in an interactive, ASCII mode as a general-purpose or time-sharing terminal at data rates as high as 1200 bps. The unit, which includes a 300-bps acoustic coupler, can be directly connected to a telephone line via a telephone company DAA or a data jack. **Digi-Log Systems, Inc.,** Horsham, Pa. **Circle No 235**

IBM 3101 DISPLAY TERMINAL. The IBM 3101 display terminal, which is Teletype-compatible, includes a 12-in. screen, a logic unit and an 87-key keyboard. The terminal displays as many as 1920 characters in 24 lines and communicates with IBM Series/1, System/370, 4300 and 8100 processors. Prices start at $1295; rental rates start at $80/mo. **Qytel,** New York, N.Y. **Circle No 236**

VT-100-COMPATIBLE TERMINAL. The model 132-1D display terminal, which is compatible with Digital Equipment Corp.'s VT-100, supports upper- and lower-case ASCII characters, full cursor control, tabbing, dual intensity, multiple transmission modes in full- or half-duplex at 300 to 19,200 bps and eight function keys. The model 132-ID comes with a printer output that can be controlled locally or remotely. Lease rates start at $75/mo.; purchase price is $2250 in quantities of one to nine, with quantity discounts available. **Qytel,** New York, N.Y. **Circle No 237**

RACK-MOUNT TERMINALS. This line of snap-apart smart terminals, for use in stationary installations such as laboratory or factory-control systems, is available in RS-310C rack-mount configurations. Each terminal includes a display unit, which contains a CRT, a power supply and logic modules, mounted in a 19- × 12¼-in. panel. The keyboard assembly is available either as an 8¾-in.-high panel unit or as a detached unit with a 6-ft. cable. Price is $280 for the detached keyboard version and $322 for the panel-mounted keyboard version, with OEM and quantity discounts available. **Teleray,** Minneapolis, Minn. **Circle No 238**

DATA DISPLAY TERMINAL. The 7900 model I interactive data display terminal includes a 12-in. screen with a displayed terminal status line. The unit operates asynchronously at rates as high as 19.2K baud. The system is said to consume less power than comparable terminals, thus eliminating the need for a cooling fan and enabling quieter operation. The 17½- × 20-in., 25-lb. system includes special function keys and an adding-machine keypad that can be changed to a telephone keypad. Communications speeds and transmission modes are user-selectable or can be changed remotely by the host computer. The model I rents for $95/mo. and sells for $2000. **NCR Corp.,** Dayton, Ohio. **Circle No 239**

BLOCK-MODE TERMINAL. The model 6520 video display terminal provides parity checking from display memory, multiple display paging and editing and program function keys, including a numeric keypad and 16 function keys with 32 user-programmable functions. Other features include conversational and block modes, point-to-point and multipoint operation at speeds from 110 to 19.2K bps, synchronous and asynchronous protocols and RS232 and current loop communication links. A second version of the terminal, the 6524, includes a printer port option. The 6520 costs $2950; the 6524 costs $3150. **Tandem Computers, Inc.,** Cupertino, Calif. **Circle No 240**

SMART TERMINAL. The Zephyr smart terminal incorporates a 12-in. CRT that provides 24 lines of 80 characters each, plus a 25th line for error messages and terminal status information. The unit stores two 1920-character pages and includes a blinking underline cursor. It supports a 128-character ASCII set and includes an alphanumeric keyboard and RS232C and 20-mA current loop interfaces. The communications interface operates in either full- or half-duplex asynchronous mode at switch selectable speeds from 110 to 19,200 baud. The Zephyr also incorporates a monitor mode that displays all received characters on the screen, including control codes and escape sequences. Price is $1220 in single-unit quantities, with volume discounts available. **Zentec Corp.,** Santa Clara, Calif. **Circle No 241**

CIRCLE NO. 85 ON INQUIRY CARD

New Software

DEVELOPMENT TOOL. XL5, an interactive software development tool for small systems, includes a compiler, an interpreter, an assembler, a disk operating system and a library of procedures. Based on the recommendations of the 1977 Forth Standards Committee, XL5 also provides a host executable code kernel, a source-code kernel and a system-generation program (SYSGEN). An XL5 development system requires less than 32K bytes of memory, and most stand-alone applications programs require less than 8K bytes. The package, available with a CP/M boot loader for 8080 and the Z80 microprocessors, costs $100. **XL Computer Products,** Bloomington, Ind.

Circle No 442

SYMBOLIC MATH. The muMATH-79 symbolic mathematics system enables users to solve such problems as polynomial multiplication, symbolic differentiation and integration, simplification of trigonometric expressions and exact solutions of nonlinear equations. The program performs actual symbolic operations taught in algebra, trigonometry and calculus courses, as well as arithmetic, using exact rational operations with precision as high as 611 digits. muMath-79 runs on 8080-, 8085- and Z80-based microcomputer systems under TRSDOS, standard CP/M, Cromemco CDOS or IMSAI IMDOS operating systems. **The Soft Warehouse,** Honolulu, Hawaii.

Circle No 443

TERMINAL GRAPHICS. The MGS-7F package supports use of the vendor's Whizzard 7000 graphics display unit with DEC VAX 11/780 computers running under the VMS operating system. Data is transferred to the terminal using programmed I/O or direct memory access; both methods are transparent to the user. Price is $3500 per installation. **Megatek Corp.,** San Diego, Calif.

Circle No 444

WORD PROCESSING. The Manuscripter text editor and formatter, written in the Programmable Text Processor language (PTP) for 8080-based systems running under CP/M, provides 16 English-language editor commands, and more than 40 format commands. The editor includes cursor and context editing capabilities. Format commands set page boundaries, print page headings and footings with page numbers, justify text, center titles, print boldface and underline. Manuscripter can also select paragraphs from a master file to compile tailored document and print personalized form letters from address lists. **CompuSystems of South Carolina,** Columbia, S.C.

Circle No 445

INVENTORY CONTROL. INV-V, an on-line inventory control system for 32K TRS-80 disk systems provides an ordering strategy and performance measuring tools. An order report lists items at or below safety levels, with out-of-stock items shown first, then high-profit items, second and high-usage items last. A performance report summarizes total inventory cost, total number of out-of-stock items and over-stocked items. A report writer enables the user to specify report formats on-line without programming. Price is $99. **Micro Architect,** Arlington, Mass.

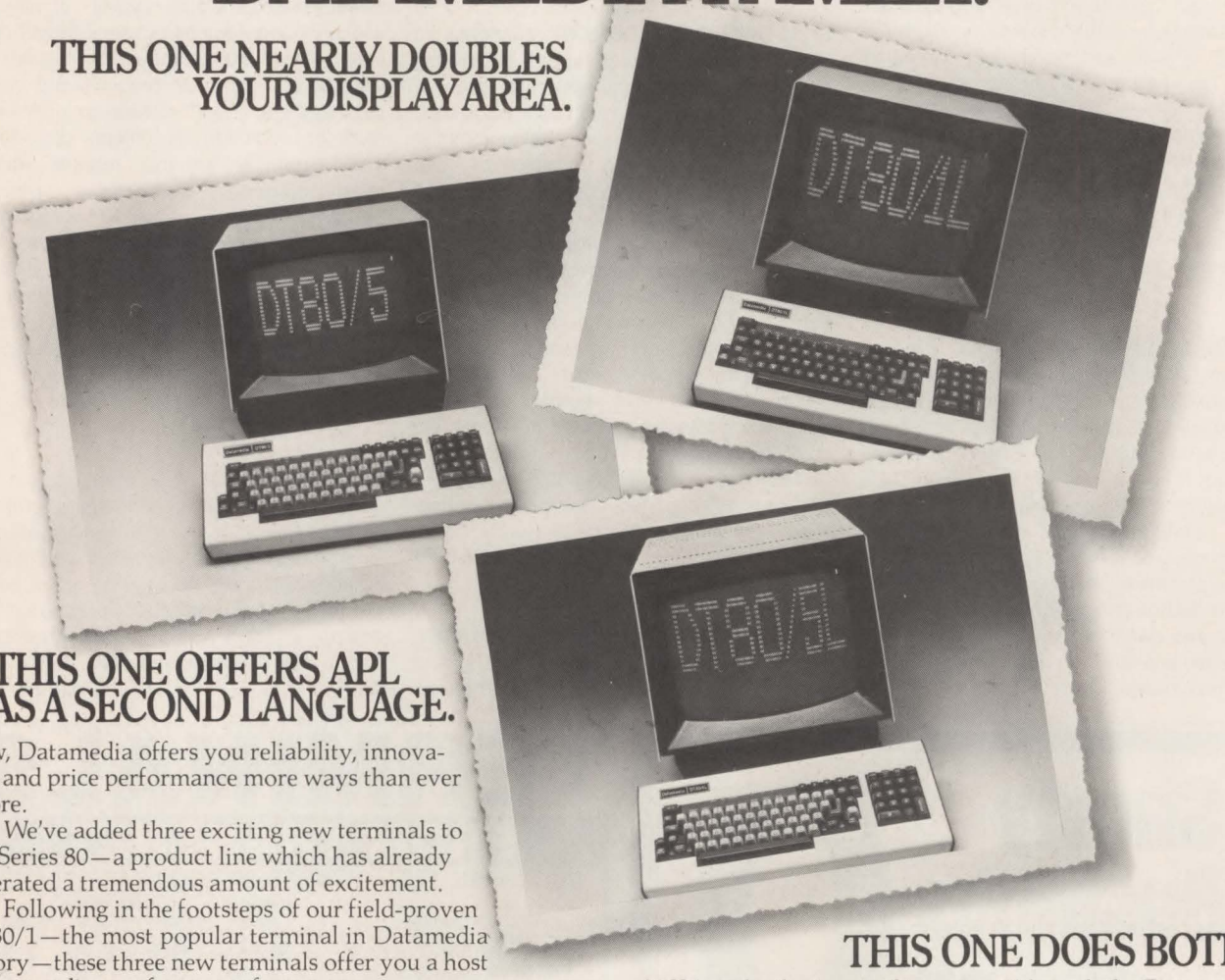
Circle No 446

CHECK PROTECTION. CKWRTR II for the IBM System/3 computer upgrades existing check-writing programs to print the amount in words on the check. Written in RPG-II, the package occupies 3K bytes of memory. Price is $450. Physical Intelligence Associates, Monsey, N.Y.

Circle No 447

INTRODUCING THREE NEW MEMBERS OF THE DATAMEDIA FAMILY.

THIS ONE NEARLY DOUBLES YOUR DISPLAY AREA.



THIS ONE OFFERS APL AS A SECOND LANGUAGE.

Now, Datamedia offers you reliability, innovation and price performance more ways than ever before.

We've added three exciting new terminals to our Series 80—a product line which has already generated a tremendous amount of excitement.

Following in the footsteps of our field-proven DT80/1—the most popular terminal in Datamedia history—these three new terminals offer you a host of outstanding performance features.

Just look at some of the features you get, standard, on all Series 80 terminals: Switchable 80 or 132 columns, split screen, partial screen smooth scroll, double wide and double high characters, special graphic character set, flexible keyboard-entered setup feature with answer-back message, user-definable alternate character set, and ANSI standard protocol.

What's more, all Series 80 terminals give you DEC* VT100* compatibility. Plus the following features—again, standard at no extra cost—which aren't in the basic VT100 model: Advanced video attributes, such as bold characters, blink, underline and reverse video, in any combination. Plus a flexible, bidirectional auxiliary port, providing printer control, independent baud rate capability, support for X-on/X-off, and screen copy features.

DT80/1L: Innovation that's easy on the eyes.
The large 15" diagonal display on the new DT80/1L increases character size significantly. That's especially good for readability in the 132-column mode.

DT80/5: The first 80/132-column display terminal with APL as a second language.
By offering APL on a 132-column CRT, the new DT80/5 saves you time and money. Because it lets you reduce your hard copy printing requirements.

ANSI is also keyboard-selectable on the DT80/5. In ANSI mode, the terminal is compatible with the Datamedia DT80/1 and DEC VT100 terminals.

In APL mode, it is compatible with the popular Datamedia Elite 1520 APL terminals.

THIS ONE DOES BOTH.

DT80/5L: 132 columns with APL, plus large 15" screen.
The DT80/5L gives you a much larger display, for greater readability in either APL or 132-column applications—or in a combination of both. Especially helpful when working with the APL character set.

Meet the rest of the family.
The popular, field-proven Elite Series of general purpose terminals includes the Elite 1521A basic interactive terminals, and the E3000 group of buffered editing terminals.

The Elite1521A offers a bidirectional auxiliary port, separable keyboard, full cursor control, and screen editing. The E3000 group features host-selectable page, line or character modes, soft function keys, and protected screen formats.

Reliability and innovation: The Datamedia way.
All Series 80 and Elite Series terminals are backed by Datamedia's 11-year heritage of reliability engineering and design innovation.

Datamedia Corporation

7300 N. Crescent Blvd., Pennsauken, NJ 08110, Tel: (609) 665-2382 TWX: 710-892-1693
*DEC and VT100 are trademarks of the Digital Equipment Corporation.

CIRCLE NO. 88 ON INQUIRY CARD

New Software

APARTMENT MANAGEMENT. This apartment and rental unit management system for the Radio Shack computers operates with tape or disk systems with or without a printer. The user can randomly access any unit, scroll through all units and modify and update all files. The package produces delinquency reports, lease expiration reports and maintenance reports. The system can accommodate multiple units and includes a cash journal program to provide the owner with a record of operations and cash balances. Price is $99. **National Software Marketing, Inc.,** Hollywood, Fla.
Circle No 248

PAYROLL/PERSONNEL. This Payroll/Personnel System, written in COBOL for users of the IBM System/3 and System/34, provides techniques for calculating wages, specifying deductions, producing paychecks and tracking labor distribution. Features include multipayroll capability, complete tax calculations, flexible deduction, accrual and check procedures and general ledger interface, as well as automatic check voiding, a deduction arrears option, separate accumulation of bonus and commission amounts, pay-stub messages and reminder notices and handling of Earned Income Credit. Price is $17,000 for the System/3 version, $18,500 for the System/34 version. **Software International,** Andover, Mass. **Circle No 249**

DATA BASE DEVELOPMENT. BASFORM, an interactive tool intended to cut data base development time, prompts the user to describe fields and to set up operations such as arithmetic calculations, summing from one record to another, and validation of data. English-language statements control all logical operations. To communicate with the data base, the user designs data entry screens resembling business forms, such as invoices and purchase orders, which contain fields to be accessed in the data base. BASFORM's report generator produces management reports, such as purchase orders, invoices and monthly or yearly summary statements. Written in Pascal, the package interfaces with COBOL, Pascal, RPG-II and FORTRAN programs and runs on TI 990/10 and 990/12 computers. **Business Application Systems, Inc.,** Raleigh, N.C. **Circle No 250**

USER ACCOUNTING/PERFORMANCE ANALYSIS. RABBIT, a user accounting and performance reporting system for the DEC VAX 11/780 and PDP-11/70, analyzes, allocates, bills and recovers computer resources. From system accounting files, RABBIT-1 accumulates system component usage by user, groups of users, department, company or project group, then produces invoices or department cross-charges from a prestored rate table. The user can define new records, revise reports, change calculations and produce special reports without reprogramming. RABBIT-2, a computer performance evaluation tool for management, graphically depicts demand for machine resources and the response to the demand over time. Input to RABBIT-2 is from the system accounting file or RABBIT-1. RABBIT rental is $99 per month; purchase price is $2500. **Raxco, Inc.,** Port St. Lucie, Fla. **Circle No 251**

PDP 11/03 COBOL. CIS COBOL runs on DEC PDP 11/03 and LSI 11/2 computers with as much as 64K bytes of memory. The package, which is compatible with ANSI 74 standards, includes compiling, debugging and executing capability. A Forms program provided with CIS COBOL enables screen formatting. Price is $1500. **ABC Computers, Inc.,** Tahoe City, Calif. **Circle No 252**

LAST NOVEMBER, DATA GENERAL AND DEC ANNOUNCED NEW COMPUTERS. THE SIMILARITY ENDS THERE.

COMPARE:	SPEED Thousands Whetstone instructions/second		PRICE
	Single Precision	Double Precision	
DEC PDP 11/44 System	**314***	**231***	**$41,900*** Includes PDP 11/44 with 256 ERCC memory, 20.8 MB dual RL02 disc subsystem, floating point processor and LA120 console printer
Data General ECLIPSE S/140 System	**450**	**380**	**$37,450** System including S/140 with 256KB ERCC MOS memory, Model 6100 25MB non-removable moving head disc with integral 1.26 MB diskette floating point hardware and Dasher TP2 180 CPS console printer
ECLIPSE S/140 is:	**43% faster**	**65% faster**	**10% lower price**

What more can we say? Our new ECLIPSE® S/140 is not only a great deal faster than the 11/44, it's also a great deal, period.
Read the chart.
Then you'll understand why our ECLIPSE S/140 is your only choice. Break the speed limit without paying the price. Send in the coupon.

Data General Corporation, Westboro, MA 01580, (617) 366-8911. Data General (Canada) Ltd., Ontario, Canada. Data General Europe, 61 rue de Courcelles, Paris, France, 766.51.78. Data General Australia, (03) 89-0633. ECLIPSE is a registered trademark of Data General. ®Data General Corporation, 1980.

Data General

Mail to: Data General Corporation, Westboro, MA 01580
☐ I can read. Send me complete information immediately.
☐ I can read but I can't wait. Send a salesman now.
MMS480

Name
Title
Company
Address
Tel.
City
State
Zip

The Computer of the U.S. Olympic Sports Medicine Committee

*As reported in DATAQUEST Research Newsletter, Nov. 30, 1979; COMPUTER SYSTEMS NEWS, Dec. 3, 1979.

CIRCLE NO. 90 ON INQUIRY CARD

New Literature

DATA LOGGER. The Micro 280 data logger, an intelligent terminal controller, is detailed in a data sheet. The publication describes the system's operation, channel capacity, channel rates, channel and port interfaces, operating environment, power supply and physical dimensions. **Micom Systems, Inc.,** Chatsworth, Calif. **Circle No 253**

LINE PRINTER CONTROLLER. The DLP-1200 programmed line printer controller is described in a data sheet. The bulletin details the specifications of the controller, which is intended for use with Data General Nova and Eclipse computers and with any line printers using Centronics or Dataproducts interface standards. The publication also explains the system's self-test capability and DIP switches. **Data Systems Corp.,** San Diego, Calif. **Circle No 254**

DATA MANAGEMENT. The QDMS data management system for PDP-11 computers using the RSTS/E operating system is described in a primer. The booklet summarizes the system's multifile linking and report writer capabilities. The publication also covers the development of data base management systems. **Quodata Corp.,** Hartford, Conn. **Circle No 255**

LIT THAT COSTS

COMPUTER GRAPHICS. More than 350 computer graphics vendors are listed in *The 1980 Directory of Computer Graphics Suppliers: Hardware, Systems, Software and Services.* The 64-page guide lists suppliers' addresses, telephone numbers, products and services. The directory also provides information on vendors' sales, dates founded, officers and employee numbers. The directory costs $17, but is offered free with a subscription to *The Harvard Newsletter on Computer Graphics.* An annual subscription to the semimonthly newsletter costs $125. **The Harvard Newsletter of Computer Graphics,** Directory Department, P.O. Box 89, Sudbury, Mass. 01776.

DATA BASE DIRECTORY. More than 200 data bases are described in a subscribers directory. The 34-page booklet provides information on medical, financial, commercial and scientific data bases and the source of each data base. The $5 publication also lists the vendor's customers that offer interactive computer-based services and data bases and software facilities that are available through the vendor. **Tymnet, Inc.,** 20665 Valley Green Drive, Cupertino, Calif. 95014.

MARKETING INFORMATION REPORTS. Information on products, industries and technologies is provided in several reports compiled from more than 350 general, trade, business and government publications. *Marketing Information Reports* explain backgrounds, economics and technologies of various subjects. The reports, which cost $125 each, cover such topics as memories, data entry systems, distributed data processing, home and personal computers, electronic games, fiber optics, word processing and optical scanners. **McGraw-Hill Publications Co.,** 1221 Avenue of the Americas, New York, N.Y. 10020.

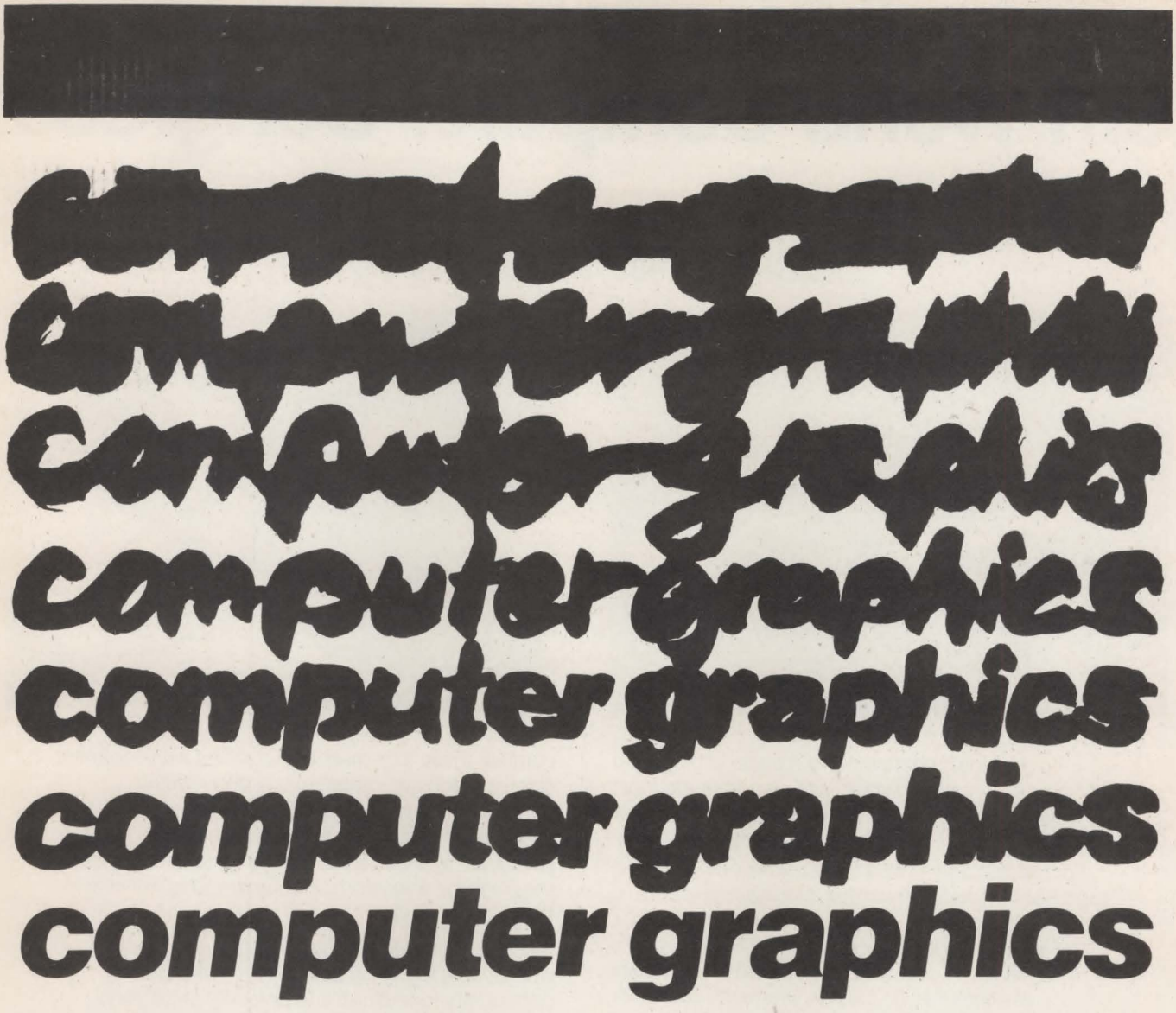
INTEGRATED OFFICE SYSTEM. The model 20/IV integrated office system is described in a brochure. The 12-page publication provides specifications on the multiterminal, multitasking computer, which supports line printers, word-processing printers, keyboard/video display terminals and full communications. **CADO Systems Corp.,** Torrance, Calif. **Circle No 256**

POSITIONING AND TRACKING CONTROLS. A line of positioning and tracking control products are detailed in a 16-page catalog. The illustrated booklet describes joysticks, trackballs, control grips and interface electronic circuits. The publication also lists possible applications, including computer peripherals, radar, other displays and apparatus positioning. **Measurement Systems, Inc.,** Norwalk, Conn. **Circle No 257**

DC/DC CONVERTERS. The PM600 series of low-power DC/DC converters are described in a data sheet. The publication includes photos, circuit diagrams and dimensional drawings. It also provides product descriptions, applications information and electrical and mechanical specifications. **Power Products,** Fort Lauderdale, Fla. **Circle No 258**

PERIPHERAL EQUIPMENT. A line of computer peripheral equipment for rent, lease or sale is described in a brochure. The 12-page, illustrated booklet lists teleprinters, CRTs, desk-top computers, store and forward devices, data test instruments, acoustic couplers and modems from various manufacturers. **Leasametric, Inc.,** Foster City, Calif. **Circle No 259**

DISPLAY TERMINALS AND PRINTERS. A line of video display terminals is described in a catalog. The six-page brochure details the ADM-3A dumb terminal console, the ADM-31 smart editing terminal and the ADM-42 semi-intelligent terminal. The booklet also covers the 300 Series of ballistic matrix printers. **Lear Siegler, Inc.,** Anaheim, Calif. **Circle No 260**

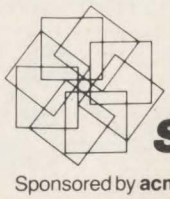


Fuzzy problems are not easily solved! Seeing problem elements and their interrelationships can enhance your problem-solving productivity. You can see how the experts do it at SIGGRAPH '80, the Seventh Annual Conference on Computer Graphics and Interactive Techniques.

We'll have a full week of intensive activity, sharply focused on the capabilities of a wide range of computer-based graphics systems. You'll see presentations on the latest computer graphics applications in business, industry, and education. You can attend basic and advanced tutorials on topics like color, interactive displays, low cost graphics, and management systems.

For more information call or write:
SIGGRAPH '80
P.O. Box 88203
Seattle, Washington 98188
(206) 453-0599

More than 80 vendors will participate in the world's largest exhibition of the latest graphics hardware, software, and services. You can discuss your needs in detail with knowlegable vendor representatives, and be able to compare and evaluate a wide variety of computer graphics systems. You'll meet other users of graphics systems who can tell you how they have increased their productivity by effectively using today's computer graphics systems. So plan to join us in Seattle, July 14-18.



SIGGRAPH '80

Sponsored by **acm**, The Association for Computing Machinery

CIRCLE NO. 92 ON INQUIRY CARD

Preview the 80's at the
8th World Computer Congress

Tokyo
October 6-9, 1980

Melbourne
October 14-17, 1980

Here is a chance without equal to be part of what promises to be one of the most rewarding and significant international computer congresses ever held.

For the first time in its 21-year history of gathering together the world's foremost information scientists, the Eighth World Computer Congress (IFIP 80), sponsored by the International Federation for Information Processing, will be held in the Asian/Western Pacific Region where the growth of computer technology and applications has been most dynamic in recent years.

Japan and Australia are your hosts for this distinguished triennial worldwide gathering. And they cordially invite all Americans involved with computer sciences and automated information systems to pursue their professional interests in the context of their two cultures. Join with representatives of 39 participating IFIP countries to witness and help shape the direction that information processing will take in the decade ahead.

By combining the benefits of participating in the world's best technical sessions with this unique opportunity for cultural and personal enrichment, world travel, and state-of-the-art information exchange, the Eighth World Computer Congress could be *your* event of a lifetime. Budget and plan now to be there in October, 1980.

An Unprecedented Opportunity
To explore the world's newest information technologies and its oldest cultures

To register or for more information, contact:
AFIPS
1815 North Lynn Street, Suite 800
Arlington, Virginia 22209
(703) 243-4100

International Federation for Information Processing/U.S. Organizing Committee
c/o AFIPS, 1815 North Lynn Street, Suite 800, Arlington, VA 22209

Microcomputer Design Courses

Hardware, software, systems design. You can now learn about all aspects of microcomputers through EDN's exclusive design courses.

—NEW 1979 Microcomputer Systems Reference Issue (over 400 pages) $6.00
Features: EDN's 6-chapter "Software Systems Design Course" (a step-by-step tutorial for a 16-bit μC disc operating system), μP Directory, μC Support Chip Directory, μC Board Directory.

—1978 Microcomputer Systems Reference Issue (420 pages). $5.00
Features: EDN's 7-chapter "Software Systems Design Course" (a step-by-step tutorial for a μC disc operating system), μP Directory, μC Support Chip Directory, μC Board Directory.

—1977 Microcomputer Systems Reference Issue (314 pages). $4.00

—Microcomputer Design Course (11 chapters, 83 pages) $5.00

—EDN Software Design Course (90 pages) $5.00

(Add $1.00 to each of the above for Canada)
(Add $2.00 to each of the above for non-USA)

Buy in combination and save even more

• Any two items—Deduct $1.00 • Any three items—Deduct $2.00 • Any four items—Deduct $3.00

NOTE: Prices Effective April 5, 1979

Payment must be included with your order. Make checks payable to: EDN Reprints

Send to: **μC Reprints/EDN Magazine**/ 221 Columbus Ave./Boston, MA 02116

Please send:
_____ copies 1979 μC Systems Reference Issue—$6.00
_____ copies 1978 μC Systems Reference Issue—$5.00
_____ copies 1977 μC Systems Reference Issue—$4.00
_____ copies μC Design Course—$5.00
_____ copies EDN Software Design Course—$5.00

Total $_____ *(Non-USA, add $2.00 to each item, Canada add $1.00 to each item)*

Check or money order must accompany each order. No COD. MA residents add 5% Sales Tax.

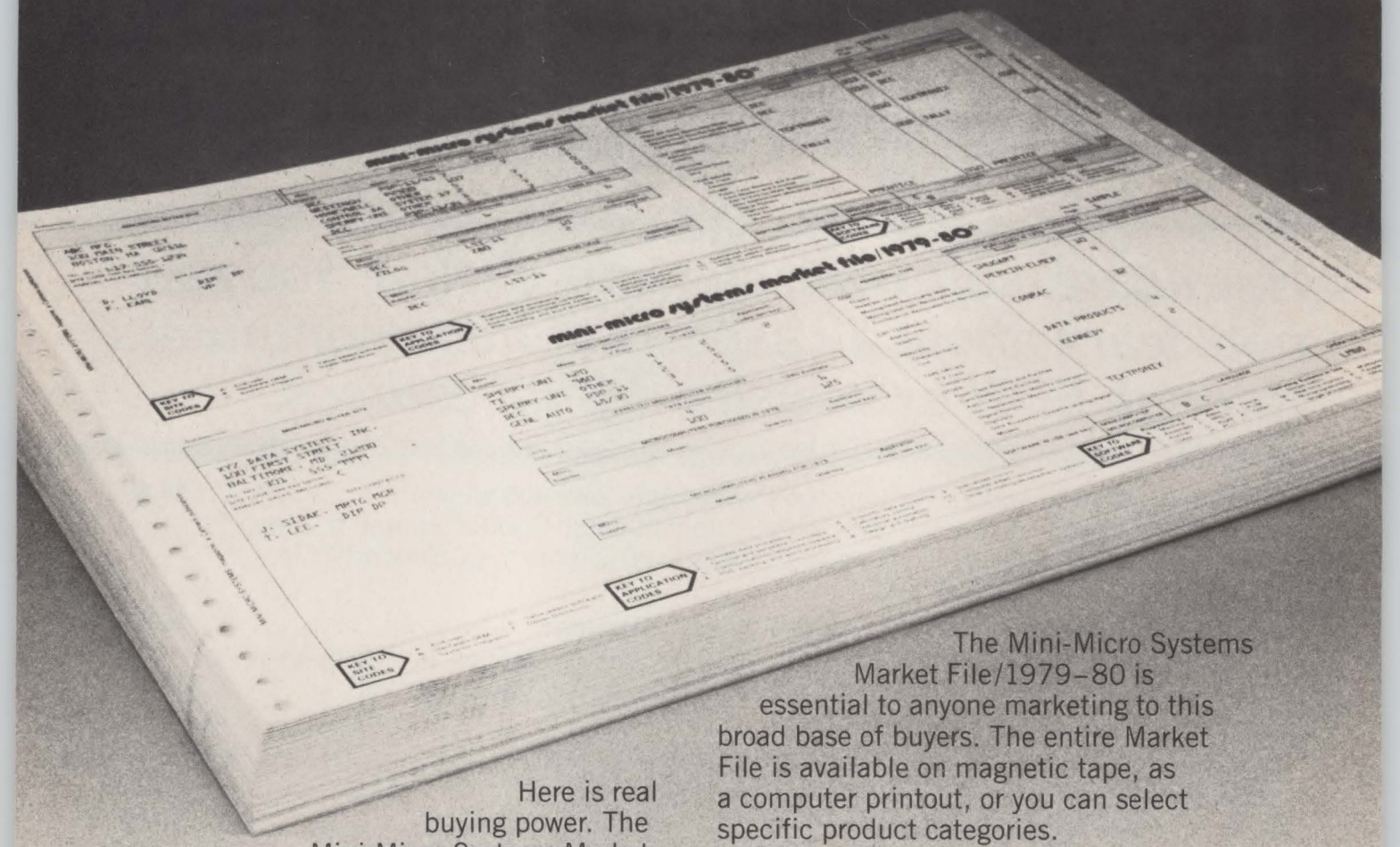
Name_____ Title_____

Company_____

Address_____

City_____ State_____ Zip Code_____

Mini-micro computer buying power



Here is real buying power. The Mini-Micro Systems Market File for 1979–80. It gives you the specific buying plans of nearly 8,000 OEM and end-user locations for minicomputers, microcomputers, small business systems and 16 categories of peripherals and related equipment. It is the most comprehensive survey of *actual* buying plans.

For the past eight years, *Mini-Micro Systems* has been compiling definitive information on the purchasing plans of its readers. The 1979–80 Market File not only gives you the specific location of existing equipment, but it gives you the name and location of the buying decision makers. Persons who will specify, buy or directly influence the purchase of approximately:

- **65,000 minicomputers**
- **50,000 microcomputers**
- **60,000 floppy disks**
- **32,000 disk drives**
- **85,000 CRT terminals**
- **46,000 printers**
- **16,000 tape drives**

The Mini-Micro Systems Market File/1979–80 is essential to anyone marketing to this broad base of buyers. The entire Market File is available on magnetic tape, as a computer printout, or you can select specific product categories.

To find out how you can have Mini-Micro Buying Power, use the coupon or call your local Mini-Micro sales office.

Mini-Micro Systems

A Cahners Publication

Regional Sales Offices:

Boston	(617) 536-7780	Denver	(303) 388-4511
Connecticut	(203) 255-6293	Los Angeles	(213) 933-9525
Chicago	(312) 654-2390	San Francisco	(408) 377-6777

MM5

Mini-Micro Market File
c/o Mini Micro Systems
221 Columbus Ave.
Boston, MA

☐ Send me more information on Mini-Micro Buying Power.

☐ Have your district manager call me.

Name_____

Title_____

Company_____

Address_____

City_____ State_____ Zip_____

Telephone_____

Classified Ads

HARDWARE

HEWLETT • PACKARD

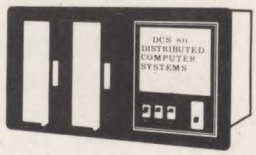
★ RTE IVB SYSTEM ★

56 KB High Speed Memory
2113E Proc. 7905 Disc
2644A with Dual Tapes
2607A Line Printer
7970B 800'BPI Tape Drive
Dual Bay Rack
Powerful AUTO Recovery

CRISIS COMPUTER CORP

2356 Walsh Ave., Santa Clara, CA 95051 (408) 246-0402
For domestic and international sales TWX 910-338-7330

Circle No. 318



DCS/80
Intel Multibus
Compatible Development/Control System

The DCS/80 is an industrial quality rack-mountable unit which includes dual 8" floppy disks, power supply and 5-slot Multibus card cage. The DCS/80 CPU is an enhanced version of the iSBC 8010 which can contain up to 4k RAM, 16k PROM/ROM, 48 bits parallel I/O and 2 completely independent serial I/O ports. A complete 16k system is $3595.

Software:
PASCAL, Fortran, C, Process Control Basic, IBM Bisynchronous communication protocols, cross-assemblers.

Distributed Computer Systems
223 Crescent Street,
Waltham, Ma. 02154 (617)899-6619

Circle No. 319

PROJECT MANAGERS AND ENGINEERS

If you need a fast, flexible, efficient, low-cost tool for managing projects; if you need results in minutes instead of hours or days, you need MicroPERT (tm).

MicroPERT (tm) Project Management System offers features unparallel in its price range, including:

Over 200 graphic output options including Network Diagrams, Gantt, Manpower, Resource & Cost charts on a variety of graphic output devices.

Over 45 report output options including Event, Activitiy, Manpower & Resource schedules, Cost detail & summary reports & exception reports for most categories on a variety of output devices.

MicroPERT (tm) is available for purchase or rental, in disk & tape-based versions for Tektronix 4050 series (desktop) Graphics Computers from:

SHEPPARD SOFTWARE COMPANY
1523 Coronach Ave.
Sunnyvale, CA 94087
(408) 733-8651

CLASSIFIED ADVERTISING ORDER FORM

Mini-Micro Systems' classifieds reach more mini-micro people.

Rates: Our rates apply to both display classified and regular classified listings. There is no charge for typesetting regular listings. Attach clean typewritten copy — double-space, please. Plan approximately 50 average words to a column inch — eight lines. Art work for display ads MUST accompany order.

Frequency:	1X	2X	3X	4X	5X	6X
Per Column Inch:	$57	$55	$52	$49	$47	$45

Category: Be sure to specify the category you wish to be listed under: Business Opportunities, Consulting Services, Design Aids, Hardware, Hardware & Media, Microsoftware, Miscellaneous, New Literature, Rentals, Seminars, Software, Software Services, Supplies & Accessories. (other categories may be employed at our discretion.)

Frequency rate:_____X Run this ad in_____(number issues)
Ad size: _____col. wide by_____inches deep. Under_____(category)

Check enclosed for $_____*(Pre-paid orders only)*

Signature _____

Name _____Title_____

Company _____Telephone No._____

Address _____

City _____State_____Zip_____

MAIL TO: Attn: Linda L. Lovett, Classified Advertising, Mini-Micro Systems, 221 Columbus Ave., Boston, MA 02116

MICROPROCESSOR SOFTWARE

8048, TI9900, 8080/8085, 6800, 6502, Z80, etc.

Fortran IV Microprocessor Cross Assemblers and Simulators for all computers. Over 250 installations on 16 bit minis to 60 bit maxis (over 25 different manufacturers). Features include macros, conditional assembly, cross reference tables, etc. Most assemblers are relocatable and include linking loaders. For more information contact **Microtec, P.O. Box 60337, Sunnyvale, CA 94088, (408) 733-2919.**

Classified Ads

CONSULTING SERVICES

SOFTWARE CONSULTING SERVICES

Let us develop your new software — from design thru documentation. Operating systems, compilers, graphics, text processing, or applications.

We deliver software to meet your specifications. On time.

JEFFREY L. KENTON & CO.
CONSULTANTS

ONE BACON STREET · WELLESLEY, MASS. 02181
(617) 237-4589

SERVICES

MEMORY REPAIRS

Any Manufacturer
DIGITAL DATA SYS
305-792-3290

Circle No. 320

DEADLINES

Copy deadline: Advertising copy must be received by the 3rd of the month preceding the issue date. Camera-ready mechanicals for display ads must be received by the 5th of the month preceding the issue date. For example, to appear in the February issue, copy must be received by January 3; mechanicals by January 5.

MMS CAREER OPPORTUNITIES

To place an advertisement in this section contact:
Lynn George, Recruitment Advertising Manager, Eastern USA
1200 Summer Street, Stamford, CT 06905. Telephone (203) 327-6772/6746
Telecopier No. 203, 324-5825
DIANE SMITH, Recruitment advertising manager LOS ANGELES
5670 Wilshire Blvd, Los Angeles, CA 90036. Telephone (213) 933-9525
Rates: $60.00 per column inch, commissionable to advertising agencies

Even Webster's Knows About QUEST

QUEST (kwest). v.I. To make a search; to go on a quest.

QUEST SYSTEMS, INC. n.I. Founded in 1968.2. Among the largest professional recruitment firms in the U.S. functioning solely in the computer sciences; its client companies pay all employment fees, interviewing and relocation expenses. Quest is known for its deep personal commitment to relate to each candidate as an individual with individual goals. 3. Its professional staff averages over 6 years of experience in EDP recruiting (additionally, staff members have direct hands-on experience in programming, systems, hardware sales, etc.). 4. Quest is presently searching for programmers and analysts (commercial, scientific, systems software) for over 3,500 client companies in the U.S. *Quest has openings in over 700 U.S. towns and cities;* salaries to $38,000. 5. Methodology - see Questsystem.

QUESTSYSTEM (kwest sis'tem).n.I. Discussing with an individual what he/she would like to be doing in light of what he/she has been doing. 2. Analyzing the realities of his/her objectives as they relate to the current job marketplace. 3. Contacting client companies and other Quest staff personnel to identify positions of possible interest. 4. Introducing the job candidate to prospective employers by providing complete details to each about the other, ensuring the efficacious use of everyone's time. 5. Arranging interviews. 6. If employment offers are extended, Quest assists in evaluating the responsibilities, compensation and opportunities (and relates those to the initially stated objectives). The Questsystem has been working for thousands of professionals at no expense, whatsoever. Ask your friends of their past dealings with Quest. Then, put the Questsystem to work for you. For additional information on this subject, please inquire directly to Quest Systems, Inc. (All inquiries/resumes received will be responded to immediately and in confidence.)

Call Toll Free
(800) 821-7700, Ext. 114

QUEST SYSTEMS INC®

6400 Goldsboro Road
Washington, D.C. 20034 (301) 229-4200
Baltimore: (301) 788-3500 • Philadelphia: (215) 265-8100

CIRCLE NO. 110 ON INQUIRY CARD

PROGRAMMERS AND ANALYSTS

Free Employment Service
Northeast, Southeast & Midwest U.S.

Scientific and commercial applications • Software development and systems programming • Telecommunications • Control systems • Computer engineering • Computer marketing and support

Call or send resume or rough notes of objectives, salary, location restrictions, education and experience (including computers, models, operating systems and languages) to either one of our locations. Our client companies pay all of our fees.

RSVP SERVICES, Dept. MM
Suite 700, One Cherry Hill Mall
Cherry Hill, New Jersey 08002
(609) 667-4488

RSVP SERVICES, Dept. MM
Suite 300, Dublin Hall
1777 Walton Road
Blue Bell, Penna. 19422
(215) 629-0595

RSVP SERVICES
Employment Agency for Computer Professionals

ALL FLORIDA

Daytona Beach
Mfg. Engr. ..... High Speed Assy.
Orlando
Production Supv. ..... N.C. Drilling
Fort Walton
Radar Engineer ..... Hands On
Fort Lauderdale
A.D. Engineer ..... R.F.
Orlando
Methods ..... P.C. Boards

Salaries Range — 20-33,000. Multiple openings. Some do not require a degree. For confidential consideration send your background or call (317) 783-7812. Don Pergal, Dunhill Executive Search, 7460 South Madison Ave., Indianapolis, Ind. 46227.

Have you heard about TECHNICON on the *SAN FRANCISCO PENINSULA?* Important things are happening here!

HARDWARE ENGINEERS

Assume responsibility for developing hardware specifications for equipment used in our medical information system. You will evaluate and provide hardware design for external sources, as well as provide technical assistance for new and existing customer contracts.

These positions require experience in hardware digital circuitry design and/or system integration of computer equipment. Your ability to document procurement specifications and technical descriptions and interface with outside vendors necessary.

TECHNICON, innovative specialists in communications systems to the Health Care Industry, is a stable, growth-oriented company offering competitive salaries and most comprehensive benefits, located in an area offering complete cultural and recreational opportunities for your personal pleasure. Please send resume, including salary history, to **Rita Olds,** Professional Employment, TECHNICON, 3255-1 Scott Blvd., Santa Clara, CA 95051. 408/727-9400. Individuals only apply. An equal opportunity employer.

TECHNICON

Medical Information Systems Corp.

Stop excusing your life away.

Everyone has an excuse for not seeing their doctor about colorectal cancer. However, 52,000 people die of colorectal cancer every year. Two out of three of these people might be saved by early detection and treatment.

What's your excuse? Today you have a new, simple, practical way of providing your doctor with a stool specimen on which he can perform the guaiac test. This can detect signs of possible colorectal cancer in its early stages before symptoms appear. Ask your doctor about a guaiac test, and stop excusing your life away.

American Cancer Society

THIS SPACE CONTRIBUTED AS A PUBLIC SERVICE.

SCIENTIFIC PROGRAMMERS

The Navy's major research, development, test and evaluation activity, located in California's High Desert, has immediate openings for professionals in data processing who wish to live in a clean, small-town atmosphere and work on challenging scientific applications in the following areas:

- ☐ SOFTWARE ENGINEERING
- ☐ MINICOMPUTER SYSTEMS
- ☐ SCIENTIFIC DATA BASE DESIGN
- ☐ PROCESS CONTROL
- ☐ GRAPHICS SOFTWARE
- ☐ DATA INTEGRITY
- ☐ TEST RANGE DATA REDUCTION

Send your application or resume to:

NAVAL WEAPONS CENTER

Code 09-6224-ED
China Lake, CA 93555
Call Collect (714) 939-6441

An Equal Opportunity Employer • U.S. Citizenship Required

Advertisers Index

Advanced Electronics Design, Inc. 62
Advanced Micro Devices 36-37
AFIPS 158
Ampex MPD 148
Astrocom 138
Axiom 26

Ball Computer Products 77
Beehive International 121
Burroughs OEM Marketing Corp. 4-5

Cap-CPP, Inc. 38
Centronics 1
Century Data Systems 84-85
Charles River Data Systems 33
Clary Corp. 42
Columbia Data Products, Inc. 39
Compas Microsystems 74
Computer Automation 23
Computer Interface Technology 22
Custom Systems 120

Data General 155
Datamedia Corp. 153
Data Printer Corp. 147
Dataram Corp. C2
Data Systems Design 2
Datum Inc. C3
Digital Communications Associates 141
Digital Computer Controls 152
Digital Equipment Corp. 16-17
Digital Pathways 122
Digital Research 78
Distributed Logic 56
DOSC/Digitron 82
Dunn Instruments, Inc. 25
Dylon Corp. 46

EDN Magazine 159
Electronic Processors, Inc. 110
EMM/SESCO 14
Ex-Cell-O Corp 30-31

First Computer Corp. 9
Forth, Inc. 88
Frequency Technology 106
Fujitsu America, Inc. 76

General Electric 111
General Terminal Corp. 12-13
GenRad/Futuredata 48-49

Hall-Mark Electronics 86-87, 109
Hazeltine Corp. 83
Hewlett-Packard Corp. 136-137
Heyman Mfg. 154

Imlac Corp. 34
Innovative Data Technology 152
Intel 65-68

Dennison Kybe Corp. 8

3M Company 10-11
Magnavox *(Division of North American Philips)* 112
Megatek Corp. 29
Microcomputer Rentals 144
Microengine Co. 20
Micropolis Corp. 70
Mini-Micro Systems 160
Monolithic Systems 55, 119
Mostek 134-135

National Instruments 140
National Semiconductor 6-7, 73
NEC Information Systems, Inc. 21

Ohio Scientific C4
onComputing Magazine 151
Ontel Corp. 91
Oregon Software 59

Peripheral Dynamics Inc. 81
Peritek Corp. 46
Perkin-Elmer Corp. 143
Plessey Microsystems 125
Practical Automation 146

Quodata Corp. 45
Ramtek Corp. 75
Rental Electronics, Inc. 47

Scientific Micro Systems 113
Shugart Associates 40-41
Shugart Technology 60
Siemens Corp. 131
Siggraph '80 157
Sola, a unit of General Signal 149
Superior Electric Co. 145

Tally Corp. 104
Tandon Magnetics 51
TEAC 142
Tektronix, Inc. 57
Teleray Div., Research Inc. 52
Texas Instruments 18, 124
Transnet 154

Unitronix 156

Visual Technology 24

Western Electric Co. 117

Sales Offices

BOSTON
John J. Fahey,
Eastern
Regional Manager
221 Columbus Avenue
Boston, MA 02116
(617) 536-7780

NEW JERSEY
Joseph F. Fitzhugh,
Regional Manager
P.O. Box 183
Parsippany, NJ 07054
(201) 625-9225

CHICAGO
Clayton Ryder,
Regional Manager
Charles Durham, Jr.,
Regional Manager
15 Spinning Wheel Rd.
Hindsale, IL 60521
(312) 654-2390

DENVER
John Huff,
Regional Manager
270 St. Paul Street
Denver, CO 80206
(303) 388-4511

JAPAN
Tomoyuki Inatsuki,
General Manager
Trade Media Japan Inc.
R. 212 Azabu Heights
1-5-10 Roppongi
Minato-ku,
Tokyo 106 Japan
Tel: (03) 585-0581

ENGLAND
Tony Kaminski
Systems International
Dorset House,
Stamford Street
London, SE1 9LU England
(01) 261-8498

LOS ANGELES
Robert A. Billhimer,
Regional Manager
5670 Wilshire Boulevard
Los Angeles, CA 90036
(213) 933-9525

ORANGE COUNTY
David E. Pearson,
Regional Manager
2041 Business Center Drive
Suite 214
Irvine, CA 92715
(714) 851-9422

SAN FRANCISCO
Frank Barbagallo,
Regional Manager
Sherman Building, Suite 1000
3031 Tisch Way
San Jose, CA 95128
(408) 243-8838

The Microcomputers you should take seriously.

The Challenger III Series is the microcomputer family with the hardware features, high level software and application programs that serious users in business and industry demand from a computer system, no matter what its size.

Since its introduction in August, 1977, the Challenger III has become one of the most successful microcomputer systems in small business, educational and industrial development applications. Tens of thousands of Challenger III's have been delivered and today hundreds of demonstrator units are set up at systems dealers around the country.

The Challenger III systems offer features which make their performance comparable with today's most powerful mini-based systems. Some of these features are:

Three processors today, more tomorrow.

The Challenger III Series is the only computer system with the three most popular processors— the 6502A, 68B00 and Z-80. This allows you to take maximum advantage of the Ohio Scientific software library and programs offered by independent suppliers and publishers. And all Challenger III's have provisions for the next generation of 16 bit micros via their 16 bit data BUS, 20 address bits, and unused processor select codes. This means you'll be able to plug a CPU expander card with two or more 16 bit micros right in to your existing Challenger III computer.

Systems Software for three processors.

Five DOS options including development, end user, and virtual data file single user systems, real time, time share, and networkable multi-user systems.

The three most popular computer languages including three types of BASIC plus FORTRAN and COBOL with more languages available from independent suppliers. And, of course, complete assembler, editor, debugger and run time packages for each of the system's microprocessors.

Applications Software for Small Business Users.

Ready made factory supported small business software including Accounts Receivable, Payables, Cash Receipts, Disbursements, General Ledger, Balance Sheet, P & L Statements, Payroll, Personnel Files, Inventory and Order Entry as stand alone packages or integrated systems. A complete word processor system with full editing and output formatting including justification, proportional spacing and hyphenation.

OS-DMS, the software star.

Ohio Scientific offers an Information Management system which provides end user intelligence far beyond what you would expect from even the most powerful mini-systems. Basically, it allows end users to store any collection of information under a Data Base Manager and then instantly obtain information, lists, reports, statistical analysis and even answers to conventional "English" questions pertinent to information in the Data Base. OS-DMS allows many applications to be computerized without any programming!

The "GT" option yields sub-microsecond microcomputing.

Ohio Scientific offers the 6502C microprocessor with 150 nanosecond main memory as the GT option on all Challenger III Series products. The system performs an average of 1.5 million instructions per second executing typical end user applications software (and that's a mix of 8, 16 and 24 bit instructions!).

Mini-system Expansion Ability.

Challenger III systems offer the greatest expansion capability in the microcomputer industry, including a full line of over 40 expansion accessories.

Networking and Distributed Processing

OS-65U level 3 now provides networking capabilities as well as time sharing ability allowing Challenger III based systems to be expanded to meet the most demanding business applications.

Prices you have to take seriously.

The Challenger III systems have phenomenal performance-to-cost ratios. The C3-S1 with 48K static RAM, dual 8" floppies, RS-232 port, BASIC and DOS has a suggested retail price of under $4000. 80 megabyte disk based systems start at under $13,000. Our OS-CP/M software package with BASIC, FORTRAN and COBOL is only $600, and other options are comparably priced.

The Challenger III Series from Ohio Scientific.

C3-B

C3-S1

C3-OEM

For literature and the name of your local dealer, CALL 1-800-321-6850 TOLL FREE.

CIRCLE NO. 95 ON INQUIRY CARD

C3-B wins Award of Merit at WESCON '78 as the outstanding microcomputer application for Small Business.

OHIO SCIENTIFIC
1333 SOUTH CHILLICOTHE ROAD
AURORA, OH 44202 • (216) 831-5600

HEWLETT-PACKARD® TAPE SPEED BARRIER BROKEN BY DATUM

Need more speed than 45 ips for your Hewlett-Packard system? Datum breaks the speed barrier with compatible vacuum column tape systems operating at 75 and 125 ips, as well as 45 ips. Dual Density is standard in all 3 speed configurations.

A new concept in tape subsystems, the 1041 Series is compatible with Hewlett-Packard Models 1000, 2100, 2114, 2115, 2116 and 2100 MX minicomputers. A single EIA rack-mounted external controller is the heart of the Datum system.

Along with increased system thru-put, Datum's Series 1041 offers you multi-transport operation using NRZI and/or PE formats. Up to four tape transports may be driven by each controller.

And we're software transparent to all Hewlett-Packard operating systems.

See Datum break the Hewlett-Packard tape speed barrier for yourself; contact your local Datum sales representative or headquarters today. And Datum gives you one more very special benefit. A superior price/performance ratio!

125

75

45

datum inc

CORPORATE HEADQUARTERS 1363 S. State College Blvd., Anaheim, CA 92806. Tel: 714-533-6333. TWX: 910/592-1289. Telex: 68-5579 • **EUROPEAN HEADQUARTERS,** DATUM (ELECTRONICS) LTD., DATUM HOUSE, 51 High St., Esher, Surrey, England. 372-67282 • **DATUM SALES OFFICES, CANADA,** Willowdale, ON. Tel: 416-491-6960. Telex: 06-966857 EOR TOR • **NEW ENGLAND,** Framingham, MA 01701. Tel: 617/872-6911; **EAST COAST,** Mountainside, NJ 07092. Tel: 201/654-5590; **MIDWEST,** Des Plaines, IL 60018. Tel: 312/296-1064; **SAN JOSE,** San Jose, CA 95117. Tel: 408/249-5370.

PPD 107

CIRCLE NO. 94 ON INQUIRY CARD

® Registered Trademark of Hewlett-Packard