Fault-management system addresses salient failure modes

Benchmark tests evaluate major local-area networks
UNIX does business with office-automation systems
Integrated software combines multiple business functions
THE PERIPHERAL DESERT

Many tri and tri again — but never make it.

Model 9400 GCR tape system—the latest in a long and honored line of Kennedy products. Products that have always been first in innovation, design, and performance. Model 9400 carries on this tradition of 'first across the line'. For complete details on the industry’s premier tri-density, hi-performance tape system, write or call today.

KENNEDY
An Allegheny International Company
1600 Shamrock Ave., Monrovia, CA 91016
(818) 357-8831 • ITT TELEX 472-0116 KENNEDY
TWX 310-472-0116 KENNEDY
CIRCLE NO. 1 ON INQUIRY CARD

KENNEDY • QUALITY • COUNT ON IT
No other company can make this statement.

*COMPAQ* Computer Corporation had the most successful first year in the history of American business. We sold $111 million worth of the COMPAQ Portable and COMPAQ PLUS™ personal computers.

What made them so successful?
They simply work better.
They work better because they run all of the most popular, most useful programs, right off the shelf. And because they show text and graphics on the same built-in display screen. And because we not only built them to be compact, we built them rugged enough to be portable. And versatile enough to grow with you. The COMPAQ Portable can be converted to the high-performance COMPAQ PLUS with ten megabytes of data storage.

By offering more capabilities than most personal computers, the COMPAQ Portable and COMPAQ PLUS have quickly earned a reputation as the most productive personal computers on the market.

What statement will we make in 1984? Our customers will have the final say. Yet in a recent survey, 98 percent of COMPAQ Computer users said they would recommend them to a friend.

We like to think they'll say what we say: "It simply works better."

For the location of your nearest Authorized Dealer, call 1-800-231-0900.

*©1984 COMPAQ Computer Corporation. COMPAQ® is a Registered Trademark and COMPAQ PLUS™ is a Trademark of COMPAQ Computer Corporation.

It simply works better.
MINI-MICRO WORLD

News

33 HP unveils 9-pound portable with MS-DOS, Lotus 1-2-3 in ROM
35 Molecular's supermicros smooth transition from 8- to 16-bit systems
37 IBM, Zenith portables challenge Compaq
41 DEC/3M pact prods 1/2-inch tape-cartridge market
44 Aston-Tate announces Framework, enters integrated software market war
48 Expanded IBM 9000 system targets multi-user business applications
53 MegaTape boosts capacity to 500M bytes per cartridge
56 Heard on the Hill: Check customs guidelines before traveling with your computer
61 SMI introduces BASIC-to-C translator
62 C. Itoh and Delphax join forces to produce low-cost non-impact printer
66 U.S. representatives blast Japanese export policy

Corporate and Financial

85 Personal printer, portable computer advance HP's market strategy
86 Corporate and financial briefs
91 Guest Forum: Acquisition fever rises among microcomputer software vendors

International

93 Microsoft makes XENIX compatible with UNIX System V
99 Europeans debate tariff on ICs
100 Convergent, Future Technology pursue high-volume buyers in Europe
104 Market Barometer: European PC distribution: the market's bottleneck
110 France's Bull Group enhances its minicomputers
110 Overheard Overseas: IBM hopes to absorb popular X.25 in new SNA 'standard'
INTERPRETER
119 Artificial intelligence faces a crossroads
129 Plated promises and sputtering shipments characterize thin-film media makers
141 Why can’t Europe produce computers?

INTEGRATOR
153 On-board diagnostics lower service costs for OEMs and system integrators
161 Transportable operating system promotes network benchmarks

FEATURES
181 Feature Highlights
183 Fault-management system lowers cost, expands applications...a parallel-processing computer addresses all phases of system failure
195 Integrated software solves complex business problems...the newest business software handles financial analysis, data handling and communications
221 VT200 terminals incorporate higher text speed and multinational features...new models boost performance and save space
231 Streaming-tape applications extend beyond backup...full-function cartridges provide data compression, file backup and software distribution
241 SCSI bus solves peripheral interface problems...device promises universal interchangeability, integration flexibility and lower cost
253 UNIX’s place in office automation is assured...standardization trend promises wider selection
263 Wang Professional Computer surpasses IBM PC in performance and ease of use...attractive features create an effective software-development environment
275 Optimizing a dual-processor micro for UNIX...NS16000-based system boasts virtual memory, VAX-compatibility and dedicated slave processors

DEPARTMENTS
4 Editorial Staff
11 Editorial
14 Letters
17 Breakpoints
285 New Products
301 Career Opportunities
307 Calendar
309 Mini-Micro Marketplace
311 Classified Advertising
312 Index to Advertisers
PUT AN END TO EXPENSIVE COMMUNICATIONS SERVICE CALLS.

We can save you the expense of repeated and troublesome third party service calls by giving you the same equipment and application assistance your telephone company already uses to find your communications problems.

The Navtel Datatest I gives you a do-it-yourself data communications trouble kit that satisfies the needs of even the largest user...at a price that allows the savings to start right away.

Weighing less than two pounds with battery, the Datatest I packs a host of features into a hand-held test unit. It is easy to use with test parameters clearly marked for all phases of operation including colour grouped functions and bright LED read-outs.

Put Datatest I to the test. Your telephone company, all the major OEM's and end users, have already declared it a winner.

Datatest I. Your datacomm trouble kit for the one time charge of just $1295.00.

Call, write or circle the reader service number for free literature and application notes. Navtel, 8461 Keele Street, Concord, Ontario, L4K 1B1. Telephone (416) 669-9918.

FREE application notes available.

FOR THE TESTING TIMES

A division of Atelco
Now Gould offers the widest range of UNIX-based systems in the world.

Gould's PowerSeries™ computers span the performance range. From professional desk-top computers and high-resolution graphics workstations to shared resource and back-end processors with up to twice the performance of a VAX 11/780.™ And, all with the UNIX® operating system to assure interconnectibility and software compatibility.

In addition, there's utility. Gould PowerSeries computers are designed for the way you work. Users have all the advantages of a dedicated system plus the lower-cost-per-user option of sharing resources with Gould's offering of standard networking strategies including Ethernet.™

Computer users also need compatibility. Gould's years of expertise with UNIX software have produced the "Compatibility Suite" of application software packages that is compatible and consistent across the entire PowerSeries product line under our Universal Timesharing Executive, UTX, ¹ a unique combination of Berkeley 4.2 BSD with selected features from AT&T's System V.

And, for your service and support needs, you can rely on Gould's worldwide customer support network.

Put Gould PowerSeries Computers to work for you now.

Gould Inc., Computer Systems Division
Distributed Systems Operation
6901 West Sunrise Boulevard
Fort Lauderdale, FL 33313
1-800-327-9716

¹UNIX is a trademark of AT&T Bell Labs
²PowerSeries and UTX are trademarks of Gould Inc.
³Ethernet is a trademark of Xerox Corp.
⁴VAX is a trademark of Digital Equipment Corporation
You’re the of our

We build computers for the way you do business.
Cromemco builds some of the most advanced micro and supermicro computers in the world.
And we sell them to people who design and package total computing solutions.
People who need flexible computers so they can respond quickly with exact solutions to their customers’ problems.
People who want computers they can upgrade and expand without creating new problems for themselves or their customers.
People very much like you.

Computers matched to your customers’ applications.
If your customers’ needs can be met with a micro or supermicro, Cromemco can deliver the right one to do the job. Right from the pages of our catalog, you can select from more than two dozen 68000- and Z-80-based computers.
They’re all built on the IEEE-696 (S-100) bus.
And they’re all compatible. So you can move from one to another without losing your software investment.
To fine-tune your system, our computers include up to 21 board slots. And over 35 system boards to fill the slots just about any way you choose.
We can back the CPU with as much as 16 Mb of error-correcting RAM. An SMD interface that can support 1200Mb of disk storage. High resolution color graphics. Communications. You name it.

Cromemco
DEDICATED TO SYSTEMS BUILDERS
FOUNDED 1975
cornerstone business.

And you can choose the right storage solution from our selection of high-performance floppy, hard disk and tape systems. For distributed processing applications, you'll want to take a look at our C-10 personal computer. It can serve any of our computer systems as an intelligent workstation.

What does all that mean? Just this. With Cromemco you can offer your customers individually tailored, expandable computing solutions. At off-the-shelf prices. Immediately.

Software that speaks your customers' language.

Our software tools help you and your customer get down to business quicker, too.

Our UNIX-like operating system can execute both 68000- and Z-80-based programs. And our high-level language support for both microprocessors is superior. From Macro Assemblers. To Fortran 77, PASCAL, C, BASIC and GSA-certified high-level COBOL.

Cromemco means business. Your business.

What it comes down to is this. Since our founding in 1975, you've been the cornerstone of our business. So Cromemco computers are designed specifically for the way you do business.

And whether you provide computing solutions for business, science or industry, you really should be doing business with Cromemco.

For a copy of our Systems Catalog, contact: Cromemco, Inc., 280 Bernardo Ave., P.O. Box 7400, Mountain View, CA 94039, (415) 964-7400, TWX 910-379-6988.


Cromemco®

©1983 Cromemco, Inc.

CIRCLE NO. 7 ON INQUIRY CARD
TAKE A SHORT 20,000-HOUR DRIVE.
And wave goodbye to the competition. Presenting the Shugart 712. Our new 5.25” half-height 10 Mbyte Winchester. It's a high performance compact that redefines reliability. So much so, it outdistances all other half-height Winchester.

For starters, it runs at an MTBF of 20,000 power-on hours. That's 60% longer than other drives. And it's roomy. With 10 Mbytes of formatted storage.

Plus four-point shock and vibration mountings, for a very smooth ride. And rugged enough to withstand up to 40 G's.

The 712 is based on 3370 flexure technology, bringing mainframe horsepower down to size.

And our new, low-mass head design complete with pre-amp is standard equipment, too. This makes flying height more uniform. And data integrity a given.

All this was made possible by our venture group approach. A specially chartered engineering and manufacturing team that makes sure the bugs are out the first time out. And we make sure they have everything they need. Like the $40 million investment we made in capital equipment.

Which includes more progressive assembly lines. Class 100 clean tunnels. Even a more advanced spindle motor.

In short, everything you need for single-user personal computers. Intelligent workstations. And, down the road, multi-tasking software.

You won't have to reinvent the wheel every time you want to redesign, either. Thanks to our 1600 controller with built-in SCSI. Plus the drive level interface standard.

So test drive the 712 today. Or its 5 Mbyte version, the 706.

Just call your local Shugart sales office. Or, contact Hamilton/Avnet, our authorized distributor.

And find out how a little drive can take you a lot further. Shugart Right from the start.
Add it all up, and you get today’s finest range of Winchester disk drives.

You can figure it out for yourself. With storage capacities of between 5 and 40 megabytes (formatted), and offering both 5¼" and 3½" models, Rodime has developed today’s finest range of Winchester disk drives.

Take the Rodime 200 series. Launched in April 1982, it was the first to offer a full range of storage capacities from 5 to 20 megabytes and is currently providing reliable memory storage for many of the leading manufacturers of 8- and 16-bit business microcomputers.

Take the Rodime RO 206 and RO 208. With storage capacities of 30 and 40 megabytes, these high-performance drives have an average access time of 60 ms. As you’d expect, they’re designed specifically to meet the memory requirements of today’s 16-bit multi-user microcomputers, at highly competitive prices.

And, finally, take Rodime’s RO 350 3½" Winchester. With storage capacities of 5 and 10 megabytes, the RO 350 is the first of a new generation of rugged Winchesters designed primarily to bring the benefits of Winchester technology to the hostile environment of portable microcomputers.

It all adds up. Take Rodime’s RO 200, 206, 208 and 350 together and you’ve got the finest range of Winchester disk drives. Add Rodime’s outstanding reputation for reliability, its manufacturing capacity, and its ability to deliver large volumes reliably, and you’ll see why Rodime has its numbers resoundingly right.

If your systems still aren’t using Rodime Winchesters, then someone, somewhere has got their numbers wrong.
Office automation mandates reflection and redirection

In his keynote address delivered at the 1984 Office Automation (OA) Conference last February, David Kearns, president, chief executive and a director of Xerox Corp., indicated that there exists no clear sense of mission when automating office functions nor a clear sense of the prevailing urgency of OA needs. The office of the future, said Kearns, requires the management and measurement of clear-cut goals, operating plans, business strategies and performance plans. And all of these must come before equipment strategy. Citing the boom of personal computers as an example of the lack of goal orientation, Kearns commented that computers are, for the most part, incompatible, isolated and uncommunicative. Recommending remedies for the less-than-spectacular acceptance of OA in the field, Kearns called for capital investment in a combination of people, machines, facilities and support services.

Another obstacle that OA must overcome to attain widespread market acceptance is the absence of a workable definition of the term. Disagreement about OA's goals among system manufacturers, integrators and users has actually spawned office resistance to advanced technology. One of the better OA definitions to date appeared recently in the trade press. Dr. Karen Rancourt of Wang Laboratories Inc. states: "Office automation is an ongoing dynamic process comprised of people, organizations, technologies and tools, integrated to meet business goals and objectives."

Note that both industry experts emphasize people as the primary ingredient in the OA success formula. Office information communications deal with people interactions in the form of correspondence, reports, meetings and conversations. However, says Rancourt, most OA installations have attempted to force-fit people, machines and organizations into available technologies and tools. As a result, most users have disputed new office procedures and changes because OA standards are non-existent, costs are prohibitive, equipment proves overwhelming and system integration is inflexible. Consequently, installation attempts come across as though the changeover itself were the problem. Rancourt concludes that it is the process used in making the changeover that prevents successful OA integration. All OA explorations and decisions, therefore, should involve the users concerned.

Accordingly, to achieve equipment success in the OA arena, system integrators must avoid technology-driven hardware and software and move toward more people-oriented computer systems. Improving the effectiveness, efficiency, productivity and quality of business communications, rather than automating existing ones, demands more than just the addition of ergonomic or user-friendly features; it demands complete user transparency. Computers, peripherals and software should be configured around and integrated for people—not the other way around. And instead of the term "office automation," with its negative connotation of substituting machines for people, let's change it to something more positive, such as "office integration." What do you think?
THE DSD FLOPPY SYSTEMS.
MORE OR LESS JUST LIKE DIGITAL'S.
MORE FEATURES. LESS MONEY.
When we designed our DEC®-compatible storage systems, we kept one very important idea in mind. "Compatible" doesn't mean "the same." So while our drives work perfectly with Digital's computers, they're also designed to give you more than just compatibility. Our 430 and 440 Floppy Systems are a case in point.

The DSD 430. Your lowest cost RX02 alternative.

Budgets being what they are, you'll be pleased to know there's a single-sided, double-density, 1-megabyte floppy system you can buy at a ridiculously low price.

But the best part is, even if it didn't cost less, the DSD 430 would still offer more than the alternatives.

Like a built-in hardware bootstrap. LSI-11/23 4-level interrupts. On-board diagnostics. And more. All with a low 5¾" profile.

The DSD 440. Your full-featured alternative.

Our 440 has all the features of the economical 430, and then some.

Like our exclusive HyperDiagnostics™, a built-in, stand-alone diagnostic system that lets you test, exercise and debug without a CPU. And, in many cases, lets you get back up and running without a service call.

The 440 works with the PDP®-11, the LSI-II, VAX® and emulates both the RX02 and the RX01.

And the service and support to match.

Like the rest of our systems, we back up the 430 and 440 with DSD exclusives like our Rapid Module Exchange™ program, designed to give you next-day replacement of a faulty module. HyperService™, which takes over when your 90-day warranty expires and covers everything. And a DEC-compatible sales and support network second only to Digital.

So you see, when it comes to a floppy for your Digital system, there really isn't an alternative. After all, why settle for something that's just compatible, when you can have a system that's incomparable?

Corporate Headquarters: 2241 Lundy Avenue, San Jose, CA 95131. Eastern Region Sales and Service: Norwood, MA, 617 769-7620. Central Region Sales: Dallas, TX, 214 980-4884. Western Region Sales: Santa Clara, CA, 408 727-3163.

DATA SYSTEMS DESIGN
CHRISSLIN MEMORY

MULTIBUS MEMORY
512KB TO 2 MB EDC

• Error Detecting and Correcting (EDC).

SINGLE QTY. PRICE:
Without/EDC W/EDC
512KB $ 895.00 $1,495.00
2MB $ 477.50 $ 777.50

LSI 11 MEMORY
256KB TO 1 MB

• Control Status Register (CSR).

SINGLE QTY. PRICE:
256KB $ 525.00

CALL FOR MORE DETAILS!

MORE MEMORY ON A SINGLE CARD THAN ANY OTHER MANUFACTURER

2 MB QBUS ERROR DETECTING AND CORRECTING

CALL FOR MORE DETAILS!

CHRISLIN Industries, Inc.
31352 Via Colinas • Westlake Village, CA 91362 • 213-991-2254
TWX 910-494-1253 (CHRISLIN WKVG)

MULTIBUS is a trademark of Intel Corp. LSI QBUS are trademarks of Digital Equipment Corp.

CIRCLE NO. 11 ON INQUIRY CARD

CCA EMACS

The most complete screen editor available for the Unix1 and VAX/VMS2.

CCA EMACS from Computer Corporation of America has the greatest combination of power, speed, and functionality of any text editor available for Unix or VAX/VMS. With close to 400 built-in commands, CCA EMACS allows virtually any editing task to be accomplished in just a few keystrokes, including tasks that would be difficult or impossible to do using other editors. In addition, a set of more than 60 predefined variables allows each user to customize CCA EMACS to meet various application needs and user styles. All of these features are supported by a full online documentation package that can assist the user at any point, giving information that ranges from the definition of a single command to manual pages that contain complete explanations of major CCA EMACS features.

Operating Environment

Runs on Berkeley Unix (4.1BSD and 4.2BSD), Bell Unix (System III and System V), and VAX/VMS. Requires 500 K of address space.

Price

Prices for a full source license range from $350 to $2400. Contact CCA for further details.

For More Information Contact

Computer Corporation of America, Four Cambridge Center, Cambridge, MA 02142
(617) 492-8860

OEM inquiries are encouraged.
(1) Unix is a trademark of Bell Laboratories.
(2) VAX and VMS are trademarks of Digital Equipment Corporation.

CIRCLE NO. 12 ON INQUIRY CARD

Letters

COMPUTER ARCHITECTURE

To the editor:

I found the article “Computer Architecture” by Efrem G. Mallach (MMS, December 1983, Page 145) to be very interesting but believe it missed one of the first, if not the first, multimicroprocessor computer systems – the CP9000 communications processor. M/A-COM DCC Inc. designed the CP9000 (well-known as the TP4000) in conjunction with Telenet in the 1975 time frame. Although modest by today’s standards, it supported up to 62 6602 8-bit microprocessors (each with 8K bytes of local memory), connected via a high-speed bus sharing a common 256-byte memory.

As the article describes, multiple processors are often better than just one when a task must be done more quickly. The CP9000 addressed the difficult problem of growth in a packet network by adding a microprocessor-based line-processing unit for each group of eight data lines. Previously, this had been done by a standard minicomputer with fixed processor and memory resources. The CP9000 was found to be far superior and is still the principal switching vehicle in the Telenet network.

A second area mentioned in the article is fault tolerance. Again, the CP9000 pioneered in this technology. All buses, memories, power supplies and main processors are fully redundant with built-in switch-over mechanisms.

William P. Simmelink
Director of Marketing
Communications Group
M/A-COM DCC Inc.
Germantown, Md.

Author's response:

I appreciate Mr. Simmelink's taking the time to tell Mini-Micro Systems readers about the CP9000. Because it was apparently developed for a single customer and was not marketed as a general-purpose system, the CP9000 did not get the publicity of later products from other companies. That lack of publicity does not reduce its technical merit one iota.

There may well be other early multimicroprocessor systems that are equally little known. If enough people write to me about their multimicroprocessors from the mid-1970s, I'll try to assemble the information into an article.

Efrem G. Mallach
Needham, Mass.
PERFORMS LIKE A BALLERINA.

Choose a printer that won't crack under pressure. Our secret weapon? Okidata's stored-energy, non-ballistic print head. It has one moving part instead of three which means a smaller heat sink, less maintenance, and ultimately, an extremely low cost of ownership. For added durability, its armature is laser welded, not soldered. And its tough tungsten pins crank out 200,000,000 characters with ruthless precision.

But, a virtually invincible print head isn't the only reason our nationwide network of service people get so few calls. Okidata printers have exceptional MTBF and MTTR ratings: up to 4000 hours and as little as fifteen minutes, respectively. And no duty cycle limitations.

Yet, all this rugged reliability is delivered with the speed and grace of a prima ballerina. Inside their stamped steel bodies, our fastest models perform at up to 350 cps bidirectionally, with short line seeking logic and fast horizontal and vertical slew. As for style, our correspondence quality truly rivals a daisy-wheel's at speeds up to 85 cps. All models boast superior talents for their modest prices. Most, for instance, accept downline loadable character sets.

Plus, Okidata's compatibility is unlimited, and our technical staff can make alterations to fit your special OEM needs. Our innovations get standing ovations. For our latest product specification sheets, call 1-800-OKIDATA. In New Jersey, (609) 235-2600. Okidata, Mt. Laurel, NJ 08054.

CIRCLE NO. 13 ON INQUIRY CARD
A CIT-467 changes the whole way your graphics look

The CIT-467 is the quickest, easiest way we know of to get into color without getting into heavy expense.
You can have color for your business graphics, presentation graphics, scientific graphics, because the CIT-467 gives you a built-in color command set. It turns monochromatic Tektronix® 4010/4014 graphics into full color, without time and money consuming software changes and headaches.

The CIT-467 is fully compatible with PLOT 10™ DISSPLA® DI3000/GRAFMAKER® and other major graphics packages.

In terms of quality, the CIT-467 will meet anyone’s terms. The dot resolution is a sharp 572 x 480. The Addressable Plot Area in the Tektronix mode is 4096 x 4096.

The CIT-467 gives you point, vector, polygon, circle and pie segments on command to reduce communications time, cut CPU overhead and save program development time.
You get user-defined area fills, five line types and built-in cross hair cursor.
Special plot features include a programmable scale factor for vector size and relocatable origin, allowing for simulated pan and zoom.

The CIT-467 is a total color graphics terminal. It’s everything you need to give your present graphics software colorful new life.
We’d be happy to tell you much more about it and exactly how much less it can cost you to get into color with the reliable CIT-467. Just write or call.


SEE US AT COMDEX BOOTH #1740
PHOENIX TO UNVEIL OFF-THE-SHELF PC-COMPATIBLE ROM BIOS

Phoenix Software Associates Ltd., Norwood, Mass., plans to release the ROM portion of an IBM-compatible basic input/output (BIOS) system, the MS-DOS operating system and other software packaged for those integrating IBM PC-compatible systems. Phoenix, which has done many ports of MS-DOS to a variety of hardware clone systems, also offers a $30,000 off-the-shelf software BIOS. Each licensee must write the BIOS portion of the MS-DOS operating system. Many licensees choose to implement part of the BIOS in ROM, as IBM has. Phoenix expects its product to foster price wars because would-be compatible manufacturers can integrate systems quickly.—L. Valigra

SHUGART PLANS HIGH-CAPACITY 3½-INCH MICROFLOPPY

Shugart Corp., Sunnyvale, Calif., is developing a high-capacity 3½-inch microfloppy drive for possible introduction by year-end or the first quarter of 1985. The drive is expected to have an unformatted storage capacity of 3.3M to 5.8M bytes and to use the same form factor and hard-jacket media housing as that used on the Shugart SA300 series drives. To achieve the higher capacities, Shugart is exploring the use of standard 600-oersted media, Spin Physics’ Isomax small-particle media and a perpendicular recording media developed by Vertimag Corp. According to Shugart president William Bayer, the company is working to resolve issues such as double-sided head designs and positioners. Working with Shugart on the perpendicular-recording version using the Vertimag media is 3M, which is developing methods to package the sputtered perpendicular media in a Sony Corp.-type floppy media cartridge. Similarly, Spin Physics is seeking ways to reduce the thickness of the particle layer on the substrate to less than 5 mils.—C. Warren

BOEING WILL IMPLEMENT OSI COMMUNICATIONS STANDARD AT NCC

At June’s National Computer Conference, Boeing Computer Services will demonstrate what could be the first major cooperative effort to implement the International Standards Organization’s Open Systems Interconnect (OSI) model for communications. One participant in the demonstration will be Charles River Data Systems (CRDS) Inc., a Framingham, Mass., supplier of supermicrocomputers running the UNIX-like UNOS operating system. A source at CRDS says the connections will be concentrated on the transport layer of the OSI model, which is the machine-to-machine connection layer. The National Bureau of Standards (NBS) is backing the demonstration, and participants include Digital Equipment Corp., Hewlett-Packard Co., Honeywell Inc., NCR Corp., Intel Corp. and CRDS, according to the CRDS source. The demonstration will include the 802 standards committee’s recommendation for a local-area network, which will transfer files between the participating vendors’ machines. The CRDS source says the NBS is validating the participants’ products, so that each implementation meets OSI criteria.—L. Valigra

ADDS ADOPTS TAIWAN MANUFACTURER’S PC-COMPATIBLE

Hoping to speed its entry into the IBM PC-compatible market, Applied Digital Data Systems (ADDS) Inc., Hauppauge, N.Y., is readying its PC-clone, PC-1, for release as early as next month. ADDS adopted the PC-1 from Multitech Indus-
Breakpoints

trial Corp., whose MPF-PC is the result of a design project created by the Taiwanese government-sponsored Electronics Research & Service Organization. ADDS' PC-1 probably will include 64K bytes of memory, a monochrome monitor and one floppy disk drive and will sell for $2,100, notes ADDS technical support specialist Michael Genes. ADDS is the exclusive U.S. distributor of the Multitech product. Multitech also offers Apple Computer Inc.-compatible units.—L. Valigra

CONVERGENT TO UNVEIL EIGHT-USER SUPERMICRO

Convergent Technologies Inc., Santa Clara, Calif., is expected to ship the one-to eight-user MiniFrame supermicrocomputer this month. The system supports Convergent's demand-paging implementation of UNIX System V, which first appeared on the Company's MegaFrame superminicomputer. Starting price for the MiniFrame is less than $6,000. It is based on Motorola Inc.'s MC68010 virtual-memory processor operating without wait states. An entry-level configuration is expected to include a 13M-byte hard disk drive, memory-management software with demand paging, a high-speed floppy disk drive for backup, 512K bytes of RAM, two RS232 ports, a Centronics-compatible port and a high-speed RS422 port. Convergent will sell the MiniFrame only to OEMs.—T. Moran

NEC ENTERS PC-COMPATIBLE MARKET

NEC Information Systems Inc., Boxborough, Mass., is entering the IBM PC-compatible market with a microcomputer that is part of its Advanced Personal Computer (APC) series. Unlike earlier APC models, the new microcomputer uses 5¼-inch rather than 8-inch floppy disk drives to make it appropriate for a more general market, NEC sources say. The system is based on a version of the Intel 8086 processor manufactured by NEC in Japan, runs MS-DOS 2.11 and has 128K bytes of RAM in its basic configuration. Price for a version with one floppy drive and a CRT display is $1,995. The display includes NEC's powerful 7220 graphics processor. A UNIX System III operating system on a combination hardware/software "softcard" will be available.—L. Valigra

FRANKLIN UNWRAPS PORTABLE RUNNING MS-DOS, CP/M

Franklin Computer Corp., which this year reached an out-of-court settlement in its long-running legal battle with Apple Computer Inc., should this month introduce its CX-2M portable computer. The 27-pound CX-2M runs the MS-DOS and CP/M operating systems and Apple II+ software. It incorporates the 8086, the Z80 and the 6502 processors; half-height floppy drives; and a 7-inch green phosphor screen with a resolution of 640 by 200 dots while running MS-DOS. A CX-2M with 128K bytes of RAM for MS-DOS, 64K bytes of RAM for the Apple-compatible Franklin DOS, 64K bytes of RAM for CP/M and two floppy drives sells for $2,395.—D. Bright

DRIVETEC TO DOUBLE FLOPPY CAPACITY

To meet the needs of system integrators for more storage on removable media, Drivetec Inc., San Jose, Calif., is preparing to offer a 6.66M-byte version of its model 320 floppy disk drive, which currently stores 3.33M bytes unformatted. The 320 has a track density of 192 tracks per inch (tpi) and a data-transfer rate of 500K bits per second and can read 48- or 96-tpi diskettes. The new drive, possibly ready for sampling by selected OEMs in late summer, will offer chara-
When the world of computer graphics required standards, the world of standards acquired NOVA*GKS™

Computer graphics takes an unprecedented step into reality with NOVA*GKS™ software from Nova Graphics International. Years of innovative research make NOVA*GKS today’s most advanced, full implementation of the Graphical Kernel System (GKS), the international graphics standard. Because of its unique, distributed architecture, NOVA*GKS allows multiple hardware configurations in host, workstation, and microcomputer environments.

A graphics development tool, NOVA*GKS makes it easier to design and construct graphics applications. In a fraction of the traditional time. In addition, applications using NOVA*GKS are totally device independent. Even portable.

To learn more about NOVA*GKS and its bottom-line competitive advantages, contact us today. We’ll show you how NOVA*GKS and the Nova Graphics International support team can put your products on the leading edge of an escalating, worldwide market.

CIRCLE NO. 15 ON INQUIRY CARD
You Don’t Have To Be A Magician To Select The Right System

Advanced Digital makes system selection easy. No tricks. No illusions... just an expanding line of Single and Multi-user, Multi-processing S-100 based computer systems that exceed the most demanding customer requirements.

For 1 To 8 Users, It’s Super Star...

Tired of fighting the limitations of floppies and streamer tapes? SUPER STAR is the FIRST S-100 based system to use the 5 MByte Fixed/5 MByte Removable cartridge Winchester disk drive as standard. SUPER STAR offers such outstanding features as a six-slot motherboard, low power consumption, and S-100 Bus, IEEE 696 compatibility. Easily expandable to eight users with TurboDOS® and Advanced Digital’s Master/Slave boards, SUPER STAR is the best Cost/Performance Act on the stage today.

New 8/16-Bit Super System II Gives You Up to 20 Users...

For those large installations, its Advanced Digital’s new SUPER SYSTEM II. Its many features appear right before your eyes like magic. Features such as a 12-slot motherboard, a choice of 20 MByte Winchester disk drive (standard) to 140 MByte of on-line capacity, high-speed, high-reliability 5 MByte Removable Cartridge for back-up at speeds approaching 1.5 MBytes/min, and a one year, 100% parts/labor warranty. SUPER SYSTEM II – A hard act to follow.

All Advanced Digital Systems are compatible with CP/M* 2.2, CP/M 3.0, Concurrent CP/M and TurboDOS. When equipped with Advanced Digital’s new SUPER 186 16-Bit Single Board Computer, you magically change from 8-Bits to 16-Bits. You can even perform simultaneous multi-tasking operations of both 8-Bit and 16-Bit programs.

Advanced Digital computers may perform like magic, but there’s no rabbit in the hat... only high-quality, extremely reliable components designed and manufactured to assure user satisfaction. Don’t be dazzled by cheap tricks and illusions; see your Advanced Digital dealer and take the mystery out of system selection.

CIRCLE NO. 16 ON INQUIRY CARD
See us at Booth 7010, Comdex, Atlanta, Ga.

Advanced Digital
5432 Production Drive, Huntington Beach, CA 92649
Tel. (714) 891-4004 • Telex 183210 ADVANCED HTBH
In Europe:
Advanced Digital U.K. Ltd.
27 Princess St., Hanover Square
London WIR8NQ • United Kingdom
409-0077 • 409-3351 Telex 265840 FINEST

*CP/M is a trademark of Digital Research
*TurboDOS is a trademark of Software 2000
teristics similar to the original but with doubled track density, making it plug-compatible with current drive controllers. Company marketing manager Vladimar Langer says the next generation of drives will offer 13.2M bytes, a 19,816-bit-per-inch density and a 1M-byte-per-second data-transfer rate. The increased rates will necessitate the use of new controllers and interfaces for the drive. — C. Warren

**SHARP TO ANNOUNCE $350 FOUR-PEN PLOTTER**

Sharp Electronics Corp.'s Industrial Equipment Division, Paramus, N.J., plans to introduce the $350 four-pen CE-515P plotter at this month's Comdex show in Atlanta. Sharp intends to begin selling the plotter in August to business personal computer users through distributors and dealers. Graphics speed for the approximately 3-pound plotter ranges from 0.22 to 3.24 inches per second, and resolution is 0.008 inches. The plotter uses black, blue, green and red ball-point pens and draws on A4-, A5-, B5- and letter-size paper. It also can use 4.56-inch-wide rolls of paper. A Centronics parallel port and an RS232C port are standard. Sharp is seeking software vendors to develop device drivers for the plotter. — D. Bright

**TWO 5¼-INCH OPTICAL DRIVES MAY COME OUT IN 1985**

Information Storage Inc., Colorado Springs, Colo., is vying with Laser Memory Systems Inc., Calabasas, Calif., for market share for a 5¼-inch optical drive that will debut early in 1985. Information Storage's drive should be similar to Laser Memory's unit: each will have 100M to 200M bytes of storage, write-once/read-always capability and a price of less than $1,000. Although Information Storage program manager Martin Houser won't release many details of the forthcoming drive, he does say that the company has a $1.5 million R&D budget and that financing is expected. — C. Warren

**VICTOR FOUNDER CHUCK PEDdle STARTS A NEW COMPANY**

Chuck Peddle, founder and former president of Victor Technologies Inc., is back in business, this time with an R&D start-up called NNA Inc., for No Name Available. NNA, which has headquarters in Scotts Valley, Calif., will seek design projects from domestic and foreign companies. Peddle says he has a gentleman's agreement with Britain's ACT Plc. to finish an IBM PC-compatible prototype. NNA's president is Bob Taylor, former Victor technical vice president, and the staff includes about 20 technical "refugees" from Victor, Peddle says. — M. O'Gara

**TECH FILES: A QUICK LOOK AT INDUSTRY DEVELOPMENTS**

**Hannover Fair Review:** Activity at this year's Hannover Fair industrial trade show, which attracted about 400,000 to Hannover, West Germany, mirrored that of many U.S. exhibitions: **there was a flurry of new IBM PC-compatible machines, crowds around Apple Computer Inc.'s Macintosh microcomputer and many new systems sporting small disk drives.**

Several major European companies are leapfrogging to the next level of integration—complete systems—to enter the IBM PC-compatible market quickly.
U.S. manufacturers have been creating PC clones or configured systems from component parts, such as Faraday Electronics Corp. with its IBM PC-compatible motherboard. But several European companies are buying complete personal computer systems from other companies and selling them under their own monikers. **Commodore International Ltd.,** for example, attracted crowds to its booth to view its portable personal computer, a system purchased from Bytecomterm Inc., Ottawa. Likewise, **Philips Kommunikations Industrie AG,** West Germany, showed its personal computer, a desktop system from Corona Data Systems Inc.—L. Valigra.

**Six Taiwanese manufacturers made a major push to entice U.S. and European buyers to adopt their IBM PC-compatible desktop units.** The six—CAF Computer Corp., ADI Corp., Mitac Inc., Multitech Industrial Corp., President Enterprises Corp. and Tatung Electronics Corp.—are seeking U.S. and European dealers and OEMs for their products, which sell for around $2,000 each in floppy disk-based versions. The products from CAF, Multitech and Sony Taiwan (which did not exhibit) stem from a design created by the government-sponsored Electronics Research & Service Organization in Taiwan. Tatung's product is based on Intel Corp.'s 80186 processor.—L. Valigra.

Japanese companies, including Casio, Panasonic and Sharp Corp., featured IBM PC-compatible units. **Kyocera Corp.,** showed its PC-compatible KC-1000 and KC-2000 at Hannover, but the systems are not yet available for sale. A Kyocera spokesman says the products will be available this summer in the United States. The KC-1000 will be priced at about $1,000 for OEMs, and the KC-2000 will sell for around $1,100, with neither including a display. The KC-1000 is based on Intel's 8086 processor. The 8087 and 8089 processors are optional. The KC-1000 has 32K bytes of ROM, 128K bytes of RAM, 128K bytes of video RAM, a slimline 5¼-inch floppy disk drive, an RS232 port, a parallel port, three open slots and MS-DOS 2.01. The KC-2000 has 8K bytes of ROM, 128K bytes of RAM, a slimline floppy drive, one parallel port, one serial port, five slots and 4K bytes of video RAM. It uses Kyocera's proprietary KC-DOS V.2.10 operating system, a PC-DOS 2.1 look-alike.—L. Valigra.

Meanwhile, **the new IBM Portable PC surfaced in Europe for the first time.** IBM hasn't put it on the market yet, but to ward off the competition it put a solitary American model running English-language software on its Hannover stand. It looks like Big Blue is not going to let the grass grow under its feet again as it did last time with a long delay between U.S. and European introductions, thereby losing market share to the start-ups, such as Victor Technologies Inc.—M. O’Gara.

**Small floppy disk drives stole the spotlight at Hannover, with six companies showing new models of 3½-inch microflossies.** BASF, Mitsubishi Electric, Olivetti OPE, TEAC Corp., Tokyo Electric Co. Ltd. and Toshiba Corp. all had models on display. Systems incorporating the small drives appeared in Hewlett-Packard Co.'s HP150 microcomputer and in Apple Computer Inc.'s Lisa and Macintosh microcomputers.—L. Valigra.
The CIT-500 has a screen that doesn't screen out half the page. You get full page display.

It's because the user-friendly CIT-500 monitor is designed like a page. Vertically, the screen measures 15 inches high by 13 1/2 inches wide, giving you up to 64 lines of data. (A regular screen gives you only 24 lines, less than half a page.)

When you can see the whole page all at once, it makes data entry and filling in forms so much faster and easier.

Full-page display also makes the CIT-500 ideal for word processing and text editing, because what you see is what you get when you print out.

And the ergonomics of the CIT-500 don't stop there.

The monitor tilts and swivels. The screen is non-glare and all surfaces are non-reflective. The detached keyboard tilts and, with its six-foot coiled extension cord, is easily moved for operating convenience.

The CIT-500 is DEC VT100® compatible, down-line loadable for multiple character fonts and is able to create special fonts and symbols.

It also has an intelligent, programmable printer port—a perfect link to our CIE-3500 Serial Printer.

All in all, the CIT-500 is all you could want in a terminal.

Want to see more of it? Just write or call CIE Terminals, 2505 McCabe Way, Irvine, CA 92714-6297. Or call toll free 1-800-854-5959. In California, call 1-800-432-3687.
HOW TO MAKE YOUR SUPERMICRO LIVE UP TO ITS NAME.

Add DSD's RAMTRAC™ MULTIBUS® controller.

You're building a supermicro. A 16/32-bit CPU on one end. And a high-capacity 5¼" Winchester on the other.

Now, what are you going to put in the middle? A plain vanilla controller?

That's a little like a Ferrari with a Ford transmission. All show and not much go.

On the other hand, you could use a controller that's especially built to wring every last bit of performance out of supermicros.

DSD's RAMTRAC controller.

It controls Winchesters, floppies and tape. All on a single MULTIBUS board.

And it's packed with performance features like pipelined architecture for quick system throughput, support for the new high-capacity 15-head Winchesters, 24-bit addressing to run with the most powerful microprocessors, and 32-bit ECC.

Not to mention file oriented tape transfers, on-board data separation, and a whole lot more.

Match a RAMTRAC controller to your application.

Our line of three RAMTRAC controllers emulate Intel's® iSBC® 215, iSBX™217 and iSBX™218. And they're compatible with all SA460-, SA850-, SA1000- and ST506-type drives.

Just select the model that's right for your application.

<table>
<thead>
<tr>
<th>Model</th>
<th>5217</th>
<th>6217</th>
<th>7217</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winchester</td>
<td>5¼&quot;</td>
<td>5¼&quot;</td>
<td>8&quot;</td>
</tr>
<tr>
<td>Floppy</td>
<td>5¼&quot;</td>
<td>8&quot;</td>
<td>8&quot;</td>
</tr>
<tr>
<td>Tape</td>
<td>QIC-02</td>
<td>QIC-02</td>
<td>QIC-02</td>
</tr>
</tbody>
</table>

Call DSD for details.

If your supermicro is going to live up to its name, you really ought to take a look at our RAMTRAC controllers, today. The easiest way to do that is to call the DSD Sales office in your area for a copy of our RAMTRAC controller data sheet.

Eastern Region Sales and Service:
Norwood, MA, (617) 769-7620. Central Region Sales and Service: Dallas, TX, (214) 980-4884. Western Region Sales:
Santa Clara, CA, (408) 727-3163.
Officials at BASF's Ludwigshafen, West Germany, headquarters are targeting U.S. disk drive manufacturers as potential purchasers of plated media that BASF unveiled at Hannover. BASF now offers a second source to supplier Ampex Corp. According to the BASF specification, the plated media's magnetizable film is about 0.05 µm thick. To produce the media, BASF plates aluminum disks with a nickel coating using a wet-chemical, currentless deposition process. The nickel coating is then polished, and the cobalt-phosphorus recording layer is deposited. A protective coating can then be applied. BASF quotes a typical data density of 12,000 flux changes per inch and a track density of 1,000 tracks per inch. Company officials believe the plated disks are as well-suited for conventional manganese-zinc ferrite heads as for thin-film heads.—K. Jones

Epson Corp.'s busy booth hosted many new products, including the lap-sized PC-8 portable computer. The PC-8 incorporates a Z80 CPU, 64K bytes of main memory, 6K bytes of video RAM, 32K bytes of operating system ROM for CP/M and Microsoft Corp.'s BASIC language. It has a 72-key keyboard, a 480-by-64-dot liquid-crystal display with eight 80-character lines, microcassette software and an RS232C interface. Options include RAM packs, floppy disk drives, an acoustic coupler and a small printer. Memory is expandable to 120K bytes. Price for the PC-8 is less than 3,500 German marks, or about $1,000. Availability is scheduled for this month in the United States and Europe. Also available with the PC-8 is a portable Wordstar word-processing program, a financial program called Portable Calc and a portable scheduler program.—L. Valigra

Also at Epson's booth was the JX-80 four-color dot-matrix printer. It uses a ribbon that can be used to mix as many as seven different colors. It prints at 160 lines/sec., has a Centronics parallel interface and IEEE 488 or RS232C options. Price is 2,000 to 3,000 German marks, or about $800 to $1,400.—L. Valigra

Reporters poking around the Sperry Corp. stand at Hannover turned up a prototype Keytronics Corp. keyboard meant to make the lives of Wordstar word-processing software users easier. The keyboard will make some now-cumbersome coding automatic and will provide for voice input. The end-user price in Germany is roughly $280. Deliveries are slated to start in about two months. The intelligent board is the brainchild of German design house Rafi GmbH, which has set up a joint venture called Eurokey GmbH with Keytronics.—M. O'Gara

RANDOM DISK FILES: Microscience International Corp., Mountain View, Calif. is preparing to enter the 3½-inch Winchester disk drive arena with its "Mighty Mouse" product. It will join others expected at July's National Computer Conference (MMS, April, Page 21). Thus, the drive will hold 12M bytes of unformatted information and be ST-412-compatible.—C. Warren

In a move that took the ½-inch tape-backup industry by surprise, IBM introduced in March the model 5480 ½-inch tape subsystem for use with 3380 hard disk systems. The drive offers 200M bytes of storage and a 5M-byte-per-second data-transfer rate using an 18-channel thin-film head with chro-
mium dioxide tape. The product's significance may lie in the tape cartridge rather than in the drive. Measuring 4 inches by 5 inches by 1 inch and housing a single reel with a picker arm for automatic loading of the tape, the cartridge has virtually established the physical requirement standards for 1/2-inch cartridges. Dan Collier, an industry consultant and general manager of the Freeman Report, Santa Barbara, Calif., expects IBM's announcement to cause compatibility problems for manufacturers of low-end 1/2-inch drives.—C. Warren

This month, MegaTape Corp., Duarte, Calif., should introduce a 500M-byte version of a 1/2-inch backup tape drive. The drive is downwardly compatible with the company's 300M-byte model MT-300 cartridge drive. According to Gary Webb, vice president of marketing, plans call for production units to appear early in the third quarter.—C. Warren

MICRO FILES: American Telephone & Telegraph (AT&T) Co., which began the year by announcing an OEM agreement with Convergent Technologies Inc. for a proprietary line of information-processing equipment, recently unveiled a homegrown crop of computers, the 3B family of six computers. The 3B family ranges from a supermicrocomputer desktop unit priced at $9,950 to a high-end minicomputer priced at $340,000. The 32-bit machines, to be sold through OEMs and value-added resellers, are based on the UNIX System V operating system and Western Electric's 32-bit processor. There is still no word on the much-speculated-about personal computer forthcoming from AT&T, but analysts say the machine, priced at less than $5,000, will be available this summer through retail channels. In addition to its first lineup of computers, AT&T introduced the Ethernet-compatible 3BNET local-area network, which links 3B computers, and the PC Interface, which enables personal computers that run the DOS operating system to communicate with each other and with 3B computers.—M. Stenzler-Centonze

NOTES FROM OVERSEAS: Reports of IBM's upcoming lap-sized computer, code-named Poseidon, reached Europe last month. The machine will reportedly have a 1M-bit bubble memory, software in ROM, a communications port and an 80-character-by-8-line or 80-character-by-6-line display. Indications are that Matsushita Electric Co. Ltd. will produce the IBM product, which is expected to sell for $800.—M. O'Gara

N.V. Philips, Eindhoven, the Netherlands, and Control Data Corp. (CDC), Minneapolis, have set up a joint company to manufacture and market optical-disk products, including a 1G-byte drive undergoing field trials. Called Optical Storage International (OSI), the joint company also embraces the two joint development centers set up by the companies in 1982—Optical Media Laboratory, Eindhoven, and Optical Peripherals Laboratory, Colorado Springs, Colo. Those labs will also operate under the OSI name. The OSI strategy calls for the manufacture of the drives at Santa Clara, Calif., while the disk media are expected to be manufactured at a Philips plant in Blackburn, England. Philips owns 51 percent of OSI, and CDC owns the remaining 49 percent.—K. Jones
Micro-to-mainframe:
Before you settle for a simplistic solution, ask a few serious questions.

Choosing a micro-to-mainframe communications system is no game. So before you toy around with "easy" solutions, ask some serious questions.

Will this product support full IBM Terminal Emulation? Make sure the system can emulate remote batch and interactive IBM terminal systems.

Does the company offer a variety of products? You should have your choice of stand-alone front-end processors, IBM PC or XT boards, or an OEM board. All ready to run on the most popular operating systems.

Can I get fast answers to my questions? Insist on toll-free access to qualified service personnel before and after the sale.

What if I need a quick analysis of a problem? Ask if the manufacturer has a Communications Test Center for product testing over public phone lines. And find out if the system has internal diagnostics.

Suppose something goes wrong with the unit? The company should offer a 30 day money-back guarantee and a 12 month warranty that includes a free replacement unit.

What about future product development? Make sure the products you’re going to need soon will be available soon.

Who am I dealing with anyway? How long have they been in business? The longer, the better.

How much is all this going to cost? Here’s a point of reference: Our own DataTalker product line will give you all the capabilities and services just described for as little as $695. Complete. If you’d like to know more, contact our Marketing Support Group at 1-800-321-7785.

Winterhalter, Incorporated
3853 Research Park Drive
P.O. Box 2180, Ann Arbor, MI 48106
313/662-2002 800-321-7785,
TWX 810-223-2423
TELEX 234-216

DataTalker™
By Winterhalter, Incorporated

Winterhalter, Incorporated has been providing data communications solutions to major manufacturers of microcomputers and word processors since 1978. Our DataTalker front-end processors and PC boards are used by companies around the world, from start-up manufacturers to the Fortune 1000.

CIRCLE NO. 19 ON INQUIRY CARD

Now available for the IBM PCjr.
68000-based systems to fit your application.

Right from the pages of our catalog, we can deliver 68000-based supermicro systems to match virtually any application. Including yours.

Here’s how.

Built on the IEEE-696 (S-100) bus, Cromemco systems offer up to 21 board slots. And a family of 35 boards—CPU, memory and specialized I/O—to fill the slots any way you choose.

At the heart of each system is our 68000/Z-80 dual processor. Backed by as much as 16 Mb of error-correcting RAM. Full multi-tasking capability. I/O to handle up to 16 terminals.

And that’s just the beginning.

You can select single or dual floppies, 5¼” or 8” A 21 Mb 5¼” Winchester hard disk. And a nine-track tape drive.

We can accommodate your taste for the exotic, too. With boards like our SMD interface that supports up to 1200 Mb of disk storage. An NTSC standard color graphics interface. A TV camera digitizer. A/D and D/A converters. An IEEE-488 bus interface. Communications. And more.

Intelligent workstations.

Then, if you’re designing a distributed processing system, you’ll want to take a look at our C-10 personal computer. The Z-80-based C-10 can serve our 68000-based systems as a powerful intelligent workstation in a distributed processing mode. Or as an independent personal computer with its own floppy storage.

High-level languages and applications software.

That brings us to software. It starts with CRÖMIX, our UNIX-like operating system that you’re free to tailor to your application.

CRÖMIX can execute both 68000- and Z-80-based programs. So right along with your 68000-based packages, your system will accommodate a wide selection of CP/M® software written for the Z-80.

And our high-level language support is second to none. From a 68000 Macro Assembler. To 68000 FORTRAN 77, PASCAL, GSA-certified high-level COBOL, C and BASIC.

Cromemco means business.

Your business.

You see, when we say, “Just tell us what you need,” we’re not kidding. You won’t find another family of
systems. what you need.

68000-based microcomputers that can fit your needs as exactly as ours. So if you're in the business of providing specialized computing solutions, you really should be doing business with Cromemco.

For a copy of our Systems Catalog, contact Cromemco, Inc., 280 Bernardo Avenue, P.O. Box 7400, Mountain View, CA 94039. (415) 964-7400.


*Cromemco and CROMIX are registered trademarks of Cromemco, Inc. UNIX is a registered trademark of Bell Laboratories. *CP/M is a registered trademark of Digital Research. ©1983, Cromemco, Inc.

CIRCLE NO. 20 ON INQUIRY CARD
For years, Digital’s VT100 terminal has been the CRT to choose if you want the most out of your computer. It has become the industry standard for reliability and ease of use. Not to mention the largest-selling ASCII terminal in the world.

Now Digital advances this standard with the VT200 family.

Three new terminals that embody everything Digital has learned about how to make people comfortable with computers. They offer non-glare screens that can be positioned for the best viewing angle. Keys that are so well arranged on our low-profile keyboard that you increase productivity and convenience. Fifteen programmable function keys eliminate keystrokes to speed up tasks. Plain-language setup commands to easily tailor the screen to each user. Plus, a built-in printer port for hardcopy convenience.
We've even included our most advanced video capabilities—like smooth scrolling and 132-column display—as standard features.

All packaged in our sleek new design that fits conveniently on your desk. And all supported by Digital's worldwide service organization.

But the best news is yet to come. Because despite all the advances, the VT200 family is very competitively priced.

Simply stated, Digital has advanced the standard. Once again.

For the full story, call 1-800-DIGITAL, extension 700.
DEC Compatibility... with 8" RX02!

Why be forced to step down to 5 1/4" floppies on DEC's newer systems when you know you really want to maintain media compatibility with your existing 8" RX02-based systems? Dataram agrees, and offers an innovative series of system options that provide 8" RX02 capability for your PDP-11, LSI-11, or VAX minicomputers.

Q-bus and UNIBUS FD-311 subsystems provide dual RX02-compatible 8" floppy drives for $2490. Or our dual RX02-compatible 8" slimline floppies, combined with an 8-quad slot Q-bus card cage, LSI-11/23, and 256KB memory are available for only $6510. Both products are supported by the industry’s widest range of LSI-11 compatible products. Call or write for details.

Dataram Corporation □ Princeton Road □ Cranbury, New Jersey 08512 □ Tel: 609-799-0071 □ TWX: 510-685-2542

DEC, LSI-11, PDP, UNIBUS and VAX are trademarks of Digital Equipment Corporation.
HP unveils 9-pound portable with MS-DOS, Lotus 1-2-3 in ROM

Tom Moran, Associate Editor

The latest addition to Hewlett-Packard Co.'s growing family of products for personal and business computer markets is the Portable (HP model 110) personal computer, a nine-pound, MS-DOS "knee-top," or lap-sized, system. The Portable is designed to bridge the weight/performance gap between bulky, full-function transportables and low-function knee-top machines. Measuring 10 by 13 by 3 inches, the Portable fits into a 5-inch-wide briefcase.

HP has tentatively set retail price for the Portable at approximately $3,000. The price includes Lotus Development Corp.'s 1-2-3 integrated software package, MS-DOS and other software in ROM. The Portable has a flip-up, 16-line-by-80-column liquid-crystal display (LCD), a built-in modem, a built-in rechargeable lead/acid battery and an AC adapter/charger. An RS232 serial port, an HP interface loop (HP-IL) port and an integral 300-baud Bell-compatible modem with RJ-11 telephone jack provide data communications and interfaces to other devices.

HP tries for 700K-byte floppy

HP has also introduced the HP9114 portable disk drive, a battery-powered 3½-inch Sony Corp. microfloppy drive. At press time, HP planned an initial capacity of 700K bytes for the drive. If that goal is not met, the initial capacity will be 270K (the same as the drives on the HP150), and a 700K-byte drive will follow. The higher capacity depends on Sony's ability to deliver the double-sided version of its 3½-inch microfloppy drive.

With a projected retail price of about $700, the 9114 measures 11.5 inches wide by 8 inches deep by 3 inches high, weighs 5½ pounds and interfaces to the Portable through the HP-IL interface. The Portable is file-compatible with the HP150, IBM PC and Compaq Computer Corp.'s Compaq portable. HP expects the Portable to be compatible with other IBM work-alikes.

"We're redefining the [portable] market by making no compromises," says Cyril Yansouni, general manager of HP's Personal Computer Group in Cupertino, Calif. "The reason why people have been using categories [like portable and transportable] is that, as you move from category to category, you're making trade-offs." Yansouni claims that until now most portables have been dedicated or very expensive. "Now we have a full-power CMOS (complementary metal-oxide semiconductor) machine that runs all the popular software." HP will begin shipping the Portable a few weeks after its announcement.

The inclusion of MS-DOS, Lotus
1-2-3 and the large amount of memory make the Portable price-competitive, Yansouni says, adding that this has not been traditional for HP. For people who want Lotus 1-2-3, the Portable should be strong competition for the IBM, Compaq and other MS-DOS portables. The Portable will also challenge machines from Gavilan Computer Corp. and the $1,995 PC 5000 from Sharp Electronics Corp.

The Portable differs from other knee-top systems in the large amount of software in ROM and the segmentation of ROM and RAM. The Portable boasts 272K bytes of static system RAM, 384K bytes of socketed custom ROM and 8K bytes of both display RAM and configurations erasable programmable read-only memory (EPROM). Users can dedicate different amounts of the system RAM (in 4K-byte increments) for use as an electronic hard disk drive emulator. Data in RAM is kept intact via battery backup when the system is turned off.

'ROM disk' speeds system

The most unusual feature of the system is the "ROM disk." Steve Sakoman, project manager for the Portable, says, "The standard ROM contains Lotus 1-2-3 and the BIOS. We provide a driver in the operating system (OS) that treats the rest of the ROM (about two-thirds) as a read-only disk." The ROM disk includes the OS, the Personal Application Manager user interface, MemoMaker word-processing program and the Terminal communication programs. Terminal drives the auto-dial/answer modem and emulates an HP 2621 terminal in character mode only. It provides up-and down-loading capability and a data-capture mode. The Portable can be programmed to send and receive unattended. Emulation of the 3270 terminal is in the works.

Sakoman says that, because of the size of the ROM, HP is putting a large amount of quality assurance into the code. The ROM is socketed to allow for upgrades, such as the addition of Lotus's Symphony integrated package.

The Portable's 8086 microprocessor runs at 5.33 MHz. Use of the ROM disk significantly speeds the system over non-ROM disk designs. Although the 9114 disk drive's data-transfer rate over the HP-IL averages only 36M bits per second, Sakoman says that a user can copy into the RAM disk, "making everything blazingly fast," says Sakoman.

The Portable's flip-up LCD screen covers the keyboard when closed and supports 480-by-128-dot resolution bit-mapped graphics. The keyboard is similar to that of the HP150 but lacks a keypad. The system has eight programmable function keys that provide 16 functions.

16-line LCD is from Japan

Sakoman says HP will have the first production portable with a 16-line LCD. HP will obtain the LCDs from several vendors in Japan. "I wouldn't expect to see 24-line LCD technology for about a year," says Sakoman, "although initial samples are available now." When 24-line LCDs are available, HP expects to be among the first to offer them. However, the 16-line versions cannot be field upgraded to 24 lines.

Designed and to be produced at HP's Corvallis, Ore., division, the Portable uses all CMOS technology to minimize power requirements. The system also turns itself off after a user-selected interval of non-use. HP says a charge on the lead/acid battery will last for one to two weeks under what HP considers normal conditions. When tested with a program designed by HP to drain power, the battery lasted for 20 hours of continuous operation.

The 9114 disk drive also uses a lead/acid battery, and HP claims it has a similar charge life. Combined with the battery-equipped HP-IL version of HP's ThinkJet printer, the Portable and the 9114 give HP a modular system of high-performance, battery-powered portable devices.

Company sources will not reveal sales projections for the Portable. HP will distribute the Portable and the 9114 disk drive through its direct sales force and 750 domestic retail dealers.

A design team in HP's Corvallis, Ore., division designed four custom CMOS ICs for the Portable—a 256K-bit ROM, a 64K-bit static RAM, an LCD controller and a chip that contains the keyboard interface, system timer and serial port.

---

**LASER MEMORY OPTICAL DRIVE HAS 150M BYTES**

The newly formed Laser Memory Systems Inc., Calabasas, Calif., is preparing to launch a 150M-byte, write-once/read-always, removable-platter optical disk drive in the fourth quarter. According to company founder and chief executive officer Ray Brock, the drive, tentatively dubbed the LaserFile, should be in mechanical prototype versions by June. The drive has 15,800 tracks per inch and will use a 120-mm. platter and, most likely, a small computer systems interface. According to Brooke, the goal is to work up to reversible media, which he says is not readily available. The drive is expected to sell for less than $1,000 in OEM quantities.
Molecular’s supermicros smooth transition from 8- to 16-bit systems

Chris Bailey, Western Editor

Molecular Computer, San Jose, Calif., has introduced what it claims will be a strong multiuser solution for accessing 8- and 16-bit software: two new supermicrocomputer systems capable not only of concurrent execution of the popular 8- and 16-bit operating systems—including CP/M-80, MP/M-80, CP/M-86, MP/M-86 and MS-DOS—but also of growing incrementally from three to 64 users.

The systems, the Series 9 and Series 36, are software-compatible with Molecular’s X family of multiuser systems and accept a maximum of nine and 36 application processors, respectively. But unlike Molecular’s older computers, the new systems provide “on-demand” processing that permits users to execute applications simultaneously on any multiple set of 8- or 16-bit processors. Previously, each user was assigned a single dedicated application processor. In the new Series 9 and 36, with the use of eight-port terminal concentrator processors (TCPs), each user can concurrently access as many as eight application processors.

According to Jerry Braun, Molecular’s product manager, “These systems offer OEMs and value-added resellers a smooth transition from the 8- and 16-bit worlds. In a single multiuser system users can execute applications written for both 8-bit CP/M-MP/M or 16-bit MS-DOS environments.”

Both systems are based on Molecular’s proprietary networking m/BUS with 8-bit AP/Z80 (Z80A-based) and 16-bit AP/186 (80186-based) application processors. The m/BUS, a local-area network in a box, is a high-speed (400K-byte-per-second) bus that uses a carrier sense, multiple access with collision detection (CSMA/CD) protocol similar to Ethernet to provide high-speed data transfers between multiple processors and I/O devices.

TCP key to the 9/36 series

The key to both on-demand processing and transparent multiple operating system support is the introduction of a terminal concentrator that has been added to Molecular’s networked architecture. The TCP connects users with the desired application processors and permits the easy transition between CPUs and operating systems. For example, a user can start a job stream on one processor and then access a second processor to execute a program running under a different operating system. When the job stream is complete, the user can reattach to the processor and release it for use by another user or execute another program.

The TCP, a two-board set, consists of a standard 16-bit 80186 application processor and a multiplexer card. The processor has 256K bytes of RAM; the multiplexer card uses four two-port dual asynchronous receiver/transmitters that provide eight ports of serial I/O at 19.2K bauds per port. All communications between user terminals and application processors pass through the TCP. In turn, the TCP controls the configuration of users and processors under a firmware-based multitasking operating system executing on the TCP. The firmware oversees the operation of each terminal port and provides the system log-in functions for each user.

The resident firmware controls the allocation of system processor resources and temporarily permits each user to “own” as many as eight

Series 9 supermicrocomputers from Molecular Computer permit users to execute applications simultaneously on a set of any multiple 8- or 16-bit processors. In the foreground is a Series 9 unit; a Series 9 and an expansion unit are in the background.
The key to the power of the Molecular Series 9/36 systems is the local-area-network-in-a-box architecture that supports a parallel CSMA/CD inter-processor bus for connecting 8- and 16-bit processors. Each user can access as many as eight processors simultaneously.

application processors at a time.

In keeping with the aim of increasing performance through a distributed-logic architecture, the system includes Z80 processors for print-spooling, data-communications and file-server functions. In particular, the file server contains 64K to 256K bytes of cache RAM that helps improve overall disk I/O performance. These intelligent I/O processors eliminate the I/O-processing overhead in shared-logic systems.

Series 9 packs 20M or 30M bytes of Winchester disk storage, a 320K-byte floppy disk drive and an optional streaming-tape drive into a desktop system. A minimum system offers system integrators an expandable multiuser configuration for as little as $8,995.

Series 36, designed for larger multiuser configurations, is housed in a free-standing 12-inch wide by 31½-inch long by 24-inch high cabinet. It supports a 60M-byte, 5¼-inch Winchester disk with space for two additional drives, a 320K-byte floppy, an optional tape drive and as many as 36 application processors. Prices start at $18,995.

**MMI makes two systems one**

Aware of the customer resistance to multiuser systems that limit growth beyond six to 12 users, Molecular has developed the Molecular modular interconnect (MMI) bus that allows the m/BUS to be extended between system enclosures. Thus, two or more systems can be joined to operate as one large system. As many as five expansion cabinets may be attached, supporting additional application processors, file processors and mass-storage devices. This setup provides a virtually linear growth path from a low-end three-user configuration with 20M-bytes of hard disk storage to a powerful 64-user system supporting more than 400M bytes of on-line disk storage. This gives system integrators a means of avoiding technological obsolescence. As new mass-storage technologies become available, new disk/file processor subsystems can be introduced in separate expansion cabinets that attach via the MMI.

In addition to standard CP/M and MS-DOS software packages, Molecular offers ATOM, a set of office-automation software packages designed for its supermicro-computer family. Included are the m/WORD word processor, the m/CALC electronic spreadsheet and m/MAIL electronic-mail facility. These menu-driven programs support a consistent user interface and an extensive HELP facility. Planned additional ATOM applications include a relational database manager, a filer, data-communications software and a business graphics package.

**MS-DOS compatibility is key**

John Kiefer, senior analyst for InfoCorp, a Cupertino, Calif., market research organization, says MS-DOS compatibility will make the Series 9/36 attractive to integrators and OEMs. He notes that in the last three years Molecular has achieved success by providing a stable, reliable multiuser system capable of running industry-standard CP/M-based software. With the new systems, he believes, Molecular is in a position to duplicate that success with the emerging base of MS-DOS software. "The key to the success of the microcomputer was the availability of standard operating systems that permitted the development of a large number of 'transportable' application-software packages. For the supermicro market to accelerate, application software must be portable between hardware systems."

Molecular believes that the availability of the MS-DOS operating system on the Series 9/36 will be the key to expanding the company's market penetration. Product manager Braun points out that most software suppliers for popular programs running on the IBM PC under PC-DOS have transported or are transporting their programs to the hardware-independent MS-DOS environment.
IBM, Zenith portables challenge Compaq

David Bright, Assistant Editor

Compaq Computer Corp.'s Compaq portable established itself as a benchmark in the fast-growing IBM PC-compatible portable ranks soon after its introduction in 1982. But IBM Corp. itself and Zenith Data Systems Corp. may now be threatening Compaq's stronghold in the market with their own portables—the IBM Portable PC and the Zenith Z-160.

Officials at Compaq, Houston, say they anticipated IBM's announcement and will continue to ramp up production of its portable. Compaq, which had sales of $111 million in the first year of production of the Compaq, opened a 457,000-square-foot facility on the same day as IBM's announcement. "Demand [for the Compaq] continues to be high," says a Compaq spokesman. The Compaq portable can be upgraded to the Compaq Plus, which incorporates a 10MB-byte Winchester disk drive, making the computer compatible with the IBM PC XT. The IBM Portable does not yet come in a hard disk version, and IBM says initial supplies of the unit will be limited.

Base prices of the three manufacturers' machines are similar. List prices are $2,795 for the IBM, $2,799 for the Zenith Z-160 and $2,995 for the Compaq.

Portables are 8088-based

The Compaq, Zenith and IBM machines use the Intel 8088 microprocessor and have built-in 9-inch monitors. The IBM Portable PC, basically a repackaged PC, includes 256K bytes of RAM, expandable to 512K bytes, a 360K-byte, half-height floppy disk drive, PC-DOS 2.1, a color graphics monitor adapter and an optional second floppy disk drive. It has an 83-key, detachable keyboard that is identical to the PC's. Its card cage has seven slots. Five are expansion slots, but only one of those is full-sized. That compares with five full-sized slots on the Compaq, of which three are available for expansion. The Portable PC weighs about 30 pounds and comes with a carrying case. IBM is distributing the Portable through retailers, IBM Product Centers and direct sales.

The Zenith Z-160 portable is a repackaged version of the Z-150 desktop model that the company introduced at the same time as the Z-160. "Both offer features not found in the IBM PC or other compatibles, and both offer more value," claims Randall Griffin, Zenith Data Systems vice president of product management and planning. However, at 38 pounds, the Z-160 is one of the heaviest PC-look-alike portables on the market. Griffin says the company may reduce the system's weight by altering the casing, power supply and fan.

The Z-160's keyboard layout is a modified version of the IBM Portable PC's. The Z-160's keyboard has an enlarged, L-shaped return key with a double-width shift key below it. It has an extra "enter" key next to the keypad. Two standard diagnostics levels are power-on with light-emitting diode indicators and ROM-based, menu-driven displays. Disk-based diagnostics are optional. Griffin says the diagnostics boot up in less than 5 seconds. To insert a diskette into the Z-160, a user must first pull up a
Emulex improves and tape backup by

Emulex sets the pace with three great storage subsystems for the full range of DEC QBus and Unibus systems. Whether you need Winchester disk, cartridge disk, ¾" streaming tape, or a combination unit, you'll be a step ahead with Emulex.

**INTRODUCING VAULT.**

Emulex rises above the competition with the Vault. This 70-MByte tape subsystem is built around the CDC Sentinel ¾" cartridge tape streamer and uses Emulex's own TC05 (QBus) or TC15 (Unibus) tape coupler to interface with your system. The Vault is totally software transparent to standard TS11 software. So this compact tape unit looks just like a big ½" TS11 subsystem to your operating system and diagnostics.

Vault comes complete with power supply in a single compact cabinet. It's the perfect backup unit for smaller QBus systems such as the MICRO/PDP-11 and MICRO/VAX.

**PRESENTING SABRE.**

SABRE is a sharp solution for LSI users who need more storage and backup. It packs 31.2 MBytes of main storage onto a 5¼" Winchester and 10.4 MBytes of backup onto a removable 8" cartridge disk.

And since SABRE is an exact RL02 emulation, all existing operating and diagnostic software can be used as is. SABRE is 5¼" high and slips into any 19" RETMA enclosure. A desktop version is also available. Both come complete with power supply, host adapter and connecting cables.

SABRE needs only one-eighth the space and one-quarter the power of four RL02s. And it eliminates the need for a separate system bootstrap, bus terminator and clock control board.

©1984 Emulex Inc.
ANNOUNCING MEDLEY™

Emulex has another winning combination with the Medley™ Winchester cartridge tape subsystem. It gives you either 35 or 110 MBytes of formatted storage and up to 70 MBytes of streaming tape backup. The Medley is fully software transparent to the operating system and diagnostic software of QBus and Unibus CPUs. And it uses the powerful and versatile Small Computer System Interface (SCSI) which keeps your options open for peripheral expansion.

Medley is interfaced to the system with a TC05/ TC15 tape coupler and a UC02 (QBus) or UC12 (Unibus) host adapter. By using the Mass Storage Control Protocol (MSCP), the UC02 and UC12 allow the operating system to utilize the precise characteristics of the Winchester disk drive without patches or modifications to the operating system. For convenience, Medley's disk drive, tape drive and power supply all fit into an attractive cabinet that easily mounts in a standard 19" rack. The Medley is also available in an attractive desktop version.

Find out how Emulex subsystems can keep you ahead of the game. Call toll-free (800) 854-7112. In California (714) 662-5600. Or write Emulex Corporation, 3545 Harbor Blvd., P.O. Box 6725, Costa Mesa, CA 92626.

CIRCLE NO. 23 ON INQUIRY CARD
Networking Your System?
Change a 12 Month Design Cycle to 12 Days.

Time. Development time. Time to market.
If you’re building your new computer system around a LAN, you’re in a race against time.
Ethernet* gives you a fast start, but the protocol software and system integration efforts can take as much as a year — even longer.

But now you can shorten that design cycle. With EXOS™, from Excelan. EXOS technology gives you a complete LAN capability, hardware and software, that simply plugs into your computer system’s backplane. Integration takes next to no time.

With EXOS, you can be up and running in as little as 12 days — even sooner. EXOS, or EXCelan Open Systems, is a family of Ethernet front-end processor boards, standard high-level protocol software which runs on the front-end processor, and network application software which runs on the host computer.

EXOS technology includes front-end processors for all Multi-bus®, VME bus, Qbus* and Q-Bus based computers and software supporting the standard TCP/IP high-level protocol. And if your host system supports any variety of UNIX®, then half a dozen network applications are provided as well.

EXOS. It gives your computer system a complete LAN capability with the ease of plug-in integration. That can change your design cycle from 12 months to 12 days. And get your product to market before your competition.

2180 Fortune Drive
San Jose, California 95131
(408) 945-9526  TELEX 176610

*Ethernet is a trademark of Xerox Corporation. Multibus® is a trademark of Intel Corporation. Unisbus is a trademark of Digital Equipment Corporation. Qbus is a trademark of Digital Equipment Corporation. UNIX® is a trademark of AT&T Bell Laboratories. EXOS is a trademark of Excelan Inc. Copyright © Excelan Inc. 1987. All rights reserved.
DEC/3M pact prods
½-inch tape-cartridge market

David Simpson, Associate Editor

In a move to make order of the chaos of the ½-inch tape-cartridge market, Digital Equipment Corp. and 3M Co. recently announced a joint program to develop a cartridge and recording-format standard for data interchangeability. The CompacTape cartridge and associated drive—which is still in development at DEC—provide 20M to 200M bytes of Winchester backup. The companies submitted the proposal to the American National Standards Institute (ANSI) X3B5 committee in mid-February.

The testing version of the 1-by-4.15-by-4.165-inch single-reel, self-threading cartridge has 600 feet of tape. The tape has 22 tracks and uses a modified-frequency-modulation (MFM) recording format at a minimum density of 6,667 bits per inch.

3M will manufacture and jointly market the tape cartridge, but only DEC will manufacture and market the drive. DEC officials decline comment on drive specifications, and analysts predict that DEC is at least a year away from shipping the drive in high quantities.

A lack of standards plagues the market for ½-inch tape cartridges. Although Rosscomp Corp., MegaTape Corp. and Tandon Corp. are the only manufacturers shipping ½-inch tape-cartridge drives, recent announcements from Electronic Processors Inc. (EPI), Memorex Corp., Data Electronics Inc. (DEI) and Tandberg Data Inc., promise more competition by year-end.

"DEC's move is a throwing down of the gauntlet to other ½-inch tape-cartridge manufacturers," says Don Collier, an analyst with Freeman Associates, a Santa Barbara, Calif., research and consulting company.

Reaction from other manufacturers varies. "The DEC announcement is an endorsement of ½-inch tape cartridges," says Gary Webb, vice president of marketing at MegaTape. MegaTape's MT-300/1210/1220 ½-inch tape-cartridge drive is the capacity leader with 330M bytes. The company plans to introduce the 500M-byte MT-2000 series in the third quarter of this year. The MegaTape units employ a dual-reel cartridge in a rack-mount enclosure, making them considerably larger than other ½-inch tape-cartridge drives.

Webb says that MegaTape is considering ¾- and 8-inch form factors and that the company might develop a product compatible with a standard, should one emerge. MegaTape will announce a second source for the MT series drives this year, according to Webb.

Rosscomp director of engineering Bob Richmond echoes Webb: "DEC's announcement is confirmation of the viability of the ½-inch tape-cartridge approach and shows the move from ¾- to ½-inch tape."

Rosscomp's Series 50 and Series 80 use a single reel, or spool, measuring 4 inches in diameter. Rosscomp plans to introduce a 320M-byte drive by year-end and is expected to announce a second-sourcing agreement within the next few months. Richmond says the DEC drive won't have any short-term effect because DEC doesn't have the backing of a secondary OEM source. But he admits that the proposed DEC/3M standard may influence the market in the long term. Richmond also believes that the relative complexity of DEC's drive may discourage near-term second sourcing.

Tandon's TM951 tape cartridge is similar to DEC/3M's and holds 50M bytes. Company officials decline comment on the differences between the products because specifications on DEC's drive were not available to them.

The ½-inch tape cartridge manufactured by Memorex and used by EPI in its STR-STREAM II drive is
similar to the DEC/3M cartridge. The major difference is in the way the drive pulls the tape out of the cartridge. DEC's prototype has a leader at the end of the tape, while EPI/Memorex's approach uses a hook mechanism on the tape with the leader located on the take-up reel. "Whatever standard emerges," says EPI product manager Vince Stinton, "EPI is in a position to adapt." EPI expects to begin quantity shipments in July or August. The Memorex drive, licensed under an agreement with EPI, is due by year-end. The companies submitted the design to an ANSI committee for consideration as a standard last November.

The other entrant in the ½-inch tape-cartridge market is a joint effort by DEI and Tandberg. DEI will manufacture the cartridge, and both companies will develop the drive, which is scheduled for high-quantity shipments by year-end. Company officials will not

<table>
<thead>
<tr>
<th>Company Model</th>
<th>Media package</th>
<th>No. of Tracks</th>
<th>Recording format</th>
<th>Unformatted capacity (8 bits)</th>
<th>Drive interface</th>
<th>Price ($)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Electronics Inc. / Tandberg Data Inc.</td>
<td>1 x 4- x 6-in. dual-reel 3M-type (¼-in.) cartridge</td>
<td>18</td>
<td></td>
<td>100</td>
<td>QIC-02</td>
<td>N/A</td>
<td>drive and media in development stage; specifications not final; deliveries scheduled for year-end.</td>
</tr>
<tr>
<td>Digital Equipment Corp.</td>
<td>1 x 4.15- x 4.15-inch single-reel cartridge (manufactured by 3M Co.)</td>
<td>22</td>
<td>MFM</td>
<td>20-200</td>
<td>N/A</td>
<td>N/A</td>
<td>drive in development stage; specifications not final</td>
</tr>
<tr>
<td>Electronic Processors Inc.</td>
<td>1 x 4.1- x 4.2-inch single-reel cartridge (manufactured by Memorex)</td>
<td>12,000</td>
<td>MFM</td>
<td>130</td>
<td>ESDI</td>
<td>$1,500 (single unit) &lt; $1,000 (OEM quantities)</td>
<td>3.25 x 5.75 x 8 in.; prototypes are scheduled for May/June; production volumes for July/August</td>
</tr>
<tr>
<td>MegaTape Corp.</td>
<td>1 x 4.1- x 4.2-inch single-reel cartridge (manufactured by Memorex)</td>
<td>500</td>
<td>GCR</td>
<td>Pertec/Cipher</td>
<td>$3,200–$4,000 (Q100)</td>
<td>MT-300/1210 is 8.75 x 19 x 17.5 in.; MT-1200 is 10.2 x 6.4 x 24 in.; MT-2210/2220 is scheduled for Q3 shipping</td>
<td></td>
</tr>
<tr>
<td>Memorex Corp.</td>
<td>1 x 4.1- x 4.2-inch single-reel cartridge</td>
<td>12,000</td>
<td>MFM</td>
<td>130</td>
<td>ESDI</td>
<td>N/A</td>
<td>3.25 x 5.75 x 8 in.; year-end scheduled delivery date; drive manufactured under license with Electronic Processors Inc.</td>
</tr>
<tr>
<td>Rosscomp Corp.</td>
<td>1 x 4.1- x 4.2-inch single-reel cartridge</td>
<td>4-in. diameter, 1-in. thick single reel</td>
<td>GCR</td>
<td>40, 80, 160</td>
<td>BSTI, QIC-02, SCSI, Pertec 9-track</td>
<td>$1,385–$1,895 (Q100)</td>
<td>Series 50 is 3.25 x 5.75 x 6 in.; Series 80 is 4.62 x 8.55 x 11 in.</td>
</tr>
<tr>
<td>Tandon Corp.</td>
<td>1 x 3.5- x 3.5-inch single-reel cartridge</td>
<td>6400</td>
<td>MFM</td>
<td>50</td>
<td>5 ½-in floppy standard or 5 ¼-in. Winchester standard</td>
<td>&lt; $500 in large-volume OEM quantities</td>
<td>3.38 x 5.88 x 8 in.; drive is in evaluation stage</td>
</tr>
</tbody>
</table>

*The MT-300/1210/1220 use 1000-foot tape. The MT-1220 is compatible with the CDC 9715 FSD drive. The MT-2210/2220 accepts 1000- or 1500-foot tape.
The CONCEPT AVT+
In a word: capability.

THE CONCEPT AVT+ DISPLAY TERMINAL

ANSI standard conformance, DEC software compatibility, eight pages of memory, 80/132 columns, windowing, multiple computer connections...and a full range of practical ergonomic features. Capabilities which enable all terminal users to maximize their productivity and explore their creativity. Only from Human Designed Systems.

Introducing the new concept AVT+ display terminal from Human Designed Systems. Simply the smartest interactive display terminal available today. And at a very competitive price.

It starts with ANSI standard (X3.64-1979) conformance and DEC software compatibility, and incorporates superior human design features, advanced functionality and highest quality construction. A commitment to quality that is reflected in each of the individual components.

The concept AVT+ keyboard is ergonomically designed for optimum operator comfort, incorporating a VT100-style numeric pad for DEC software compatibility. And it builds on those human design features with a range of capabilities that make the concept AVT+ an ideal choice for smart terminal users.

The concept AVT+ offers up to eight pages of display memory that eliminates unnecessary hardcopy printouts and provides a powerful tool for applications requiring multiple formats and storage of large volumes of text, non-volatile memory that enables users to permanently configure a terminal for their needs or applications, windowing that allows users to create individual displays within display memory, programmable function keys which transmit data and/or execute terminal commands, up to three additional communications ports for connection to other peripherals and computers; flexible user networking and functionality for use in a wide range of different applications, including multiple computer connections, and much more.

The new concept AVT+. More to offer at its price for terminal users than any other terminal available today.

human designed systems, inc.
3440 Market Street, Philadelphia, PA 19104
215-382-5000

$1295*

*quantity one DEC and VT are trademarks of Digital Equipment Corporation

0215-391-9763; Boston - (617) 469-6446; Chicago — (312) 625-2660; Dallas — (214) 437-1888; Delaware — Infocon, (302) 239-2942; Denver — (303) 669-1953; Howlett — Iciri Associates, (808) 361-3360; Houston — (713) 952-1403; Los Angeles — (213) 419-4674; Northern New Jersey — Infocon, (201) 644-1372; New York City Area — Infocon; (212) 689-8833; New York State — Naro Electronics, Rochester; (716) 223-4406; Syracuse; (315) 699-3661; San Francisco — (415) 692-4184; Washington, DC — International Systems Marketing (301) 270-5775, Alexandria — Infocon, (301) 270-5775; Argentina — Computer Gravity Ltd. (02) 241-3385; Belgium — TELECOMP: 091-31-52-22; Canada — CANSystems Toronto (416) 362-1000; Denmark — ADCOM DACS APS 1-1944-66, Finland — Fujitsu: 0 413/4; France — WATSON (1) 226-06-99; Japan — Mitsubishi g3 (346) 9595, Singapore — DTS Singapore (65) 334-854, Switzerland — Miele SA (41) 461-23-23; United Kingdom — Shandell Systems Ltd. 02407-307; Venezuela — H. Rodolfo SA 2 541.21.22; West Germany — COMEO Computertechnologie GmbH: 0224-48-30-51. DISTRIBUTORSHIP INQUIRIES INVITED.

CIRCLE NO. 25 ON INQUIRY CARD
release specifications of the drive, but the cartridge is a dual-reel unit similar to the ¼-inch 3M cartridges. The DEI/Tandberg drive accepts ¼- and ½-inch tape.

With the DEC announcement, says Freeman Associates' Collier, buyers will begin to perceive a critical mass forming in the market for ½-inch tape cartridges. Although MegaTape and Rosscomp are shipping to OEMs, many value-added resellers are waiting for a de facto standard or at least assurance that a drive will have a sufficient number of second sources for an adequate supply.

The biggest unknown in the ½-inch tape market, however, is IBM Corp.'s long-awaited "Octilillo" drive, which some analysts expect this year. The DEC announcement "may draw IBM out of the 'no-comment' mode," says MegaTape's Webb.

Ashton-Tate announces Framework, enters integrated software market war

Marjorie Stenzler-Centonze
Associate Editor

Ashton-Tate, Culver City, Calif., recently unveiled Framework, a unified software product that the company claims adds new dimension to the burgeoning integrated software market.

Framework consists of a data structure, or "frame," which resembles windows on a screen. The product includes word processing, spreadsheet, data management, graphics and an embedded procedural language plus an external frame mode, which gives users the ability to access and operate PC-DOS application programs within Framework. In addition, Framework offers an outline mode that enables frame-by-frame organization of ideas and documents in a numbered outline form.

"Framework is quite different from other integrated products," states David Cole, president of Ashton-Tate. "Virtually every process in the product is accessible to all other processes and even to outside products because it's engineered around a database as the nucleus."

Entire program in memory

Martin Mazner, product manager at the company, says Framework offers software developers a spreadsheet and word processor that gives standalone programs a run for their money. He also points out that the whole program is memory-resident, "which makes it incredibly quick." Mazner claims Framework enables the user to move from one area on a spreadsheet to another, repainting the screen faster than Lotus Development Corp.'s 1-2-3 integrated software program.

Telecommunications is now offered through a windowing function. The company is readying communications functions integrated at the base level, Mazner says. Ashton-Tate will offer that function as an upgrade to current users in the months to come.

Framework should hit retail shelves in July and is expected to be priced at $600 to $700, Mazner says. The program runs on the IBM PC and PC-compatible microcomputers and requires 256K bytes of memory and a single disk drive.
Now DTC offers a full family of advanced controllers—the DTC-500C Series—that perfectly match most popular Winchester, floppy and streaming tape drives to today’s most popular microcomputers.

These controllers are based on DTC’s new VLSI NMOS chip set, with bit slice speed, a data separator that functions up to 10 MHz, ECC and other features that provide high drive through-put and fast interface turnaround. Comdex Spring May 22 to 25, Atlanta Booth No. 3854.

Working closely with drive and computer manufacturers, DTC has developed a new generation of controllers. For years, major OEMs have relied on us for the best in controller technology. Once again, DTC comes through with high performance, high reliability and reasonable cost.

Ask DTC now for more information on the new DTC-500 Series of controllers and host adapters.

CIRCLE NO. 26 ON INQUIRY CARD

Helping You Manage Information
DATA TECHNOLOGY CORPORATION
2775 Northwestern Parkway
Santa Clara, California 95051
Telephone: (408) 496-0434
TWX: 910-338-2044
Eastern Regional Sales
15 Wiggins Avenue
Bedford, Massachusetts 01730
Telephone: (617) 275-4044
Take it along for the drive.

The floppy disc drive, that is. There's a world of floppy drives out there. All begging for quick, thorough testing.

They're in the field. On the QA test bench. And even back in engineering.

Wherever they are, our new programmable Performance and Alignment Tester, PAT-2+, is ready to run them through their paces.

In conjunction with our Digital Diagnostic Diskette, the PAT-2+ performs over 30 vital drive tests. Things like head radial alignment, head positioning linearity, head azimuth alignment, diskette centering, index timing, read/write data handling tests. And it can function as an exerciser.

You can even program and memorize (in non-volatile memory) data rates and drive parameters. So you can meet the challenge of the new high density drives.

The PAT-2+ tests virtually any standard interface 5 1/4", 8" or microfloppy drive. And adaptors will be available soon for non-standard interface drives.

All this comes in an inexpensive, accurate instrument you can hold in the palm of your hand.

An easy-to-use instrument that plugs right into the drive interface. And, in most cases, eliminates major disassembly of the computer under test.

Just the kind of innovative instrument you'd expect from Dysan. The leader in quality media and diagnostic tools.

The PAT-2+.

Next time you go for a drive test, take one along.

For more information or to place an order, call toll free (800) 551-9000.

Dysan Corporation, 5201 Patrick Henry Drive, Santa Clara, CA 95050, (408) 988-3472.

Dysan is a registered trademark. Digital Diagnostic Diskette and PAT-2+ are trademarks of Dysan Corporation. Copyright 1984, Dysan Corporation.
Ashton-Tate unveils multiuser dBASE II

Ashton-Tate, Culver City, Calif., will begin shipping a multiuser version of its dBASE II relational database-management system this month. The system, which enables users to share information files, features lockout capability to prevent more than one user at a time from accessing and updating a file.

"Current network technology allows microcomputers to share data, but, as we tie these computers together, there needs to be traffic direction to avoid a collision of users trying to change the same record," says David Cole, president and chief executive officer of Ashton-Tate. The multiuser dBASE II enables a user to lock onto a record or file, modify the database and unlock and release the record. Locking is not required to read data.

Framework's English-like procedural language and a special DOS window place the product a step up from other multifunction products, Mazner points out. The window enables a user to create a frame, enter the frame, invoke a command to operate PC-DOS within that frame and then run other programs within the program, Mazner explains. Framework will run under Microsoft Corp.'s Windows, he notes.

Ashton-Tate expects the outlining feature to be a major draw. "It gives users the ability to throw down thoughts and concepts and then flesh them out and organize them at will," Mazner says. As users reposition frames, all other frames are renumbered to follow the sequence adjustments.

The company is mounting a major marketing and support program to launch Framework in the computer retail market, says company president Cole.

Ashton-Tate will offer a starter kit that allows four users to access a network or multiuser environment. Prices for the kit start at less than $1,000. Four-user upgrades start at less than $500.

Ashton-Tate supports 3Com Corp.'s EtherSeries network and a TurboDOS environment. Cole says the company will adapt the product to some new players in the local-area network market. Plans call for the support of Corvus Systems Inc.'s Omninet, Novell Inc.'s Netware and Orchid Technology's PCNet. The company has announced support of Apple Computer Inc.'s Macintosh microcomputer, but the date for availability of that support has not been set. Multiuser dBASE II will be available for the Apple Lisa II during the fourth quarter of this year.

Ashton-Tate's strategy is to offer first-time business computer users all the primary software when the computer leaves the store. "The idea is to give users all the core software in a single package with an easy set of commands," Mazner comments, "and then make it open for people to develop specialized applications written in our command language."

Ashton-Tate will not initially push Framework as an OEM product, but company officials say the product's success in the retail arena is likely to make it attractive as an OEM product later.

JAPANESE WANT TO PATENT SOFTWARE

The Japanese Ministry of International Trade and Industry (MITI) has proposed eliminating the copyright protection for all software, including application- and operating-system programs, sold in Japan. Japan instead proposes to protect software under a patent-type scheme with a 15-year protection term. The current protection term runs for the author's lifetime plus 50 years. The MITI proposal would empower the Japanese government to designate licensees of software without compensation to the companies that own the programs. The Computer and Business Equipment Manufacturers Association (CBEMA) reacted strongly to the proposal by saying its members would re-evaluate their business plans in Japan if the proposal were adopted. CBEMA has urged that Congress consider reciprocal measures. Japan should act on the MITI proposal during the Japanese Diet by the close of the current legislative session on May 23.
Expanded IBM 9000 system targets multiuser business applications

Lori Valigra, Senior Editor

The tip of IBM Corp.'s multiuser business system solution appeared recently in the form of a System 9000 engineering/scientific workstation extended to support business professionals. It precedes an expected announcement from IBM's Entry Systems division, which handles the Personal Computer, of yet another multiuser system this year.

The new 9002 desktop system, which IBM claims has the power of a minicomputer, is based on an 8-MHz Motorola Inc. MC68000 processor and runs Microsoft Corp.'s XENIX version of American Telephone & Telegraph Co.'s UNIX Version 7 operating system, as well as supporting the standard IBM-proprietary CSOS real-time, multitasking operating system resident in RAM.

But the 9002 gives no answer to those awaiting IBM's corporate strategy for UNIX. The forthcoming Entry Systems product is rumored to be based on the Intel Corp. 80286 and run an unspecified version of UNIX. IBM had previously announced Interactive Systems Corp.'s version of UNIX for the PC, which IBM calls the Personal Computer Interactive Executive (PC-IX).

Another question to be asked by manufacturers of multiuser systems is which of the IBM multiuser machines will set the industry standard to propel the multiuser market. Uncertainty about software standards and competition from personal computers have kept the shipment growth of $12,000 to $25,000 microcomputers to a minimum, according to information released at InfoCorp's Strategic Issues Conference. Shipments of units in that range increased 16 percent from 1982 to 1983, which represents an increase of 18,000 units, according to InfoCorp numbers. IBM's price for the multiuser 9002 falls in the low end of the range.

Desktop 9002 is smaller

In the 9002, IBM presents a desktop system 28 percent smaller than the earlier 9001 engineering/scientific model. Measuring 16 by 18 by 6.7 inches, the 9002 can be used by one professional, or, with the optional XENIX operating system, as a host supporting three additional users through attached terminals, such as an IBM 3101 display terminal. Each user can run several tasks. As many as four 10M-byte hard disk drives, four 5½-inch or 8-inch floppy disk drives and an IBM 5182 color printer can be attached to the disk-less unit.

Included is the 9002's 12-inch raster display, which has a 768-by-480 pixel bit-mapped screen. The display shows 30 rows of 80-character lines, is green phosphor, has 10 user-definable keys beneath the screen, has a tilt-and-swapel adjustment and can be configured with an optional built-in diskette drive.

The 83-key keyboard includes the full ASCII character set, a numeric keypad, cursor control, print control and 10 programmable function keys. Also resident on the detached keyboard is a 57-key keypad arranged in three rows for data entry. The keypad and keyboard are separate on the 9001.

Included are 128K bytes of RAM, expandable to 5.2M bytes in 256K-byte increments, and 128K bytes of ROM.
You know about the advantages of a Micro/II computer system. What you may not know is that it's available now. Our MDB Micro/II is functionally equivalent to the DEC Micro/PDP-II* providing an 11/23 Plus, 256KB RAM, 10.4 MB Winchester and 1 MB Dual Floppy sub-system. But there’s more.

This low-cost, compact and highly flexible work station provides the exclusive feature of being software driver and media compatible to the RX02. This unique capability allows diskette transfer to and from other DEC systems. Also, unlike the DEC unit, our Winchester is RL02 software compatible. Even optional 20 MB RL02 or RP02 emulating Winchester are available to enhance your system.

When it comes to interface modules, however, the MDB Micro/II has lots of company. The system, with its 8 quad slot (16 dual slot), Q-22 backplane and its rear distribution panel, accommodates all of MDB’s unequalled repertoire of FCC compliant Q-bus controllers and interfaces. They include multiplexors, line printer controllers, disk and tape controllers, high speed DMA modules and interprocessor links.

As for price, we won’t hold you up there either. Single units cost only $7,800 and substantial discounts are available for quantity purchases.

So why wait? It’s all available now. Start by contacting us today. You won’t be alone.

*Trademark of Digital Equipment Corporation.
The American Dream is still alive.

A belief in excellence

Remember what it was like? Sunday morning. You're still not quite awake, but already you've got fifty pounds of paper on your back. It's raining. And old Mrs. Henriksen's paper just skidded off her porch into the thorn bushes.

Now what do you do? Leave it there and go on? Of course not. For you, there's no choice. You go find it and put it where it belongs.

That spirit—the spirit of doing things right no matter what it takes—isn't dead. Not at ATASI. We not only talk quality. We deliver it.

Example: Every one of our 5¼-inch Winchester disk drives is tested 22 different ways before it goes out of the door, including an extended burn-in at 120°F.

Example: Our platters all have dedicated landing zones, so that they preserve your customer's data even in the event of an emergency power-down.

Example: The acceptable ambient temperature range for our drives is up to 33% greater than the acceptable range for our competitors.

We could go on and on. But we'd rather prove our point with a demonstration.

For more information, call or write ATASI, 2075 Zanker Road, San Jose, CA 95131, (408) 995-0335.
Introducing the TI 855 microprinter. No other printer says better so many ways.

Feature for feature, no other microprinter can match the versatility, compatibility, reliability and productivity of the OMNI 800* Model 855 microprinter. Here's why.

**Two Printers In One.** With the TI 855 you get the speed of dot matrix draft copy. Plus the precise clarity of the most advanced matrix technology for letter-quality print. It's two printers in one — at one low price.

**A Great Family Name.** Texas Instruments is known for providing the world with the industry standard for printers — the TI 810. TI builds the same reliability into every 800 series microprinter. Both the 855 and the data processing Model 850 are part of the expanding TI line of high-performance, low-cost microprinters.

**Hardware Compatible.** The TI 855 microprinter is compatible with all major PC hardware. And it provides both serial RS232C subset and "Centronics-type" parallel as standard interfaces.

**Software Compatible.** The TI 855 uses industry standard escape sequences for compatibility with virtually all third-party software. And for those with proprietary software needs, a model is available with ANSI standard escape sequences.

**Tough Font Modules For Quick Character Change.** Three font modules can be inserted into the front of the printer at one time, and are accessed individually. Each contains both draft- and letter-quality character sets. They're easier to use, more reliable and more durable than traditional metal or plastic daisy wheels.

**More Productivity Than Any Other Microprinter.** The 855 offers both friction and tractor paper feed, to handle all types of word and data processing applications. A quick-change snap-in cartridge ribbon. Raster and mosaic graphics. And intelligent printing which maximizes document throughput — regardless of format.

Get the printer that makes for better information systems. For more information visit your nearest TI authorized dealer or write Texas Instruments Incorporated, P.O. Box 402430, Dept. DPF-00000, Dallas, TX 75240. Or call toll-free: 1-800-527-3500.

---

Copyright © 1983 Texas Instruments * Trademark of Texas Instruments
**MINI-MICRO SYSTEMS/May 1984**

**NEWS**

**Mini-Micro World**

**XENIX will be sold by VARs**

XENIX is scheduled for availability in the second quarter of this year. Though the 9002 will be marketed by IBM Instruments Inc., Danbury, Conn., which released the 9000, IBM's National Accounts and National Marketing divisions, selected IBM National Distribution division value-added remarketers (VARs) and authorized distributors, XENIX initially will only be available from IBM Instruments. IBM expects the other sales groups to sign on for XENIX. The one-time license charge for XENIX is $995.

As many as four users can be supported simultaneously on XENIX. XENIX has memory-management and file-protection facilities, is multitasking and includes a full C compiler for developing structured application and system programs. An assembler and linker also are available. Optional support is for FORTRAN, Pascal and RM/COBOL. IBM advises those wishing to ship XENIX outside of the United States that they will require a government license to do so.

The RAM-resident CSOS operating system supports system calls and maintains file systems designed as hierarchical directories. It uses the same calls on all files and devices with which it communicates. CSOS uses software interrupts and inter-process message buffers to link small general-purpose processes, thus eliminating the need for a large special-purpose program. With its command-language interpreter, users can execute programs in the foreground or background. The command language interpreter also allows batch control files and easily redirects and chains an input/output program. IBM provides a CSAR file utility in XENIX so files can be transferred to and from CSOS.

With a system unit, display, keyboard and standard operating system, the 9002 sells for $6,495. A 256K-byte memory card is priced at $1,395. A complete system with XENIX starts at $15,960, including the required 10M-byte hard disk, diskette drive, more memory and a memory-management card. FORTRAN and Pascal each carry a $595 one-time license fee. RM/COBOL's license fee is $1,250. List price of the 5182 color printer is $1,995. IBM will give discounts for volume purchasers of both the hardware and software. The 9002 also is scheduled for second-quarter availability.

The 9001, priced at $5,695, includes a display, but no diskette drives or keyboard. The keyboard is priced at $270, and an expansion card sells for $95. A $2,095 integral printer/plotter provides hard-copy output. Memory expansion to 5.2M bytes is the same as the 9002's, as are the attachable floppy and hard disk drive options. The 9001 measures 22.3 by 18 by 6.7 inches.

---

**MegaTape boosts capacity to 500M bytes per cartridge**

**Ron Shinn, Senior Editor**

The new 500M-byte, ½-inch MT-2000 series tape-cartridge drive from MegaTape Corp., Duarte, Calif., keeps pace with increasing capacities of 14-inch Winchester disk drives by attempting to provide a one-cartridge-per-disk-drive storage overlap. MegaTape claims that is the ultimate in Winchester backup and user convenience. The concept has led the company from a 200M-byte drive, delivered in 1980, to a 300M-byte design—the MT-300 and MT-1000 series—introduced and shipped in 1983, and to the current 500M-byte drive.

The capacities of MegaTape's tape cartridges have lagged behind those of the new Winchester disks they are intended to back up by about two and a half years. As the company is introducing the 500M-byte MT-2000, for example, makers of 14-inch disk drives are regularly announcing 600M-byte capacity drives. Gary Webb, MegaTape vice president of marketing, says that 600M-byte versions of the cartridge will be available this year. The 600M-byte versions will be compatible with the 500M-byte MT-2000.

To add capacity to its basic 300M-byte design, MegaTape uses 1,500 feet of higher-coercivity, thinner tape in the MT-2000. That compares with the 1,000 feet of tape used in the MT-300 and MT-1000 series cartridges. MegaTape has also changed the cartridge's read/write electronics to match the higher coercivity. The 300M- and 500M-byte cartridges will operate in the new MT-2000 series, but the MT-300 and MT-1000 series will still include only 300M-byte cartridges.

Ampex Corp. makes the tape for the MegaTape cartridge, and at least two other second sources will join Ampex to produce the new, thinner media, according to Webb. Single-unit price of the 300M-byte cartridges is $120, and 100-unit price is $85 each. Webb points out that a single 300M-byte MegaTape cartridge holds as much data as eight 10½-inch reel-to-reel tapes.
Mini-Micro World

News

MegaTape’s MT-2000 series tape-cartridge drives add capacity by using 1,500 feet of high-coercivity, thin tape. The model MT-2210 (pictured) stores 500M bytes in a book-sized cartridge.

recording at 1,600 bits per inch (bpi). Based on media alone, the cartridges—at about $15 each—are about equal in price to reel-to-reel tapes. The MT-2000 cartridges will be priced about 20 percent more than the 300M-byte cartridges and will contain 40 percent more tape to reduce per-bit storage costs.

The MT-2000 cartridge drive can accommodate capacity increases of as much as 1G byte without incorporating new technology, says Webb. As a result, the cartridges will be upwardly compatible, meaning that all MegaTape cartridges will operate in all future transports. Webb says a 1G-byte drive will be ready for shipment in 1986.

“There are three parameters that you can press for higher capacity—track density, recording density or tape width. Our track density is 44 tracks per inch (tpi), which is equal to the lowest-performance floppy disk. To get 1G byte, all we really have to do is go to 96 tpi, and this can be done,” Webb says. He says that, if MegaTape cannot achieve at least a two-to-one increase through increasing track density, it will try increasing recording density, which is 9,600 bpi. “We know that recording technology experiments are pushing 50,000 bpi in laboratories,” Webb says. But he says the company will probably not use the third option—increased tape width—to increase capacity because it would prevent upward compatibility of the cartridges.

Webb says that a second sourcing agreement for the drives should be finalized by mid-year. “This is part and parcel of our business plan,” says Webb. He believes that, if the company acquires a second source for the drives, it will be the only maker of ½-inch drives with a high-capacity second source.

MegaTape’s goal for 1983 was to ship 200 machines, and Webb says the number of shipments approached that goal even though the company didn’t begin shipments until the last quarter of the year. The company has aggressive plans for 1984—shipments of 3,000 to 4,000 units. “We’re now at a rate of about 100 machines a month, and our backlog is around 1,000 machines,” Webb says.

The company is also looking at other possibilities such as smaller versions of its current drive that would be compatible with 8- and 5¼-inch Winchesters. “But right now,” says Webb, “we have a full business plan with higher-capacity drives. We will introduce two additional capabilities for all of our machines in the future—cache memory and more diagnostics. The cache memory will allow the drives to operate in systems that have not perfected streaming software, and enhanced diagnostics will tell the user which module and in some cases which component has malfunctioned.”

The MegaTape drives operate at 200 or 50 inches per second (ips) in streaming mode and 50 ips in start/stop mode. The recording density is 9,600 bpi, and the tape has 24 tracks across its ½-inch width. A two-track head that supports the tracks is stepped 12 times to cover all tracks. Packaging is for standard 19-inch-wide rack mounting or desktop use, and both the MT-1000 and MT-2000 series are available as full- or half-width models. The half-width version is made by turning the full-width model on its side. It was developed for use with the Control Data Corp. 9715 disk drive. The MT-300 is available only in a full-width version.

Prices for the MegaTape drives in single-unit quantities are $4,700 for the MT-300 (300M bytes, full-width, no intelligence), $5,500 for the MT-2210 (500M bytes, full-width, intelligence), $4,950 for the MT-1220 (300M bytes half-width, intelligence), and $5,750 for the MT-2220 (500M bytes, half-width, intelligence).
Our giant commitment to OEMs

BOARDS TO SYSTEMS.
YOU NAME IT.

CIE Systems is committed to being your source for the very latest in micros and all that goes with them. The micros are the CIES 680™ Business Computers with the advanced 32/16-bit 68000 microprocessor and Intel's Multibus™ architecture. So from boards to systems, you can easily configure your product line for virtually any business.

There are four 680 models. The 680/30 (shown above), 680/20 (on the right), 680/35 and the 680/40.

The 680/30 and 680/35 will accommodate up to eight interactive users. The 680/20 expands to four users. And the 680/40 expands to as many as 20 users.

Disk capacities range from 10 to 300 Mbytes, memory from 256K to one Mbyte.

Operating systems include REGULUS™ (UNIX™ compatible) and RM/COS™.

Language processors include BASIC, FORTRAN, COBOL and PASCAL.

Applications offered are general accounting, financial worksheet and word processing, as well as a wide range of vertical applications.

And you can include PRO-IV™ the applications processor that allows you to develop applications in one-tenth the time or modify applications in one-hundredth the time it normally takes.

Boards up to complete CIES 680 systems. Our name or your name on them. That's an ongoing commitment to OEMs from CIE Systems, the company backed by the third largest trading company in the world with well over $50 billion in sales.


CIRCLE NO. 29 ON INQUIRY CARD
HEARD ON THE HILL

Check customs before traveling with your computer

Stephen J. Shaw
Washington Editor

Computer manufacturers and system integrators planning to export their products or simply wanting to take their portable computer along on their next trip abroad should check first with the U.S. Customs Service. The equipment could end up with the hundreds of other computers, components and peripheral devices that customs officials have seized during the past several years.

In cooperation with the Department of Commerce, the Customs Service runs "Project Exodus," a two-year-old program intended to staunch the flow of critical U.S. technology to the Soviet Union and its allies. Customs inspectors conduct ongoing investigations into suspected cases of computer smuggling, like the one that netted parts of a Digital Equipment Corp. VAX-11/782 minicomputer in Sweden and West Germany that were en route to Eastern Europe.

Based on tips and experience with certain airlines and destinations, customs authorities target specific outbound flights for inspections of cargo and personal checked and carry-on baggage.

From Oct. 1, 1982, through March 15, 1984, Project Exodus racked up 721 seizures of computers and parts, including peripherals, valued at approximately $18 million. Approximately one-third of all seizures recorded by the Exodus program since it was started in early 1982 have involved computer-related equipment. The remainder was equipment seized for violations of arms-control statutes, such as components for advanced weapons systems, and for violations against other provisions of the Export Administration Act. Customs officials were unable to determine how many of the seizures by the Exodus program involved equipment with embedded microprocessors but suggested that the percentage was high. "Not much is high-tech unless it does have a computer in it. We don't record it as such, though," comments a customs official. The growing popularity and advanced sophistication of transportable and portable microcomputers have put customs officials into a quandary. They must decide whether briefcase-sized microcomputers that incorporate bubble-memory systems, 256K-bit RAMs and flat-screen video monitor devices should be considered "critical technology." If such devices are critical technology, they are subject to stringent export controls when a businessman takes them on a trip abroad. But microcomputers are showing up on international flights in such large numbers that enforcement of export regulations may be futile.

Microcomputer technology is advancing far more swiftly than customs guidelines for seizure and detention. Since the Commerce Department, which is charged with interpreting the Export Administration Act, decides all seizure and detention incidents on a case-by-case basis, guidelines for what constitutes "critical technology" for computers are vague. "I wish I could tell my inspectors that, for instance, 64K bytes is a cutoff point, but I can't since every [seizure and detention] case stands on its own merits, according to Commerce," says a customs source.

Computer users and trade associations have complained that vigilant customs inspectors have seized microcomputers carried onto or checked as personal baggage on international flights. Such complaints prompted William von Raab, commissioner of the Customs Service, to meet with members of several electronic industry associations in February to iron out the problem. "Our priority is not to go out and dump planes to look for microcomputers," von Raab told the associations.

Following the meeting, the Customs Service announced guidelines that have resulted in a reduced number of portable personal computer seizures, according to a Customs Service spokeswoman. The guidelines state that travelers may take their personal computers and related equipment out of the United States as long as the traveler owns the computer, does not intend to sell the computer abroad and does not plan to go to a country for which an export license is required (the Soviet Union, China, Eastern Europe, Cuba, Iran, Libya, Vietnam, Laos and Kampuchea).

If a traveler's employer owns the computer or if the traveler plans to use it for "commercial" purposes—as a sample or display, for instance—Customs could seize the machine. Financial penalties range to as much as 10 percent of the computer's value, and it could take a user as long as six months to recover the lost equipment. Customs officials advise travelers who want to avoid seizure to complete a Shipper's Export Declaration form and submit it to the customs office at the airport before departure even if the traveler intends to return to the U.S. with the computer.

Since these guidelines are subject to various interpretations as applied to specific cases, travelers should check with their local customs office to avoid problems. Otherwise, their expensive computer equipment could be left standing at the gate as the plane takes off.
Waiting gets you nowhere. Waiting wastes time. It wastes money.

- To save both, Tally presents the MT400 FlexiForm printers. And to help you boost efficiency, these high volume, high speed serial printers have productivity features you won’t find anywhere else.
- For about half the cost of a line printer, a Tally FlexiForm will whip through paper work at up to 300 LPM.
- You’ll produce draft copy at a consistent 400 CPS. Your correspondence will have a high resolution, professional look. From inventory reports and spreadsheets to business graphics and bar codes, nothing in their class is engineered to perform like FlexiForms.

- For speed and ease of programming, direct menu access lets you arrange page and print formats with just a few front panel commands. And there’s always the ideal paper handling choice for the work you do. Because FlexiForm printers can have tractors that push and pull, friction feed, a quick-tear bar, automatic feeders for single sheets and more.
- Waiting for important information is the last thing you want. So wait no more. Call Mannesmann Tally today for information on the world’s best engineered serial printers: (206) 251-5524.

MANNESMANN
TALLY
An open-and-shut case for making MiniFrame your first choice in low-cost OEM systems.

**IMPRESSIONS CPU SPEED.** Running the AIM™ Benchmark, MiniFrame is as fast as a VAX-11/750. The MiniFrame's MC68010 microprocessor operates at 10MHz, with no wait states.

**VIRTUAL MEMORY MANAGEMENT.** MiniFrame's custom MMU provides unique demand-paged implementation of UNIX™ System V... with 3.5 Mbytes of address space per process.

**RUNS AS MANY AS 8 TERMINALS.** Convergent PT and/or GT, or standard ASCII. Multidrop RS-422 communications line operates at 307 Kbit/sec.

**COMMUNICATIONS EXPANSION.** LAN capability via optional high-speed Ethernet interface module, and/or 8 additional RS-232 ports.

**ECONOMICAL MEMORY EXPANSION.** MiniFrame provides 1/2 Megabyte of RAM standard; up to three boards can be added for system expansion to 2 Mb.

**ONE TO EIGHT USERS.** MiniFrame can be configured for up to 50 Megabytes of integral mass storage: 5½ Winchester fixed disks of 13, 26 or 50 Mb.

Copyright, 1984, Convergent Technologies, Inc.
MiniFrame: another first from Convergent Technologies. Super-minicomputer power at PC prices.

OEMs can now meet the needs of small to medium-sized organizations for low-cost, high-performance systems capable of handling large UNIX-based applications.

The MiniFrame system—which effectively opens a whole new market for you—is unique not just for its price/performance advantages. It also provides complete flexibility in meeting requirements ranging from single-user "personal UNIX systems" to eight-terminal data-processing installations.

Convergent Technologies achieved this breakthrough by adapting the innovative hardware and software developed for its MegaFrame multiprocessor.

The result is a powerful, compact and expandable unit priced to give you the maximum opportunity of capitalizing on a rapidly growing UNIX market.

There are, of course, many other unique benefits of the MiniFrame system.

Convergent provides foundation software for office applications—including a powerful, Wang keystroke-compatible word processor, an advanced financial spreadsheet and complete electronic mail facility.

The Window Manager permits viewing and manipulating of up to four applications running simultaneously on Convergent's PT or GT terminal screens.

Major performance increases result from utilizing these terminals with the MiniFrame. At only slightly higher cost than standard "dumb tubes", our PT or GT terminals offer high-speed communications plus built-in processor with enough memory to execute key portions of the system code.

Programming languages include industry-standard High Level COBOL and BASIC, full FORTRAN-77, Pascal and C.

OEM prices for the MiniFrame start at less than $5,000; an eight-user MiniFrame can be configured for under $10,000. Prices like these make it an open-and-shut case for choosing the MiniFrame.

Graceful upgrade path to the MegaFrame™

The MegaFrame, Convergent Technologies' revolutionary super-minicomputer system, utilizes multiple processors; has expansion potential to 128 users, 8 MIPS and gigabytes of disk storage. It enables OEMs to handle today's growing demand for computing services without discarding a single piece of hardware... or being forced into expensive CPU upgrades.

Applications software can be transported—unchanged—from the MiniFrame to the MegaFrame whenever the workload requires it. The two systems are object-code compatible, allowing OEMs to provide a complete family of systems.

MegaFrame: proof that if anyone can build a UNIX system the way it should be built—it's Convergent Technologies.
One of the best brand name printers has a brand new name.

At Genicom today, we offer the same complete line of printers we offered while a part of General Electric. We have the same facilities, the same nationwide service network, and the same corps of experienced employees...only the name has changed.

Above all, Genicom offers you the same reliable product quality you've come to expect from us over the years. Our Genicom 3000 printers feature outstanding performance for end-users as well as superior flexibility for many OEM’s, distributors, retailers and dealers. There are 3000 models with speeds from 40 to over 400 cps. Single or dual mode printing. Type quality from EDP to NLQ. Multi-color printing. Graphics. Selectable type fonts, American craftsmanship and more. There are even 3000 family printers for personal computers...ideal for business needs.

We're proud of the excellent brand reputation we established under General Electric. But now we're going to make a new name for ourselves by bringing you more innovations, and more of the reliable quality you've always found in each of our products.


For the solution to your printing needs call
TOLL FREE 1-800-437-7468
CIRCLE NO. 32 ON INQUIRY CARD
SMI introduces BASIC-to-C translator

Edward Foster, Associate Editor

SMI, a BASIC-to-C language translator from Software Manufacturers Inc., (SMI) Carson, Calif., provides a direct software migration path to UNIX for BASIC language programmers and users.

SMI is delivering three versions of S-Tran—for Microsoft BASIC, OASIS BASIC and for the IBM PC XT—according to Ernest J. Hutchins, president of SMI. “Our next announcement will be the Apple Lisa and Macintosh versions,” he says. “Beyond that, we expect to release C BASIC and SMC BASIC by the third quarter of this year.” The company also plans to support HP BASIC and DEC BASIC.

“We have produced multiple versions of S-Tran because no single software tool would be capable of translating all forms of BASIC due to its considerable variances,” Hutchins says. He adds that SMI started with OASIS BASIC because it offered the opportunity to enhance multiuser software with UNIX performance. “With S-Tran, converted OASIS BASIC applications can be used on UNIX-based machines in the 8- to 16-terminal category,” he claims, “compared with three to four terminals for the BASIC version.”

Although SMI describes S-Tran as a translator, the product can be called a multipass compiler when linked with the C compiler that comes with most UNIX-based systems.

Menu selectors prompt S-Tran users as S-Tran performs syntax checking, formatting, translation and C source-code generation. S-Tran translates programs individually or in batches merged in a common data file.

When S-Tran completes a translation, it returns the user to the menu selector to link to the system’s C compiler. Other features of S-Tran’s menu include a data file-conversion program and communications routines to move software applications to the target system for translation.

SMI officials agree with many industry experts who predict that UNIX will become an industry standard operating system, but SMI officials also say there is a serious shortage of application software available for UNIX. According to James Getzinger, SMI’s vice president of marketing, “There are a lot of good applications within BASIC that can fill this void, and SMI plans to provide the migration path.”

With its marketing strategy oriented toward directly or indirectly providing UNIX applications, SMI is also offering an accounting software package, Spectrum, which S-Tran converted from BASIC. With two product lines—one for end use and one for development—SMI will market UNIX-based applications to computer manufacturers and distributors, as well as tap potential new sales channels through software companies that can adapt their proprietary packages using S-Tran. “The entire concept of UNIX is portability, thus avoiding hardware dependence,” asserts Getzinger. “Until now, software companies have been restricted to selling their products only on the number of systems they could support.” With S-Tran, however, users can implement standard C source code on systems using a wide range of computer languages.

SMI chairman Russell C. Gerns, who led a group of investors in a recent venture-financing round for SMI, believes the company will be successful because “S-Tran has the capability to port software...a software developer must take a serious look at using it.”

DBMS MERGED WITH UNIX OA UTILITIES

Horizon Software Systems Inc., San Francisco, and Relational Database Systems (RDS) Inc., Palo Alto, Calif., have announced a cross-licensing agreement whereby they will offer RDS’s Personal Informix database-management software as a component of Horizon’s family of UNIX office-automation utilities. The Horizon package includes mail/merge, telephone logging, calendar management, sorting facilities, word processing and spreadsheet capabilities. The office-automation packages will create Informix database files, thus allowing direct access and manipulation by any RDS database-management programs or by commercial packages incorporating RDS’s C-indexed sequential access method. Price of the system has not been set.

COMPLEXX MAKES SOFTWARE FOR MACINTOSH

Complexx Systems Inc., Huntsville, Ala., is yet another company jumping into the Apple Computer Inc. Macintosh bushel of value-added vendors. According to a Complexx spokesman, the communications software that works with the company’s XLAN network and TRIMUX probably will be ported to the Macintosh windowing functions. The company claims this will maintain the high-level user interface Macintosh users expect.
Edward S. Foster, Associate Editor

An ion-deposition printer priced at less than $10,000 and printing 30 pages per minute (ppm) will be the result of a recently announced contract between Delphax Systems, Mississauga, Ontario, and giant Japanese trading concern C. Itoh, represented in the United States by Itoh Electronics Inc., Los Angeles.

Both companies will market the new printer, which will be demonstrated at trade shows this month.

The desktop-sized printer will offer a print resolution of 300 by 300 dots per inch (dpi). Delphax, the only provider of ion-deposition print engines, is supplying the technology for the device and will manufacture some components; C. Itoh will provide marketing and financial clout and will sign an agreement to help produce the device in high volumes.

The printer will provide a high level of price and performance, claims Mark Takeuchi, president of C. Itoh Electronics. By comparison, the page printer that industry observers believe to be the largest seller—Xerox Corp.'s 2700—is priced at $18,995 and offers 300-by-300-dpi resolution at a speed of 12 ppm. C. Itoh officials estimate that more than 10,000 units of the printer will be sold in 1985, and end-user value of the units will be $100 million.

**C. Itoh pursues low-volume**

Delphax president and chief executive officer Gary Sharpe says the new device, which he dubs "the Office Printer," will be targeted at low-volume, high-speed office applications. Delphax now offers a $60,000 60-ppm ion-deposition unit that is fundamentally different from the new printer, says Sharpe. "While our first printer had the imaging capabilities for graphics applications, such as forms generation and check printing, it was still primarily a line-printer replacement." Sharpe believes the new desktop version will be appropriate for office applications now performed by high-speed serial printers.

Sharpe says the critical trade-off for the new printer in undercutting the price of the previous unit was designing a lower duty cycle, particularly in regard to paper handling. "For a desktop device, you have to have a limited paper-stacking capability with the expen-
We just made IBM's PC/XT 20 times more powerful.

Introducing Dragon's New 65 Mb and 140 Mb Hard Disk Drives.

See us at Comdex/Spring, Atlanta, Booth #6031, May 22-25, and PC Expo, New York, Booth #3118, June 26-28.

What makes Dragon the best hard disk drive for the IBM PC, XT, and compatibles?

Larger Storage Capacity...
With 65 Mb of on-line storage, the SP-65 holds up to 57 Mb of formatted data. The SP-140 stores up to 121 Mb of formatted data with a total capacity of 140 Mb. No 5 1/4 inch Winchester stores more than these new Dragon Disks.

Faster Access Time...
At 30 msec. average access time, the SP-65 and SP-140 are faster than other 5 1/4 inch Winchester...3 to 4 times faster.

Better Features...
The SP-65 and SP-140 come with hard disk, controller, host adapter, power supply, cables, and chassis. Both systems are compatible with PC-DOS and MS-DOS.

More Options...
Additional options include: Dual drives with up to 280

$4995 Now available for immediate delivery.

$6995 Mb of on-line storage (or 260 Mb formatted). Streamer tape and random access back up. 90 day warranty. Responsive technical help.

For more information, contact Dragon Industries, 35 Main Street, Hopkinton, Mass., 01748, (600) 824-8006 or (617) 435-4183 in Massachusetts. Distributor and OEM inquiries invited.

Dragon Industries
Turning Micro Computers into Monster Computers.

Interested in: □ SP-65
□ SP-140

CIRCLE NO. 33 ON INQUIRY CARD
FOR OEMs, THE GREATEST STRENGTH OF OUR TOWER IS OUR TOWERING STRENGTH.

To build a successful system, OEMs need more than just a strong product. You need a strong product backed by a strong company.

A company like NCR.

NCR designed and manufactures Tower 1632 especially for OEMs. But that's only the first of many reasons why you should put your name on our famous shape.

NCR is a high volume, high speed, high reliability manufacturer. We're deeply committed to 16 and 32-bit VLSI technology. With truly significant R&D expenditures that only a multibillion-dollar, international corporation can sustain. And long-term dedication to the UNIX* market.

That means you can rely on getting all the product you need from us, when and where you need it. It means that you get quality control from a company that knows real quality and can afford to build it into every product. For example, our field engineers participate in the design of our products to ensure exceptionally cost-effective serviceability.

Our award-winning design engineers packed Tower's 7"-wide cabinet with up to 2MB of ECC memory, 7 controller slots, standard interfaces, power-fail recovery and 92MB of Winchester disk storage. Not to mention maximum software compatibility and flexibility.

But the real reason Tower is becoming the industry standard for multi-user, 16-bit and 32-bit UNIX-based systems is the strength of NCR.

Which proves that the shape you're in is determined by the company you keep.

*UNIX is a trademark of Bell Laboratories.

BUILT FOR SYSTEMS BUILDERS.
TOWER 1632.

NCR
OEM Systems Division

tion that the user can reload paper as needed,” he says. “Otherwise, you find yourself right back with a giant standalone unit that costs a great deal more.”

Delphax has improved technology over the previous printer by using 300-dpi resolution instead of 240 dpi and a 6-mm. rather than 8-mm. dot diameter.

**IBM compatibility possible**

Sharpe expects the Office Printer to be used for intermittent, on-demand office printing. For that reason, Delphax expects to offer optional configurations for the printer, such as an IBM PC-compatible processor within the electronics, to allow direct interfacing to standard office peripheral devices. “You could, for example, put a floppy or Winchester disk drive on it to spool up jobs from external sources,” he says. A user could then walk up to the printer and call up any document to be printed, much as he might an office copier.

Sharpe predicts that some users will interface a daisy-wheel printer to the ion-deposition device, using the high-speed printer for in-house and draft-quality printing and the slower daisy-wheel printer to reprint texts for letter-quality output. “Many users will find the print quality of the Office Printer perfectly acceptable for correspondence,” he notes, “but there are still going to be those who feel it looks too much like a copy to be sent out.”

Robert Cowan, vice president of marketing for C. Itoh Electronics, is more positive about the new printer’s acceptability as a letter-quality device. “At 300-dpi densities, it is going to be the high-quality office printing device,” he asserts. He also expects to see it used in data-processing applications as a line-printer replacement. “With this resolution, you can get the equivalent of two computer printout pages on one 8½-by-11-inch sheet of paper and still have it quite readable.” Even at standard type sizes, Cowan points out, the printer functions at a rate roughly equivalent to 2,000 lines per minute.

Cowan expects C. Itoh to demonstrate the printer with a PC-like controller, but C. Itoh will not make the final decision about control electronics and options until about the fourth quarter of this year.

Cowan and Sharpe say that the two companies have not determined how they will divide the marketing of the printer. However, Sharpe says that Delphax does not plan to sell to end users, and Cowan expects C. Itoh to market the printer through all possible distribution channels. Both companies expect the final end-user price of the unit to be in the $5,000 to $10,000 range, depending on options, with OEM quantity discounts available.

---

**U.S. trade representatives blast Japanese export policy**

Stephen J. Shaw
Washington Editor

“The Japanese market remains essentially closed,” the undersecretary of commerce for international trade Lionel H. Olmer told a group of computer and other high-technology industry executives in March at a forum on international trade issues. “Our trade efforts with Japan have been completely unsatisfactory over the last year.”

Olmer’s bleak assessment of the state of high-technology trade relations between the United States and Japan comes on the heels of recently released figures from the U.S. Department of Commerce. Those figures reveal a massive U.S. trade deficit in computer equipment with Japan that has increased almost 30-fold during the past two years. Commerce calculates that U.S. exports to Japan in 1982 of electronic computing equipment and parts, including bundled software, reached $790 million while comparable imports from Japan totaled $822.2 million. Alarming as the resulting deficit—$32.2 million—is, it is trifling compared with what was to come last year.

In 1983, says Commerce, U.S. exports of computers and related equipment increased a modest 7 percent over the previous year to $842.6 million. Imports from Japan, however, more than doubled to approximately $1.76 billion during the same period.
Now, a major advancement in Net/One local area networking. Lower cost.

Our new VLSI chip set has allowed us to do with one printed circuit board what we used to do in three. The result is a new Network Interface Unit, the NIU 150, that's half the cost of its predecessor, the NIU-1. In areas where a smaller number of either broadband or baseband connections are required, the pared-down NIU 150 brings per-port connection costs well below $500.

Streamlined NIU 150's mean more flexibility, too, by serving small equipment clusters in more diverse locations at a lower cost.

Like our other Network Interface Units, the new NIU 150 is equipped, off the shelf, to support most industry-standard equipment interfaces. And like our other NIU's it comes with complete network services software. It's also programmable, so special interface protocols can be added now or anytime in the future to support special equipment.

The broadband version of our new NIU 150 has an integral modem. Both baseband and broadband NIU 150's can accommodate up to six ports for device attachment.

Give us a call, or write for more information about turning the equipment you have now—whatever it is—into the network you need now, at a lower cost than was possible before.

Telephone (408) 496-0111.

Net/One from Ungermann-Bass
Not everyone is happy about it.
For instance, our new 286/310 multi-user, multi-tasking OEM supermicro is going to make guys who push minis awfully uncomfortable.

You see, it's based on our advanced iAPX 286 microprocessor, the most powerful 16-bit processor in the world. To which we've added our 80287 math coprocessor as a, shall we say, turbocharger?

That little bit of technological tinkering makes it a very fast supermicro. Faster than a VAX* 11/750. In fact, according to independent benchmarks, the 286/310 is the world's fastest Xenix* supermicro.

It doesn't do too badly in irMX* real-time OEM applications, either (3x the performance of any comparably-priced system.)

The kicker is the 310 costs less than $10,000. And that's list, quantity one. OEM quantities are so much less expensive it's embarrassing.

But before you start thinking about all the money you can make with the 310, let us tell you...
a little about how easy it'll be.
Like all Intel systems, the 286/310 is built on standards.

The MULTIBUS* architecture. The iRMX real time operating system. Ethernet* networks and protocols. And the Xenix* operating system. Not to mention the world's most-written-for microprocessor architecture, the 8086 family.

All of which makes the 310 a very open system. Open to all kinds of OEM configurations. And enhancements like integrated software, interactive speech, graphics, networking, even software-in-silicon. And that means it's also open to new markets and new opportunities.

You'll also be able to find service and support for you and your customers' systems from more than 80 service centers worldwide.

Which is what you'd expect from a company with more than a billion dollars in sales.

So get the information you need on the world's fastest supermicro. Including a series of independent benchmarks. Call toll-free, (800) 538-1876. In California, (800) 672-1833. Or write Intel, Lit Dept. S8, 3065 Bowers Avenue, Santa Clara, CA 95051.

Enough said.
Take a close look under the hood of a Datasouth printer. Inspect for loose parts, cheap fittings. Search for things that show more concern for speed on the assembly line than the communications line.

You won’t find them. Instead you’ll find the source of the Datasouth reputation: design, engineering and materials dedicated exclusively to high performance value.

Now look closer.

MORE THAN THE HUM OF ITS PARTS

Count the moving parts in a Datasouth printer. You won’t find many. Most of those are dedicated to transporting the printhead and the paper from point to point with optimum speed and accuracy, while the rest of the printer sits quietly with the motionless authority of a Stonehenge.

And thinks.

Under the hood of every Datasouth printer is a highly intelligent microprocessor. Its sophisticated brainwork eliminates the need for many parts still common in other printers, and optimizes carriage and paper travel so the printhead intelligently follows the shortest path from one printable character to the next. So more work gets done with less strain on the machinery.

MODULAR MAINTENANCE

Datasouth design simplicity assures easy maintenance. All control electronics are on a single printed circuit board. The 9 wire printhead is rated at over 500 million characters, and is easily replaced in minutes.

Everything that matters is easy to reach, right there under the hood. Even the cartridge ribbon, rated at 3 to 4 million characters, snaps into place in seconds.

JUST TURN THE KEY

Datasouth printers are easily driven by virtually any mini or microcomputer. The fully instrumented dashboard allows the user to program up to 50 different applications features at the touch of a few buttons. Meanwhile, the digital readout shows everything from programming prompts to line count.

TAKE YOUR CHOICE

Datasouth reliability comes in two high performance models. The DS180 is a legendary workhorse that delivers crisp data quality printing at 180 CPS. The new multimode DS220 cruises at 220 CPS for high speed data printing and at 40 CPS for letter quality word processing. Both models print precision dot-addressable graphics.

If you have a high performance printing need, Datasouth has a high performance printer to fill it.

DRIVE ONE TO WORK TODAY

Both the DS180 and the DS220 are on display at more dealer showrooms every day, including one near you. So go take a hard look at the kind of hard copy you get from high performance Datasouth printers. See what really counts when you compare printers.

Find Datasouth Printers At Participating Computerland® Stores And Other Fine Dealers.
Trade talks move slowly

The 1983 $919 million trade deficit in computer equipment, part of an overall U.S. trade deficit with Japan pegged at between $18 billion and $22 billion, has helped fuel a growing impatience on the part of Reagan administration officials toward the slow pace of negotiations to resolve trade differences. The trade differences bar increased access to Japanese high-technology markets. U.S. trade and industry representatives are applying increasing pressure on the Japanese government to liberalize several long-standing restrictive trade practices.

Efforts are also under way to kill new proposals that have recently surfaced in the Japanese Diet that the United States fears would further restrict software and information-processing companies’ entry into Japanese domestic markets. Indications are that the Japanese are beginning to take seriously the

Nippon Telephone and Telegraph (NTT), Japan’s government-run telecommunications giant, had agreed in 1980 to allow foreign organizations to compete on an equal basis with Japanese companies for a share of NTT’s $3 billion annual equipment-procurement budget. The results of the NTT Agreement have been slow to develop and are largely disappointing for U.S. computer and electronic companies. The U.S. companies saw the accord as a means not only to sell to NTT but to gain entry into wider Japanese computer and telecommunications markets.

In testimony before the House Subcommittee on Telecommunications, Consumer Protection and Finance, the undersecretary of commerce for international trade Lionel H. Olmer underlined the importance of renewing the agreement. NTT, said Olmer, represents approximately 40 percent of the Japanese telecommunications market. Perhaps more important, he continued, is the tremendous influence NTT has over the development of Japanese high-technology and associated companies.

“Without access [to NTT], U.S. companies would be at an inherent disadvantage compared to their Japanese competitors, who have long had access to U.S. telecommunications technology,” Olmer testified.

In economic terms, U.S. companies have had little success with NTT despite Japanese assurances. In 1980, the first year of the NTT agreement, U.S. companies sold a paltry $12 million worth of equipment to NTT, according to the American Electronics Association (AEA). There has been some improvement since then. In 1981, U.S. sales increased to

$39.6 million and jumped again in 1983 to $140 million, or 5 percent of the total NTT equipment procurement for that year.

A spokesman for the North American Telecommunications Association (NATA) says that a significant percentage of NTT’s procurement of U.S. equipment was low-technology supplies—copper wiring and coaxial cables. Rolm Corp., ITT Corp. and Northern Telecom Inc. have succeeded in placing some of their digital private-branch exchanges (PBXs) with NTT, and Paradyne Corp. has sold NTT some high-speed modems. NTT has purchased only one American computer system, a VAX 11/780 from Digital Equipment Corp., NATA records indicate.

In contrast, Japanese companies have moved quickly to capitalize on the breakup of American Telephone and Telegraph (AT&T) Co. and the newfound ability of former Bell Operating Companies to buy from sources other than Western Electric Co. Nippon Electric Co., for example, has already captured an estimated 5 percent of the U.S. PBX market, according to the AEA. Overall, Japanese companies are projected to capture 10 percent of the U.S. PBX market by the end of this year.

“Japanese companies can sell into the United States three to four times the volume of what the United States is selling to NTT as a result of the AT&T divestiture,” comments Ralph Thompson, AEA senior vice president.

This year, U.S. trade representative William Brock and Japanese foreign minister Shintaro Abe signed an accord that extended the term of the NTT agreement for three more years, subject to one-year bilateral reviews on its progress. The extension incorporates several modifications that U.S. officials hope will result in more sales by U.S. companies to NTT.

Brock concedes that the agreement does not necessarily guarantee increased U.S. sales. “The extension of the NTT agreement is only one step on a long road...I do not believe that sales by American firms to date are anywhere near their potential. It is essential that this potential be fully realized,” Brock says.
growing sentiment on Capitol Hill toward enacting protectionist trade legislation to staunch the flow of Japanese high-technology products toward enacting protectionist trade.

 Proposal advanced to get foreign VANs off NTT highways

A contentious issue raised in a recent proposal by the Japanese Ministry of Posts and Telecommunications (MPT) would restrict foreign ownership shares of value-added networks (VANs). The anticipated increase in the number of privately owned information-processing networks has alarmed MPT. It is afraid that in a national emergency the government would not be able to control independent and foreign-owned telecommunications systems.

Japanese prime minister Yasuhiro Nakasone's ruling party, the Liberal Democratic Party, backs a proposal that would restrict foreign ownership shares of value-added networks.

The issue of who should own and control VANs—data networks in which a system operator adds value to the information transmitted through packet switching, protocol conversion, digital processing and other computer-based techniques—is tied up with the planned organizational shake-up of Nippon Telephone and Telegraph (NTT). Now owned wholly by the Japanese government, NTT is expected to be opened to private Japanese investment. Under a reform bill now pending before the Diet, up to 50 percent of NTT's stock will be offered for sale exclusively to domestic investors. Unlike AT&T's divestiture, NTT will not be split up but will be allowed to acquire manufacturing capabilities of its own for the first time.

The relaxation of government control over NTT and the government monopoly of domestic telecommunications has raised MPT concern that American companies will dominate the Japanese market for VANs. Accordingly, the ministry has advanced a three-point plan to avoid this scenario:

- companies that own their own circuits would be required to obtain an MPT license to operate. Foreign participation would be limited to a 33 percent investment.
- companies that lease circuits from NTT would also be required to be licensed by MPT, and foreign ownership would be limited to 50 percent.
- companies that provide local or specialized services, such as banking networks currently in operation, and that do not engage in the resale of circuits or information-processing services would be required to notify MPT of the details of their networks, but they would not need special permission to operate. There would be no restrictions on foreign ownership in these types of networks.

With the approval of the Japanese government, IBM Japan has run several experimental VAN systems for videotext and integrated voice/data networks in Japan. According to John Choy, an economic analyst at the Japan Economic Institute, Washington, IBM Corp. and American Telephone and Telegraph Co. were poised to enter the Japanese VAN market in early 1983, but pulled back after MPT started to make noises about restricting foreign participation. Japan watchers are divided over whether the Japanese Diet will formally adopt the MPT proposal. But Choy says the measure has strong backing from the Liberal Democratic Party, the ruling party of Japanese prime minister Yasuhiro Nakasone. "It's got a good chance of going through," he comments.

CIRCLE NO. 162 ON INQUIRY CARD
We Made It.

We reached our first milestone in becoming the leading manufacturer of high-capacity, high-performance 5¼-inch Winchesters. Achieving volume delivery wasn't easy, but we made it.

Thousands of our XT-1000™ disk drives are already in the field. Thousands of XT-2000s™ and EXT-4000s™ are on the way.

But it takes more than delivering products to become a leader in the Winchester marketplace.

It takes a commitment to the most stringent quality assurance. Modern, efficient manufacturing facilities. Ongoing new product development. Dedicated technical support. Worldwide channels of distribution.

It takes a company that's proven higher capacity and higher performance can be achieved with innovative designs.

It takes a company called Maxtor.

Maxtor Corporation, 61 E. Daggett Drive, San Jose, California 95134, (408) 942-1700, TELEX 17107. Eastern Regional Sales Office: (617) 872-8556. Southwest Regional Sales Office: (714) 859-3100.

XT-1000™, XT-2000™, EXT-4000™ are trademarks of Maxtor Corporation.

©1983 Maxtor Corporation.

CIRCLE NO. 38 ON INQUIRY CARD
IF COLOR IS A LUXURY YOU THINK YOU CAN'T AFFORD, THINK ABOUT OUR WY300—the smart color terminal as low as $975.*

The WY300's high-resolution 8-color display adds vivid relief to any text editing or data entry task, without adding significantly to the price you'd pay for monochrome.

Ergonomically designed with a swivel and tilt CRT and a detachable keyboard, the compact WY300 fits into the workplace as comfortably as it does into your budget.

On top of that, the WY300 gives you a host of features like a soft downloadable character generator; extensive alphanumeric and line drawing symbols; and compatibility with most standard, monochrome oriented, off-the-shelf software.

Best of all, the WY300 is plug compatible with our monochromatic WY100's and most ASCII terminals. So, using color is as easy as it is inexpensive.

Need more information? Call or write us today. We'd like to convince you our smart color terminal is your wisest buy.

CIRCLE NO. 39 ON INQUIRY CARD

WYSE TECHNOLOGY 3040 N. First St., San Jose, CA 95134, 408/946-3075. TLX 910-338-2251. Outside CA call toll-free, 800/421-1058, in So. CA 213/340-2013.
to the United States. Vice president George Bush and

MITI proposal draws fire

Computer software sold in Japan has customarily been protected under Japanese copyright law. No one could sell or copy programs without the consent of the author for a period of time usually equivalent to the author's lifetime, plus 50 years.

Although Japanese courts have upheld copyright protection of software and have accorded computer programs the same rights of authorship accorded to other literary works, software has never explicitly been listed as a protected means of literary expression in Japanese statutes. Several months ago, the Japanese Ministry of Education proposed amending the copyright statutes to include software. When the trade ministry learned of the proposed revision, it drafted its own legislation that would exclude software from copyright law and replace it with patent-type protection for only 15 years.

If the MITI plan goes into effect, certain U.S. software programs that have been available in Japan for more than 15 years would be unprotected. The proposal would also force software vendors to grant licenses to Japanese companies in special cases of national interest that would allow resale without additional royalty payment.

The proposal has raised a storm of protest among U.S. government officials and industry executives. “If this goes into effect, there’s a very strong chance of retaliatory measures being enacted here,” says Ralph Thomson, senior vice president of the American Electronics Association (AEA). He adds that AEA has conducted several briefings on the measure with American computer companies, including a meeting with Steve Jobs, chairman of Apple Computer Inc. During the meeting, Jobs indicated that the measure would force Apple to reconsider the viability of its Japanese operations. Apple, which runs a wholly owned subsidiary in Japan, cannot confirm Jobs’ comment, says a company spokeswoman.

SONEX kills printer noise beautifully.

Hard walls reflecting printer chatter? Thick, rich, lush carpeting might cut much of the noise, but SONEX acoustical foam will absorb four times as much noise at about the same cost. The anechoic wedge surface looks good, and its open-cell structure absorbs, deflects, scatters and de-energizes sound energy. It will silence annoying disk drive and fan hum, or kill noise from collators, shredders, copiers...anything noisy. Call us at 612/521-3555 or write us at 3800 Washington Avenue North, Minneapolis, MN 55412.
U.S. trade representative William Brock are scheduled to visit Japan this month. U.S. officials have intensified their efforts to force Japanese trade concessions before the trip to give the U.S. representatives some positive news to report afterward. Computer and high-technology trade issues likely to be on the agenda include:

- implementation of an agreement to liberalize the procurement policies of Nippon Telephone and Telegraph (NTT). The three-year-old pact, which was extended this year, has produced minimal results for U.S. companies attempting to sell computers and software to the giant Japanese telecommunications company;
- a proposal by the Japanese Ministry of International Trade and Industry (MITI) that would replace the copyright protection afforded computer software with shorter patent-like protection;
- a proposal by the Japanese Ministry of Posts and Telecommunications to restrict the foreign ownership of value-added networks;
- liberalization of foreign companies’ access to Japanese capital markets;
- full implementation of an agreement to eliminate U.S. and Japanese semiconductor tariffs;
- access to the Japanese market for domestic communications satellites and associated ground-control equipment, including minicomputers—a market that the Japanese government has restricted;
- reduction of the disparity between the relative value of the yen and the dollar. Current exchange rates are pricing some U.S. computer equipment out of the market in Japan.

Concern over U.S. access

Concern over some of these unresolved U.S.-Japan trade differences is not limited to U.S. industry and its desire for increased access to lucrative Japanese computer and telecommunications markets. According to an MITI official at the Japanese Embassy in Washington, the Japanese government is alarmed at legislative efforts in Congress and at the state level. The Japanese government views those efforts as restricting Japanese companies’ access to U.S. markets. Those efforts include:

- the “unitary tax” imposed by
If you're looking for a PC network that's not work, cut it out.

NetSource/PC-LAN is the best bet for cost-effective, reliable PC networking, whether you're a compatible manufacturer or a systems integrator. Make the NetSource/PC-LAN connection today!

Send me your full-color NetSource/PC-LAN brochure, including complete product details.

Send me ordering information on the NetSource/PC-LAN Evaluation Kit, which includes boards for three nodes, cable and software.

Time is of the essence. Please call me immediately at (phone number)

Name ____________________________
Title ____________________________

Company __________________________
Address __________________________
City __________________ State ______ Zip __________
Phone __________________ Ext. ______

Mail to: Western Digital Corporation
         Literature Dept.
         2445 McCabe Way
         Irvine, Ca 92714

NetSource/PC-LAN is user friendly, too. It uses low cost cable and is user installable in minutes. It even offers encryption for data privacy.

Today NetSource/PC-LAN is available in the IBM PC/XT form factor with MS-DOS compatible software. Or we can build a proprietary LAN board for your system.

So if you're a PC manufacturer, or a systems integrator, make WD your NetSource. And make your system more competitive. Use the coupon. Or call our NetSource Hotline 714/863-7828.
several states, including California, that taxes foreign companies based on their total worldwide revenues, rather than on revenues generated by facilities within the state;
- Congressional legislation that would limit the percentage of foreign components in American products;
- Federal legislation to abolish the semiconductor tariff, now pending in Congress, that could be blocked by rising protectionist fever and Congressional resentment over the U.S.-Japan imbalance.

**U.S. desires access**

U.S. trade officials are trying to pressure the Japanese Finance Ministry to speed the liberalization of Japan's capital markets. This would allow foreign companies greater access to additional funding sources for domestic expansion projects. The United States is not satisfied with the pace of the liberalization, which is based on a pledge Japan made to President Ronald Reagan during his trip to Japan last November.

Beryl Sprinkel, undersecretary for monetary affairs at the U.S. Department of the Treasury, reportedly gave the Japanese Finance Ministry a deadline for fulfilling the pledge to Reagan during a meeting in late February. According to a Commerce Department trade specialist, Sprinkel is pushing the Finance Ministry to raise what are considered to be artificially low interest rates to increase the relative value of the yen compared with the dollar. Higher interest rates would increase capital availability and lower the prices of American products in Japan.

**U.S. hopes to eliminate tariffs**

Congress is in the final stages of enacting legislation that would give the president authority to negotiate with Japan to eliminate semiconductor tariffs. The legislation—S. 144, incorporated as Title III of H.R. 3398—is expected to receive final positive action from the Senate this spring.

As the 1984 presidential election draws closer, the volume of rhetoric from administration officials on unresolved U.S.-Japan trade issues in the computer and information industries is certain to increase.
See Software.
Dick is a programmer. Dick is bored. Harried. Dick struggles with trace chores. Debugging routines. Nonexistent documentation. Hidden bugs. So Dick is four months behind schedule. And customers are upset when bugs slip through. They yell and make Dick upset. They make Dick’s boss upset. Nobody is very happy.

See Software Run.
Jane is a happy programmer. She uses ANIMATOR™. It’s a VISUAL PROGRAMMING™ aid for MICRO FOCUS™ LEVEL II COBOL™. It runs on a micro. It makes child’s play of test and debugging tasks.

With ANIMATOR Jane sees a picture of the program explaining itself. In real time. In COBOL source code. ANIMATOR tracks the program’s exact execution path. Including subroutine branches. Jane can have the program run fast. Or slow. Or stop. With one key. This makes it easy to spot problems. Insert fixes. Set breakpoints. Instantly.

Jane’s programs are best sellers. They’re delivered on time. With no hidden bugs. Jane’s boss likes this about Jane. Because he doesn’t like customers to yell at him.

Run, Software, Run.
This software vendor just went public. Because he doubled productivity. Eliminated bugs. Cut costs. Produced terrific applications. Beat the competition to market. And customers don’t yell at him anymore. All thanks to ANIMATOR.

See ANIMATOR now.
Let ANIMATOR help you do better work. And speed your applications to market. Write for more information. Or call (415) 856-4161. Right now.

MICRO FOCUS
2465 E. Bayshore Rd., Suite 400, Palo Alto, CA 94303

© 1984 Micro Focus Inc. All Rights Reserved.
LEVEL II COBOL, ANIMATOR, VISUAL PROGRAMMING, MICRO FOCUS and the MICRO FOCUS Logo are trademarks of Micro Focus Ltd.
National's CIM Board family.
Take a close look now because where they're going you wouldn't want to be.

From commercial applications, to industrial control, National supplies more systems with board-level CMOS solutions than anybody else.

Now's the time to take a close look at CIM™ (CMOS Industrial Microcomputer), National's CIM family high-speed CMOS microcomputers, which includes CPU, memory expansion, and digital and analog I/O boards. Already over 60 products are available off-the-shelf today.

No other family of boards withstands wider temperature extremes, draws less power, performs better, or fits tighter than CIM, on the factory floor, under the sea, to the skies and beyond.

And best of all, National's microCMOS technology gives these boards high NMOS performance at low CMOS power.

CIM CPU boards are based on the NSC800 microprocessor, which executes the Z80® instruction set.

CIM operates from $-40^\circ C$ to $+85^\circ C$ in harsh environments. That's 125% wider than the 0°C to $+55^\circ C$ range of typical NMOS boards. A commercial version operates from 0°C to $+70^\circ C$ and costs less.

Lower power consumption means high reliability, portability, and lower operating cost. CIM draws 240mW, while equivalent NMOS can draw 20W. That's 1/30 the power for a 97% savings.

And you can back up or operate them from a battery, and toss out your cooling fans.

Smaller boards also mean more compact systems. CIM's Eurocard form factor is 15% smaller than STD BUS and 69% smaller than MULTIBUS™. CIM measures 3.9-inches by 6.3-inches (100mm by 160mm).

CIM's pin-and-socket connectors resist corrosion and vibration better than card-edge connectors.

And alternate sources mean there's no reason not to spec CIM boards. And over 60 reasons you should.

Shouldn't you take a close look at National's CIM boards? It all goes to prove National supplies more board-level CMOS solutions than anyone else.

For complete details on National's CIM family, and a free copy of our new CIM databook, call or write National Semiconductor, 2900 Semiconductor Drive, MS 23200, Santa Clara, CA 95051.

CIM is a trademark of National Semiconductor Corporation. MULTIBUS is a trademark of Intel Corporation. Z80 is a registered trademark of Zilog Corporation.
THE BETTER CONTROLLERS
AND FOR GOOD REASONS.

NO OTHER 5¼" OR 8" FLOPPY CONTROLLERS MATCH THEM.

First, they’re both low cost. Yet they employ powerful control and interface electronics for full emulation and operating system compatibility. All completely self-contained on a single dual height PCB. The DQ619 controls the 5¼", SA450 I/O floppy and the Model DQ419 is for the 8", SA850 I/O floppy.

Next, they share standard features you’ll need:
- complete DEC RX02 emulation
- RT-11, RSX-11 and RSTS compatibility
- and 22-bit addressing for up to 4-megabyte memory access.

And they both include an exclusive feature that extends both media life and drive reliability. It’s a DC motor control and associated electronics that unloads the read/write heads and turns off the drive motor following access periods beyond 15 seconds.

There are numerous other features to make your life with a floppy easier, like on-board diagnostics, full sector data buffer, media present monitor, 4-level interrupt that’s jumper selectable, on-board bootstrap loader and write precompensation.

Write or call to discover for yourself all the features and benefits these better controllers have to offer.
Prototype Design Center opens in Silicon Valley.

A new Design Center has been established in Los Gatos, California, to make it easier than ever for systems builders to tap WD's specialized expertise in disk controller and network subsystems. The Design Center reinforces WD's "technology partners" concept of making the Company's design and engineering group a direct extension of the customer's engineering efforts. The Northern California Design Center, first of several planned across the nation, is linked to WD's headquarters computer-aided design center in Irvine, California.

71% of office micros projected to be IBM or IBM compatible by 1989.

Pointing out that 71% of all office computers and 64% of all home computers will be IBM or IBM-compatible before the end of the decade. Zenith Data Systems has entered the IBM-compatible market with a new line of desktop computers. The new Z-100 PC series has a footprint 20% smaller than an IBM PC and text display input-output rate that's almost twice as fast. WD has received a multi-million dollar contract to provide Zenith with FDI179X floppy disk controller VLSI devices and a customized version of the WD1002-WX2 disk controller board.

WD launches major SMT production program.

Improved system efficiency, higher density and greater reliability are a few of the reasons board-level manufacturers are eagerly pursuing surface mount technology (SMT). WD is making strategic investments in SMT and, to that end, has taken an equity position in Array Technologies, Inc. High volume SMT production facilities will soon be brought on-line at the Company's Camarillo, California and Cork, Ireland manufacturing facilities. WD is committed to the design and production of its standard network and storage management board-level products using SMT.

Robotics network automates pipe mill.

TAK Automation, Burlingame, California, has developed a highly automated pipe mill system, using a network of robots for handling and storage of materials. The robots are equipped with WD's NetSource/25 X.25 Packet Switching Controllers, which control the flow of data between both fixed and roving robots and a central computer. NetSource/25's media independence permits the use of fiber optic links for communications, or, in the case of roving robots, radio links. Centralized control of the robots boosts quality and productivity, according to a TAK spokesman.
Personal printer, portable computer advance HP’s market strategy

Tom Moran, Associate Editor

With the introduction of its low-cost ThinkJet family of fast, quiet printers (MMS, March, Pages 17 and 36), and the Portable personal computer, Hewlett-Packard Co. is delving further into broad personal and business computer markets. HP believes that the future of the company hangs on its success in those markets.

Since its formation in January 1983, HP’s Personal Computer Group, Sunnyvale, Calif., has introduced the HP150 touch-screen desktop personal computer, the ThinkJet series, the Portable and the portable disk drive that accompanies it.

Before the formation of the Personal Computer Group, HP was making personal computers at a number of divisions. That led to marketing conflicts and competition between machines such as the 125 and the 80 series of desktop personal computers.

Organization was not HP’s only problem in moving into consumer areas. “In consumers’ eyes, we just entered the market last year,” says Cyril Yansouni, general manager of the Personal Computer Group. “In our eyes, we entered the market in 1968 [when] we created the desktop calculator for engineers. Our only big mistake was that we never called them personal computers.” Yansouni says that, when IBM entered the PC market, it encouraged a lot of first-time users. “And now we had a choice: do we stay in the niche, do we keep just selling to engineers and scientists, or do we expand. And the conclusion was, we have to expand.”

HP’s reasoning was that, because personal computers are general-purpose machines, other companies could make them into products for engineers. “So, we felt we could not protect our niche for too long if we stayed only in the niche,” says Yansouni.

HP lagged behind in marketing

HP’s biggest challenge was to learn new market-research techniques, says Yansouni. “It’s one thing to know what engineers want. I ask five people, and I’ve got my market research. With the consumer, you’ve got to talk to more people, and you have to use a different language. We are becoming very much more market-oriented.” He says people in the organization had to change the way they do things.

Aaron Goldberg, research manager for research concern International Data Corp., believes that HP may not have the marketing expertise to succeed. He lauds HP’s decision to assign R&D people to the sales outlets temporarily as “a stroke of genius because it forces engineers to understand the end-user market.”

ThinkJet is HP’s ‘bright hope’

Yansouni says HP is a price leader with the ThinkJet printer—not just a technology leader. “The perception of the industry is that [the personal printer] marketplace has been captured and owned by the Epsons and so on of the world. And here we come with a product that’s quiet, cheap and high-performance.”

Yansouni estimates that about 100,000 to 120,000 of the Epson-, Okidata-type draft-quality printers in the $400-to-$600 range are shipped worldwide every month. He claims that HP can ramp to production of 40,000 units a month without a major reallocation of resources because HP uses an
Cyril Yansouni, general manager of HP's Personal Computer Group, says the ThinkJet family may capture as much as a third of the worldwide market for low-cost dot-matrix printers.

HP, including software, accessories, plotters, the HP150, the ThinkJet and the Portable.

Although doubt still exists about whether consumers will accept touch screens, HP had delivered 20,000 HP150s to dealers by the end of HP's fiscal quarter in January. Major deliveries began in November. HP projects total sales of 100,000 units for the 150 by the end of 1984.

The company estimates that 1982 sales in the personal computer business were $400 million to $500 million. Sales hit $700 million in 1983. Those figures include handheld products and terminals but exclude plotters and mass-storage devices. "We make all of our terminals in my group, because we think that terminals and personal computers are going to become the same thing," Yansouni says.

Paul Ely, executive vice president for computer operations, says HP will introduce another major personal computer product in June.

Financings

Read-Rite Corp., Milpitas, Calif., has grabbed $13.4 million in its first round of financing. The money will be used to produce thin-film magnetic recording heads for disk drives. The financing package comprises venture capital, a research and development partnership and a capital equipment lease line. Hambrecht & Quist and Concord Partners were the lead investors....Lotus Development Corp. competitor Ovation Technologies has raised $5.5 million in its second round of venture funding. Most of the money will go towards marketing the Canton, Mass., company's integrated Ovation software package for the IBM PC. Oak Investment Partners led the financing. Ovation received $1.3 million in its first round....Year-old graphics workstation supplier Cadmus Computer Systems, Lowell, Mass., has closed a $7.75 million second round of financing, bringing the total to $11.25 million. Citicorp Ventures, Charles River Partnership, and L.F. Rothchild, Unterberg, Towbin, participated with 11 other investors....Verticom Inc., Sunnyvale, Calif., one of the first to produce a North American Presentation Level Protocol Syntax (NAPLPS)-compatible color graphics terminal, has attracted an additional $1.9 million in its second round. The first round netted $1.5 million. The investment group included Vanguard Associates and Ventech Partners. NAPLPS is a proposed graphics standard for simultaneously handling graphics and text....Custom Silicon Inc., a Lowell, Mass., manufacturer of custom integrated circuits, has obtained $1.1 million in venture capital and equipment financing....Automatic sheet-feeder company LQ Corp.'s recent financing of $2.8 million brings the Meriden, Conn., company's total to $5 million.
THERE ARE AT LEAST EIGHT MORE TERMINALS HIDING IN YOUR VAX.

All you need is one Able VMZ/32 asynchronous terminal controller to find 8 more lines in your DEC VAX-11/730, /750 or /780, for a total of 16. With an additional VMZ/32 you can discover 16 more lines.

The VMZ/32 board plugs into the same space as the standard DEC DMF32 board it replaces, providing 16 lines instead of 8. Without patches to the VMS. And with complete VMS compatibility.

Immediately you'll unleash a minimum 13% increase in processing speed. You'll instantly realize a 50% reduction in costs per line, obtain a 50% space savings in the backplane and see a surprising reduction in power consumption.

The VMZ/32 also reveals hidden performance within your CPU by increasing its availability (idle time) up to 500%.

To handle this newly acquired power, the VMZ/32 gives you modem control on all sixteen lines. This lets you easily manage the terminals, including those remotely located. Plus, you can easily vary the speed on each line from a 50 to a 19.2K baud rate, including split baud capability.

Here's a dependability clue: an MTBF of over 100,000 hours. To back it up, the VMZ/32 comes with a one-year warranty from Able that can be extended if you like. Ask your Able representative for full details.

If you do unearth a problem, Able Support Service is as close as the phone.

You can also uncover extra performance hidden in your printer with Able's VMZ/LP. The VMZ/LP provides a dramatic reduction in CPU overhead and is LPII cable compatible.

So, to discover the full potential hiding in your VAX, Able's got a simple solution: just plug in the VMZ/32.

CIRCLE NO. 46 ON INQUIRY CARD

1732 Reynolds Avenue, Irvine, California 92714. Call toll free: 800-332-2253. In the Irvine area: (714) 979-7030. Or, TWX: 910-595-1729

DEC, VAX, DMF32 and VMS are trademarks of Digital Equipment Corporation.
Mass production.

Our goal was to create a design so simple and a production line so unerringly accurate that we could turn out ¼" streamers by the thousands with cookie-cutter consistency.

At Archive, that goal was met. In the last three years, we've shipped more than 50,000 streamers—nearly three times as many drives as the rest of the industry combined.

Others are still learning how to build streamers in quantity. But we perfected our production process years ago.

Today we're shipping over 5,000 streamers each month. And everything is in place to boost our capacity to 15,000 streamers per month.

Of course we haven't sacrificed quality for quantity. Our 98% reliability rate is among the industry's best.

But still, we're improving our products. For example, our recent advancements in LSI technology have reduced the number of parts in our newest streamers by 40%. So there's even less of a chance that something will go wrong.

You'll like our approach to mass production. It means if anyone is going to be able to turn out a perfect batch of streamers, it's Archive. For more information, write Archive Corporation, 3540 Cadillac Avenue, Costa Mesa, CA 92626. Or call (714) 641-0279.

Archive offers 8" 5¼" full-height and 5¼" half-height streaming tape drives.

ARCHIVE CORPORATION
CIRCLE NO. 47 ON INQUIRY CARD
Introducing The
HiREZ 100™

The Graphics Terminal
You Asked For
Selanar's been listening. As a leader in retrofit graphics technology, we've heard OEMs, distributors and end-users demand hard-working, quality, reliable service, and a range of ergonomic and functional features in a high resolution graphics terminal. So we built it ourselves—the Selanar HI'REZ 100. Available now at a surprisingly low Selanar price and low operating costs to match.

Selanar Features
Meet The Demand
We've also listened to what operators want: ease of use, and comfort. Just some of the Hi'REZ 100's ergonomic features include a familiar detachable VT100 keyboard with 30mm key-height, a screen that swivels and tilts, a bright no glare 14" display for less eye fatigue, and up to 20 programmable functions that demand fewer keystrokes.

You've also asked for true high resolution: we're giving it to you at 1024 x 768, with 4096 x 4096 addressability. You wanted fast response: the Hi'REZ 100 features 72,000 pixel/sec drawing speed and 19.2K baud transmission rate—with lots of local memory and intelligence to reduce CPU overhead. You wanted hard copy: the Hi'REZ 100 features a range of standard dot matrix printer and pen plotter interfaces for presentation-quality output.

The Hi'REZ 100 wins out in the price/performance battle with features like these:
- Point plot, incremental point plot and write-thru modes
- 80 and 132 columns by 24 or 48 lines, selectable
- Set-up mode with English prompts
- Cross-hair cursor
- A variety of character sizes and line types
- Support for all video attributes
- Pan and zoom
- Compatibility with all PLOT 10™ software and any software with 4010/4014 drivers
- Full ANSI X3.64 terminal standards

Ask Selanar For More
Whether you're a systems manager who's interested in productivity, the bottom line, vendor reliability and support—or a systems engineer interested in nuts and bolts, features and functions, Selanar's met your needs with HI'REZ 100. What more could you ask for? Call us today—or write, if you prefer—and we'll tell you more about the graphics terminal. The Hi'REZ 100 from Selanar.

Call now 408-727-2811

Selanar
437 A Alto Avenue, Santa Clara, CA 95050

European Hq:
Selanar GmbH, AHASTRASSE 5, D-600 DARMSTADT
FDR Germany. Tel. 06161/33391. Tlx. 4197201 seta d
Until recently, automatic sheet feeders have cost almost as much as the printers to which they attach. But the lure of potential high-volume markets is now tempting both new and established vendors to introduce aggressively priced models, some as low as $200 in large quantities. Advent Technology Plc. and L.F. Rothchild, Unterberg, Towbin participated....Tecstor Inc., Huntington Beach, Calif., plans to step up its 14-inch Winchester disk drive production with its recent $2.8 million in venture funding. Citicorp Venture Capital Ltd. is the largest investor.

GUEST FORUM
A column for guest experts to speak out

Acquisition fever rises among microcomputer software vendors

Gilbert Mintz
Broadview Associates

Over the past four years, there have been nearly 500 mergers and acquisitions in the information-processing and software industry with a value of approximately $2.9 billion in cash and stock. Last year, a record number of 146 transactions resulted in mergers and acquisitions totaling $1.01 billion.

While software companies accounted for 60 percent of those transactions, it is just as significant that the percentage of total acquisitions involving microcomputer software companies rose from 6 percent in 1982 to 17 percent last year. Broadview Associates expects this trend to continue as industry outsiders, including major wholesale and retail distributors, consumer goods manufacturers and publishers, as well as companies committed to the software industry, acquire more microcomputer software companies.

In prior years, large publicly owned information-processing companies such as Automatic Data Processing, Control Data Corp., Electronic Data Systems and General Electric Co.'s Information Services Co. were the dominant acquirers. Though acquisition continues to be critical in these companies' growth strategies, the smaller software companies have now become the merger activists in the $26 billion information-processing and software industry.

Broadview Associates and the Association of Data Processing Service Organizations documented this trend in 1985 as part of a semiannual mergers and acquisitions index. According to the index, last year showed a mix of companies and a diversity of products. Informatics General Corp. acquired insurance-industry microcomputer software specialist Sigma Software Systems, income-tax processor Computer Language Research purchased Microcomputer Tax Systems, McKesson— one of the nation's largest drug and packaged goods wholesalers—and Action Industries acquired personal computer program distributor Software Knowledge Unlimited, Management Science America entered the educational software market with Edu-Ware Services, McGraw-Hill bought Aardvark Software Inc., Computer Associates International purchased EasyWriter word-processing software marketer Information Unlimited Software Inc., Wyly Corp. acquired application-software developer Open Systems Inc. and ASK purchased Software Dimensions Inc.

Despite their charisma, microcomputer software companies face numerous marketing challenges that are uncharacteristic of other parts of the software industry. To establish and then maintain brand-name recognition for their products, they must engage in costly packaging, sales promotion, point-of-sale merchandising, product endorsement and cooperative retail and national advertising programs. Often, funds that should be used to develop new products must be diverted to the multimillion-dollar promotional budgets required to launch and market products.

In an industry in which a single product error can lead to corporate disaster, Broadview expects that many companies with a demonstrated ability to develop successful business and consumer microcomputer software products will continue to avoid these dilemmas by merging with larger organizations with proven distribution, promotion, sales and financing know-how.
Advancing the technology of data security

Introducing Data Sentry.®

Computer security so advanced, even Mata Hari couldn't hack it.

Your most confidential files may be easy prey for the advances of an artful hacker.

That's why Lockheed used its years of experience with high-technology systems to create Data Sentry.

Protection for sensitive data

Its own internal computer gives you the telecommunications features of an intelligent modem. But unlike other modems, Data Sentry is smart enough to keep your secrets from the most persistent computer intruders.

Data Sentry puts an electronic wall around both large and small computers. And because its protection is external to your CPU, it can eliminate the expense of internal security software. It blocks the inquiries of would-be Mata Haris with a sophisticated security sequence.

Security for every situation

First, Data Sentry requests the phone number of a caller desiring access to your computer. Then it hangs up the phone and searches its list of authorized phone numbers. If the caller's number is authorized, Data Sentry dials the caller back and requests entry of a password. If the correct password isn't supplied within three tries, Data Sentry disconnects and will not return further calls from that phone number.

Data Sentry also lets users select other lower levels of security if desired, including callback to any number with entry of password. And an option, Remote-ON®, lets you turn your computer's power on and off from a remote terminal after security has been cleared.

Versatile and confidential

Data Sentry logs all attempted contacts for audit trails and analysis of users. Its security set-up is locally controlled by a master password that is accessible only to authorized personnel. And its design includes high-reliability components, the latest LSI circuitry, plus Autodial 300/1200 baud full-duplex communications, with auto ranging for incoming data.

Data Sentry will deal with your toughest security problems.

And it'll never fall for just a pretty face.

For a list of your nearest Data Sentry distributors, call toll-free 1-800-443-0100, Ext. 471. Or write: Lockheed GETEX, Suite 945, 1100 Circle 75 Parkway, Atlanta, Georgia 30339.

 Lockheed-GETEX
 Leadership in Technology
Microsoft makes XENIX compatible with UNIX System V

Keith Jones, European Editor

Microsoft Corp., Bellevue, Wash., plans to make its UNIX-based operating system, XENIX, source-code compatible with UNIX System V from AT&T Technologies Inc., Greensboro, N.C. AT&T has earmarked its System V as its UNIX standard. Microsoft's European distributor, Logica UK Ltd., London, has begun investigating the technical problems of achieving compatibility with System V. Microsoft's aim is to have its products remain compatible with the current release of XENIX—XENIX 3.0.

One of the major vehicles for System V will be the Intel 286 processor. Digital Research Inc., Pacific Grove, Calif., will port System V to the 286 (MMS, March, Page 33). But, because System V is not yet available on the 286, some companies are choosing XENIX for their 286-based computers. One example is Northern Telecom Data Systems, Hemel Hempstead, England, the European computer arm of telecommunications giant Northern Telecom Ltd., Mississauga, Ontario. The company has opted for XENIX as the main operating environment on its new Vienna family of multiterminal systems.

Beverley Josephs, senior analyst with the software information service of Gnostic Concepts Inc., San Mateo, Calif., notes that System V compatibility will enable XENIX to support the library of application programs being compiled by AT&T and Digital Research. Josephs doubts that the System V version of XENIX and System V itself will conflict because XENIX has a niche as the system for smaller UNIX hosts, such as IBM Corp.'s PC, Digital Equipment Corp.'s Professional series and Apple Computer Inc.'s Lisa.

Tandy praises compatibility

One successful vendor of UNIX-oriented systems, Tandy Corp., Fort Worth, Texas, has no intention of abandoning XENIX in favor of AT&T's System V, according to the company's director of computer merchandising, Mark Yamagata. At the same time, he acknowledges the appeal of System V compatibility under XENIX.

Logica's software products division commercial manager, Hector Hart, claims that many of UNIX System V's advantages over System III are available in XENIX 3.0, so there is little necessity for XENIX system integrators to change to UNIX System V, especially in view of the upcoming XENIX System V compatibility.

XENIX accounts for the lion's share of UNIX environments in the field. But some industry observers believe that users may drop or pass by XENIX as AT&T moves to dominate the market for the software product it invented. "Why wait for a System V-compatible version of XENIX when you can go to AT&T?" asks Jean Yates of Yates Ventures, a Los Altos, Calif., consulting concern.

Applications should run on both

John Kiefer, senior analyst with research company InfoCorp, Cupertino, Calif., believes that most applications written for XENIX should be able to run under UNIX System V. Dominic Dunlop, techni-
cal director of UNIX application software vendor Sphinx Ltd., Maidenhead, England, agrees: "Microsoft has not locked users into XENIX."

Altos Computer Systems Inc., San Jose, Calif., one of the most successful vendors of XENIX hosts, could recompile applications to run under another UNIX-based operating system "without a major effort," according to Robert Bozeman, the company's director of marketing. Bozeman believes that IBM will announce a bigger multiuser UNIX host this year. "We are waiting for a standard to be set, and IBM and AT&T are the two players," Bozeman declares. Kiefer at InfoCorp says that IBM is readying a superset of System V for its rumored upcoming machine, which is configured around the Intel 286 and is code-named "Popcorn."

Bozeman at Altos does not regard IBM's current UNIX microcomputer implementations as serious competition. These implementations are XENIX on the Motorola MC68000-based 9000 series from IBM Instruments Inc., Danbury, Conn., and Personal Computer Interactive Executive (PC-IX) for the PCs. PC-IX is a modification of IS/3 from Interactive Systems Corp., Santa Monica, Calif. IS/3 is based on UNIX System III.

Nadine Malcolm, senior marketing specialist at Interactive, says her company, like Microsoft, is seriously looking at System V compatibility for IS/3. But she acknowledges that there is no guarantee that IBM will adopt System V.

IBM's UNIX choices still not clear

John Ulett, product manager at Microsoft, refuses to confirm that System V compatibility for XENIX is being planned with IBM in mind. Ulett notes that Microsoft could "junk" its UNIX System III-based version of XENIX in favor of a System V based-implementation. But he believes that would be of no advantage to users. "We offer an alternative to purchasers of generic UNIX. They simply need to be able to check the box for System V to make sure they can run System V programs." Citing XENIX's availability on the Intel 286 and the Motorola MC68000 series processors, Ulett says, "System V porters are starting from scratch on these processors. We just need to add system calls for System V features."

Compatibility will include support of the System V facility that allows two programs to exchange messages within main memory. Microsoft has not made a decision about whether to offer another System V feature—disk block transfers of 1,024 bytes compared with 512K bytes under System III. Ulett says that larger blocks use space inefficiently on small disk files. He notes that XENIX already provides another System V facility, record locking.

XENIX also supports shared memory but takes a different approach from that of System V. "Shared data is held in the kernel of XENIX, avoiding pointers that have to be handled by a memory-management unit." Ulett notes that AT&T developed System V for the DEC VAX and that porting the shared-memory feature to other processors poses problems. A spokesman for AT&T acknowledges that it developed System V for the VAX and that the shared-memory feature will be tailored to other processors, including the 286.

CALIFORNIA LEADS IN ELECTRONICS EMPLOYMENT

Worldwide sales by U.S. electronics and information-technology companies reached $240 billion during 1982, according to an American Electronics Association study. Worldwide employment for those companies totaled 3.7 million in June 1982. Domestic employment was 2.1 million. The top 10 states for electronics employment were California, with 485,000 in the electronics work force, New York with 215,000, Massachusetts with 177,000, Texas with 105,000, Illinois with 102,000, New Jersey with 90,000, Florida with 86,000, Pennsylvania with 78,000, Minnesota with 66,000 and Arizona with 57,000. AEA broadly defines "electronic industry" companies as those that manufacture electronics components or products and systems that require electronic components.

GROUP MOVES TOWARD CASSETTE STANDARDS

Headed by industry consultant Ray Freeman, the working group for Data Cassette Compatibility (D/CAS), is rapidly solidifying interface, recording and unrecorded cartridge standards for small tape drives. The proposed standard is compatible with the individual track format of the QIC-24 spec adopted for 1/4-inch cartridge streaming-tape drives. The goal is to have the specs ready by the July NCC, says Freeman. Currently, the D/CAS-5 spec defines a device interface, and the D/CAS-6 spec defines the recording format. D/CAS-12, which defines the unrecorded cassette, was to be addressed at last month's meeting. Members of the D/CAS working group include Memtec Corp., Salem, N.H., Raymond Engineering Inc., Middleton, Conn., and Verbatim Corp., Sunnyvale, Calif.
Reliability. It's crucial to OEMs and systems integrators. Without it, you can't generate business and a good reputation.

**CompuPro**'s System 816 answers your needs for reliability. It's respected among OEMs because it not only outperforms the competition, but also operates with incredible dependability. The Most Valuable Performer...what you'd expect from a company with more than ten years of setting industry standards.

**More Power to You**

The System 816 series has the power and speed multiple workstations demand. We enhance this even more by offering a whole range of CPUs to select from and standard RAM memory expandable to 1 Mbyte or higher.

As for disk storage, the System 816 can handle up to 4.8 Mbytes on floppy drives and as much as 320 Mbytes per controller on hard disk.

**Incredible Flexibility**

If that's not enough, **CompuPro** makes the System 816 even more attractive by structuring it on the IEEE 696/5-100 bus. For the systems integrator, this means amazing potential in arranging packages. Just select the appropriate components, you can't go wrong. And **CompuPro** makes sure of that, because we offer our components independently, in any combination you need. This bus also provides the flexibility to use compatible boards for graphics and other unique applications.

**Built to Last**

No matter what configuration you select, everything's housed in our famous enclosure. Unlike the plastic construction of most other computers, ours is made of rugged metal for durability and shielding. A constant voltage power supply protects against brownouts. And the common modular architecture of our System 816 family makes upgrading or reconfiguring remarkably easy.

When you get right down to it, **CompuPro** speaks your language. With operating environments like CP/M® MP/M-86™ MP/M-68K™ and our own CP/M®-8-16™ MP/M®-8-16™ and CCP/M®-8-16™. The capability to support languages like Pascal, C, mapFORTH, BASIC, COBOL, PL/1 and FORTRAN 77™ and much more.

**Total Support**

To show you the confidence we have in the System 816's reliability, **CompuPro** backs it with the industry's longest warranty coverage: from 12 to 24 months.

---

**Find out more about the CompuPro System 816...The Essential Computer™**

- Send me your OEM/systems integrator application package.
- Send me your catalog with warranty information.

Name __________________________
Title __________________________
Address _________________________
City __________ State __________ Zip __________
Telephone Number _______________

Mail to: CompuPro Attn: Sales Department 3506 Breakwater Court, Hayward, CA 94545

© 1984 COMPUPRO

MINI-MICRO SYSTEMS/May 1984
You ensure your success when you make Western Digital your technology partner in digital communications. Whether your system needs are as direct as a printer-to-computer interface, as sophisticated as a local area network, or as large scale as a packet switching network, you can turn our expertise and technology resources to your advantage.

**Systems in silicon.**

We're experts at putting complex systems into silicon. Our NetSource™/25, for example, is a powerful VLSI device incorporating three microprocessors into a single chip. It’s the first and only VLSI controller for X.25 packet network applications. Years of painstaking software development and the complexities of the X.25 protocol are reduced to a single integrated circuit.

NetSource is a trademark of Western Digital Corporation.
Chip-to-board synergy.

To get you to market even quicker, our VLSI network controllers are the foundation of an emerging family of board-level products. Our NetSource/PC-LAN, for example, is an IBM compatible single board local area network interface including data encryption. It’s based on our NetSource/40, an awesome token-passing network controller implemented in a VLSI device.

With our advanced computer-aided design systems and highly automated board manufacturing and test facilities, customized variations of this PC network board are never more than weeks away.

Make us your NetSource.

Our pioneering efforts in communications began in 1971, with the development of the first LSI receiver/transmitters, still basic building blocks in all data communications applications.

Today we’re committed to providing the basic building blocks for reliable, efficient networks in the office and across the factory floor.

Make us your NetSource and you get more than chips or boards, though. You get a corporate commitment to roll up the sleeves and work side-by-side with you to get your system or network to market quickly and economically. Ensure your success. Call our NetSource Hotline, 714/863-7828. And get your network off to a fast start.

START HERE.

For the complete story of our communications capabilities and a poster-size reproduction of the illustration above, send your business card to Western Digital, Network Literature, 2445 McCabe Way, Irvine, CA 92714.
There is a Facit Printer to satisfy virtually all printout requirements. From putting your Personal Computer on low cost printing terms, to the most professional heavy duty application with printers that put four-colour dots anywhere on paper.

Facit Matrix Printers, Daisy Wheel Printers and Graphic Flexhammer Printers offer intelligent solutions to any of your printing problems.

Just state your printing speed, print width, single sheet, fanfold or paper roll handling, letter quality, font and graphic print demands and Facit Printers will handle the rest.

So when comparing printers, think professionally.

Contact Facit – we'll introduce you to a whole family of Quality Printers.
Europeans debate tariff on ICs

Keith Jones, European Editor

The British government is backing European computer builders in a campaign to reduce the Common Market’s import tariff on semiconductors. The tariff—now 17 percent—is intended to protect Europe’s IC manufacturers against U.S. and Japanese competition.

But European computer builders contend that the tariff has failed and is threatening future European system manufacturing because of the high cost of imported semiconductors. They warn that if the tariff is not lowered it will force them to transfer their manufacturing to areas outside the Common Market, including the United States.

Under the General Agreement on Tariffs and Trade, the Common Market has reduced the tariff on complete systems to 6 percent over the past few years and may reduce it even further. But the tariff on ICs remains high. System builders contend that, as ICs increase in complexity and sophistication, they represent a growing proportion of total manufacturing costs.

In a report to Kenneth Baker, Britain’s minister of state for industry and information technology, the National Economic Development Office (NEDO), London, describes the European tariff situation as anomalous. Baker has accepted NEDO’s recommendation that the Common Market reduce IC tariffs to the same level as that of computers over a two-year period. Now, he must convince the Common Market. A spokeswoman for the Department of Trade and Industry in London says the department will open negotiations with the Common Market in Brussels, Belgium, as soon as possible.

IC, computer tariffs may be equal

The British Microcomputer Manufacturers Group (BMMG), an association of 19 small- to medium-sized manufacturers, commissioned the NEDO report. “The problem is worst in Britain because the microcomputer manufacturing industry is more advanced here than in Continental Europe,” explains BMMG chairman David Broad, who is also chairman of personal computer manufacturer Comart Ltd., Huntingdon, England.

European computer system manufacturers share the view of BMMG, according to Gunther Moeller, secretary general of European trade association Eurobit, Frankfurt, West Germany. He calls the 17 percent tariff nonsense and says European chip manufacturers have not kept up with U.S. and Japanese IC builders despite the tariff that has protected the European manufacturers for more than 10 years. He concedes that the Common Market sometimes suspends the tariff on a device if there are no European sources for it, but he says component manufacturers strongly resist such suspensions.

IC makers might oppose cut

Most members of the European Electronic Component Manufacturers Association, Brussels, Belgium, are likely to oppose a tariff reduction, according to association secretary Neville Lyons. The only group in the association that will approve a cut is Britain’s Electronic Components Industry Federation (ECIF), London. But Lyons notes that ECIF is different from other groups in the association in that ECIF’s members include circuit board manufacturers that want board and system assembly to remain in Europe. ECIF will accept a cut only if the British government or the Common Market financially supports its members whose profits are affected by the tariff reduction.

While NEDO recommends a tariff cut, it acknowledges that the tariff’s impact is not universally damaging. NEDO concludes that the tariff raises average IC prices in Europe by as much as 8½ percent—not 17 percent. But it affects some companies, particularly small manufacturers of computers, more than others. BMMG’s Broad asserts that component distributors use the tariff to justify prices that are 15 percent higher than U.S. prices.
Convergent, Future Technology pursue high-volume buyers in Europe

Keith Jones, European Editor

Marketing professional microcomputers is often more difficult than designing and building them. The costs and complications of supporting an extensive distributor/dealer network can be prohibitive. Two companies active in Europe—Convergent Technologies Inc., Santa Clara, Calif., and Future Technology Systems Ltd., London—are avoiding these marketing problems by targeting only high-volume customers that can handle their own sales to end users and system integrators.

The larger of the two, Convergent offers a more extensive product line. But Future has the advantage of manufacturing facilities that are close to its European customers—in Beith, Scotland. Both companies have acquired several major customers in Britain and are negotiating big contracts in other parts of Europe. Convergent has a solid foothold in France with the Bull Group, Paris, whose Bull-Transac division sells Convergent workstations as the B4000 desktop terminal.

European customers important

Convergent ships products to several large U.S. customers, notably Burroughs Corp. and NCR Corp., which generated most of Convergent's $163 million revenues in 1983. But European customers will not have to wait for products if demand exceeds supply, says Bob Groves, Convergent's international vice president, who works out of the company's European sales offices in Amersham, England. He says European contracts will be as big and therefore as important to Convergent as are its United States deals. "The minimum volume we are interested in is around $20 million over two or three years. The total number of potential customers in Europe is only about 30," he says. Groves sees European manufacturers as his most likely customers but does not discount very large system integrators such as accounting system vendor Star Computer Group Plc., London.

Future Technology will sell directly to system integrators that will buy 500 to 1,000 units a year, according to managing director Peter McHugh. Future is also targeting computer and office system manufacturers.

Both companies have policies to steer clear of end-user sales. Future will confine its end-user business to British public-sector customers. Groves says Convergent's policy is "written in blood" because the company's OEM customers fear that Convergent might start selling at lower prices to end users than the OEMs do.

To survive, both companies must stay at the forefront in product development so that their customers can justify buying from an outside source rather than building in-house. "Our only real competition comes from our customers' own engineering departments," notes Groves. Ralph Gilman, senior vice president of consultancy InfoCorp, Cupertino, Calif., attributes Convergent's success to high-quality engineering and the ability to sell products to OEM customers at lower costs than the OEMs could manufacture them in-house.

Future offers customizing

McHugh at Future points to his company's establishment of a subsidiary dedicated to design and development projects—Future Technology Developments Ltd., Glasgow, Scotland. The subsidiary's work will be to customize and enhance standard products and to develop special products for specific customers. One of the first special projects, being developed for common carrier British Telecom, is a board that can provide a computer with support for the teletex text-interchange standard. McHugh believes any country employing the same version of teletex could use the board.
UNIX* UNLIMITED ON THE DEC SYSTEM OF YOUR CHOICE.

Now, when you choose from our large selection of VAX, and Q-bus 68000 systems, we'll integrate the power, flexibility, and portability of UNIX...so all you have to do is open the box, plug in and run! That's how Cambridge Digital gives you "The Edge" in system integration. To make your job easier and more productive.

First, choose from a selection of FOUR UNIX operating systems—each a fully supported implementation of AT&T's UNIX:

- UNIX System III and V for VAX and PDPs with all the commercial enhancements and support features you'd expect.
- Real-time UNIX for PDPs with the best elements of versions 6 and 7 plus a text-editor, database manager, and communications package.
- UC Berkeley 4.2 BSD for VAX with all the Berkeley utilities and systems features including optional Ethernet networking.
- UNIX System III for Q-bus-based Univax 68000 gives you VAX performance in a low-priced system.


The result: you get the power of UNIX, the performance of a DEC-based system, and the confidence of dealing with a PROFESSIONAL organization, totally dedicated to satisfying your needs. That's The Edge you get only from Cambridge Digital. The system integrator's system integrator since 1979. To find out more or to receive our latest fact-filled catalog, call us at 800-343-5504 or write to us at Dept. 7401, P.O. Box 568, 65 Bent Street, Cambridge, MA 02139.

I want The Edge:

Name ___________________________ Title ___________________________
Organization/Company ___________________________
Address ___________________________
City ___________________________ State/Province ___________________________
Zip/Postal Code ___________________________ Country ___________________________
Phone No ___________________________

*UNIX is a trademark of Bell Laboratories

Cambridge Digital
DIVISION OF COMPLIANT
The Edge in System Integration
800-343-5504
In Massachusetts call 617-491-2700
CIRCLE NO. 53 ON INQUIRY CARD
The IBEX PCT-1000 is a revolutionary new IBM format compatible 1/2-inch tri-density streaming tape drive that slims and trims your space and budget requirements in one easy installation.

At less than 40 lbs., this mighty mite weighs over 60% less, costs 25% less and occupies 25% less space than any other 9-track tape drive available.

The PCT-1000 is IBM and ANSI compatible. It can accommodate standard 1/2-inch, 9-track tape reels from 7 to 10-1/5 inches in diameter, yet it fits into dual 8-inch Winchester or floppy drive footprint.

There's more. Much more. The IBEX PCT-1000 gives you:
- Storage of up to 136M bytes per reel
- Transfer rates of 20K to 160K bytes/second
- 800 bpi NRZI, 1600 and 3200 bpi PE format operation
- Plug compatible with standard Cipher/Pertec interface
- Internal diagnostics
- Mounting options: 5-1/2" high top-loading drawer mount or 14" high front-loading conventional rack mount

No matter what your application—disk backup, data interchange, or access to archives—the PCT-1000 is your most cost-effective, load-lightening answer.

PCT-1000. The lean machine that out-muscles the competition.

Call, TWX or write today for complete technical data.

IBEX

Right for the times

IBEX COMPUTER CORPORATION
20741 Marilla Street, Chatsworth, CA 91311
(818) 709-8100 - TWX 910-493-2071

CIRCLE NO. 54 ON INQUIRY CARD
Customizing Future's standard products involves not only modifying colors and cabinet shapes to suit individual customers but also modifying electronics to support specific screen resolutions and special peripherals such as streaming-tape drives. Convergent's Groves notes that his company's customizing is confined to changing colors and modifying casing plastics. The only company receiving totally customized products from Convergent is American Telephone and Telegraph Co. A separate Special Systems Division at Convergent handles customizing for AT&T.

**Competition may heat up**

Of Convergent's three other product-based divisions, only its Distributed Systems Division, which builds workstations, is faced with direct competition from Future, according to Groves. He believes that Future offers nothing to compete directly in power with the two products from Convergent's Data Systems Division, the Mini-frame, which is configured around a 10-MHz Motorola MC68010 processor, and the Megaframe, which employs multiple application processors, each based on the MC68010. The multiple application processors communicate over a 32-bit-wide, 11M-byte-per-second bus with multiple file and terminal processors, each based on an 8-MHz Intel 186 processor.

McHugh at Future notes that his company's next generation of machines will be based on an Intel 286 chip and thus will compete more directly with Megaframe. Future's main offering, the PC 86, is configured around the 8-MHz Intel 8086, as are Convergent's IWS and AWS workstations. A short supply of the Intel 186, the CPU of Convergent's IWS/AWS successor, the N-Gen workstation, is delaying shipments of that product.

**Both offer multiple OSs**

On the software side, both companies offer multiple operating environments. Future's FTOS system adds menu and password features to Concurrent CP/M-86 from Digital Research Inc. Future offers Release 3.1 of Concurrent DOS, which supports applications written for the PC-DOS 1.1 environment on the IBM Corp. Personal Computer.

The Convergent equivalent to FTOS is CTOS, which supports CP/M and two systems from Microsoft Corp., MS-DOS and XENIX, Microsoft's version of UNIX. UNIX does not lend itself to Future's current products, according to McHugh, but will be offered with the upcoming 286-based machines. CTOS also runs on Convergent's larger machines. Groves notes that the environment on Megaframe includes UNIX System V with full virtual memory. "We beat Motorola in putting System V on the 68000," Groves asserts. "We move fast."

**TRAINING EFFORTS SPUR ADA**

According to AdaData, a newsletter published by International Resource Development (IRD) Inc., the total Ada market, still in its infancy, should boom from $150 million this year to nearly $1 billion in 1986. IRD says that growth will be due to increased commercial activity and training costs. "This mushrooming interest in education and training is going to drive the entire market from relative obscurity to major proportions in a remarkably short time," states the newsletter. From 1984 to 1986, commercial training expenditures for Ada are expected to rise from $6 million to $55 million, and Department of Defense programmer training costs will rise from $25 million to $300 million. Sales of validated compilers should increase from $9 million this year to $160 million in 1986. The newsletter predicts that small computer and software vendors will "grudgingly acknowledge" their need to compete with large companies in the Ada market.
European PC distribution: the market's bottleneck

Gordon Curran
Intelligent Electronics Europe

Personal computer markets in the major European countries have developed differently, but all countries have one factor in common: a shortage of distribution channels. As a result, many manufacturers are chasing too few dealers. The shortage of dealers makes it tough for manufacturers. Despite it, however, unit sales advanced 50 percent in 1983 over 1982 and are forecast to advance 40 percent this year.

Throughout Europe, there are no more than 1,250 qualified business and commercial computer stores and about the same number of office-equipment stores that carry computers. Office-equipment stores are usually tied to one manufacturer through concession agreements. Italy's Olivetti SpA and Germany's Triumph Alder Co., both known for their typewriters, control more than half of the concession-type agree-
SyQuest Removable and Fixed Disk Drives
Doing more in more applications.

SyQuest Winchester drives—with removable cartridge or fixed media—are working in more applications than any other half-height Winchester. They are giving microcomputers and add-on storage systems a competitive edge. Increasing the utility of portables. Adding another dimension to telecommunications systems. Giving database systems unlimited off-line storage. Helping local networks and multi-user systems share resources.

Increasingly, OEMs and systems integrators are specifying SyQuest half-height drives. Because they get reliable Winchester performance—with fixed disk drives or cartridge disk drives. They fit almost anywhere and are designed to work most anywhere. They use standard Winchester controllers and interfaces.

SyQuest can help your system applications do more for less. For product information, circle our reader’s service number. For delivery and pricing information, call us direct.

SyQuest Technology
47923 Warm Springs Blvd. 
Fremont, California 94539

Telephone: 415-490-7511
Telex: 910-381-7027

Distributed by Hamilton Avnet
CIRCLE NO. 55 ON INQUIRY CARD
OEMs/Distributors:
Price/Performance -- Is your Mini competitive?

Performance/Price -- Is your Supermicro competitive?

Multi-CPU SUPERMAX family breaks the price/performance deadlock!

SUPERMAX modularity supports growth from:
- 1 to 8 MC68000 16/32 bit CPUs
- 2 to 8 I/O Coprocessors
- 1 to 128 Users
- ½ MB to 128 MB main memory
- 20 MB to 10 GB disk

Expansion is easy and cost-effective.

Modularity protects hardware investment. UNIX System III software is the same from the smallest to the largest SUPERMAX system.

Start with competitive supermicro prices -- grow to supermini performance -- keep the supermicro prices.

Dansk Data Elektronik A/S
199, Herlev Hovedgade
DK 2730 Herlev, Denmark
Telephone: int. +45 2 84 50 11
Telex 35258 dde dk

UNIX is a trademark of Bell Laboratories.
ments in Europe.

IBM Corp.'s stringent dealer requirements have a significant influence on the quality of computer shops in Europe. Most new European outlets for IBM products compare favorably with those in the United States. New European computer stores include RYO, Paris, which has more than 4,000 square feet of display area; Geotel in Brussels, Belgium, the first of a chain of computer stores in that country owned by mass retailer GB INNO; Microland, Geneva, Switzerland; and Steiger Computer, London, advertised as the world's largest computer store. All the stores are well-designed, offer a wide choice of products and services and have extensive training facilities.

In spite of rapidly improving standards and ever-increasing numbers of outlets, only the strong companies and popular products are getting dealer shelf space. Most stores can efficiently carry only three or four brands. IBM now uses nearly 900 of the best dealers in Europe and is searching for more. Apple Computer Inc. also has approximately 900 dealers. Both companies are effectively increasing their product ranges and requiring extra shelf space, thus heightening the pressure on other manufacturers to get their products into stores.

Big names such as Digital Equipment Corp., Hewlett-Packard Co. and, possibly, ITT Corp. have a better chance of acquiring shelf space in outlets. Manufacturers such as Texas Instruments Inc. and NCR Corp., IBM PC-compatible equipment manufacturers and mainframe and minicomputer manufacturers now offering microcomputers and wishing to adopt a dealer distribution policy will have to work hard to get even minimal dealer coverage.

Of the European companies, market leader Olivetti has the best chance of retaining its position in retail stores. The Commodore International dealer network, which was larger than Apple's in Europe just a short time ago, and the Sirius/Victor network, which is much stronger in Europe than in the United States, are crumbling. However, British company ACT, with its Apricot microcomputer, retains many Sirius/Victor outlets, particularly in Britain.

So far, Japanese companies have not achieved distribution or market share in Europe. Sharp Corp. and Epson Corp. are the only major Japanese manufacturers with effective European distribution.

For the moment, system houses are an alternative channel for manufacturers seeking distribution in Europe. Although system houses exploit vertical markets, they have neither the ability nor the expertise to succeed in mass-volume markets. Several system houses recognize this and are opening retail stores to cater to the increasing demand for packaged software. In many instances, setting up stores qualifies system houses as IBM dealers.

Standing aloof from this scramble is Tandy Corp. with more than 700 stores in Europe. With new products and an aggressive promotional campaign aimed at professional users, Tandy should continue to command a significant market share.

One bright spot for European distribution is action being taken by the powerful mass-distribution organizations that exist in most European countries. These organizations are moving to enter the dealer market. Large German retailers Karstadt, Kaufhof, Hertie and Horten; Netherlands group Vroom & Dreesman; Belgium's GB INNO; and Spain's El Corte Ingles have opened computer shops and have ambitious plans for development within their countries. Computer dealers in France and Britain are starting multibranch operations with the goal of operating national distribution chains. This should help improve the dealer network situation over the next few years.

As for Pan-European operations, companies such as ComputerLand find it difficult to build a significant presence. One reason is that European cultural and mental barriers between countries are more formidable than physical borders when it comes to getting even adjacent countries to cooperate.
Take a Look at
FUJITSU
Our Commitment

Quality, added value, unequalled service. That is the commitment Fujitsu’s Storage & Peripheral Products Group is making in the United States. Through development of engineering, manufacturing and marketing facilities in the United States and expansion of field support and repair capabilities, the Group is furthering its position of offering products of quality and value to the OEM and consumer computer peripheral markets.

The Group’s line of disk drives and printers reflect our commitment to quality and added value. Value which centers around timely product design, selection of quality materials and components, consistent workmanship, and comprehensive product support.

Wherever you look in the Group you will see professional people answering your needs. Whether it’s specially trained service representatives or engineers working in the Group repair center, their goal remains the same; to provide you with the most comprehensive service available. Service which supports our products and thus offers you added value.

Together, our commitments to quality, added value and service translates into industry standards for reliability, performance and product support. And with the addition of engineering, manufacturing and marketing facilities throughout the United States, the Group will continue to provide you with the best products available.

At Fujitsu we will always strive to be your first choice. The choice where commitments to quality, added value and unequalled service help to facilitate your future growth.

Take a look at Fujitsu. With tomorrow right around the corner, there is no better time than today.

For more information contact Fujitsu America, Storage and Peripheral Products Group, 3055 Orchard Drive, San Jose, CA 95134, 408-946-8777.
France's Bull Group enhances its minicomputers

Keith Jones, European Editor

France's Bull Group, the largest European minicomputer manufacturer, has significantly enhanced its three incompatible minicomputer product lines. The company has enhanced its Solar family, aimed at scientific/industrial system integrators, and has added a 32-bit model to the line. Bull Group will enhance its other two families, aimed at business system integrators—Mitra and Mini 6—with new models.

Bull officials have made Mini 6 the company's future in the business minicomputer field. A company spokesman notes that Mitra development will be slower in the future than that of Mini 6. Bull acquired Mitra and Solar last year when a government-owned electronics group, Thomson-CSF, transferred ownership of Société Européenne de Mini-informatique et de Systèmes (SEMS) to Bull. The acquisition is called Bull Sems.

At the end of last year, Bull Sems put aside development of a 32-bit machine, according to a Bull spokesman. It is now to build and sell a 32-bit computer from Ridge Computers Inc., Sunnyvale, Calif., which runs UNIX system V.

Deliveries of new 16-bit Solar machines from Bull Sems should

IBM hopes to absorb popular X.25 in new SNA 'standard'

Tim Palmer
European Contributor

The X.25 packet-switching protocol has been one of the few success stories for Pan-European cooperation. All the major European markets have adopted the protocol for their public packet-switched networks. This means that even IBM Corp. has had to provide X.25 implementations for its major products.

But no company owns X.25, and IBM is usually unhappy with an industry standard it does not own. IBM's long-term strategy is to swallow X.25 into the Extended Network Architecture (XNA), a new and more comprehensive version of Systems Network Architecture (SNA). If XNA is widely adopted, IBM terminals and terminal computers will once again be the first choice for every major buyer. System integrators that want to pick up the crumbs left by IBM will either have to incur the expenses of implementing the enhanced IBM protocol or drop out of the race.

In Italy, IBM is wooing the government with a proposal that it take over the management and implementation of an X.25 national packet-switched network project. That project still is not operational after five years of development. In exchange, IBM wants a preferential position as a supplier of terminals to the telecommunications authorities and most likely a shift of the protocols used from X.25 to XNA.

As a sweetener, IBM has suggested that it might build a plant in Italy to manufacture Rolm Corp.'s digital private-branch exchange (PBX) for the European market. To interface easily to the IBM version of the Rolm PBX, users will have to implement either IBM SNA or IBM local network interfaces on the systems they build.

In Britain, IBM has persuaded common carrier British Telecom to build the first European node for IBM's Satellite Business Systems joint venture with Communications Satellite Corp. and Aetna Life and Casualty. IBM is also lobbying behind the scenes for a major role in future British public networks and has almost certainly won the contract to build a national electronic funds-transfer network on behalf of British clearing banks.

In West Germany, IBM fought a bitter battle to win the contract from common carrier Deutsche Bundespost for implementation of the national videotex network, Bildschirmtext. The project is nine months behind schedule, and the cost overruns would have knocked out a company without IBM's resources. But IBM has achieved one of its primary aims—a close working relationship with the national postal and telecommunications authority.

Given the stakes that IBM is playing for in networking and the time frame of its strategy, it seems hardly a coincidence that the company has chosen to make its 1984 gift to European colleges a data network, the European Academic and Research Network (EARN).
Quality
High Capacity
Drives

From
FUJITSU

With every high-capacity drive from Fujitsu America you get something more than just faster access speeds, greater capacities and superior price/performance. You also get the Fujitsu quality and reliability that only comes from 16 years experience as a leading OEM disk drive supplier.

Fujitsu's quality is built into every disk drive through a completely integrated manufacturing operation. Ninety-five percent of all components used in the disk drives are Fujitsu manufactured. The other 5% are purchased according to Fujitsu's strict quality standards.

Fujitsu's 14 inch line offers the lowest cost per megabyte storage. The Fujitsu 10½ inch Eagle is a state-of-the-art drive for fast positioning time.

All Fujitsu drives are backed by excellent service and field support, available through Fujitsu America regional offices and Fujitsu's network of authorized regional distributors.

For more information or assistance in selecting the right Fujitsu disk drive for you, contact the Fujitsu America sales office nearest you.
Northwest: (408) 946-8777, Central: (612) 835-7025, East Coast: (617) 229-6310, Southwest: (714) 558-8757, Europe: 441/493-1158.

<table>
<thead>
<tr>
<th>STORAGE PRODUCTS DIVISION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality Lives</td>
</tr>
</tbody>
</table>

CAPACITY (M Bytes) | 10½" | 14" |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AVG. POSITIONING TIME (ms)</td>
<td>18</td>
<td>27</td>
</tr>
<tr>
<td>TRANSFER RATE (M Bytes/s)</td>
<td>1.86</td>
<td>1.01</td>
</tr>
<tr>
<td>INTERFACE</td>
<td>SMD (MOD)</td>
<td>SMD</td>
</tr>
<tr>
<td>POSITIONING METHOD</td>
<td>Rotary Voice Coil</td>
<td>Rotary Voice Coil</td>
</tr>
</tbody>
</table>

New product is indicated in red.
JOIN US IN SUPPORT OF THE 1984 U.S. OLYMPIC TEAM.

TEST DRIVE
THE LATEST MODELS
OF ESPRIT

ESPRIT from HAMILTON/AVNET

We'd like to get you behind the keyboard of some terrific new terminals from Esprit. We'll start by giving you a demonstration here. Then, take one for a live-day spin, on-line with the system at your facility! We think you'll be quite impressed when you get your hands on these great new features:

AFFORDABLE COLOR! The new Esprit III Color Terminal brings the price of color display down, so it costs only a little more than monochrome display terminals. SMARTER THAN THE AVERAGE... TeleVideo 950. Esprit III and Esprit III Color Terminals emulate the TVI 950's "smart" performance, at prices that make a lot more sense. Programmable remote commands and programmable function keys allow you or your users to reconfigure the terminals according to the application.

BUFFERED TERMINALS, TOO! Esprit II buffered terminals offer a very practical selection of features, including switch selectable modes of operation for compatibility with Hazeltine 1500, Regent 25*, and ADM-3A* applications. CALL OUR SPECIALISTS. Our factory-trained Computer Product Specialists can help you select the Esprit terminal with the best price/performance ratio for your system. Call them for a free "test drive." Also, ask about the wide range of computer products and services at Hamilton/Avnet—where being #1 means more.

CIRCLE NO. 58 ON INQUIRY CARD
start in July. The smallest is the 16-35, which provides a central processor and 512K bytes of main memory on a board. The 16-35 is based on a 4.4M-byte-per-second bus. Three larger models each incorporate two buses—a 14M-byte-per-second bus for processors and memory modules and a 4.7M-byte-per-second bus for the input/output system. The single-processor Solar 16-70 comes with as much as 2M bytes of main memory, and the 16-90 comes in single- and dual-processor models.

Bull has enhanced the Mitra family with a top-end machine, the 725, which can "map" the standard Mitra 1M-byte logical address space onto 4M bytes of physical main memory. The 725's 32K-byte cache memory is twice the size of the previous high-end Mitra machine, the 625. Offered as standard with the 725 is a disk access "accelerator," which manages as many as 16 disk drives with storage-module-drive (SMD) interfaces. It contains as much as 16M bytes of RAM, which can be used either as an "electronic" disk drive or as a cache memory for the attached disk drive.

**Bull, Honeywell cooperate**

Bull Systèmes is the outlet for the computers that emerged from Cii Honeywell Bull's long-standing relationship with Honeywell Information Systems (HIS) Inc. As such, Bull Systèmes will sell Bull's Mini 6 computers. HIS' parent is Honeywell Inc., whose share in Bull has been cut from nearly half to less than 10 percent since Bull's nationalization. But Bull continues to build Honeywell computers for customers in Europe, except in Britain and Italy, where HIS maintains its own marketing operations.

Bull and Honeywell still cooperate in product development. The Mini 6 line is closely related to HIS' DPS 6 family. Both run the GCOS Mod 400 operating system. The smallest of the three new Mini 6 machines, the single workstation Mini 6/10, employs the same processor, the 16-bit LSI-6, as the microSystem 6/10 launched by HIS in Britain last year. Like the HIS machine, the Mini 6/10 runs GCOS 6 Mod 400 as standard and can host MS-DOS and CP/M-86 using an optional processor board based on the Intel 8086. But, unlike Mini 6/10 purchasers, microSystem 6/10 customers can receive an option of 20M bytes of Winchester disk storage in addition to standard dual floppy disk drives. The microSystems buyers can also opt for a larger model, the microSystem 6/20, which comes with as much as 40M bytes of Winchester storage and supports as many as five workstations or printers.

Bull customers who want more power than the Mini 6/10 offers can consider the other new Mini 6 machines, the Mini 6/210 and 6/290, which fit between the Mini 6/10 and the larger machines in the Mini 6 family. They are both based on the Megabus architecture employed by all the larger Mini 6 machines and by the HIS DPS 6 models above the microSystems.
IT'S THE LONG WAY TO GO, BUT THE DRIVE'S WELL WORTH IT.

No other OEM supplier manufactures more of the parts that go into their drives than we do. Which is why we claim that Tandon is the only true manufacturer of disk drives.

Other so-called manufacturers might more accurately be called assemblers. They buy other people's parts and put them together.

About 80% of the cost of our drives consists of parts we manufacture ourselves. Which gives us several major advantages over our erstwhile competition.

We keep better control of quality, since our people manufacture our parts to our specifications.

That same control helps us keep a tighter grip on costs, too. And naturally we pass these cost savings on to our customers.

We're independent of the kind of supplier problems that cause product delays for the assemblers. We get what we need when we need it, from our own factories.

This vertical integration story has helped us go from a start-up company to the industry leader faster than any of the assemblers thought possible. It's made a significant contribution to our success at achieving our goal of providing our customers with the best performing, highest quality drives at the lowest possible cost.

A combination the assemblers just can't put together.
Introducing The Ridge 32. Mainframe Performance For Under $43,000.

A mainframe computer for under $43,000 is economical.

A mainframe computer that networks, distributes resources and talks to the world is logical.

The Ridge 32 is both.

Everything you demand from the most expensive mainframes. Without the headaches. And at one-fifth the cost.

The Ridge 32 is a full 32-bit, UNIX® System V based computer. A computer powerful enough for the simultaneous operation of as many as four high-resolution graphics terminals. But for under $43,000,

it's practical for single users too. And you can expand, one Ridge 32 at a time, as your needs grow.

The Ridge 32 comes in a logical new package that gives you enormous computational power without the frustrations of timesharing. Or the costs of an air-conditioned room.
And with Ethernet and a gateway you can access the world. All in a workstation suited for any office environment.

A quick comparison of commonly available benchmarks proves the Ridge 32 to be the greatest price/performance value available.

The figures say it all. Give yourself power at an affordable price. Write Ridge Computers today: 2451 Mission College Boulevard, Santa Clara, CA 95054. Or call 408/986-8500.

Make the economics of logic work for you.

<table>
<thead>
<tr>
<th></th>
<th>Single Precision Whetstone Benchmark (1000 Whetstones/sec)</th>
<th>Puzzle Program (subscript version) Time (sec)</th>
<th>HSPICE™ Circuit Simulation Time (sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ridge 32</td>
<td>1.500</td>
<td>2.2</td>
<td>123</td>
</tr>
<tr>
<td>VAX™ 11/780 FPA</td>
<td>1.100</td>
<td>10.2</td>
<td>143</td>
</tr>
<tr>
<td>DEC™ 2060</td>
<td>1.500</td>
<td>5.4</td>
<td>143</td>
</tr>
<tr>
<td>Prime 750</td>
<td>750</td>
<td>7.3</td>
<td>180</td>
</tr>
</tbody>
</table>

CIRCLE NO. 60 ON INQUIRY CARD
Riches and power don't always go together. Take Plexus, for instance. The world's most powerful UNIX-based supermicros.

Powerful because multiple processors share the UNIX load. So processing power is distributed to where it does the most good.

Terminal I/O. Disk I/O. Data communications. And, of course, data processing.

Our unique architecture also lets us bring you the world's first UNIX Network Operating System (NOS). So you can combine Plexus systems in an Ethernet network for even more power.

NOS gives you real time, continuous access to files. From anywhere in the network.

Files are also updated on the same basis. So everyone in the network works with up-to-the-minute data. Automatically.

No waiting for file transfers. And that's a decided improvement over everything else that's out there.

You also get to save money on powerful UNIX-based software, including COBOL, FORTRAN, Pascal, BASIC, and C. Database management and word processing, too. As well as hundreds of third party UNIX packages.

Plus our own software and maintenance support. And even a software referral service for your OEM programs.

Does all this make us expensive? Absolutely not.

In fact, Plexus systems cost thousands of dollars less than the minicomputers we outperform.

To get a better idea of just how good that performance is, come get a demonstration. Call 800-528-6050, ext. 1444. In Arizona, 800-352-0458, ext. 1444. Or write Ralph Mele at Plexus Computers, Inc., 2230 Martin Avenue, Santa Clara, CA 95050.

You see? You don't have to be rich to be powerful. Just smart.

PLEXUS
Built for speed.
Artificial intelligence faces a crossroads

Developers of expert systems must choose between LISP and Prolog

Edward Foster, Associate Editor

Publicity surrounding Japan's Fifth-Generation computer project has done much to alert system developers to the long-term potential of artificial intelligence (AI). It has also engendered an emotional controversy in the United States between proponents of the two leading development languages, LISP and Prolog. At issue is not which language computers will use in the 1990s but which offers greater potential for developing current AI software products, such as expert systems.

LISP has been the predominant AI language in the United States since the 1950s when it was developed at the Massachusetts Institute of Technology. Prolog, developed in Europe in the early 1970s, is the language of choice among AI researchers there. In addition, the Japanese Fifth-Generation computer project chose Prolog as its software-development language.

"It is a complex issue involving a number of things that are going to influence the industry for the next five years, if not throughout the rest of the decade," predicts Dr. Douglas Partridge, a senior scientist at Hughes Research Laboratories' Corporate AI Center, Calabasas, Calif., where he helps develop in-house expert systems. Partridge believes that logic programming, represented by Prolog and its dialects, is ascending in the American AI community. But he questions whether it can be "matched to the way people approach the kind of problem-solving tasks expert systems will have to do."

Many LISP advocates have greater doubts about Prolog. They admit bewilderment about why the Japanese chose Prolog to develop Fifth Generation software. "They've made a serious mistake," says one. "Prolog is an elegant way to approach research problems, but it is too limited in its inherent structure for serious applications." The growing number of U.S. converts to Prolog suggests that such attitudes are the result of a general misunderstanding of Prolog and logic programming. There may be an emotional tie to LISP by some researchers forged by the years they've spent learning it.
Neither language suits everyone

In spite of the passions the LISP-vs.-Prolog controversy arouses, there is a consensus about each language's strengths and weaknesses. "Prolog is very simple to use," says William Kornfeld, vice president of software technology for Quintus Computer Inc., Palo Alto, Calif., a new company developing Prolog software. "Programming is much easier in Prolog than in LISP, which has evolved into a very complicated language requiring a highly proficient programmer."

Kornfeld notes, however, that, in its original implementation, Prolog pays a price for its simplicity: "In its initial design, some decisions were made that limit the kinds of problems it is good at handling." Such limitations are not inherent in logic programming, Kornfeld asserts. He stresses that the potential of logic programming—not current Prolog dialects—has won over Prolog's advocates.

The most obvious deficiency in current Prolog is its inefficiency in searching a large knowledge base, the AI equivalent of a database. Prolog uses a "depth-first" mechanism—it searches to the end of each possible solution until it finds one that meets certain criteria. An exponential explosion of combinations makes the search of any large knowledge base practically impossible.

"Prolog does not offer any facility for heuristic search mechanisms of the type the programmer employs in LISP," says Mache Creeger, director of marketing for LISP Machine Inc., Culver City, Calif. Heuristic mechanisms, which break a decision into increments, help a system narrow its search by identifying those areas of a knowledge base that will be most fruitful to available to programmers. One of the first objectives of the Japanese Fifth-Generation project is to develop a similar system for a Prolog environment.

The software development environment for LISP users is more sophisticated than the one Prolog offers. This screen dump for a Symbolics 3600 system demonstrates some of the tools, such as debugging facilities and graphic representation of LISP structures.
In 1980 when Tandberg Data introduced the TDV 2200 family, they were the first and only terminals in the world meeting the stringent specifications of the 1985 German Ergonomic Standard... a standard set to protect the safety, health and comfort of the operator. The TDV 2200 includes such features as tilt, swivel, height adjustment, ultra-low profile, detachable keyboard for comfort of operation, non-reflective surfaces, and anti-reflex tube for screen clarity. Since its introduction and as a testimonial to its innovative design, over 50,000 units have been installed.

Today, there are a lot of "me-too" terminal manufacturers who have tried to copy our ergonomic design and that's certainly a plus for the industry. But, with our new TDV 2200S, an even improved version, it will be a lot tougher to copy our performance.

The TDV 2200S can emulate virtually any popular terminal and protocol. It can be equipped with up to 56k bytes of memory and some models will store up to eight pages of data. It has superb communications capabilities including networking; up to 1024 different characters in a single terminal; optional high resolution business graphics; a 70Hz refresh rate for flicker-free viewing; and a 15" screen and big letters for easy readability.

Like its predecessor, the TDV 2200S also features sixteen soft switches called PUSH keys that recall previously stored words, phrases or code sequences; a simplified menu protocol that cuts set-up time in half; and character, page, block or line/field transmission. No other terminal on the market today can match all of these features. But, they are probably trying.

So, you can wait while they try to catch up with us, or you can go with the terminal that sets the pace for the industry. Tandberg Data, Inc., P.O. Box 99, Labriola Court, Armonk, N.Y. 10504. Phone: (914) 273-6400. Telex: 137357 Tanberg Arnk.
WHOSE IDEA WAS IT TO BUY COLORWARE?

Hopefully yours.

It would mean that you've chosen the complete family of advanced color graphics hardware solutions.

You see, some people get into color graphics by buying one solution at a time, as their needs arise. Different manufacturers. Different systems. Incompatible software. Big problems.

But with Colorware, you have an ongoing selection of three terminals and one full system.

AED's terminals, the Model 512, the 767 and the 1024, are all software-compatible (Tektronix 4010 emulation). All completely upgradeable. All offering the best price/performance in their category.

Colorware covers the entire range of color graphics from low end business graphics to high end CAD/CAE and simulation.

The three terminals are for those people who want to add color capabilities to their existing host processor.

The Colorware System 11 is for those who want to buy a complete stand-alone system. One with the power of an LSI 11/23 processor. And the availability of a wide variety of third party software applications packages.

So next time it's your turn to choose color graphics, choose Colorware from AED. The full family of color graphics hardware that stands out from the rest. Call us for a brochure at (408) 733-3555. Or write AED at 440 Potrero Avenue, Sunnyvale, CA 94086.

Quick, before someone else takes credit for it.
search. "A depth-first approach is simply not appropriate in an expert system application because you need to be able to explore a broad range of options quickly."

Creeger cautions others not to jump on the Prolog bandwagon too quickly, arguing that no one approach or language will solve all AI problems. He points out that, despite its name, LISP Machine is not limited to LISP. It recently introduced a version of Prolog called LM-Prolog that runs on its Cadr and Lambda LISP machines.

**Integrated languages borrow from both**

LM-Prolog is just one of many languages that integrate aspects of LISP and Prolog. Developed at the University of Uppsala in Sweden, it allows researchers doing Prolog work to use development tools for LISP environments. "Prolog is very good for such things as expert systems, but it is weak in development tools such as editors, debuggers and I/O facilities," notes Sten-Åke Tärnlund, a professor at Uppsala. "LM-Prolog allows for use of development tools that already exist in the LISP environment." Tärnlund is, nevertheless, committed to logic programming, asserting that when "people develop expert systems in LISP or other programming languages they are really implicitly developing a Prolog system."

Dr. J. Alan Robinson, research director at the Center for Advanced Technology at Syracuse University, Syracuse, N.Y., is also attempting to combine LISP and Prolog. Robinson laid the theoretical groundwork for Prolog's creation with his work in the 1960s on resolution theorem proving. He voices concern about the antagonism of the LISP-Prolog debate: "There really ought not to be a controversy." He maintains that developers must bridge the gap between logic and functional programming before a Prolog-based system can be practical. "Prolog is purely relational; you don't have a way to write an evaluative expression as can be run in functional programming."

Robinson's current project is developing a version of an integrated language he calls Super-LOGLISP, and he is working closely with another project at the center to explore parallel processing architectures. The coexistence of the two projects underscores one of Japan's arguments for choosing Prolog for its Fifth-Generation project: the Japanese believe that logic programming lends itself to parallel processing architectures. Robinson reports that researchers at Syracuse expect to complete software prototypes of Super-LOGLISP in two years and hardware prototypes of parallel processors in three to five years.

Robinson envisions a true fifth-generation computer that employs a language with both LISP and Prolog characteristics. That does not, however, resolve the dilemma that faces those developing expert systems and other AI-based software for conventional computer

---

**The Interpreter**

Prolog programming is based on declared facts and conditional rules that programmers can manipulate in a declarative fashion. A fact consists of a relationship or a predicate and an object or objects. Standard Prolog notation for the English statement "John is father of Mary" would be:

\[
\text{Father (John, Mary).}
\]

A simple query to a database with this fact stored in it of "X is the father of Y."

meaning "Does Mary have a father?"

will produce the answer:

\[
X = \text{John.}
\]

Once Prolog finds a fact that satisfies the desired goal, it stops searching the database unless asked to continue searching for additional facts that also meet the criteria. Conditional rules are declared by the notation ":-" which can be read as "if:" The rule:

\[
\text{Parent (X, Y) :- father (X, Y).}
\]

would mean "X is the parent of Y if X is the father of Y."

Prolog can logically apply such rules to facts in the database to answer more complicated queries. For example, after a program states the following facts, Prolog can logically answer questions about relationships described in them:

**Prolog statement**

- Father (John, Mary).
- Father (Paul, John).
- Grandfather (X, Y) :- parent (Z, Y), father (X, Z).
- Parent (X, Y) :- father (X, Y).

When the following question is asked:

\[
?- \text{grandfather (X, Mary).}
\]

then Prolog will answer:

\[
\text{Is there an X that is grandfather of Mary?}
\]

\[
X = \text{Paul}
\]

Applications that lend themselves to such declarative programming can be relatively quick and easy to write. However, it is difficult to know whether the answer the program provides is necessarily the best solution to a problem. This drawback is magnified in a large database.

**English meaning**

- John is the father of Mary.
- Paul is the father of John.
- X is grandfather of Y if some Z is parent of Y, and X is father of Z.
- X is the parent of Y if X is the father of Y.

**A 1-minute course in Prolog programming**

- The rule Parent (X, Y) :- father (X, Y).
- Then Prolog will answer:

\[
\text{Is there an X that is grandfather of Mary?}
\]

\[
X = \text{Paul}
\]

This drawback is magnified in a large database.
MUSE Software now runs on more computers than ever.

MUSE now operates on Prime, Harris, HP-9000, Apollo, WICAT, Masscomp and the complete line of DEC computers, VAX and PDP-11 included.

And because MUSE is office-grade word processing, you get all the features that make word processing fast and easy. Menus, prompts, messages, single keystroke functions, and a what-you-see-is-what-you-get screen display are but a few of MUSE’s powerful capabilities.

To see for yourself how important office-grade word processing can be to your office, call us to arrange a 30-day trial. On your computer, of course.
The Interpreter

systems in the immediate future. Dr. S. Jerrold Kaplan, chief development officer for Teknowledge Inc., Palo Alto, Calif., feels that most developers won't have to choose between LISP and Prolog. "Anybody worrying about the problem in those terms now is attacking it the wrong way," he insists. "The choice for most will be picking the specific expert system development tool to use."

Is LISP portable?

Teknowledge and many other recent AI start-ups are bringing software tools to market that make the AI implementation-language transparent to a user—who might be the expert whose knowledge is being recorded. However, companies like Teknowledge must still grapple with the LISP-vs.-Prolog debate. Kaplan believes a number of questions remain unanswered about the ultimate implementation language. "LISP is definitely more mature, which means for many applications its software development tools will be superior," he says. "Currently, it is my impression that Prolog is the more portable language of the two, but that situation can change quickly."

Proponents of both languages make conflicting claims concerning portability. "LISP is not at all good as an application language for an expert system," states a Prolog advocate at a major systems house. "Generally, you use it to implement an expert system shell in something else such as EMYCIN, [an application language used in expert systems]. Prolog, on the other hand, looks like it might prove better as an application language than EMYCIN, as well as functioning as the implementation language, as LISP does."

Most observers characterize LISP as a lower-level language than Prolog. Critics suggest this makes it too dependent on dedicated hardware to run efficiently. However, LISP supporters argue that its low-level nature makes it malleable enough to incorporate the virtues of higher-level languages, including Prolog, wherever needed.

Prolog still lacks development tools

"LISP and Prolog really aren't competitors because Prolog is essentially a user-level language," says Henry Baker, director of business development for Symbolics Inc., Cambridge, Mass. "LISP, on the other hand, is a system-building language." One of the main reasons LISP has survived as long as it has, argues Baker, is that it allows developers to build layers on top of the underlying LISP structure for higher-level languages, such as Prolog, APL, Ada or FORTRAN. "I think what we will see are some excellent, powerful Prolog systems written in LISP and running in a LISP environment," Baker maintains. "Prolog is very elegant and starts from a far more sophisticated base than LISP does. The problem Prolog has with controlling the search of its database is strictly a technical one, and I'm sure we will eventually see implementations that get around a lot of that. The intrinsic problem that will remain is the very strong statement that Prolog makes about the type of logic it uses."

Baker and Hughes' Partridge believe Prolog has a more general limitation: it is too strongly tied to mathematical logic, rather than the less-precise logic involved in common-sense problem solving. To mimic common-sense approaches, AI researchers have developed a variety of problem-solving mechanisms, one of which is "fuzzy thinking." Most of these mechanisms employ the heuristic facilities provided by the LISP environment.

Although Prolog advocates agree with many of Baker's points, they refuse to accept his belief that logic programming has intrinsic limits. Quintus' Kornfeld acknowledges that "there is still going to be some need for LISP, at least until fast Prolog programming systems are available. It will be 20 years before things that look like LISP die out."

LISP's strengths are its dedicated architecture, well-developed software-development tools and long-established popularity with the U.S. AI community. However, Prolog's supporters believe that logic programming will dominate when Prolog becomes mature. "It's true that the tools one finds today are all in LISP," says Ray Weiss, of Silogics Inc., a Los Angeles start-up company developing software under Prolog. "You can see the fact that Prolog has a particular kind of search strategy as its great weakness or a great strength. The essential difference is that, when you see a good LISP program, you can be sure a very good programmer wrote it. For expert systems and other things to become commonplace on a variety of systems, you are going to want to consider the trade-offs between the many years required to develop it and the sheer amount of software the market needs."

The choice between LISP and Prolog seems likely to remain difficult for expert-system developers until progress renders both languages obsolete. In some cases, the type of application or the experience of the developers themselves will make the choice easier. And, while not a certainty, the paths leading from both languages could eventually lead a developer to one destination.
"We bought an IBC Middi Cadet™ because no other system could do the job."

Sue Kardas
Director of Career Training
Burlington Area Vocational-Technical Center

"When the Burlington Area Vocational-Technical Center needed a multi-user system for student training, we considered many multi-user systems, but in demo after demo there was too much of a user delay.

Then IBC contacted us, and offered to demonstrate the Middi Cadet's multi-user capabilities—we were skeptical, but we gave it a try.

First, the Middi Cadet ran 9 users doing word processing without any delays. As a second test, we had the Middi operating 3 terminals each on word processing, accounting and BASIC programming. Again, no user delay. This was the multi-user, multi-tasking system we had been looking for.

With the Middi Cadet, we got a higher speed Z80B processor, a very fast hard disk drive and enough memory to do the job (512K Bytes).

On top of that, we felt that we got a very good price from an excellent vendor. Our system was delivered and installed two weeks later. Since then we've been so pleased with the Middi that we're planning to buy another. With two systems providing 18 stations we will be equipped to offer training in all aspects of information processing."

The Middi Cadet is a 10 user system that includes a 6MHz, Z80B CPU; 256 to 512K Bytes of RAM memory; a 20 MB, 5¼"" hard disk drive and a one megabyte 5¼"" floppy disk drive.

For more information on the Middi Cadet, see your local IBC dealer.

To locate the dealer nearest you, call or write:

OUTSIDE THE USA
IBC(Integrated Business Computers)
21621 Nordhoff Street
Chatsworth, CA 91311
(818) 882-9007 TELEX NO. 215349

WITHIN THE USA
IBC/DISTRIBUTION
1140 36th Street, Suite 212
Ogden, Utah 84403
(801) 621-2294

Circle No. 65 For END USERS.
Circle No. 197 For DEALERS.

See us at Comdex, Atlanta, Booth #D0658.
Announcing the WY-75.

Our new WY-75, VT-100 software-compatible terminal has a style that's truly impressive. It offers a combination of features you can't find in any other VT-100 software-compatible terminal. Like a compact, ergonomic design. A sculpted, low-profile keyboard. And a swivel and tilt non-glare 14" screen, tailored with an 80/132 column format.

Priced in a class by itself, the WY-75 lists for only $795.

Contact Wyse Technology for more information. And discover a great new outfit.

$795

All DEC'd out and ready to go.

Wyse Technology, 3040 N. First Street, San Jose, CA, 95134, 408/946-3075, TLX 910-338-2251, Outside CA call toll free, 800/421-1058, in So. CA 213/340-2013.

DEC is a trademark of Digital Equipment Corporation.
DIMENSION.
THE MOST POWERFUL,
MOST COMPATIBLE
PERSONAL COMPUTER
YOU CAN BUY.

Introducing the capability the world has been waiting for. A single personal computer able to handle Apple®, IBM®, TRS-80®, UNIX™ and CP/M® based software.

The Dimension 68000 Professional Personal Computer does it all. It actually contains the microprocessors found in all of today's popular personal computers. And a dramatic innovation creates the environment that lets these systems function merely by plugging in the software.

Add to this the incredible power of a 32 bit MC68000 microprocessor with up to 16 megabytes of random access memory.

Dimension has the power of a mainframe at a personal computer price. It's obviously the best value you can find. For more information ask your dealer or call us at (214) 630-2562 for the name of your nearest dealer.

---

Apple is a registered trademark of Apple Computer, Inc.; IBM is a registered trademark of International Business Machines Corp.; TRS-80 is a registered trademark of Tandy Corporation; UNIX is a trademark of Bell Laboratories, Inc.; CP/M is a registered trademark of Digital Research Corporation.
Plated promises and sputtering shipments characterize thin-film media makers

Robert Sehr, Associate Editor

Before an audience of his fellow disk drive entrepreneurs gathered at the Dataquest Inc. Memory Industry Conference, Norman Dion, founder and chairman of Dysan Corp., recalled an experiment with plated media he took part in 20 years ago at IBM Corp. In those times, areal densities on the 14-inch platters were about 5.022M bits per square inch. Today's 5¼-inch platters are approaching densities of 25M bits per square inch. But even back then, there was a demand for higher density media.

The experiment, Dion recalls, was a dismal failure. IBM discovered it could not achieve a cost-effective plating process that could be transferred to high-volume manufacturing. Dion believes that, despite the rush to thin-film media today, nothing has changed IBM’s basic finding that technology can’t be rushed. “Technology is organic; it grows in increments,” he says.

Dysan, the largest supplier of 5¼-inch oxide platters, wants to do nothing to hasten the demise of its best-selling product. But the message from the market seems clear: thin film is in. No fewer than three dozen companies or divisions of companies have dedicated themselves in the past year to meeting a demand that disk drive analyst Jim Porter, author of Disk/Trend Report, published in Mountain View, Calif., believes may reach 4 million 5¼-inch disks by 1986.

Analyst Ray Freeman, president of Freeman Associates in Santa Barbara, Calif., says there is a “market of opportunity” within the 17.9 million rigid Winchester platters measuring 5¼ inches or less that will be shipped in 1988. Most of those, Freeman believes, will be thin-film media platters.

Freeman notes, however, that the proliferation of both OEM and captive suppliers has made it unlikely that most of them will remain profitable, especially since thin-film media is often a capital-intensive rather than labor-intensive business, requiring a lot of capital up front. “It’s not clear how they can all survive,” he comments.

Plated media takes an early lead

Of the two types of thin-film media—plated and sputtered—the most widely available is plated. Two methods of plating are in use: electroless, primarily a chemical batch process, and electroplating, which uses electric current to coat the disk with chemicals. The most common disk now shipped uses the electroless process. Shipping those disks are the industry’s original suppliers—PolyDisc Systems Inc. (now a subsidiary of National Micronetics Inc., San Diego) and Ampex Corp., San Jose, Calif.

Ampex developed the first plated media in 1966 under the trade name “Alar” to increase recording densities in its instant-replay video equipment. Until 1981, however, there was little industry demand for plated or any other kind of thin-film media. The IBM PC and the resulting proliferation of 5¼-inch Winchesters—not to mention portable computers—changed all

---

ANNOUNCED PLAYERS IN THIN-FILM MEDIA

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Disk Technology</td>
<td>West Lake Village, Calif.</td>
<td>plated</td>
</tr>
<tr>
<td>Akashic Memories</td>
<td>Santa Clara, Calif.</td>
<td>sputtered</td>
</tr>
<tr>
<td>Ampex Corp.</td>
<td>San Jose, Calif.</td>
<td>plated</td>
</tr>
<tr>
<td>Anelua Corp.* (NEC)</td>
<td>San Jose, Calif.</td>
<td>sputtered</td>
</tr>
<tr>
<td>Applied Information Memories</td>
<td>Milpitas, Calif.</td>
<td>sputtered</td>
</tr>
<tr>
<td>Argo</td>
<td>Radnor, Pa.</td>
<td>plated</td>
</tr>
<tr>
<td>Burroughs Memorex</td>
<td>West Lake Village, Calif.</td>
<td>plated</td>
</tr>
<tr>
<td>Button Magnekote</td>
<td>Culver City, Calif.</td>
<td>plated</td>
</tr>
<tr>
<td>Control Data Corp.*</td>
<td>Minneapolis, Minn.</td>
<td>plated</td>
</tr>
<tr>
<td>Datapoint Corp.*</td>
<td>Mountain View, Calif.</td>
<td>plated</td>
</tr>
<tr>
<td>Disc Tech One Inc.</td>
<td>Santa Barbara, Calif.</td>
<td>sputtered</td>
</tr>
<tr>
<td>Domain Technology</td>
<td>Milpitas, Calif.</td>
<td>sputtered</td>
</tr>
<tr>
<td>Evotek*</td>
<td>Fremont, Calif.</td>
<td>plated</td>
</tr>
<tr>
<td>Fujitsu America Inc.*</td>
<td>Santa Clara, Calif.</td>
<td>sputtered</td>
</tr>
<tr>
<td>Hewlett-Packard Co.*</td>
<td>Boise, Idaho</td>
<td>sputtered</td>
</tr>
<tr>
<td>Ibis Systems Inc.*</td>
<td>Duarte, Calif.</td>
<td>plated</td>
</tr>
<tr>
<td>Information Memories Inc.</td>
<td>Santa Clara, Calif.</td>
<td>plated</td>
</tr>
<tr>
<td>KemTec</td>
<td>Burbank, Calif.</td>
<td>N/A</td>
</tr>
<tr>
<td>KSI Disc Products Corp. (International Memories Inc.)*</td>
<td>Chino, Calif.</td>
<td>plated</td>
</tr>
<tr>
<td>Lanz Corp.</td>
<td>San Jose, Calif.</td>
<td>sputtered</td>
</tr>
<tr>
<td>Lin Data Corp.</td>
<td>Santa Clara, Calif.</td>
<td>sputtered</td>
</tr>
<tr>
<td>Media Technology Corp.</td>
<td>San Jose, Calif.</td>
<td>sputtered</td>
</tr>
<tr>
<td>Micro Disc (SyQuest Technology)*</td>
<td>Fremont, Calif.</td>
<td>sputtered</td>
</tr>
<tr>
<td>Nashua Corp.</td>
<td>Nashua, N.H.</td>
<td>plated</td>
</tr>
<tr>
<td>National Micronetics Inc. (formerly Poly-Disc)</td>
<td>San Diego, Calif.</td>
<td>plated</td>
</tr>
<tr>
<td>Oktel (Xidex)</td>
<td>Campbell, Calif.</td>
<td>N/A</td>
</tr>
<tr>
<td>SAE Magnetics</td>
<td>Santa Clara, Calif.</td>
<td>plated</td>
</tr>
<tr>
<td>Tandon Corp.*</td>
<td>Santa Clara, Calif.</td>
<td>sputtered</td>
</tr>
<tr>
<td>Tri-Media Corp.</td>
<td>Fremont, Calif.</td>
<td>sputtered</td>
</tr>
<tr>
<td>Ultra Disc</td>
<td>San Jose, Calif.</td>
<td>plated</td>
</tr>
<tr>
<td>Xerox Magnetics</td>
<td>San Jose, Calif.</td>
<td>plated</td>
</tr>
</tbody>
</table>

*Signifies captive supplier  
Source: Freeman Associates
that. Plated media delivered the higher capacities and ruggedness the compact machines needed.

Ampex shipments of plated disks jumped from less than 25,000 in 1981 to 430,000 in 1983. In 1986, Ampex expects to ship 3 million disks from its new $15 million facility in San Jose, Calif., and another planned facility in San Mateo, Calif., which will produce only sub-5¼-inch platters.

Although Ampex has enjoyed a clear lead—almost a monopoly—in plated-media shipments, it has not entirely cherished the role. In thin-film media, yields and shipments are key, and Ampex has frequently disappointed its customers on both counts, as is often the case when one source has the only game in town. By setting up licensing-fee agreements, Ampex is sharing its technology with fledging competitors, thereby broadening the supplier base. "It's a nightmare to be a sole supplier of anything," says Ed Fleming, general manager of Ampex's disk media operations division. "It has been our effort to generate competition." Rather than being apprehensive about the new competitors, he says, "I just hope they get rolling faster than they are."

The only new OEM supplier out of the starting gate appears to be Domain Technology, Milpitas, Calif. Domain was founded in October 1982 by former Memorex Corp. Media Products Group president Richard Martin and Datapoint Corp. director of technology Frank D. Ruble. The company has $4 million in venture capital and began shipping products last October.

Other companies preparing OEM shipments of plated disks include a new Xebec Systems Inc. subsidiary, Information Memories Inc., Santa Clara, Calif., headed by Burton Sisco, a co-founder of Evotek. Another disk drive manufacturer, Storage Technology Corp., has unleashed its captive supplier of 14-inch platters, Media Technology Corp., San Jose, Calif., allowing it to enter the OEM plated-media battle. Similarly, International Memories Inc. has set up a plated-media subsidiary, KSI Disc Products Corp., in Chino, Calif. The list has grown faster than a venture capitalist's stock portfolio (see Table, Page 129).

Advocates of electroplated thin-film media claim Ampex's electroless method carries a hazard within its batch process: contamination of the chemicals means contamination of the entire batch. In contrast, the electroplating process, which uses electrical current to coat the surface of the substrate with nickel, can be controlled on every disk. "You've got to have superb process control with electroless plating, something that's not always possible," says a spokesman for Media Technology. "Although the [electroplate]process is more costly, you buy it back in yields."

Fleming acknowledges that process control is top priority in the Ampex Alar process. He says Ampex has made a major investment in process-monitoring equipment so that technicians can check every step of the chemical-plating process, both manually and with instruments. Every disk that passes through the line is individually certified, Fleming emphasizes.

**Sputtered media enters the arena**

Many proponents of plated media believe it is a temporary solution to the density issue. They believe the real answer is sputtered media, a dry, well-controlled but much more expensive process. Unlike plating, sputtering is performed in a vacuum chamber, which eliminates oxygen contamination. The sputtering process needs no lubricants and ends the threat of heads sticking to the landing zone. An outgrowth of semiconductor technology, sputtering is very costly. "Sputtering has always had allure for academic types," says Fleming, "but it's not very practical for volume manufacturing."

However, some of the "academic types" who favor sputtering work in influential corners. Hewlett-Packard Co. announced late last year that it would supply its own sputtered disks for its new line of 5¼- and 3½-inch disk drives (MMS, October 1983, Page 27). Digital Equipment Corp. is experimenting with sputtering processes, as is the most influential disk drive user of them all: IBM.

OEM suppliers of sputtered media are also ramping up. Applied Information Memories, Milpitas, Calif., has announced plans to start manufacturing both sputtered media and disk drives this spring at a facility in Austin, Texas (MMS, September 1983, Page 40). Lin Data
The freedom some birds have to migrate is remarkably similar to the freedom you have with software for the System 8000.

Moving your application program with Zilog's System 8000 is as easy as the migration of Canadian geese.

Zilog's solutions free you from the constraints of traditional systems.

Outdated proprietary languages and operating systems limit your movement from vendor to vendor, much like the restricted flight of the albatross.

GSA schedule for Federal government applications.
For the whole story, call Zilog Systems Division at (800) 841-2255. Or write: Zilog Systems Division, Corporate Publications, 1315 Dell Avenue, MS C2-6, Campbell, CA 95008.

*UNIX is a trademark of Bell Laboratories. Zilog is licensed by AT&T. DEC and DIBOL are registered trademarks of Digital Equipment Corporation. ICOS and Proxi are trademarks of Data General Corporation.

Zilog's high performance, multi-user, UNIX®-based System 8000 supermicros give you a proven way to quickly port your minicomputer software onto affordable micros. For instance, we offer compatible migration tools for Basic Four BB III, DEC®, DIBOL®, and DG ICOS® COBOL and Proxi®. And with the UNIX operating system, you can take advantage of one of the fastest-growing business opportunities in the industry.

Get a level of service, support and company stability not found from other microcomputer vendors.

Find out what it's like to free yourself from expensive minicomputers, and get a level of service, support and company stability not found from other microcomputer vendors. Ask about our RSVP Referred Software Vendor Program, too, where you can find the applications software and tools you need as well as list your software. Zilog is also on the

CIRCLE NO. 68 ON INQUIRY CARD
KEL Graphics. So explicit we suggest you discover them in the privacy of your office.

An affordable, high-resolution graphics family

If you could personally test a KEL graphics terminal or printer—in your own office, on your own applications—you would discover a presentation so remarkably sharp and clear it leaves virtually nothing to the imagination.

You would also discover a product that offers exceptional performance at a highly competitive price. One that's easy to use. Reliable. Versatile enough to handle the most demanding business, engineering, scientific and medical applications. Fully compatible with standard industry software such as PLOT 10, DISSPLA and TELL-A-GRAFTH. And readily integrated into your OEM or end-user system.

J1000—Series terminals

KEL J1000—Series graphics terminals are available with the J1014 14" monochrome display, the J1014C 14" color display, and the J1019C 19" color display. All KEL terminals offer the economy of raster scan technology, Tektronix 4010/4014 and DEC VTI00 emulation, and 1024 x 780 screen resolution. They also include as standard features, such non-standard capabilities as conic generation, area fill, selective character and vector erase, menu set-up mode, and built-in interfaces for a digitizer tablet and hard copy device. The 4120 Printer produces hard copy directly from any KEL terminal.

A remote PLOT 10—compatible printer/plotter

The KEL Model 4135G Printer is designed for applications requiring the production of superior graphics and high-quality text. A high-speed impact printer, the Model 4135G operates, through its RS232 I/O port, as a remote printer/plotter. The Model 4135G accepts PLOT 10 commands, generates and prints alphanumerics and graphics at 2300 dot-rows per minute with 160 dot-per-inch resolution. In its line printer mode, the Model 4135G produces alphanumerics at 120 lines per minute.

Discover for yourself

Please use this magazine's reply card for more information, or contact KEL directly. We'll be glad to arrange a no-cost, no-obligation trial for qualified prospects. Call us now to discover—in your own office—how truly impressive a KEL terminal or printer is.

KEL, INC.

400 West Cummings Park
Woburn, MA 01801
(617) 933-7852

KEL, INC. is a subsidiary of Kanematsu Electronics Ltd., one of the leading Japanese suppliers of computer products.

CIRCLE NO. 69 ON INQUIRY CARD
The Interpreter

Corp., Santa Clara, Calif., survived a legal challenge from IBM against the company's founder, Young S. Lin, a 16-year veteran of Big Blue's Magnetic Recording Center in San Jose, Calif. The outcome of the challenge was that Lin Data agreed not to use proprietary IBM processes or hire any more IBM employees. Lin Data is now gathering some $4 million in venture capital to begin producing samples of sputtered media and is preparing for spring production.

The major stumbling blocks to using sputtered media are high entry-level costs and delays in receiving sputtering equipment. Dr. James H. Smith, director of Advanced Media Development at Evotek, which supplies electroplated media for its high-performance, 5¼-inch Winchesters, prefers sputtered to plated media but believes sputtered media's time has not yet come. "When you get over 20,000 flux changes per inch, plated media just won't do it," he says. "However, it will be able to handle the current and next generation of disk drives."

Smith claims that, because so little production equipment to make sputtered media is available, anyone entering the market should be prepared for delays in equipment deliveries. However, Varian Associates, Santa Clara, Calif., a veteran manufacturer of sputtering equipment for the semiconductor industry, reports no inordinate delays.

Richard Lavine, administrator of Varian's magnetic disk project, says the company's new model MDP-100 sputtering machine can produce as many as 180 sputtered disks per hour, depending on the process. The process is fastest for ordinary longitudinally recorded disks and much slower for vertically recorded disks, which require greater thickness. The machine costs $1 million, and Lavine reports that delivery time is only six months. There are at least three other manufacturers of sputtering equipment in the United States and Japan.

James V. DeStefano, manager of business strategies for advanced technologies at Dysan, believes the cost of sputtering machines will probably not decrease, despite increased demand from disk media manufacturers. "Semiconductor technology has already put sputtering machines far down on the cost curve," he says. "It's unlikely that they will drop much further." DeStefano agrees, however, that sputtering is a big improvement over plating because sputtering does not allow contamination of materials and because the sputtered surface melds itself into the coating of the disk instead of into the substrate.

Although Dysan's DeStefano and Ampex's Fleming disagree on every other issue, they both agree that the cost of making sputtered media may push manufacturers to raise prices. If the prices go too high, they may not hold. "The market will determine the ultimate price of the disk," Fleming says, "no matter what the actual cost of making the disk may be."

As a result, Fleming says, some manufacturers of sputtered media will not have big enough profit margins to give them a return on their investments. Disk drive manufacturers will not necessarily be willing to pay a premium for sputtered media, Fleming concludes, since market pressures force them to achieve the highest performance at the lowest cost.

Oxide media suppliers use the same kind of particles to coat disks today that they used in 1947, says Jim DeStefano, manager of business strategy for Dysan. Using newer particles such as Isomax, developed by Spin Physics, will strengthen the viability of oxide media, making thin-film media unnecessary, he predicts.

Sputtered media will not be required until perpendicular recording becomes commonplace, believes Ed Fleming, general manager of Ampex's disk media division. In the meantime, he says, plated media provides high density in a small package at a lower cost than sputtered media.
Manufacturers position themselves

DeStefano maintains that the move toward thin-film media and away from oxide media may be premature because disk drive technology cannot keep pace with advances in coating technology. Today's drives are barely able to break the density barrier of 10,000 bits per inch (bpi), he emphasizes. Recent studies show that oxide media can achieve densities of 32,000 bpi, while thin-film media can reach 44,000 bpi. In addition, new oxide-particle media, such as the Isomax isotropic media developed by Eastman-Kodak Co. subsidiary Spin Physics Corp., can reach densities of 46,000 bpi and may eventually reach 62,000 bpi, DeStefano claims. “What is our economic incentive to go through all of the pain, aggravation and cost of thin-film media, when drive technology is nowhere near ready for it?” he asks.

Although analyst Freeman agrees with DeStefano’s analysis, he maintains that Dysan will have to respond to the demand for thin-film media. “It’s a real and very large market,” Freeman points out. “If Dysan wants to retain its dominant market role, it will have no choice but to respond to the market.”

In the meantime, the battle is on to wrest the thin-film media leadership role from Ampex, and Ampex is fighting back. Ampex recently signed a licensing agreement with German-based media giant BASF that allows BASF to make Alar disks. Ampex had previously granted a similar license to Ultra Disc, a subsidiary of Computer & Communications Technology Corp., Santa Barbara, Calif.

Fleming acknowledges that Ampex has had problems in meeting customer demand. “Just one customer, like a Seagate [Technology], could wipe out our total manufacturing capacity,” he notes to explain licensing other manufacturers to make Alar disks.

Getting a $15 million manufacturing facility on-line was no small effort, Fleming admits. Even though the lines are now producing 73,000 disks per month, yields are still not as high as the company would like. “We are still debugging some of the equipment,” Fleming adds. “As the equipment improves, the product will improve.” Ampex can be sure that its competitors are waiting for any missteps it might make along the way.
There are a lot of powerful reasons to write software for HP systems.

An enhanced UNIX™ operating system. And the cash bonuses you'll earn when you sell your UNIX-compatible applications with an HP system.

Those are compelling reasons to participate in HP's special program for software companies.

We have a whole range of products that can run UNIX, from our popular line of MC 68000-based machines to our powerful 32-bit systems. And we'll be expanding that range all the time.

While we're giving you a wider choice of products for your programs, we're also making it even easier for you to write them.

We've developed an especially powerful version of the industry standard UNIX, called HP-UX. Its enhancements provide for graphics, database management and networking, to name just a few.

When you team up with HP, you have our full service organization behind you. Our factory and field support teams are dedicated to problem-solving. So, if you or your customers have any questions about HP-UX, just give us a call. We're ready to help.

And we're ready to make your efforts very rewarding. When your customer buys an HP system because of your application, we'll give you a cash bonus of 30% of your software's sales price — up to 6% of the net HP system's price. Our only restriction is that, to qualify for the bonus, your software must sell for at least $10,000.

There are lots of other good reasons to write HP-compatible software for UNIX or any of our other operating systems. To find out all about them, write to Hewlett-Packard, Attn: Gwen Miller, Dept. 08190, 19447 Pruneridge Avenue, Cupertino, CA 95014. In Europe, contact Henk van Lammeren, Hewlett-Packard Nederlands B.V., Dept. 08190, P.O. Box 529, 1180 AM Amstelveen, The Netherlands.

UNIX is a trademark of Bell Laboratories.
INFO/Software gives you:
THE BEST THINKING ON SOFTWARE

The INFO/Software Conference is the single, most complete source of solutions for your complex software problems. Solutions to strategic management software problems. Solutions to practical day-to-day software problems. Solutions based on the professional experiences of the best minds in the computer industry.

The Conference Chairman is Software News Editor, Ed Bride. And the roster of Conference Advisors reads like a Who's Who in the Computer Industry.

These leaders will be addressing the most relevant, most timely, most important topics that affect business software decisions. Topics that cover the entire spectrum of mainframe, mini and microcomputer software, operating systems and applications. Topics like: • Micro-to-mainframe: access vs. security • Integrated mainframe applications: what do they mean to the end user? • Information Center Operation • Business Graphics • Overseas Operations: selecting software.

There will even be a panel discussion called "Meet the Pressure." Where you can ask the CEOs of leading companies hard questions about software.

This complete Conference is held concurrently with the INFO/Software Show — the single most complete Show to see every kind of business software.

So find out how the best thinking in the software industry can turn your problems into solutions. At the INFO/Software Conference.

For further information contact:
Clapp & Poliak (A Cahners Exposition Group Company) 708 Third Avenue, New York, N.Y. 10017
Telephone 212-661-8010 Telex 12-6185 Cable CLAPPOLIAK NYK

After April 1, 1984
999 Summer Street, P.O. Box 3833, Stamford, CT 06905
Telephone 203-964-0000 Telex 649400 CAHEX WU STD

136 CIRCLE NO. 72 ON INQUIRY CARD
MINI-MICRO SYSTEMS/MAY 1984
Now you can watch the entire Whizzard family in 3D. Because the industry's widest range of high performance graphics systems now has a whole new dimension.

A third dimension.

Which means now you can buy 3D Megateknology starting for under $12,000. For instance, the Whizzard 1600 desktop design terminals with color or monochrome capabilities, very high resolution and VT-100™ compatibility.

Or our Whizzard 3355, which holds the speed record for its price range—400,000 vectors per second—thanks to our one-of-a-kind Graphics Engine™.

Then there's the ultimate computer graphics system: the Whizzard 7200. It guarantees remarkable speed and flexibility, modular architecture that supports high resolution and real-time dynamic color raster displays, and unmatched interactive graphics capabilities.

Plus, with every one of our products you get Megateknology—our longstanding trademark of innovative design, quality and high reliability.

There's a whole new dimension to our Whizzard family, thanks to the latest in 3D Megateknology.

Watch it add more dimension to your creativity.

That's Megateknology™.

See us at NCGA Booth #318, Anaheim, California May 14-17.
Our reputation on the line.
We're a manufacturing company. Our engineers are manufacturing engineers. And our assemblers know that our reputation, and your system's, are in their hands.

Our strategy is simple. We build reliable disk drives, in volume. We've concentrated on perfecting the medium capacity Winchesters you need, now. 8" drives, from 10 to 85 megabytes; 5¼" drives, from 20 to 40 megabytes. By perfecting, we mean as perfect in 10,000 of your systems as they were in one demonstration unit.

We start with a cleaner design. Fewer parts. A design that can be assembled smoothly, tested effectively, and produced in volume without compromising quality.

Our production techniques, like our Winchesters, are a highly refined blend of experience and innovation. The "clean tunnel" approach we pioneered, for example, is less costly, more flexible, and yet just as free of contaminants as standard clean rooms. The modular sections can be expanded, duplicated or rearranged around changing production needs.

We'd like an opportunity to show you why we're so confident about putting our reputation, and yours, on the line. Give us a call.


QUANTUM
Too many COMDEX exhibitors forget who their customer is. They think it's you, the dealer or distributor. OSM knows better. Our customer is the same as your customer. The end-user.

So, when you visit OSM's booth, you won't find a lot of flashy gimmicks. The best way to impress you is to build computers that impress your customers.

And our computers do just that. Take the Zeus systems, for example. Our hard-working multi-user, multi-processor family. End-users can put multiple work-stations on their employees' desks, each with a dedicated CPU, for only about $2,000.00 a piece.

Impressive? There's more. Like IBM-compatible PCs with many more options, models, and a better price tag than IBM's. And a complete family of profitable peripherals.

So come visit OSM at COMDEX. Then together, we can impress our customers.

Our Solutions Mean Business

OSM Computer Corporation

BOOTH 4406
IN THE NEW WEST HALL

See us at COMDEX Spring '84
Why can’t Europe produce computers?

Members of Western Europe’s computer industry analyze their failure to compete with U.S. and Japanese manufacturers

Keith Jones, European Editor

Western Europe matches the United States in the production of many traditional commodities—chemicals, steel and motor vehicles, for example. In electronics, production of telecommunication equipment and consumer electronics goods, it compares favorably with that of its U.S. counterparts. But computer manufacturing stands among Europe’s least successful industries.

In most sectors of the European computer market, U.S. vendors dominate. IBM Corp. conquered the mainframe market many years ago, and Digital Equipment Corp. and several other U.S. manufacturers took over the minicomputer market soon after. Most recently, U.S. suppliers captured the lion’s share of the burgeoning business market for microcomputers. Even in Europe’s mightiest industrial citadel, West Germany, U.S. vendors dominate most market sectors; IBM has a stronger hold over the mainframe market there than it does in many other parts of Europe.

A few exceptions counter otherwise complete U.S. domination of Europe’s computer market. Nixdorf Computer A.G. is a formidable contender in West Germany’s small business systems market. Britain’s ICL Plc. retains most of its domestic mainframe base despite fierce competition from IBM. France boasts an impressive computer services industry. And Italy is home for Olivetti SpA, one of the few European-based companies to have a significant presence in most parts of Western Europe.

National boundaries fragment the market

Unlike Olivetti, most European-based computer manufacturers sell a majority of their products within the boundaries of their own countries. Industry observers identify this market fragmentation as perhaps the biggest obstacle to the manufacturers’ success. “People talk about the United States of Europe, but there is no such thing,” remarks microcomputer market analyst Gordon Curran, a director of Intelligent Electronics, Paris. “Success in one country is not good enough. Bigger American vendors can spend far more money on advertising and distribution than European manufacturers.” Curran cites language barriers and the non-existence of European-wide distribution and maintenance companies as two obstacles keeping European companies from growing big enough to compete effectively with U.S. competitors.

A study done by Logica UK Ltd., London, entitled “Telematica 1984,” confirms the dominance of U.S. microcomputer vendors. Logica UK consultant Stephen Timms points out that U.S. vendors outnumber European suppliers in every European country. “U.S. companies are first with the technology,” Timms declares. “The investment [in a new technology] is too large for small European companies, while big European manufacturers take a long time to realize the significance of a technology.”

The fragmented European market also discourages investment from venture capitalists, the entrepreneurs
who nurture so many successful U.S. computer companies through their formative years. Venture capitalist Peter Dicks, a director of Abingworth Ltd., London, explains how differences in the U.S. market make it easier for new companies to develop there: "The United States is a vast domestic market; a company can grow without having to export in its early life." Even though Abingworth is based in London, it primarily backs U.S. enterprises.

Another London venture-capital house, 3i Ventures, directs most of its investments toward British companies because its funds come from leading British banks, including the Bank of England. But 3i director Geoff Taylor explains that his organization still puts about one-third of its money into U.S. high-tech companies and has just opened an office in Newport Beach, Calif. This allows 3i to keep in touch with developing technology and to maintain a U.S. presence that can help establish British companies there.

Taylor believes that innovative British companies can grow as fast as young U.S. enterprises by ignoring Continental Europe and entering the huge, homogeneous U.S. market instead. "The biggest advantage we can offer a British company is to help them get into the U.S. market," argues Taylor. "Continental Europe is not a major market for a young British company to go after. It is not a Common Market; it is six to 10 individual markets and is very fragmented."

**OTC stock markets spur venture capital**

Dicks and Taylor both credit an American-style over-the-counter (OTC) stock market established a few years ago with improving Britain's venture-capital environment. "An OTC market enables a young company to go public early in its life," explains Dicks. "This puts a value on the investor's holding and makes the investor some money."

The French also set up an OTC, called the Second Marché, in January 1983 and passed legislation similar to that in the United States to facilitate setting up venture funds and allow low capital gains taxes. A company can go on the Marché after only three years. Alan Patricof Associés SARL, Paris, set up the first venture-capital fund last June.

The European climate for venture-capital formation also contrasts with that in the United States, say Dicks and Taylor, in that talented people in the United States seem more willing than their European counterparts to risk leaving a large company to start a new enterprise. Not only are U.S. entrepreneurs attracted by the promise of rewards in the OTC market, but also they are encouraged by the success of others, Taylor

---

**COUNTRY OF ORIGIN OF BUSINESS MICROCOMPUTER SUPPLIERS IN WESTERN EUROPE, 1983**

- **USA**: 44.6%
- **UK**: 13.4%
- **WEST GERMANY**: 10.9%
- **OTHER EUROPEAN**: 10.9%
- **JAPAN**: 16.8%
- **OTHER**: 3.4%

*Source: Logica UK Ltd.*

U.S. manufacturers claimed three-quarters of the 1983 installed base for business microcomputers in Western Europe, leaving European suppliers with less than a quarter. In its study entitled "Telematica 1984," Logica UK Ltd. estimates that the installed base for business microcomputers in 1983 was 752,000 machines.

**MANUFACTURERS' SHARE OF 1983 INSTALLED BASE OF BUSINESS MICROCOMPUTERS**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Market share %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>19.2</td>
</tr>
<tr>
<td>Commodore</td>
<td>18.7</td>
</tr>
<tr>
<td>IBM</td>
<td>9.8</td>
</tr>
<tr>
<td>Olivetti</td>
<td>7</td>
</tr>
<tr>
<td>Victor</td>
<td>6.5</td>
</tr>
<tr>
<td>Hewlett-Packard</td>
<td>4.6</td>
</tr>
<tr>
<td>Intertec</td>
<td>3</td>
</tr>
<tr>
<td>Tandy</td>
<td>2.8</td>
</tr>
<tr>
<td>Digital</td>
<td>2.4</td>
</tr>
<tr>
<td>Bull</td>
<td>2.1</td>
</tr>
<tr>
<td>Televideo</td>
<td>1.9</td>
</tr>
<tr>
<td>Xerox</td>
<td>1.9</td>
</tr>
<tr>
<td>Triumph Adler</td>
<td>1.5</td>
</tr>
<tr>
<td>Comart</td>
<td>1.2</td>
</tr>
<tr>
<td>Burroughs</td>
<td>0.8</td>
</tr>
<tr>
<td>Other</td>
<td>16.6</td>
</tr>
</tbody>
</table>

*Source: Logica UK Ltd.*

U.S. suppliers accounted for nearly half the companies selling business microcomputers in Western Europe in 1983. In contrast, all European suppliers combined accounted for just over a third. (These statistics include only those suppliers that sell products in at least two countries in Western Europe.)
believes: “Managers in the United States these days know other people like themselves who have succeeded in their own businesses—so there has been a snowball effect.”

Carlo de Benedetti, chairman of Olivetti, underlines the importance of venture capital in the success of new U.S. companies. Speaking at a London conference last year sponsored by Britain’s leading business newspaper, the Financial Times, he cited a study of 72 U.S. companies that were started with venture capital. They required $200 million in venture funding from 1970 to 1979, but by 1979 they employed 130,000 people and had generated revenues of $6 billion. De Benedetti also sees European OTCs as a prerequisite for increased venture-capital activity in Europe.

**Government-funded research holds promise**

The Common Market, run by the European Commission (EC), targets publicly funded strategic research as the long-term cure for Europe’s computer malady. The EC plans to spend $750 million over the next five years on the European Strategic Program of R&D in Information Technologies (ESPRIT) program. The program’s goal is to put European companies in the race with the United States and Japan to develop fifth-generation computing technologies. Participating companies will match the commission’s contribution, boosting total funding to $1.5 billion. (MMS, July 1983, Page 81).

To qualify for funds, companies must form consortia with companies from at least two Common Market countries. The Common Market believes that the “pre-competitive” nature of the research should eliminate tensions between participants. Thus, the Common Market will try to avoid the problems it encountered in an ill-fated attempt at Pan-European computer industry cooperation in the early 1970s. The project tried to create Unidata, a company on the scale of IBM, which would have merged the computer product lines of Siemens AG, West Germany, multinational company N.V. Philips, the Netherlands, and an ancestor of the Bull Group, France. Plans called for each company to manufacture computers for one product line and to sell the entire line. Unidata crashed when the French government decided that a trans-Atlantic accord was more promising and merged the French operation with Honeywell Inc., Minneapolis, to form Cii Honeywell Bull.

National interests have not yet killed ESPRIT, but they did delay final approval of its funding. Problems grew out of a disagreement among member countries about contributions to the overall Common Market budget, of which ESPRIT’s costs account for only a fraction. Far from concerning the future of high technology in Europe, the dispute centered on the Common Market’s massive agricultural subsidies.

Some members of Europe’s computer industry view ESPRIT with skepticism. The Association of European Independent Information Industry (AEIII), a group of small- and medium-sized manufacturers of computer peripherals and small systems, believes that large companies will get most ESPRIT funds. AEIII members claim that the commission is too preoccupied with ESPRIT to consider funding a board of experts to identify and investigate those peripheral technologies European manufacturers should develop. Such a board could help European manufacturers recapture local markets for disk drives, printers and other items now dominated by U.S. and Japanese vendors.

AEIII spokesman Donald Willis complains, “The Common Market recognizes peripherals as a critical area, but it is too tied up with ESPRIT at the moment. We will have to wait until the end of 1984 for something to happen.” European suppliers’ technical expertise is far behind that of their U.S. competitors, he believes. As evidence of the problem’s severity, he points to licensing agreements that European peripheral builders must negotiate with U.S. companies to manufacture products that incorporate the latest technological advances.

Don Toombs, consultant with the European arm of consulting company The Yankee Group, Boston, voices
even stronger criticism of ESPRIT. In analyzing measures European companies might take to survive in the potentially huge office automation market, he concludes, "ESPRIT will not get Europe into office automation; Europe needs a marketing strategy—not more technology."

**Europe fares well in telecommunications arena**

Despite these shortcomings, the EC is taking one practical step toward creating a more homogeneous market in Europe by encouraging Pan-European telecommunications standards. Europe's common carriers cover only one country each, and most are publicly owned. The EC wants to standardize end-to-end digital communications between terminal equipment.

One area of incompatibility is teletex, a standard for message interchange. Some carriers plan to use packet-switched networks to carry teletex messages, while others favor circuit-switched networks. This year, the 26 members of the Conférence Europeéenne des Postes et de Télégraphes (the Conference of European Postal and Telecommunications Authorities) took a step toward greater uniformity by agreeing to the EC's goal of standardization.

Olivetti's de Benedetti stresses the advantage of cooperation between common carriers and believes that Europe must become a "wired continent like its American neighbor," supporting innovative value-added networks. He argues that government-owned telecommunications authorities are too protective of their domestic markets, delaying innovation rather than acting as leading edge customers for products such as private automatic branch exchanges. De Benedetti also believes that Europe's last chance to claim a leading position in the information technology industry may rest on its performance in the office-automation market.

European companies are keeping up with U.S. companies in awareness of one key technology in the office automation arena: local-area networks (LANs).

**Two successful British companies stand out as exceptions**

The huge, homogeneous U.S. market enables young U.S. computer companies to get big quickly before they tackle the fragmented European market. Two European companies can attribute their success to following this strategy themselves: at a very early stage in their development, they established the United States as their main market. The two companies are Winchester disk drive builder, Rodime Plc., Glenrothes, Scotland, and vendor of COBOL programming tools for microcomputers, Micro Focus Ltd., Newbury, England.

In 1979, when Micro Focus was still tiny, co-founder Paul O'Grady moved to the United States, where he chalked up OEM deals with major computer manufacturers, including Digital Equipment Corp., Intel Corp. and Convergent Technologies Inc. O'Grady believes that Micro Focus Inc., the U.S. arm of the company, based in Palo Alto, Calif., is as American as any company that originated in the United States, even though product development for Micro Focus still takes place in England. Although Britain represents the biggest segment of the European market for microcomputer products, O'Grady maintains that Micro Focus would have blundered by relying on Britain as an adequate base for growth: "No microcomputer company can survive just in Britain, because it cannot achieve the size and momentum of a U.S.-based company. So we made the United States our home market."

He advises other European companies to follow suit but cautions, "it is absolutely essential [that the companies] send out their very best people."

"Heroic" is the word Rodime director of marketing Malcolm Dudson uses to describe Rodime's decision to sell its disk drives in the United States. "But we had to do it; the European market is not big enough," he concedes. Rodime set up a U.S. sales office—now based in Mission Viejo, Calif.—in 1981, about a year after the company started.

Sales generated in the United States now account for the lion's share of Rodime's revenues. U.S. customers include Compaq Computer Corp., Houston, which is expected to buy $20 million worth of Rodime's 3½-inch Winchester drives this year, and TeleVideo Systems Inc., Sunnyvale, Calif., which has contracted to buy $50 million worth of drives. To consolidate its success, Rodime built a manufacturing facility in Boca Raton, Fla., conveniently close to the personal computer plant of a huge potential customer: IBM Corp.

Aside from their decisions to enter the U.S. market, both Micro Focus and Rodime have other ingredients for success. Both launched the right products at the right time, and both primarily addressed the OEM market, which requires smaller sales and marketing investments than entering the end-user market would have. But both companies insist that an early and powerful U.S. debut was vital to their success.
Attention Dealers:
The IBM System 9000 multi-user micro . . .

. . . now links up with IBM PCs!

We've opened up another new world of sales opportunities!

When we first introduced the IBM System 9000, it was hailed as one of the most exciting arrivals on the microcomputer scene. And with good reason. This Motorola 68000-based micro with our UNI-DOS Operating System supports up to 16 users and runs thousands of proven minicomputer software packages written in DEC DIBOL, Business Basic, APL and Fortran. LinkData’s IBM System 9000 offers the performance of a minicomputer at a fraction of the cost!

And now . . . LinkData's IBM System 9000 accommodates IBM PCs as on-line terminals, enabling it to tap into hundreds of thousands of PCs and PC-compatibles installed the world over! With our exclusive Link-PC Program, users can switch from on-line business applications to their favorite PC software, and back again, by toggling a single key . . . truly, the best of both worlds!

LinkData is looking for Value Added Remarketers who are capable of providing professional service and technical support to business users. We offer dealers a complete library of commercial application software as well as comprehensive training, service and sales support.

To obtain an IBM System 9000 Dealer Information Kit and Remarker Application, write: LinkData, 2005 Route 22, Union, NJ 07083. Better yet, call us today at (201) 964-6090.

DEC and DIBOL are registered trademarks of Digital Equipment Corp.
IBM is a registered trademark of International Business Machines Corporation
NOTE: Color display on the IBM System 9000 is simulated only and not an available feature.

Dealer inquiries invited

LinkData

2005 Route 22, Union, NJ 07083, (201) 964-6090

☐ Please send Dealership Information on LinkData's IBM System 9000
☐ Also send information on LinkData's selection of standard software packages

Name:
Title:
Company:
Address:
City: State: Zip:
Telephone: (_______)

CIRCLE NO. 76 ON INQUIRY CARD
Logica consultant Sarah-Jane Austin sounds an optimistic note in her study of data networking in Europe for "Telematica 1984." She reveals that European computer manufacturers possess the expertise to integrate LAN technology into overall system solutions to their customers' information processing problems. She believes that European suppliers' knowledge of European requirements for telecommunication interfaces gives them an advantage over U.S. vendors in reaching this market.

**Integrated-circuit makers raise obstacles**

In contrast to strength in the communication field, European companies display a serious weakness in the key area of advanced integrated circuitry. U.S. manufacturers supply most of Europe's integrated-circuit market. To explain the superiority of U.S. and Japanese IC suppliers, observers point to the massive government-funded space and defense programs in the United States and government support of industry in Japan.

Gunther Moeller, secretary general of Eurobit, an association of European computer manufacturers, notes that European IC companies failed to catch up despite the 17 percent tariff imposed by the Common Market to protect local suppliers from overseas competition. Moeller dismisses the tariff as nonsense because tariffs on printed-circuit boards that include mounted chips are only 5 percent, and tariffs on complete computer systems are only 6 percent. Rather than protecting European IC manufacturers, the high tariff on chips simply adds to European computer manufacturers' costs and may force them to transfer manufacturing to countries outside the Common Market.

Eurobit is not the only group lobbying the Common Market to reduce its tariffs on ICs; the British government has also declared its intention to press the Common Market for a reduction. In the meantime, Eurobit and other groups that purchase chips will suffer. Moeller reports that Eurobit can sometimes persuade the Common Market to suspend tariffs on advanced chips unobtainable from sources in Europe. Even then, chip manufacturers within the Common Market voice strong opposition.
BUSINESS PARTNERS WANTED

It is small enough to sit on a desk top. Yet it can accommodate up to eighteen users.

It is a 32-bit super microcomputer running UNIX System V. But it has the power of a minicomputer. It incorporates 256K DRAM chips for high-capacity main memory of up to 2 megabytes. So more is delivered than with the average microcomputer, and at a lower cost per station.

It's the 3B2/300, From AT&T.

Perfectly targeted for an office where several people need a desk-top computer, and there's a need to accommodate growth. And it can function as an intelligent network host or file server for PCs.

And the 3B2/300 is available in a variety of solutions packages with flexible growth options.

It is the most advanced super microcomputer your customers can buy today.
These general-purpose, midrange, true 32-bit, super minicomputers are designed to run UNIX System V and can accommodate up to sixty users without putting a dent in response time.

They are remarkably easy to use, and easy to maintain because they are self-diagnostic. They are flexible, powerful tools for a variety of applications, such as software development, office systems, and CAD/CAM.

They're the 3B5/100 and 3B5/200. From AT&T.

They can be configured to suit customer needs with a wide variety of I/O, peripheral, memory, and communications options for cost-effective growth. This makes them good investments for your customers.

These computers fit neatly into the office environment. And are incredibly quiet, cool, efficient, and plug into standard wall outlets.
The 3B20S computer is the high-end supermini of the 3B family. It runs UNIX System V and is designed to meet the rigorous needs of data centers, developers, office service organizations, and manufacturing locations.

When a customer outgrows these capabilities, you simply add the attached processor forming the 3B20A. And add up to 80% to your performance range. Or you can begin serving your needs with the 3B20A right from the start.

And the growth from the 3B20S to the 3B20A occurs as painlessly as possible with only a modest increase in cost.

Both computers are energy efficient and easy to install. They perform without complex and expensive environmental controls. And unlike most computers of this capacity, the 3B20S and the 3B20A do not require air conditioning or raised floors.
3B20D

It is a powerful, 32-bit super minicomputer that will set a new standard for uptime. It runs the new UNIX RTR operating system, providing time-sharing and introducing real time and fault-tolerant features.

It operates continuously even during hardware faults, data-base mutilations, repair, software updates and growth.

It is the 3B20D. From AT&T.

It is ideal for applications requiring ultra-reliability and fast response such as reservation systems, command and control systems, on-line banking systems, and others where computer outage means serious or intolerable business losses.

Like the 3B20S and 3B20A, the 3B20D does not require air conditioning or raised floors.

For continuous computing, the 3B20D is unsurpassed in its class.
AT&T COMPUTERS

AT&T has always been a leader in the field of computer science and computer applications.
We've proven this in the most demanding data processing environment in the world—the nationwide telecommunications network.
And we intend to remain a leader by meeting your needs. As well as the needs of your customers.
We are committed. Both in our products and our partnership.
Because we know our success rests on your success, and in turn on that of your customers. Working together as partners, we can share the promise of the 3B family of computers.
But our commitment doesn't end with state-of-the-art products. When you join hands with AT&T, you also receive superb service.
We offer complete marketing support packages; product service and maintenance; financial support; and a full range of consulting services.
This is a national support system that is second to none. And with the unsurpassed R&D capability of our own AT&T Bell Laboratories, you can market the 3B family of products with confidence and guarantee them to your customers.
To find out more about this remarkable family of computers, and our comprehensive and flexible OEM/VAR programs, call us at 1-800-833-9333.
On-board diagnostics lower service costs for OEMs and system integrators

With the right equipment capabilities, customers can service systems themselves

George Fink, Data Systems Design

As hardware prices decrease, the percentage of service cost to hardware cost is increasing. According to some estimates, 35 percent of computer-ownership costs can be attributed to service, and that figure is moving toward 50 percent. Indications are that system buyers will not be willing to pay this much for service.

Traditional service has disadvantages

Consequently, computer manufacturers, OEMs and system houses are looking for a cost-effective alternative to traditional direct and third-party service. Direct service, for example, entails high overhead. It requires full-time personnel, training programs, diagnostics equipment, staff travel costs and possibly nationwide or worldwide service centers. In addition, as a supplier's market base expands, a system supplier may lack the resources for maintaining a large service organization to provide timely customer response.

Third-party service also has disadvantages. With some third parties and some levels of service, customer costs can closely approach those of direct service. An uneven level of service is also common when third-party service personnel haven't received sufficient training in a supplier's products. And it is difficult for the supplier to monitor service accurately when service reports get filtered through a third-party organization.

A third-party service organization must also support all the companies it represents—often a difficult task even with a large staff. The organization thus may not be able to give timely response to customer-service
requests at peak times or in areas where local demands are high. Even if diagnosis is rapid, the organization may lack the spare parts to make repairs.

**Hardware costs rise only slightly**

Taking advantage of microprocessor power and the low cost of peripherals and small systems, a number of small companies in national markets are providing an alternative form of service that combines remote and on-board diagnostics, customer self-help and module replacement. Some manufacturers now include on-board diagnostics in systems and peripherals. Adding the diagnostics is relatively inexpensive, usually requiring only a few switches, light-emitting diodes and some extra microcode programming. These additions typically increase equipment costs by about 5 percent.

When problems arise with equipment containing on-board diagnostics, customers can initiate the service operation themselves by running diagnostics and contacting the manufacturer with the results. Frequently, the information available at this point enables the manufacturer to identify modules that need replacing. In an extension of this approach, some systems contain built-in modems that allow a vendor to connect a terminal via telephone and run remote diagnostics.

A critical service element is equipment modularity, which allows for rapid module replacement. The many reliable, overnight-delivery services make replacement extremely cost-effective.

**Alternative service saves money**

On-board diagnostics offer a distinct financial advantage, appreciably lowering customers' service costs. Even with overnight delivery charges and the 5 percent increase in hardware costs, the cost to include diagnostics is minimal compared with the expense of supporting direct or third-party service. The approach can also shorten repair times; even when a technician is on-site, problem analysis without on-board diagnostics can be time-consuming.

This alternative service also eliminates some problems that plague traditional forms of service. For example, because on-board diagnostics don't depend on field-service personnel, high travel costs, slow response times and the problems of maintaining a consistent level of service virtually disappear. The only limiting factor is the number of phone calls requesting module replacement that a vendor can handle.

On-board diagnostics provide other direct benefits. They can help troubleshoot boards in the manufacturing and testing process before shipping. At a customer site, built-in diagnostics aid the incoming-inspection process; units with built-in diagnostics can often be tested without interfacing to a computer terminal or printer.

**On-board diagnostics aren't for novices**

Like other forms of service, on-board diagnostics have drawbacks that users must weigh against the advantages. For example, although they're effective for technically oriented users, OEMs and system houses, they are unsuited to unsophisticated end users. Vendor experience shows that end users have neither the training, the interest nor the confidence to use self-help computer service.

Even technically sophisticated customers have some concerns about this type of service. For example, users accustomed to traditional service are often unaware that modules can be "dead on arrival" (DOA). In a traditional service arrangement, the supplier's service staff would screen such occurrences. In a self-help arrangement, customers become more aware of DOAs and may erroneously conclude that the number of DOAs is unusually high. Consequently, when customers select a self-help and module-swap service, suppliers should alert them to the fact that initial failures won't be masked as they are in other service and installation methods.

**Service alternatives keep evolving**

The industry may see even further evolution in service alternatives. On-board modems, for example, will increase the trend toward remote problem debugging by factory technicians and engineers. A local technician—and ultimately a master diagnostic computer—might also be added to the debug loop. For now, one trend is clear: more OEMs and system houses are opting for economical alternatives to the ever-rising costs and personnel requirements of traditional service forms.

**George Fink is executive vice president of marketing at Data Systems Design, San Jose, Calif.**

154 MINI-MICRO SYSTEMS/May 1984
FOR A REFRESHING NEW LOOK AT COLOR GRAPHICS PUT A GENISCO G-2200 IN YOUR SYSTEM.
IMPELL CORPORATION DID!

The G-2200 is truly a refreshing approach to raster color graphics. It combines vivid colors, flicker-free picture clarity, and big screen readability with high speed graphics and extensive software support. The result is the most cost effective system on the market. That's why Impell Corporation selected it as the perfect color graphics companion to CAEMIS, their Computer Aided Engineering & Management Information Services package.

Impell is a major supplier of computer software and computer based management and engineering services to the utility industry worldwide. CAEMIS is a modular, three dimensional engineering design and data base management system which provides simultaneous access for all design functions and on-line access to design information. And, the Genisco G-2200 is its window to the world.

The G-2200 has all the features desired for CAD/CAM, CAE, scientific and business graphic applications including built in peripheral support for mouse, tablet and printer. It is software compatible with the Tektronix 4014 and supported by third party software. It will also emulate the DEC VT100 for text editing and data entry.

But the best reason to put a G-2200 in your system is picture quality. Up to 16 colors can be selected from a palette of 4,096 hues with a unique black matrix glass bringing them vividly to life. Graphics are displayed on a big 19 inch screen that is refreshed at 60Hz for flicker-free viewing while the 1024 x 792 resolution ensures sharpness and clarity. No comparably priced system can match the picture quality of the G-2200.

The G-2200 is available as an attractive, ergonomically designed desktop terminal, or it can be integrated in your own system as a board or as a controller. Whatever the configuration, you can be sure of Genisco's commitment to design and production excellence and to on-site support by its international network of offices.

For details on how the G-2200 can color your system, call us for a demonstration. It will be a most refreshing experience.
IF IT WEREN'T FOR UNIX
WE NEVER COULD HAVE
BUILT THE PYRAMIDS

Ordinary computers, yes. But not a Pyramid Technology 90x. After all, here's a supermini not just capable of running UNIX, but born to run it. And run it up to four times faster than the most popular UNIX host. For a lot less money.

The secrets of this Pyramid are a thorough understanding of UNIX, a few fundamentals of RISC (Reduced Instruction Set Computer) theory, more registers than 30 VAXs, and a 32-bit proprietary architecture that outperforms a roomful of micros.

All combined to speed up UNIX just where it likes to slow down.

For example, gone are 85% of performance-robbing memory references. The endless parameter shuffling of yesterday's technology has been replaced with a hardware register win-
Even context switching takes less than one percent of the CPU's time.
It's amazing what hardware architects can do, given the chance. It's almost as startling as what our software wizards did.
They crafted OSx, a dual port of Berkeley's 4.2 BSD and Bell's System V. Because you can switch environments at will, no UNIX port offers more capabilities. With absolutely no loss of compatibility.

Well, almost.
We do admit to one feature not compatible with other UNIX systems. Our single-source support.
One telephone number instantly connects you to both hardware and software experts. In-house pros, who spend their energy pointing you towards solutions. Not pointing fingers at each other.

So no matter how you see your requirements shaping up, contact Pyramid Technology, 1295 Charleston Road, Mountain View, California 94043. Or call (415) 965-7200.
Because when it comes to running UNIX, a Pyramid looks good from any angle.
Ourselves. NEC manufactures some of the most advanced computer systems in the world today. And inside every one of them, you'll find some of the most advanced disk drives. All designed and made by NEC.

You'll also find the same NEC drives in a lot of other well-known computer systems. Because system builders know every NEC drive is made by people who look at drives the same way they do.

One reliable source for 5½" drives. The latest additions to the NEC disk drive line are 5½" half-height Winchesters and flexible drives. The Winchester is available now with 12.91 MB of storage; flexibles with 1.0 MB. Even larger capacities will be introduced in the near future.

If you use both drives in your systems, now you can count on one reliable source for all your needs.

20 years in the driver's seat. NEC was one of the first to develop magnetic recording devices, back in 1959. But NEC has been pioneering advance-
HEIGHT DISK DRIVES TO OEM IN THE BUSINESS.

NEC is one of the few who make a full range of disk drives: 8-inch and 5 1/4" Winchester and flexible drives, along with a new high capacity 9" Winchester. Some drives incorporate such advanced technologies as NEC manufactured plated media and thin-film heads. Clearly NEC is at the leading edge of disk technology.

For more information on 5 1/4" drives or other sizes, or product literature, call 1-800-343-4418. (In Massachusetts, call 617-264-8635.) You'll discover why more and more systems builders are saying, "NEC and me."

Please send me more information on:

- 5 1/4" Half-height Winchester disk drive
- 8" Winchester drive
- 5 1/4" Half-height floppy drive
- 9" Disk drive 520 MB

Name _____________________
Title _____________________
Company _____________________
Address _____________________
City __________ State __________ Zip ________ Tel (_____) ________

NEC Information Systems, Inc.
1414 Massachusetts Avenue
Boxborough, MA 01719

MMS 5/84

CIRCLE NO. 80 ON INQUIRY CARD
The first GCR with high performance and low cost, in a small-sized package.

As the leader in ½" streaming tape drives, Cipher has been at the forefront of progress, first with Microstreamer®, then CacheTape™, and now GCR CacheTape™.

Available in two models, the M990 and M991. GCR CacheTape provides unbeatable performance features, with both start/stop functions and streaming operation. And all at an unprecedented low cost and small size.

Call or write us today for a free product brochure and GCR CacheTape specifications. We have the tape drive that meets your needs.

Cipher
data products, inc.

10225 Willow Creek Road, P.O. Box 85170
San Diego, California 92138
Telephone (619) 578-9100, TWX: 910-335-1251

European subsidiaries in:
United Kingdom (phone: 0276-682912),
West Germany (phone: 089-807001/02),
France (phone: 1-668-87-87)

CIRCLE NO. 81 ON INQUIRY CARD
Transportable operating system promotes network benchmarks

Able to run on eight popular local-area networks, the NetWare file-server operating system acts as a benchmark for testing performance

Ray Noorda, Novell Inc.

Without a controlled high-level software environment, no common ground exists to assess basic local-area network (LAN) performance. As a result, there have been few accurate benchmark tests of popular LANs. For that reason, Novell Inc., Orem, Utah, began a series of benchmark tests on eight major LANs. Novell used its NetWare file-server operating system to compare the LANs performance in speed, functionality, usability and security. This article discusses Novell's first LAN benchmark study, which compared the speeds of several popular LANs.

To allow valid comparisons of LAN performance, Novell replaced the native operating systems of several commercial networks with its NetWare software for file-server management. The test team implemented the NetWare data server on IBM Corp.'s PC and PC XT computers. The data server ran using NetWare products for the Novell LAN and those of seven other manufacturers.

The team installed each network according to manufacturers' instructions and set up the networks as an average user would. They also refrained from fine-tuning the NetWare products to improve test results. To keep test conditions constant, the team used IBM PCs or work-alikes as network stations wherever possible and used an IBM PC XT as a data server. The

The time required to write 100 128-byte records 10 times differed considerably for networks tested. Note that no bars exist for PAXnet with four to six stations and that none exist for PCnet with five or six stations. These networks experienced "drive x not ready" errors while attempting to service the higher number of stations and could not complete the test.

Key to graph legends

EL = 3Com EtherLink
GN = Gateway G-Net
ML = Davong Multi-link
NW/S = Novell Star + NetWare/S
OM = Corvus Omninet
PC = Orchid PCnet
PL = Nestar PLAN 2000
PN = Proteon proNET
LAN benchmark test backgrounds

To test eight major local-area networks (LANs), the Novell Inc. test team wrote test programs in MicroSoft BASIC and then compiled them with the MicroSoft BASIC compiler for speed. To draw graphs, they used SuperCalc3, a Hewlett-Packard Co. plotter and a Compaq Computer Corp. computer.

NetWare tests were conducted with both dedicated and multipurpose servers. Only the results and price performance for the dedicated server are shown.

To obtain more detailed information about these LAN benchmark tests, write to Novell Inc., 170 N. Industrial Park Drive, Orem, Utah 84057, on your company's letterhead.

PC XT has a hard-disk drive, which makes it a suitable shared resource. The personal computers used as stations ran the MS-DOS 2.0 operating system.

Because most LAN suppliers offer their products in specific price/performance categories, test results should indicate which networks are best suited to which applications. Ranking and evaluating throughput makes it easy to establish the relative cost/performance benefits of the networks for specific applications. The information will help users select products and draw reasonable conclusions about implementations of different LAN topologies and access schemes.

Networks exhibit a range of features

Omninet, from Corvus Systems Inc., San Jose, Calif., operates with Constellation II software and has a bus-type architecture that can support as many as 64 nodes over a maximum distance per link of 4,000 feet. Passive links can be as long as 1,000 feet. Twisted-pair RS422 wiring serves as the physical transfer medium. The network supports a data-transfer rate of 1M bit per second (bps) and employs a carrier sense multiple access with collision avoidance (CSMA/CA) access scheme. A 6801 microprocessor from Motorola Inc. and fewer than a dozen additional devices complement the network circuit.

Unlike Omninet, the ARCnet network from Davong Systems Inc., Sunnyvale, Calif., based on the ARCnet LAN developed by Datapoint Corp., employs a token-passing access scheme. ARCnet operates with Davong's Multi-link software, uses coaxial cable as its transfer medium and supports a data-transfer rate of 2.5M bps.


G-Net, from Gateway Communications Inc., Santa Ana, Calif., can connect as many as 255 nodes as far as 4,000 feet apart on one bus using RG-59, RG-11 or RG-62 coaxial trunk lines. The system's data-transfer rate is 1.43M bps, and its access scheme is carrier sense multiple access with collision detection (CSMA/CD). The G-Net system does not have a native operating system other than NetWare.
...and so on.

Dataproducts printers.
Nobody puts ideas on paper so many ways.

NOW—SUPER-PERFORMING 5¼" WINCHESTERS WITH BUILT-IN RELIABILITY.

AVAILABLE NOW
21 or 36 MBYTE CAPACITIES.

THE WRENS

The Model 9415 WRENS disk drive gives you a host of value-added features. From microcomputer and LSI control logic to special-formula media, high technology has finally delivered a 5-1/4" winchester with more reliability. Compare for yourself. Call your local Arrow or Kierulf distributor today.

Or write: OEM Product Sales, HGN08H, Control Data Corporation, P.O. Box 0, Minneapolis, MN 55440.

CIRCLE NO. 83 ON INQUIRY CARD

CONTROL DATA

Information Hot Line 1/800/828-8001
In Minnesota 1/612/921-4400, Ext. 82

MINI-MICRO SYSTEMS/May 1984
Like the Ethernet LAN standard from Xerox Corp. on which it is based, the EtherLink network from 3Com Corp., Mountain View, Calif., furnishes a 10M-bps data-transfer rate and employs coaxial cable for station-to-station links. EtherLink uses the EtherSeries operating system and a CSMA/CD access arrangement.

The Novell network employs a star topology using the Netware/S operating system with a dedicated MC6800-based data server at the center of the star. As many as 24 personal computers can share the data server. Each station can be as far as 3,000 feet from the server, connected by twisted-pair lines.

Produced by Orchid Technology, Milpitas, Calif., PCnet has an operating system of the same name. The bus-based system links workstations to 75-ohm RG-59 coaxial cable. Nodes on the network can be as far apart as 4,000 feet, and links can handle a 1M-bps data rate.

An unusual architecture is incorporated in the proNet network from Proteon Associates Inc., Waltham, Mass. This network uses the PAXnet operating system and employs a duplex path that connects devices to a local wire center. Wire centers are connected with duplex lines to form a string-of-stars configuration. Wire centers can handle eight or 16 nodes. The proNet data-transfer rate is 9.94M bps, and the transfer medium between wire centers can be coaxial cable, twin-axial cable, optical fiber or infrared or microwave links. The last three media work well in electrically noisy industrial environments.

The test team began benchmark tests by running each network with its native operating-system software and then running the same tests using NetWare. In most cases, the team could configure networks to incorporate the IBM PC XT as a dedicated data server or as a data server that could also act as a workstation. But, there were exceptions. For example, the Corvus LAN's native software does not support the IBM PC XT as a data server. It requires that a proprietary disk-server control unit be used in concert with a separate Corvus Winchester drive. The test was run, therefore, with Corvus' Constellation II software used with the Corvus system.

Another anomaly in the ordered series of tests involved three of the eight native operating systems. With Corvus' Constellation II, Davong's Multi-link and 3Com's EtherSeries operating systems, the test team had to create a separate volume for each user writing data to the shared disk. This precaution eliminated race conditions while disk blocks were allocated to each user's data files on the shared disk during the "create" and "delete" tests described below.

The DOS 2.0 operating system ran the workstations. To make valid comparisons between networks running with native operating systems vs. NetWare, testers...
turned on the DOS verify switch (software that verifies written data) when they used the native operating systems. This was not necessary with NetWare, which automatically performs read-after-write verifications. The testers used the IBM PC XT, with 512K bytes of memory, for testing both NetWare and native operating systems.

Test team members conducted LAN benchmark tests using from one to six workstations. They began with one workstation and added more as they completed the tests. Tests used currently available NetWare software and hardware from Novell and other vendors. For additional comparison, the test team ran the same tests using the IBM PC floppy disk drive and the PC XT Winchester disk drive. Network operating systems employing the IBM PC XT in the native mode included Orchid’s PCNet, Davong’s Multi-link, PAXnet’s pro-NET, Nestar’s PLAN 2000 and 3Com’s EtherSeries.

Methodology is key

“Write” and “read” tests served as the primary evaluation method to check speed. Using native software, the benchmark test program writes 100 records, each 128 bytes long, to a non-shared file. The program then resets to the first record and writes 100 records over the previous data. It repeats the process 10 times for a total of 1,000 written records. The recorded time equals the time required to write 1,000 128-byte random records sequentially. The same procedure is then used for the 128-byte read test, which randomly reads the previously written records. Read and write tests are then repeated using 512-byte records.

The test team next performed create/delete tests, which center on 128- and 512-byte records. The tests perform the same operations as the write tests except that they delete data files after 100 records are written. The program recreates the files for subsequent writes. This sequence forces the server to allocate file space repeatedly.

A 355-byte write test followed. In this test, 355-byte records are written under the conditions of the previous write tests. The record length forces uneven sector sizes, which requires the server to cross uneven sector boundaries during the test. The team then performed a “save” test using the WordStar word-processing package. This test for WordStar establishes the time required to save a 100K-byte file, or approximately 50 text pages, and exit to the system after a user gives the “save and exit” command.

A 100K-byte “copy” test concluded the test program. This test determines the time required to copy the same file used in the preceding WordStar save test into another file, using the DOS “copy” command. Its purpose is to load the data server and data-link hardware with as much traffic as possible to demonstrate performance at peak loads. Therefore, the test also provides information that shows the aggregate data-transfer rate of a given network topology.

Test results for Orchid’s PCnet were incomplete because the network could not adequately process the requests from additional workstations. In the PCNet configuration, an IBM PC XT acts as both the network server—for this test, Station 6—and as a workstation. When a workstation was added, the system returned a “disk x not ready” error message, even when Station 6 was idle.

Similarly, Davong’s Multi-link could not adequately serve all six workstations while running simultaneous 100K-byte file copies for the copy test. The sixth station, acting as both network server and workstation, completed the “copy” command very quickly (in 2 to 8 seconds), but the other stations seemingly stopped dead. After approximately 15 seconds, one of the remaining five stations returned a “fatal multi/OS error; fatal-duplicate message found in queue,” signifying that the system was down. Two other stations followed with a “disk error writing drive x” error message.

Difficulties on Proteon’s PAXnet prevented benchmark tests from being executed on more than three or four stations. The system repeatedly returned a “disk x: not ready” error message after it attempted to run a number of stations simultaneously.

Test results are presented from three perspectives: the standalone IBM PC XT, which was the standard of comparison, individual networks and combined networks.

NetWare products boost LAN speed

The Novell Netware/S star topology accommodates as many as 24 IBM PCs attached to a file server by individual dual twisted-pair lines as long as 3,000 feet. The network’s MC68000 microprocessor runs at 8 MHz in the data server with as much as 1M byte of RAM for disk and directory caching and hashing. In addition, the network’s dedicated MC68B03 microprocessors manage network communications lines, freeing the MC68000. Each networked PC uses a dedicated communications line.

This board communicates with the IBM PCs at 600K baud. In addition, the LAN board has a dedicated microprocessor for each communication line, which eliminates contention.

The NetWare/G software for Gateway Communications’ G-Net, establishes a CSMA/CD network running at 1.43 MHz over coaxial cable, using Gateway
Thousands of Cogito half-height 5¼ inch Winchester disk drives have already been delivered. All of them have one characteristic in common: unmatched high quality. This quality results from Cogito’s philosophy that our mature technology will pay off for Cogito’s customers—and for our customers’ customers.

The Cogito half-heights’ iron oxide recording media provides the long term reliability that protects our customers’ data integrity in the marketplace. And Cogito half-height Winchester disk drives use only half the power of regular disk drives. This is an achievement that has repeatedly been confirmed by the field.

Cogito’s management has transformed its wide experience in the mass production of Winchester disk drives into a product line where the quality is repeated in every disk drive that comes from Cogito’s high volume manufacturing facility.

For more information, call or write Cogito Systems Corporation, Sales Department, 2355 Zanker Road, San Jose, CA 95131, Telex 171023, (408) 942-8262.

QUALITY WORTH REPEATING.

See us at COMDEX/Spring ’84 in Atlanta

COGITO SYSTEMS
If you need tape controllers and couplers for VAX, Unibus and QBus systems, you’ve come to the right ad. Emulex offers one of the industry’s most complete selections.

**FOR VAX SYSTEMS.**

Our new TC7000 is a good example of the kind of performance you get with Emulex. This single-board controller lets you move up to the higher densities and transfer rates of state-of-the-art GCR transports. One TC7000 can handle up to four STC-type transports or eight reel-to-reel units with Pertec-type interfaces. And you can choose from three tape densities: 800-bpi NRZI, 1600-bpi PE or 6250-bpi GCR.

**FOR UNIBUS SYSTEMS.**

Our TC11 emulates the basic DEC TM11 controller. It works with up to four industry-standard tape drives with densities to 1600 bpi and speeds up to 125 ips.

Unibus users will also appreciate the TC12. This single-board TSII-compatible coupler handles industry-standard formatted Pertec-type ½" tape transport, including conventional NRZI/PE start/stop and 800/1600/3200-bpi streaming tape drives.

The new TC15 is another TSII-compatible tape coupler that allows you to interface the CDC Sentinel ¼" streaming tape drive. And it features software transparency and standard operating system support on your Unibus system.

Last, but not least, is the TC13. This universal tape coupler works across the Unibus of PDP-11 and VAX-11 CPUs. It handles industry-standard ½" tape transports, including conventional start/stop, streaming, and the new generation of GCR units.

**FOR QBUS SYSTEMS.**

The TC02 has long been an Emulex favorite. This TSII-
compatible tape coupler works with all 800/1600/3200-bpi formatters at speeds from 12.5 to 125 ips.

Another TS11-compatible coupler is our new TC05. It allows you to interface CDC Sentinel ¼" streaming tape drives without using special streaming software.

And don't overlook the TC01. TU10/TM11-compatible, it handles as many as four dual-density 800/1600-bpi ½" transports at up to 75 ips.

NEW PACKAGED SUBSYSTEMS.

Also available for QBus and Unibus users are two packaged subsystems.

Vault™ is a ¼" streaming tape that gives you up to 70 MBytes of storage.

Medley™ is a packaged subsystem that includes either a 35 or 110-MByte formatted 5¼" Winchester disk drive and a ¼" streaming tape drive with 70 MBytes of backup storage capacity.

GET YOUR TAPE PROBLEMS UNDER CONTROL.

Stick with Emulex. Call us toll-free at (800) 854-7112. In California, (714) 662-5600. Or write Emulex Corporation, 3545 Harbor Blvd., P.O. Box 6725, Costa Mesa, CA 92626.

The genuine alternative.
Communications' network-interface module. A dedicated Z80B microprocessor with 64K bytes of dual-ported RAM takes over the burden of managing network communications from the IBM PC. This assistance is critical to the IBM PC acting as the data server. The interface Z80 board can store many data packets (the amount of data the network can transfer at one time), thereby guaranteeing that no packets are lost. The data packets are quickly created or accessed via the dual-ported RAM. Because neither the data server nor IBM PC shell software needs interrupts, the overhead of interrupt servicing is eliminated.

Data packets arrive at 1.43 MHz. However, after a packet is received, the Z80 needs time to acknowledge receipt of the packet before making it available to the IBM PC microprocessor. This overhead slows the effective data-transfer rate.

The NetWare/O software for Corvus' Omninet uses Corvus network transporter cards. Omninet runs at approximately 899K baud. Each Omninet board has its own dedicated microprocessor to manage network communications and 4K bytes of RAM to use as a packet and command buffer. The Omninet transporter card guarantees that packets are received 99.9 percent of the time. However, this setup burdens driver software with the overhead of handling the lost packet cases. Because the Omninet board can buffer no more than four received packets simultaneously and also lacks interrupts, all four receive buffers in the data server could become filled under worst-case conditions. Consequently, the board would lose additional packets sent to the server.

Moreover, the RAM buffer in the Omninet board is not dual-ported; it is accessed via special autoincrementing I/O ports. Consequently, accessing the board RAM uses more overhead, and transfer time is about 20 percent longer than memory-to-memory moves.

The NetWare/E software for the 3Com EtherLine network-interface board communicates at 10 MHz with the IBM PC. It has interrupts and direct memory access (DMA) to optimize data transfers from the interface board to the IBM PC memory. Because of the fast network communication rate, Ethernet LANs work well in a multiple data-server environment.

Although an Ethernet LAN has a wide physical communications bandwidth, 3Com's implementation has several bottlenecks that slow the 10M-bps transfer rate, particularly in a single data-server environment. Most bottlenecks occur at the data-server IBM PC as data packets transfer between data-server RAM and the 3Com board's buffer RAM. The 3Com board uses an Ethernet controller chip manufactured by Seeq Technology Inc. that needs a special RAM buffer for receiving and sending packets. The major problem with the 3Com design is that the board can send or receive only one packet at a time. So, whenever a packet is received or needs to be sent, the controller chip must be turned off while the packet is transferred between the 3Com board's work RAM and the IBM PC microprocessor's RAM.

Problems result because it takes 5 to 10 times longer to transfer a packet than to receive one, even if DMA is used. Therefore, the data server EtherLink board is unable to receive packets for a significant percentage of time when the network is active. Because no "packet received" acknowledgment mechanisms exist at the Ethernet hardware level, there is no way for the requesting IBM PC to know that the data server isn't listening—except that it never receives a response to its request.

The NetWare/P software for Proteon's proNET consists of a 10-MHz token ring that provides positive acknowledgment of a packet's receipt. The board contains separate, single receive and send buffers, DMA, and interrupt support. The proNET board performs better than 3Com's Ethernet, even though both have the same communication rate and the same bottleneck in transferring packets between the boards' packet buffer area.

Two factors account for the improved performance. The first is the use of separate receive and send buffers, which let a packet be loaded for sending without disabling reception of another packet. The second factor is the "packet has been received" acknowledgement that the token ring provides. Knowing that a packet has been received improves retry-logic performance in the network driver software. If a packet sent by an IBM PC is not accepted, then the workstation immediately tries again (as soon as it regains the token), rather than waiting until it becomes obvious that the data server PC didn't receive the packet.
NOBODY DELIVERS QUALITY IN VOLUME LIKE SEAGATE.
**BULK SEMI**

Fast, reliable, high-performance memory for less than $3,000/MB*

Yours with the 32 MB BULK SEMI from Dataram...packaged in an efficient 15¼" chassis, and made possible by a powerful 64K RAM-based design that gives you the capacity, performance, and flexibility you need in today's applications-dependent environment. And available for a long — and growing — list of minicomputers. Dual-port capability optional. BULK SEMI. Memory from the leader.

Dataram Corporation
Princeton Road
Cranbury, NJ 08512
(609) 799-0071
TWX 510-685-2542

---

**The Integrator**

These retransmissions don't significantly slow operation because the network communication rate is so fast. Performance of proNET would probably improve if the network could receive multiple packets in its packet buffer.

The NetWare/D software is used for Davong's network multifunction card and the NetWare/N software for Nestar's PLAN 2000 boards. Both boards use the ARCnet controller chip provided by Standard Microsystems Corp., and their performance and functional characteristics are virtually identical. An arbitrary open-ended star connects network stations via 93-ohm RG-62 coaxial cable that provides a 2.5-MHz bandwidth.

The network hardware also provides four 512-byte pages of RAM buffer for transmitting or receiving. Thus, the server can do double-buffering. While one packet is copied into the server's memory, the ARCnet controller can receive another packet simultaneously. The dual-ported RAM buffer on the network-interface board also allows the data packets to be copied directly in and out of the board. This procedure is faster than sending data through I/O ports, as some other network hardware requires.

The main limitation of the ARCnet protocol is its small packet size. A station can transmit no more than 508 bytes in any one packet. Therefore, a request to write 512 bytes to a file, for example, must be split into two packets—one long and one short. The added overhead in cumulative transmission time for the two packets is minimal, but the station can transmit only one of the two packets when it receives the token. It must wait for the token to cycle completely around the network before it can transmit the second half of the request. If network server requests become frequent, some degradation in overall response usually emerges because of the time required to get both halves of a large request across the network. This worst-case scenario would occur only under heavy network use.

---

Ray Noorda is president of Novell Inc., Orem, Utah.

---

Each of the networks used in the Novell Benchmark was purchased before January 1, 1984. The exception to this is the Nestar PLAN 2000, which was purchased in February of 1984. Each network was purchased through normal sales channels and installed according to end user instructions. Novell Inc. realizes that possible enhancements could have an effect on the performance figures for any one of the networks.
Everybody promises you half-height drives, but you can’t ship promises.
Only Seagate ships zero-defect 10MB (formatted) half-height Winchesters in production volumes for the lowest total system cost.

Designed for survival in the real world of portable and down-sized desktop systems, the ST212 can withstand a 40G drop. It features a reliable single platter design, proven risk-free technology, controller compatibility with the ST412 standard height drive, and lower power consumption.

Why gamble when you don’t have to? Seagate assures you the most dependable half-height Winchester you can buy, product in volume to meet your needs, and the industry’s largest Winchester support team. All of which translates into 5½” Winchester disc drives with a total system cost that no other supplier of half-heights can match.

Make us prove it. We want your business. Call Seagate.

<table>
<thead>
<tr>
<th>Unformatted capacity (MB)</th>
<th>12.76</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formatted capacity (MB)</td>
<td>10</td>
</tr>
<tr>
<td>Average access time (ms)</td>
<td>65</td>
</tr>
</tbody>
</table>
Meeting the Challenge of Profit-Building...

Through Office Automation

Over 250 displays demonstrating the latest in business computer systems, word processing, telecommunications, office automation, data communications, copying/duplicating, furniture/workstations, computer peripherals and accessories and much more.

The Conference will address the most relevant topics in 4 Program Tracks: Management Issues and Concerns, Systems Planning and Perspectives, Technological Studies and Updates, Program Implementations. If you plan, design, implement, use or manage information systems you should attend.

Keynote Addresses by Industry Experts
• John J. Connell, Executive Director Office Technology Research Group
  “Challenge of the Years Ahead—Management Issues in Information Systems”
• Amy D. Wohl, President Advanced Office Concepts Corp.
  “Hardware and Software Design Issues”
• Dr. Michael Hammer, President, Hammer and Co., Inc.
  “Office Automation, Personal Computing and All That Jazz”

O’Hare Exposition Center
Rosemont, Illinois

REGISTER NOW
CALL 312/299-9311
FOR DETAILS!

Cahners Exposition Group
Cahners Plaza
1350 East Touhy Avenue
P.O. Box 5060
Des Plaines, IL 60018
If you build supermicros or any storage intensive desktop system, the 20MB (formatted) Seagate™ rugged ST425 is the natural alternative to the 10MB industry-standard ST412. In fact, to your controller, the ST425 looks just like two ST412s, speeding systems integration.

Here is the capacity and performance for powerful operating systems like UNIX™, integrated applications packages, file server and window environments, and systems designed for engineering, computer graphics, CAD/CAM, and database management.

But the ST425 offers more than capacity, performance and compatibility. It is the one 20MB Winchester built, tested, and guaranteed to meet Seagate's stringent zero-defect standards. Why take a chance? Only Seagate delivers 5 1/4" Winchester disc drives with a total system cost that no other supplier can match.

Make us prove it. We want your business. Call Seagate.

<table>
<thead>
<tr>
<th>Unformatted capacity (MB)</th>
<th>25.52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formatted capacity (MB)</td>
<td>20</td>
</tr>
<tr>
<td>Average access time (ms)</td>
<td>65</td>
</tr>
</tbody>
</table>

Seagate
NOBODY DELIVERS QUALITY IN VOLUME LIKE SEAGATE.

920 Disc Drive, Scotts Valley, California 95066
Telephone (408) 438-6550, TELEX 176455SEAGATESCVL

Regional Sales Offices:
Newport Beach, California, (714) 851-9954
San Jose, California, (408) 288-7580
Woodland Hills, California, (213) 884-2699
St. Petersburg, Florida, (813) 577-1299
Lexington, Massachusetts, (617) 488-9710
Dallas, Texas, (214) 783-6761

Authorized U.S. Distributors:
Arrow Electronics, Pioneer Electronics and Wyse Laboratories
Canada:
Sensid
(416) 475-9522, TWX 6109424455
European Sales Office:
49-89 177017, TELEX 524275 SEAG D

Seagate is a trademark of Seagate Technology. UNIX® is a trademark of Bell Laboratories.

MINI-MICRO SYSTEMS / May 1984
CIRCLE NO. 87 ON INQUIRY CARD
175
IS THERE A FUTURE IN YOUR FACTORY?

Industrial Renewal
A new era of industrial renewal is sweeping across the manufacturing landscape. Manufacturing pursuits are back on the front burner. Companies are gearing up to regain lost markets and become competitive on a now global scale.

The Manufacturing Information Network
Manufacturing is rapidly becoming an information intensive business. Allocation of resources — what's needed, how much, by whom, when and where — will be a crucial element in the success — or failure — of the manufacturing effort. New and automated production systems will be keyed into the manufacturing information network. And at the heart of this new working environment is the computer. Computer integrated manufacturing will usher in a new industrial revolution. Product reliability and quality are dramatically enhanced. Scrap and rework are minimized. And the improvements in overall productivity yield a maximum return on your investment.

Linkage and Systems Integration
The new dawn of manufacturing will not be realized by installing a few robots or numerically controlled machine tools. Even the latest systems approach to manufacturing will be rendered ineffective if the machines on the factory floor are not up to the job. The key to the future is linkage...linkage of the information vital to the manufacturing process with the computer driven production equipment designed to do the job. Not just one job. But the jobs that will be determined by today's and tomorrow's markets. After all, that's what flexible manufacturing is all about.

Beyond the Dream... The Future is Now
You've heard what's happening in manufacturing: materials requirements planning; just-in-time inventory systems; FMS; Robotics; Automatic Guided Vehicle Systems; AS/RS; CAD/CAM and more.

BUT WHERE DO YOU GO TO FIND OUT MORE ABOUT THE FACTORY OF THE FUTURE?

IT'S ALL HERE...

AMS 84
ADVANCED MANUFACTURING SYSTEMS EXPOSITION & CONFERENCE
McCORMICK PLACE, CHICAGO
JUNE 12-14, 1984

You're just one step away from finding out more about the factory of the future... Take that step today!
Return this coupon for special Reduced-Rate Show Registration Cards, Advance Conference Program and complete information on AMS 84. Or call 212-370-1100.
I want to save time and money, Send ___________ Reduced-Rate Show Registration Cards and ___________ Conference Programs.

Name
Title
Company
Division
Address
City State Zip

AMS 84
CLAPP & POLIAK, A Cahners Exposition Group Company, 999 Summer Street, P.O. Box 3833, Stamford, CT 06905
Words Alone
Don't Describe
The Lasergrafix
1200 Printer.

The QMS Lasergrafix 1200 is a breakthrough in electronic page printing. But words alone just don't describe it. Because QMS designed the Lasergrafix 1200 to do so much more than words. With a built-in intelligent controller that takes simple print commands through your normal data stream. Built-in applications firmware eliminates the need for additional software—and frees your computer's resources for other work.

The difference is graphic—for all your business, scientific and individual printing needs. Create forms that have multiple typefaces and letters up to ten inches high—all on the same line. CAD/CAM. Bit mapped and vector graphics. Pie charts. Bar charts. Even barcodes. At a crisp resolution of 90,000 dots per square inch. With a printing speed of 12 pages per minute.

And, of course, letter quality word processing.

The Lasergrafix 1200 interfaces with just about any computer system. With versatility that lets you take business graphics to the limits of your imagination. Ask for a demonstration. You'll discover that the whisper-quiet performance of the Lasergrafix 1200 speaks softer than words.

And says a whole lot more.

QUALITY MICRO SYSTEMS, INC.
P.O. Box 81250 Mobile, AL 36689
Telephone (205)633-4300 Telex RCA 266013
WHERE IMAGINATION LEADS

☐ Send me the Lasergrafix 1200 Information Packet, samples of mixed fonts, graphics and everything else it does.
☐ Please contact me to arrange a demonstration.

Name: ___________________ Title: ___________________

Company: ___________________ Address: ___________________

Type of system you are now using: ___________________

Number of print workstations you are considering: ___________________

Prime applications for printer: ___________________

QUALITY MICRO SYSTEMS, INC.
P.O. Box 81250 Mobile, AL 36689
If you're trying to keep production on schedule, cut QA and field service problems, start with our coupon.

And with a 5½” Pyxis from Ampex. Because this reliable Winchester can be in your hands in less than a week. In OEM quantities. At competitive prices.

And that—along with its industry-standard interfaces and 5, 10, 15 or 20 MB formatted capacities—makes this drive ideal when you need fast turnaround.

But short delivery times are just the beginning. Pyxis ensures quality performance over the long haul with features like a 90-msec access time. A unique dual chamber design that seals out contaminants and ensures data integrity. Exclusive temperature compensation features designed for operating environments harsher than any you're likely to encounter.

Plus self-diagnosis and board level swaps that cut mean repair time to just half an hour.

How can Ampex pack all that into a price-competitive drive? By taking advantage of something no competitor can match.
YOU NEED TO CUT 20 MB DELIVERY TIMES.

Our level of vertical integration. Plus over 20 years of computer peripheral and offshore manufacturing expertise.

So if you're trying to cut it in the OEM market, start with our coupon. Or call Ampex Computer Products Division at 800-621-0292. 800-821-9473 in California.

In return, we'll see you get a time-saving, cost-saving, repair-saving Pyxis to test for yourself. And you'll see.

It's just what it's cut out to be.

CUT ME IN!

I'd like to test a 5½" Pyxis drive. Please contact me.

Name
Title
Company
Address
City
State
Zip
Telephone
Quantity

Ampex Computer Products Division
10435 North Tantau Avenue
Cupertino, CA 95014

Ampex Corporation • One of The Signal Companies

MINI-MICRO SYSTEMS/May 1984
CIRCLE NO. 91 ON INQUIRY CARD
Meet ALL their needs with the L-XT™ and DIPLOMAT™.

DIPLOMAT™ is our amazingly simple tool for developing tailored business applications. The L-XT™ is our IBM®-compatible computer. Together, they'll help you meet your clients' needs quickly, easily, and profitably.

**Quickly**
We give you a head-start over your competition with our library of existing applications. Select the one that's closest to your client's need and tailor it to a perfect fit, or develop your own. DIPLOMAT can save weeks over the old method of generating applications from the "ground up."

**Easily**
DIPLOMAT uses easy-to-understand English nouns and verbs instead of obscure codes. Simple prompts guide you through the process. Your programs are easier to read, so they're easier to understand and modify, even long after they're created.

**Profitably**
DIPLOMAT means greater productivity, so you can produce more custom applications in less time. That adds up to more clients, happier clients, and higher profits.

What's more, your DIPLOMAT applications run on the L-XT system. The L-XT is IBM-compatible, so your customers can use off-the-shelf software for routine applications like word processing, while you take care of highly profitable custom applications. And as your clients' businesses grow, you can configure multi-user environments with the L-XT and our L-NET™ network.

Now you can meet your clients' needs quickly, easily, and profitably. Call us today.

L-XT includes: 192kB RAM, 12-inch amber display, 10mB hard disk, 360k floppy disk, two serial ports and one parallel port.

Software includes MS™-DOS 2.11, DIPLOMAT natural language, Microsoft Word word processor, Multiplan® spreadsheet.

Logical Business Machines
1294 Hammerwood Avenue
Sunnyvale, CA 94089
(408) 744-1290
800-538-1868

© 1984 Logical Business Machines
L-XT, DIPLOMAT, and L-NET are trademarks of Logical Business Machines. Microsoft and Multiplan are registered trademarks of Microsoft Corporation. MS is a trademark of Microsoft Corporation. IBM is a registered trademark of International Business Machines Corporation.
OFFICE AUTOMATION: Terminals: Looking for high text speeds and full color graphics in an office terminal? Digital Equipment Corp. may have what you seek. Its VT200 terminal family features both of the above, plus a UPS, keyboards for 16 languages and a variety of ergonomic features, such as a low-profile keyboard, non-glare screens and white, green or amber phosphors. For more information, turn to p. 221.

Computer bus: Buses represent the “superhighways” of computer systems. They carry data, addresses, control signals and power between system components. The SCSI bus is the leading intelligent interface for 5¼-inch Winchester disk drives and is used by 30 percent of installed small business systems. To find out if this component can ease your traffic jams, see p. 241.

Utilities: UNIX-based office-automation systems, pushed by AT&T and IBM endorsements, will experience explosive growth starting next year. They will surely eclipse MS-DOS and PC-DOS in the 16- and 32-bit standard arena. The UNIX trend promises a wider selection of brands and products for system integrators. For a closer look, see p. 253.

Product evaluation: Associate editor Roy Friedman tested the Wang Professional Computer and found a fast CPU, an ergonomic display monitor and a powerful editor, assets which pose a challenge to the IBM PC. See p. 263 for further observations.

PARALLEL PROCESSING: Several proven techniques can be used to remedy a failed system. These vary primarily in the length of the recovery sequence and the demands placed on end users and integrators. One technique, the fault-tolerant computer, has moved beyond on-line processing only and become less expensive. Check the details on p. 183.

MULTIFUNCTION SOFTWARE: Numerous software makers have developed integrated software packages that nearly match mainframe capability in solving complex business problems. Beginning on p. 195, MMS presents a profile article on these manufacturers, accompanied by a product table on p. 207.

STREAMERS: Most ¼-inch cartridge-tape drives perform only image backup for Winchester drives. Full-function streamers, however, such as the Model 92190/92192 Sentinel from Control Data Corp., provide data compression, individual-file backup and archival storage previously found only on larger and more expensive ½-inch cartridges. For more information, see p. 231.

MICROCOMPUTERS: A multitude of systems exist that claim to bring the power of UNIX to a low-cost system. These systems vary greatly in execution speeds and multiuser support. Unitod Systems Inc. has developed a dual-CPU, VAX-compatible micro that also includes on-board cache memory and intelligent I/O processors. Turn to p. 275 for a look at Unitod’s Cerebra.
It is the highest performance, most reliable 5 1/4" cartridge disk drive in the industry.

It features more resistance to shock and vibration than any other disk drive, fixed or removable.

Its cartridge is the least expensive among formatted 5-megabyte cartridges on the market today.

Its cartridge interchangeability from drive to drive is absolute. Its start/stop time is the fastest available of any high-performance disk drive.

It is the Beta 5 Cartridge Disk Drive from IOMEGA. And it is, in a word, superlative.
Fault-management system lowers cost, expands applications

Running under UNIX and interconnecting to the Multibus, a parallel-processing computer addresses all phases of system failure—from automatic recovery to notification and repair

Mark Pine, Parallel Computers Inc.

All computer systems are susceptible to failure. Depending upon a system's architecture and the nature of the failure, a failed system can render data invalid, stop operating or continue operating with no perceptible indication that a failure has occurred. Several proven techniques can be used to return data to a valid state and resume normal operation. These techniques differ primarily in the length of the recovery sequence and the demands placed on end users and software integrators. Fault-tolerant computers that markedly reduce recovery time have traditionally been used mainly for on-line transaction processing and command a significant cost premium. Advances in hardware and software technology, however, enable today's fault-management computers to lower the cost of fault management and expand the applications of fault-management systems.

Recovering from a system failure

Most computer systems are designed with little or no ability to recover from a system failure. When a failure occurs, the system usually stops operating and data is frequently lost. In most cases, a field-service engineer must be called to repair the system and restore it from a backup data image created before the failure. This approach to fault management places a considerable burden upon the system end user and mandates a recovery period of hours or even days. Because of data loss and downtime, it is unsatisfactory for most applications.

Early attempts to shorten the recovery period employed a second redundant computer as a backup and required the application software to update the backup...
PARALLEL PROCESSING

A system on a regular basis. Although it shortened the recovery period, such an approach failed to address the issues of fault detection and automatic recovery. In addition, it mandated substantial application software development and therefore was unsuitable for most applications.

Fault-tolerant computer systems continue to operate even after the failure of a system component. They aim at eliminating data loss and reducing the recovery period to seconds or minutes. Detecting, identifying, isolating and automatically recovering from failures, these systems vary significantly in cost and impact on the software integrator and focus mainly on medium- and/or large-scale transaction-processing applications.

Fault-management computers are also fault-tolerant and, therefore, provide immediate automatic recovery. Encompassing all phases of fault management, they also furnish notification and repair capabilities (Fig. 1). Supporting continuous operation and preserving data integrity, they return a system to its original state before the failure.

Design innovations, combined with lower hardware costs, have driven fault-management systems into the minicomputer/supermicrocomputer price/performance class. And when an end user considers costs of ownership, including the cost of service, downtime and loss of data, a fault-management system becomes the least expensive alternative for a broad range of applications (Fig. 2).

Implementing fault management

Protection against system failures with conventional computer systems typically involves manually copying system data onto a backup magnetic tape or disk on a regular basis. Recovery entails having a field-service engineer come to the site and replace the faulty component. The recovery must restore system data from the backup medium and, if possible, duplicate data accessed and work completed since the last backup. Because the system is unavailable for processing during recovery, it is unsuitable for many on-line operational-information-system (OIS) applications, which require constant access to data.

In contrast to traditional computer systems, fault-tolerant computers address the issues of fault protection and recovery and provide continuous operation without loss of data in the event of a component failure. Based on a redundant architecture in which critical system components are replicated, these systems differ

<table>
<thead>
<tr>
<th>Fault-tolerant systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovery</td>
</tr>
<tr>
<td>• fault detection</td>
</tr>
<tr>
<td>• identification of source</td>
</tr>
<tr>
<td>• isolation of area containing fault</td>
</tr>
<tr>
<td>• re-configuration of system</td>
</tr>
<tr>
<td>• resumption of processing</td>
</tr>
<tr>
<td>End-user action required</td>
</tr>
<tr>
<td>• none</td>
</tr>
</tbody>
</table>

**Fig. 1.** Fault-management computer systems provide notification and repair capabilities in addition to the automatic-recovery functions of fault-tolerant computers.

**Fig. 2.** Although fault-management computers cost more than conventional systems, they are economically justifiable for many applications. The crucial factor is an end user’s cumulative cost of ownership. The break-even point is reached when the conventional computer system’s total cost—comprising service cost, cost of downtime and cost of loss of data—equals the purchase cost premium of the fault-management system.
The Micro Five Series 1000 business computer can simplify your operations and contribute to the success of your business.

The Micro Five Series 1000 brings a new way of working to today's small business environment. It can support as many as 10 users simultaneously, each performing the same or different jobs. Whether you're word processing or balancing your general ledger, the Series 1000 can quickly translate the words and numbers of your business into useful, accurate information. And because the Series 1000 simplifies your operations it can help you deal with current activities and aid in making sound business decisions.

You'll be glad to know that the Series 1000 supports a combination of today's most popular operating systems and programming languages including CP/M-86®, MP/M-86™, SMC Business BASIC, MicroCOBOL and STARDOS™. Plus a virtually unlimited library of proven applications ranging from standard accounting, word processing and financial planning to special vertical market applications. The Micro Five Series 1000 is versatile enough to work on many desks tomorrow as well as it does on one today.

Find out more about the Series 1000 and our dealer program. Call Micro Five at (714) 957-1517 and discover the difference our multi-user approach can make in your business.

Discover the Difference
If you've been waiting for a supermicro with UNIX* System V on a 68010-based processor, stop. Introducing the Callan Unistar™ 300. It's the single best supermicro you can buy. For a couple of reasons:

One, the 10MHz 68010 CPU. It's the newest, fastest, best. It crunches numbers in a snap. And works beautifully with the new UNIX.

Two, the new UNIX System V. It's faster than UNIX System III. On the Unistar 300, it supports a host of languages. And when it comes to portability, flexibility and system support, nothing comes close.

There's more. The Unistar 300 allows for expansion to 172M bytes of high-speed disk storage with integral tape backup—all within one enclosure that easily fits under a desk.

Its convenient 12-slot Multibus* chassis lets you easily add options like networking, communications, floating point array processors and more. Up to 2M bytes of main memory provide real power for every user. And nationwide service is available through ITT/Courier.

Unistar 300. Finally a supermicro with super everything. Available today from Callan. For more information contact Callan Data Systems, 2645 Townsgate Road, Westlake Village, CA 91361. (800) 235-7055. In California (805) 497-6837. TELEX 910 3361685.

Callan Unistar

*Callan and Unistar are trademarks of Callan Data Systems. UNIX is a trademark of Bell Labs. Multibus is a trademark of Intel Corporation.
Primarily in the techniques used to achieve fault tolerance at the processor level.

Software checkpointing was one of the earliest techniques employed for attaining processor fault tolerance. In this approach, one process periodically copies (checkpoints) critical data to a backup process running on a different processor. When it detects a failure of the main processor, the system restarts the process from the last checkpoint on the backup processor.

A major drawback of this approach, however, is that the application program must implement the checkpointing. This places a considerable burden on the software integrator: he must include checkpoints in the application program and ensure that they are correctly located. Furthermore, software running on another machine or available from a third party cannot be easily transported to this type of system.

Voting fault-tolerant systems typically employ three or four processors performing the same task and periodically comparing the results. When a discrepancy occurs, the processor in disagreement is considered faulty and configured out of the system while the system continues to operate with the remaining processors. This method eliminates the need for checkpoints in the application software and results in substantially lower software-development costs. Inherent in the voting approach, however, is the extensive use of redundancy. Because it involves a substantial cost premium compared to conventional computer systems, it limits the applications for voting fault-tolerant systems.

A more recent approach to implementing fault tolerance employs a pair of closely coupled processors executing in parallel. The processors synchronize at well-defined points to ensure that they are both operating correctly. If a processor failure occurs, it is detected by the faulty processor itself or by the other processor at a synchronization point. The faulty processor is then configured out of the system, and operation continues without interruption on the remaining healthy processor.

Because coupled-processor systems provide software-transparent fault tolerance, they do not require checkpoints in the application software. And, because they only duplicate critical components to achieve continuous operation and data integrity, they are cost-effective. Figure 3 compares the three approaches to fault tolerance with the recovery methods of conventional computer systems.

**Coupled processors provide continuous operation**

Parallel Computers Inc.'s Parallel 300 fault-management system is based on the closely coupled processor approach. Offering continuous operation and data integrity in the minicomputer/supermicrocomputer price/performance class, it addresses the recovery, notification and repair phases of fault management and satisfies the stringent demands of OIS applications.

The computer's redundant architecture duplicates all vital components (Fig. 4). The heart of the system is a pair of closely coupled parallel-processing units (PPUs) that use Motorola MC68010 virtual-memory micro-
Parallel Processing

Processors running at 10 MHz without wait states. Main memory ranges from 1M byte to 4M bytes. All tasks are executed simultaneously on both processors. If a processor fault is detected, the faulty processor is logically removed from the system while the application continues to run on the other processor. Synchronization between processors and re-configuration of system components occur transparently to end users and to their application programs.

The disk subsystem comprises duplicate Winchester disk drives and duplicate disk controllers. All data recorded on disk is mirrored on both drives. System performance is enhanced by reading from the drive with the disk head closest to the required data. If a read or write error occurs because of a media defect, the system automatically maps out the bad track and updates it from the good drive. If the failure involves a hardware malfunction, the faulty drive is configured out of the system along with its associated controller. When a disk controller fails, the system logically removes the controller and its associated disk drives from the system. When a disk subsystem failure occurs, immediate and automatic system recovery without loss of data is attained by accessing the properly functioning disk controller and drive.

Duplicate power modules with integrated batteries minimize power-failure problems. If either module fails, the working power module energizes the computer system. The batteries also isolate the system from external power-source transients, voltage reductions, voltage spikes and power loss. This configuration also greatly reduces the occurrence of disk head crashes, transient disk writes and file system contamination often associated with external power fluctuations. Most approaches to external power-failure protection provide battery backup only for a system’s internal memory. In contrast, the Parallel 300’s power subsystem keeps the entire system, including the disk drives, operating for as long as 90 minutes after a power failure, allowing for orderly system shutdown during prolonged power outages.

The fault-management computer runs under the UNIX operating system. Because fault tolerance is implemented transparently within the system, users see the standard UNIX interface. Application programs can be transported from any UNIX system to the computer without modification. UNIX provides a powerful development environment that can reduce software-development costs. And because it is a de facto industry standard, many application programs using UNIX are available from third-party software houses (Fig. 5).

The computer system works with the Intel Multibus, an industry-standard interconnect bus. OEMs can
CalComp puts its reputation on another line.

The CalComp line of electrostatic plotters.

You already know CalComp as the leader in pen plotters. Now, we've taken our reputation for reliability, commitment and support, and placed it on our complete line of electrostatic plotters.

CalComp's line of electrostatics gives you a choice of 11', 22' and 36' plotter/printers. Each is perfect for plot previewing at an affordable price, and is ideal for mapping, business charts, graphics and a wide range of other applications. And by using clear mylar media, you can also produce finished-quality drawings.

To make it as easy as possible for electrostatics and pen plotters to work together, CalComp also offers a family of controllers. These unique and versatile controllers can drive up to eight electrostatic plotters with a pen plotter, freeing your host computer for more cost-efficient tasks.

Let CalComp's sales representatives and graphic consultants find the right electrostatic to fit your needs. Write us now, because we're placing our reputation on the line—for you.

CalComp, 2411 West La Palma Ave., P.O. Box 3250, Anaheim, California 92803. Or call (800) 556-1234, ext. 156.
In California call (800) 441-2345, ext. 156.

CALCOMP
A Sanders Company

[Image and text]
It's easy to make points when you're a pro.

POINT ... The Houston Instrument DMP-41 plotter meets the needs of the serious or professional user, yet it's easy to operate.

POINT ... C/D size format, comprehensive front panel controls and sophisticated firmware are all tailored to the needs of the surveyor, drafter, oceanographer, geophysicist and land developer ... to name but a few. You can generate superior architectural elevations, contour maps, circuit-board layouts and assembly drawings quickly and accurately on bond, vellum or synthetic media.

POINT ... The DMP-41 is configured to work with micros and minis, and has the capacity to take advantage of a mainframe's increased capability. RS-232-C interfacing is standard, with alternate protocols available. The DMP-41 is easy to live with, adhering to FCC Class B requirements. UL listing pending.

POINT ... Minutely defined step size and high-resolution logic—combined with robust drives and optimized pen ballistics enable you to create plots of high precision and surpassing quality.

Visit us at Comdex, Atlanta GA, Booth #D606.

houston instrument

* suggested US retail $2,995
CIRCLE NO. 97 ON INQUIRY CARD
Are fault-management computers worth their purchase-price premium?

Fault-management computers cost more than conventional computer systems. System integrators and end users deciding whether this purchase price premium is economically justifiable must consider one important factor: the cost of downtime and data loss inevitably involved with the conventional system. If this cost is greater than the higher initial cost of providing continuous operation, they will select the fault-management system. If, on the other hand, this cost is less than the fault-management computer's purchase cost premium, they will most likely decide on a conventional system that cannot provide continuous operation.

Historically, the higher cost of fault-management systems has restricted these computers to a limited set of applications, such as electronic funds transfer, that mandate data integrity and continuous operation. In contrast to conventional computer performance specifications, these characteristics measure what could be called "performance in the field." Reliability, availability for processing and serviceability determine how well a system meets the demands of an end user's application. When evaluating a computer for a specific application, system integrators and end users should consider both conventional performance parameters and performance in the field.

During the 1970s, companies tended to allocate computer resources more directly to their operational departments. These Operational Information Systems (OISs) typically run on-line applications and perform a specialized set of tasks for a department. They serve a vital role in the department's operation by improving productivity as well as performing tasks that are impractical without them. Minicomputer manufacturers have capitalized on this trend by targeting their products at this market. Recently, a new wave of computers aimed at the same market but based on microprocessor technology have become available from Convergent Technologies Inc., Plexus Computers Inc. and other manufacturers.

OISs have system-availability and data-integrity requirements that, in most cases, are not adequately satisfied by conventional minicomputers or supermicrocomputers. Some manufacturers address the shortcomings of conventional computer systems by offering service contracts that guarantee system uptime of 95 percent to 99 percent. These methods improve system availability but are extremely expensive and still result in one day to five days of downtime out of every 100 days of operation. In addition, they do not address the potentially catastrophic effects of system failure upon data integrity.

adapt the Parallel 300 to their applications by adding specialized and general boards to the system from more than 100 manufacturers.

Other Parallel 300 features support the addition of OEM-added boards, and a set of software procedures permits the integration of value-added components into the system. The system provides fault-management and driver-specific functions. If an add-on board fails, it can be put into a reset state so that it cannot affect system operation. If a board locks onto the bus, the

Fig. 5. Application programs from any UNIX system can run on the UNIX-based Parallel 300 without modification. Because the system transparently implements fault tolerance, end users see the standard UNIX interface.
status monitor detects the condition and takes appropriate action to disable the offending board.

The computer reduces service costs by minimizing the time and labor required to repair the system. Without tools, non-technical personnel can quickly replace all components, including power supplies. The computer detects and identifies a problem, isolates it to the specific component and notifies the operator via the system status display, the system console, the disk error log and fault lights adjacent to the failed component (Fig. 6).

Step-by-step instructions indicate how to replace the faulty component and bring the new one into service. Because the system continues to operate even after a component has failed, the requirement for immediate service response—usually crucial to OIS applications—is eliminated.

Service costs associated with recovery from system failure have a substantial impact on a computer system's overall costs of ownership. The Parallel 300's user-serviceable configuration allows OEMs to reduce and control their service costs and provides a range of service options: they can offer an end-user service program backed by Parallel or direct service by their own personnel. In either case, a large field-service force is not needed.

Spec summary

- **Model:** Parallel 300 fault-management system
- **Manufacturer:** Parallel Computers Inc., 3004 Mission St., Santa Cruz, Calif. 95060
- **Processor/speed:** each parallel-processing unit's (PPU's) 68010 runs at 10 MHz without wait states
- **High-speed local memory for PPU:** 1M to 4M bytes
- **System memory:** 8-inch Winchester disk drives; 80M to 160M bytes per drive; two to eight drives per system
- **Backup tape drives:** 20M-byte, ¼-inch streaming-tape
- **I/O:** processor supports 16 to 32 RS232C ports per system
- **Communications:** communications processor supports SNA and X.25 protocols; Ethernet local-area network controller and Arpanet TCP/IP protocol available
- **Operating system:** Berkeley version 4.2 UNIX
- **Languages:** C, Pascal, FORTRAN 77, BASIC, COBOL
- **Utilities:** standard UNIX, Vi Editor, C Shell, UNIX-to-UNIX copy; relational database-management system available
- **Price/delivery:** $50,000 to $100,000, depending on configuration; available for immediate delivery

Fig. 6. Fault lights notify the system operator of inoperative components, speeding system repair.

Mark Pine is vice president of research and development and a founder of Parallel Computers Inc., Santa Cruz, Calif. A co-founder of Digimedics Corp., Santa Cruz, he served as that company's vice president of engineering before assuming his current position. Pine received a B.A. from and did graduate work at the University of California, San Diego.
Microcomputer Insurance. $24.

Insure the continued efficiency of your microcomputer's read/write heads by keeping them clean with...

TEXWIPE'S NEW DUAL-PURPOSE FLOPPY DISK HEAD CLEANING KITS.

These kits are called "Dual-Purpose" because the uniquely designed cleaning disk can be used to clean both single- and dual-sided drives interchangeably. No need for separate disks for each type of drive.

Available in either 5¼" or 8" disk, each kit contains 2 cleaning disks, a can of Metered Spray Head Cleaning Solvent, protective storage sleeves and 10 free "Wet & Dry"™ Twinpaks—two foil-wrapped disposable pads, attached at the middle; one for cleaning, antistat treatment of screen, one for lint-free drying.

Also available from Texwipe, our new Microcomputer/Word Processor Datakits™. Four different cleaning kits each containing CRT terminal cleaners, keyboard cleaners, static control supplies, compressed air dusters as well as read/write head cleaners. All DataKits are packaged in handsome reusable vinyl storage cases.

Fill out the coupon and we'll send you literature and prices on our full line of microcomputer cleaning kits and "Wet & Dry"™ Terminal Cleaning Pads.
© 1984 Texwipe, Upper Saddle River, NJ

Please send more information on Texwipe's New Dual-Purpose Floppy Disk Head Cleaning Kits.

Name__________________________
Title__________________________
Company______________________
Address_______________________
City___________________________
State__________________________
Zip___________________________

TEXWIPE
650 East Crescent Avenue • P.O. Box 308
Upper Saddle River, New Jersey 07458
Executive: (201) 327-9100
Sales: (201) 327-5577 • Telex 102070

CIRCLE NO. 98 ON INQUIRY CARD
More professional software is duplicated on FORMASTER than any other system.

For good reasons.

All the best known software publishers have chosen FORMASTER systems for diskette duplication and piracy protection because they're fast, flexible, and easy to use. Plus, they are proven reliable and cost effective.

Copies over 300 per hour
FORMASTER systems duplicate up to 326 fully verified copies per hour. That's ten times faster than a microcomputer. And with a FORMASTER jam-proof automatic loader, you can cut handling time by up to 90%.

Duplicates all known formats
FORMASTER systems copy all existing 8", 5½" and 3½" diskette formats, including complex GCR. As new formats are required, FORMASTER responds immediately.

Protects your programs
FORMASTER's unique CopyLock™ protection software prevents unauthorized reproduction. It's the most effective solution to the piracy problem.

Easy, reliable operation
Anyone can operate FORMASTER duplicators. Just load and press one button. It's that simple — and reliable.

The first choice
FORMASTER has the complete solution for software production: handling, duplicating and labeling.

In Europe: FORMASTER U.K. Corporation, Milton House, 172-184 Bath Road, Slough, Berks. SL1 3XE, England. Telephone (0753) 820981.

FORMASTER
The Leader in Software Production Technology
Integrated software solves complex business problems

The latest integrated business software accommodates financial analysis, data handling and communications and offers a choice of user shell environments

Carl Warren, Western Editor

Spawned by the success of Lotus Development Corp.'s 1-2-3 integrated software package and the availability of more capable microcomputer hardware, numerous software makers have developed integrated software packages that nearly match mainframe capability in solving complex business problems. This software follows distinct guidelines, giving virtually all the packages a me-too flavor.

For example, the latest integrated software packages provide four standard functions: numerical analysis, list/database management, text editing/word processing, business graphics and—in an increasing number of packages—a fifth function: communications. A check of available packages reveals that these functions are typically implemented as VisiCalc-type spreadsheets, data handlers that range from simple list managers to full-blown relational database-management systems, memo- and report-writing functions that provide simple text editing, sophisticated word processing, business graphics that enable users to create charts, modem communications and 3270 terminal emulation.

Until now, system integrators have overlooked communications packages. Furthermore, high-resolution pointing devices—such as cursor-type mice—are becoming more important to system integrators interested in adding windowing and free-form graphics. The use of such devices, along with more complex software, however, requires powerful CPUs and more system memory, which are available in current 16-bit computer-based systems.

To link business functions in an easily viewable manner, the Lotus Symphony employs a window-management system that the company claims tightly couples word processing, spreadsheets, database, communications and graphics. Lotus plans to provide details on the Symphony architecture, enabling integrators to insert additional applications.
Decision support proves important

One of the prime motivating factors, other than the prospect of large returns on investment, for creating full-featured integrated packages is to provide business managers with sophisticated decision-support systems. According to Wesley A. Lee, product planning manager for Context Management Systems Inc., Torrance, Calif., a decision-support system is “a combination of hardware and software that provides an operating environment in which managers and other corporate users can increase their effectiveness in the decision-making process.” Lee believes that, for a decision-support system to be effective, the user (manager) must have immediate access to the data; hence, integrated packages now contain communications capability.

Context Management’s Corporate MBA package includes both 3270- and modem-type communications, which allow a user to perform analytical operations on remotely accessed data, extending the viability of the automated decision-support system. Although Context Management has established the requirements for integrated decision-support packages, Lotus Development, Cambridge, Mass., has won awards with its 1-2-3. The company is attempting to continue its market success with an enhanced product called Symphony. Symphony combines word processing, database management, a spreadsheet, graphics and a window-management system.

But, with more than 80 new entrants in the integrated software arena, Lotus and Context Management are facing stiff competition, the most notable of which is Ovation Technologies Inc., Canton, Mass. Ovation offers a five-function package with features similar to those provided by Context and Lotus. This package furnishes command-processing continuity, which the company claims makes the software easier to use and learn.

Context Management’s Lee and company president David Saykally confirm that command-processing continuity is important. “The user can’t be saddled by technical decisions related to the use of the product,” says Lee. In addition, Bob Demoura, software engineer at Digital Equipment Corp., Marlboro, Mass., warns that integrators shouldn’t force users down a narrow application path. Rather, flexibility should be the watchword.

Although IBM Corp.’s PC and its clones and Apple Computer Inc.’s Macintosh are the prime targets for writers of integrated software, some authors aren’t forsaking 8-bit machines. For example, Arktronics Corp., Ann Arbor, Mich., offers the Jane software package for Apple II and Ile computers and for the Commodore 64 with only 64K bytes of memory. The package comes with word processing, list-manager and serving as a sophisticated sleeve that surrounds both the operating system and the applications, Quarterdeck’s DESQ employs overlapping windows and manages inter-application communication. By using artificial-intelligence techniques, DESQ “learns” the nuances of applications that are tied into the system.

Serving as a sophisticated sleeve that surrounds both the operating system and the applications, Quarterdeck’s DESQ employs overlapping windows and manages inter-application communication. By using artificial-intelligence techniques, DESQ “learns” the nuances of applications that are tied into the system.
Finally! A BASIC compiler that means business. Microsoft® Business BASIC Compiler allows you to create professional applications for MS-DOS systems that are so fast your users will never know they were written in BASIC.

Because the compiler produces native code, your software will run three to ten times faster than the same interpreted programs.

But speed isn’t everything. Microsoft’s Business BASIC also has business savvy. Based on the de facto standard Microsoft BASIC, it includes a rich set of extensions:

- Decimal floating point arithmetic (14-digit precision-BCD format) for extremely accurate dollars and cents calculations.
- Two types of arrays provide maximum program flexibility: static arrays for speed, dynamic arrays for expandability.
- Over twenty string handling functions provide sophisticated character manipulation capabilities. Strings can be up to 32K bytes.
- Multi-line functions and subprograms allow you to define routines with local or globally defined variables.
- Separate module compilation means complex programs can be broken down into smaller units. Coupling multiple modules together permits creation of very large programs, up to one megabyte.

Call 800-426-9400 to order the better Business BASIC. $600*:

In Washington State, call 206-828-8088. Ask for operator B5, who will rush you your order, send you more information, or give you the name of your nearest dealer to see Microsoft Business BASIC in action.
spreadsheets. The display method uses a pseudo-window approach and icons, which a user selects using a three-button mouse. The mouse comes with an electrically programmable read-only memory (EPROM) that prevents unauthorized copying of the software. Arktronics has also developed a 16-bit (EPROM) that prevents unauthorized copying of the software.

Packages speak to each other

Another major performance factor of integrated software is that it provides for intra- and inter-application communications. This capability allows data to be entered only once per module or allows the rest of the system to share standalone application. It also eliminates the need for complex data-transformation utilities that a user must write or operate separately.

Making entered data available to all parts of the system enables a user to view multiple data scenarios, as well as to include data in the desired presentation format, such as for business graphics, a letter or a memo.

Intra-application communication is only part of the new integrated packages. Most users are already aware that these packages also be able to use data created under other software applications, such as Micropro International Corp.’s Wordstar or Ashton-Tate’s dBase II. Thus, software makers are providing inter-application utilities that permit data to be imported and exported in different formats.

The common formats are the data-interchange format (DIF), Microsoft (SYLK) and standard CP/M systems data format (SDF). The DIF is the most popular, mainly because Software Arts first used it with the VisiCalc program and Lotus and Context Management later adopted it. Microsoft, through, is seeking higher-level integration than DIF offers. The company supplies a rich set of attributes that allows system integrators to furnish several layers of compatibility when transporting or exporting data between applications that support the SYLK format.

Applications look through windows

Because of the excitement surrounding Apple’s Macintosh and the ready availability of bit-mapped displays, many integrated applications employ the windows function to establish the user environment. Unlike system-level windowing packages (see “Throwing open the sash on windows software,” right), windowed applications supply their own window managers. Many windowing packages employ specific hardware attributes, requiring a special version for each implemented machine. This dedication minimizes application transportability and, in many cases, generated data transportability.

In addition, software writers have found many ways to implement windows. One common way is to overlap windows, as in Apple’s Macintosh, and another way is tiling, whereby windows abut each another. Abutting is more memory-tolerant than overlapping, and it usually provides a method of dynamically sizing the window, depending on cursor placement. Although abutting

Throwing open the sash on windows software

Users looking for a windowing package rather than a windowed application have an assortment from which to choose. Although only a few software manufacturers make windowing shell environment packages, the packages do have wide-ranging capabilities. For example, a minimum package puts windows on a single application, and fully extended operating system hardware includes multiaction capability.

Extending the OS

Windowing software from Digital Research Inc., Microsoft Corp. and VisiCorp extended the functions of operating systems to windows, graphics and intra- and inter-application communications. All three companies are aggressive in providing extended capabilities. Digital Research, with its Concurrent CP/M release 3.1, offers PC-DOS compatibility in the OEM version. Microsoft expects to include networking in its MS-Windows, and VisiCorp offers Visi”, which comes with a full line of application software.

A neat shell

Other packages, called “shells,” surround the applications and the operating system. For example, in Trillian Computer Corp.’s Visiull, the windowing software also handles intra-application communications, thus further simplifying the interface. Shells typically operate with a pointing device, such as a mouse. Graphicon Systems’ Inview and Quarterdeck Office Systems’ DESQ can be used with keyboard inputs, and Visi” requires the use of an optical mouse. Microsoft’s Windows and Digital Research’s Concurrent CP/M both work with a mechanical mouse or with keyboard input because both tailor easily to the system architecture.

Requires modification

Windowing software that extends the operating system also extends hardware functionality. To make applications operate properly, system integrators must modify the applications to match the windowing software’s internal operation. Window packages that serve as shells, on the other hand, normally work with any software and need only to be told of an application’s existence. Built-in utilities handle data conversions and display characteristcs. Both DESQ and Inview contain an automatic learn function that simplifies combining software in the shell.
doesn't always require the use of a pointing device such as a mouse, overlapping windows typically do. In overlapping windows, the sophisticated window manager uses many hardware functions to permit the correct repainting of an underlying window.

According to Terry Myers, president of Quarterdeck Office Systems, Santa Monica, Calif., the trend is toward user-personalized packages, and integrated packages provide a path to such packages. "There are really only a few things that you do on a regular basis [with integrated packages], and you want quick access [to these functions]. The desktop metaphor that Apple is popularizing is an accurate way of depicting what we and all the other software manufacturers are trying to
Myers concedes that there are a number of ways to depict a desktop but believes users are more comfortable in an environment with a windowing function.

Query Computing Systems Inc., Torrance, Calif., offers an interesting twist on the “to-window-or-not-to-window” question—the Quick Integrated Office (QIO) package. According to Steve Bostwick, company president and chief designer of the product, windowing methods complement product operation: “Graphics depict various functions such as file cabinets on the screen; pop-up and pull-down windows serve as guideposts for the user—not as fancy front ends to increase the price.”

Generic integrated software usually consists of five standard functions.

Besides conservative use of QIO’s window functions, Query has used only generic calls to the operating system. “Our goal,” explains Bostwick, “was to create an application that could be transported across a wide range of machines. By coding in PL.1 and using a modular design, we can quickly port QIO from machine to machine and operating system to operating system.”

Another company with a different slant on integrated software is Fox & Geller Inc., whose OZ financial-management package company president Jeffrey Fox defines as a new category of integrated software. Unlike other packages, OZ integrates profit-and-loss forecasting, financial reports, variance analysis, business graphics and 3D data analysis. Like other five-function integrated packages, OZ lets users employ the data entered once to perform all functions. But OZ does not include a standard spreadsheet, database manager or windowing functions. Users can get windowing functions with OZ by attaching it to Quarterdeck’s DESQ or to Graphicon Systems’ Invview shells.

Another company that is taking its own approach to integrated software is Softrend Inc., Salem, N.H., with its $495 Aura package. This full-featured database-management system provides free-form screen entry design and report creation, a spreadsheet with linking and zoom capability and a word-processing package that simultaneously handles as many as three documents. Aura performs these functions without using windows. Instead, it uses menus that travel with the user’s current level of operation, thus allowing the user to get help with one keystroke.

Aura also provides high-level graphics flexibility. Rather than restrict users to creating standard business charts, Aura includes a free-form capability and library functions, permitting users to create lines, boxes, circles, arcs and polygons using keystrokes and a cursor rather than a mouse. The Aura package can be easily integrated into virtually all the windowing packages.

Possibly the most ambitious approach is offered by Martin Marietta subsidiary ITSoftware Inc., Princeton, N.J. The company’s IT packages contain linked modules that offer everything from database management to high-level statistical software. Each module can stand alone but can simultaneously provide links to the other modules in the family. In addition, ITSoftware ensures that the microcomputer software
Why wait? Give your workstation a V-80. Get the high resolution hard copy you want—complex graphics, software generated text, maps, even halftone pictures. And get it fast—an 11-inch wide page in just 8.5 seconds. Plot drawings in A-size, B-size, or just 1000 lines any length. Print 132-column listings at up to 1000 lines per minute. On a wide selection of paper or film media. An electrostatic V-80 costs half as much as the typical laser device. And one V-80 can serve several users without contention. Quickly. Quietly. Reliably.

Versatec interfaces, including IEEE-796 (multibus) and IEEE-488 (GPIB), intelligent controllers, and multiplexers link V-80 with many popular workstations and computers. Versatec support and supplies are available throughout the world.

So why wait? Circle our readers' service number for your free brochure.

See us at NCGA. Systems '84 and Canadian CAD.

THE FAST WAY TO HARD COPY.
is fully compatible with mainframe software. Like Context Management, it offers 3270 emulation using Digital Communications Associates Inc.'s IRMA board for the IBM PC.

Taking a similar approach is Innovative Software Inc., Overland Park, Kan., with its The Smart Set. Sold as separate modules, the package comes with word-processing, spreadsheet and database-management functions. Innovative uses windows to enhance rather than surround each application. "The question is one of loosely coupled vs. tightly coupled. We chose the former because it allows more flexibility," says company president Michael J. Brown.

A reasonable interface guess

What the user interface will ultimately be isn't clear to various hardware manufacturers. For example, Edward E. Kuerner, software and communications support manager for Qume Corp., San Jose, Calif., the maker of PC-clone Extra system, says, "It's too early to tell because the jury is still out. And I don't think anyone will really have a clear picture for about a year."

Qume has committed to using Microsoft's Windows to handle the user interface and hopes it is the right choice.

Gary White, manager of microsystem commodity software development at Honeywell Information Systems, says that Honeywell will use the interface that permits the company to handle commodity software with a minimum of trouble. Now, Honeywell prefers using Microsoft's Windows to provide Honeywell with an integrated performance platform. Similarly, DEC believes that its Rainbow microcomputer will be many things to many people. DEC isn't locked into one windowing concept but has elected to use both Quarterdeck's DESQ and Microsoft's Windows. The concept, according to a company spokesman, is that the window portion serves as the actual interface between user and machine.

Extensions attain prominence

Extensibility is key to what software integrators want. They are seeking ways to develop software packages that can be upgraded with the least difficulty. Ashton-Tate, for example, is expected this month to introduce dBase III, which will offer windows and possibly utilities for providing inter-application communications.

Software makers might be premature in planning extensions because most of the products announced over the past five months aren't yet ready to be delivered. It's unclear how much the market can absorb, but the future for vertical packages appears bright.

For your best investment in printers.
Call your nearest Qume distributor today.

United States:

American Calculator & Computer
(205) 933-2344 - AL
Aimee Electronics
(206) 643-9092 - WA
Anacomp
(206) 881-1113 - CA, UT, WA
Anthem Systems
(415) 342-9182 - CA
Bohllt & Associates
(612) 922-7011 - MN
Butler Associates
(817) 964-5270 - CT, MA
Byte Industries
(800) 972-5945 (CA Only)
(800) 277-2070 (Outside CA)
David Jamison Carlyle
(213) 410-9250 - CA, CO, HI, IL, NJ, TX
Computers & Peripherals Int.
(315) 476-6664 - NY
The Datasure
(609) 779-0200 - NJ
Equipment Resources
(404) 955-0313 - GA
Future Information Systems
(212) 732-3900 - NYC
Gentry Associates
(305) 859-4590 - FL, GA, LA, NC, SC, TN
Inland Associates
(913) 764-7977 - KS
InterACT Computer Systems
(704) 254-1949 - FL, GA, NC
Kierulf Electronics
(800) 338-8581 - AZ, CA, CO, CT, FL, GA, MA
MD, MN, MO, NC, NJ, OH, OK, TX, UT, WA, WI
MA/COM-Allanbus Data
(317) 770-1150 - MD
MicroAmerica Distributing
(800) 431-7660 (MA Only)
(800) 343-4411 (Outside MA) - CA, MA, TX
Midwest Microcomputers
(419) 782-1115 - OH
National Computer Syndicate
(312) 459-6400 - IL, MN
Pacific Mountain States
(800) 272-3222 - CA, WA
PAR Associates
(308) 371-1410 - CO, UT
PCA Microsystems
(512) 654-4711 - TX
PICS, Inc.
(214) 247-9946 - TX
Pioneer Electronics
(301) 921-0660 - AL, FL, GA, MD, NC, PA
Polygon Industries
(504) 834-7658 - LA
Printer Warehouse
(213) 829-5493 - CA, CA
(800) 245-9812 - CA
R.C. Data
(408) 946-3800 - CA
Rudor Communications
(212) 245-5509 - NY
Schweber
(800) 642-3040 - AL, CA, CT, FL, GA, IA, IL, MA, MD, MI, MN, NJ, NY, OH, OK, PA, TX, WI
Southern Microcomputer
(305) 626-4237 - FL
Tek-Aids Industries
(312) 879-7400 - IL, PA, TX
Terminal Rentals
(714) 832-2414 - CA
Terminals Unlimited
(800) 336-0423 - CA
Tricom
(516) 451-0251 - TX
Unico
(516) 451-0251 - TX
Western New York Computer
(716) 381-4120 - NY

Canada:

Abacus Data Services
(416) 677-9555 - Ontario
Datamex
(416) 781-9135 - Ontario, Quebec
DataTech Systems
(804) 479-7177 - Alberta, BC, Ontario
Data Terminal Mart
(416) 677-0184 - Alberta, BC, Nova Scotia, Ontario, Quebec
Future Electronics
(416) 697-7710 - Alberta, BC, Ontario, Quebec
Micro Distributing
(604) 941-0622 - BC
Printerm Data
(416) 977-1711 - Ontario

Qume
A Subsidiary of ITT

MINI-MICRO SYSTEMS/May 1984
A simple comparison tells the whole story. Qume's new SPRINT 11/55 PLUS™ daisywheel printer is tops in performance, with a steady speed of 55 characters per second. Print quality that's second to none. And the industry's best reliability rating—equal to almost three years of all-day, five-day-a-week business use without a single repair. That's nearly a year longer than its closest rival.

And the SPRINT 11/55 PLUS is a perfect fit for most popular business computers, via our inexpensive plug-in interface modules. That means you won't have to change printers when you upgrade your current system. It's this kind of value that has made Qume one of the largest manufacturers of letter-quality printers in the world. So don't pay more for less. Choose Qume's SPRINT 11/55 PLUS—the best printer you can buy. And the best buy in printers. For more information, contact the Qume distributor nearest you. Or write Qume Corporation, 2350 Qume Drive, San Jose, CA 95131.

Qume printers. Your best investment in productivity.
HIGH PERFORMANCE IS JUST ONE OF THE MANY BENEFITS OF THE ULTRA INTERACTIVE DATA BASE SYSTEM.
In both scientific and commercial DEC™ VAX™ environments, the ULTRA INTERACTIVE DATA BASE SYSTEM™ achieves consistently high levels of performance for your production applications. But along with high performance, the system was designed to provide a wide spectrum of other benefits to the VAX user. Here are six:

1. **Insulation From Change**
   The ULTRA INTERACTIVE DATA BASE SYSTEM's In-Line Directory and Logical User View (LUV) provide data structure independence that insulates applications from the effects of change. As a result, your application investment is thoroughly protected.

2. **Reduced Time, Cost & Effort**
   Because LUV provides a relational approach to interactive information processing, development time, maintenance and training are all greatly reduced. And with the ULTRA INTERACTIVE DATA BASE SYSTEM's high level, four verb Data Manipulation Language, there is significantly less coding, less testing and faster system implementation.

3. **4th Generation Query & Reporting**
   The Intelligent Query and Reporting facilities enable users to satisfy their ad-hoc requests with an easy to use query facility which provides features such as on-line sorting, full Boolean extraction and arithmetic operations to model "what-if" situations. As a result, both programmers and end-users are more productive.

4. **Data Integrity**
   Through the use of sophisticated task level recovery and failsafe processing techniques, both physical and logical data integrity is ensured automatically.

5. **"Always-Up"**
   The DBMS features an Always-Up facility which allows for some or all of the physical data to be duplicated in real-time. This "shadow recording" provides non-stop processing capabilities and is especially useful where downtime must be limited to seconds or minutes.

6. **Consistency and Compatibility**
   For VAX users implementing or now operating multiple data bases concurrently, the ULTRA INTERACTIVE DATA BASE SYSTEM provides a common approach to building both business and scientific applications.

**To Find Out More**
These are just six of the many benefits your DEC VAX environment can realize by implementing the ULTRA INTERACTIVE DATA BASE SYSTEM. For a complete brochure filled with more benefits, or for a demonstration, contact the:
Cincom Marketing Services Department,
2300 Montana Avenue,
Cincinnati, Ohio 45211.

**800-543-3010**
(In Ohio: 513-661-6000)
(In Canada: 416-279-4220)
3¼-inch computing is ready when you are.

Media, drives, software. Everything you need is here now.

Dysan 3¼" Flex Diskettes: Personal computing is getting more personal. Smaller, lighter, more portable.

Why? Because everything you need to get the most out of 3¼" computing is here now. In spades.

The story starts with our 3¼" one megabyte Flex Diskettes. They're built on the same tried and true technology as the large Dysan diskettes you use today. But with some very interesting innovations.

Like a durable metal hub that provides long-term read/write stability and accuracy.

A flexible combination of media and jacket, free from rigid metal shutters and fragile plastic parts.

And plastic carrying pouches that protect one to five diskettes. In your pocket. Or in the mail.

It all adds up to reliability. Dysan 3¼" Flex Diskettes are guaranteed to be 100% bit error-free. And durability. They're backed by a five-year limited warranty.

3¼" Floppy Drives. Simply put, 3¼" floppy drives are 5¼" drives refined. And cut down to size.

They're generally ¼ the size and ½ the weight of 5¼" drives. And they use less than half the power.

Yet 3¼" drives plug right into today's personal computers. All that's required is less space.

Best-selling software in 3¼". There's just one last thing necessary to turn 3¼" diskettes and drives into 3¼" computing.

Software.

And Dysan Series Software has already solved that problem by licensing and converting scores of best-selling programs to 3¼". Programs from DRI, Microsoft, Sorcim, Peachtree, Pearsoft, ADS, ADI America and more.

It's where personal computing is going. We'd be remiss if we didn't point out that 3¼" computing isn't just Dysan's good idea.

3¼" diskettes are being manufactured by several suppliers. So you're always assured of an abundant supply of quality media.

And 3¼" floppy drives are being built by a number of leading manufacturers. Including Tabor, Seikosha, MPI and, soon, Seagate.

That's the 3¼" story. Quality diskettes, reliable drives and a great selection of software.

And it's ready when you are.

Call Toll-Free (800) 551-9000 for complete information about 3¼" computing.
## Multi-Function Software

<table>
<thead>
<tr>
<th>Company Product</th>
<th>Database</th>
<th>Spreadsheet</th>
<th>Graphics</th>
<th>Word Processing</th>
<th>Communications</th>
<th>Memory Required (MB)</th>
<th>Unit Price ($)</th>
<th>Notes, Features, Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Access Technology Inc.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Pleasant St. South Natick, MA 01760</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>circle No. 836</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Advanced Business Computing Inc.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1580 N. Northwest Highway Park Ridge, IL 60068</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>circle No. 837</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Data Spectrum</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>circle No. 837</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Advanced Data Institute Inc.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1215 Howe Ave. Sacramento, CA 95825</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circle No. 838</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Aladin</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>circle No. 839</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Apple Computer Inc.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10260 Bandley Dr. Cupertino, CA 95014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>circle No. 839</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E-Z Pieces</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circle No. 840</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Jack 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circle No. 841</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Business Solutions Inc.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 E. Main St. Kings Park, NY 11754</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>circle No. 841</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Context Management Systems Inc.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23888 Hawthorne Blvd. Torrance, CA 90505</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>circle No. 842</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Context MBA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>circle No. 842</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Corporate MBA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Access Technology Inc.**

- Product: 20/20
- Features: IBM PC, DEC Rainbow, Professional
- Price: 192
- Notes: basic text editor, basic database, decision support package built around spreadsheet; available May, 1984

**Advanced Business Computing Inc.**

- Product: Rainbow, Professional
- Price: 600
- Notes: word processing limited to text editing, performs simple mathematical functions

**Data Spectrum**

- Product: Apple II series, Franklin, IBM PC and compatibles
- Price: 250
- Notes: relational database, interfaces to PASCAL, supports network communications, integrates with other packages such as dBASE II, Lotus

**Advanced Data Institute Inc.**

- Product: Apple II, IBM PC and compatibles
- Price: 595
- Notes: menu driven

**Apple Computer Inc.**

- Product: Apple II, Commodore 64, IBM PC, PCjr, Atari
- Price: 295
- Notes: introduces computer to novice, help function, comes with mouse

**Jack 2**

- Product: IBM PC, Apple
- Price: 495
- Notes: fully integrated software package, performs all functions on one screen

**Context Management Systems Inc.**

- Product: DEC, IBM PC and compatibles
- Price: 595
- Notes: "intragrating" package; user can transport CONTEXT files for use with other software packages

- Product: DEC, IBM PC and compatibles
- Price: 695
- Notes: 3270 capability, "intragrating" package; user can transport CORPORATE MBA files for use with other software packages
### MULTI-FUNCTION SOFTWARE

<table>
<thead>
<tr>
<th>Company Project</th>
<th>Database</th>
<th>Spreadsheet</th>
<th>Graphics</th>
<th>Word Processing</th>
<th>Communications</th>
<th>Systems</th>
<th>Memory required (K bytes)</th>
<th>Unit price ($)</th>
<th>Notes, features, options</th>
</tr>
</thead>
<tbody>
<tr>
<td>CULLINET</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>256</td>
<td>1,200</td>
<td>relational database, electronic mail capabilities when connected to mainframe</td>
</tr>
<tr>
<td>OFFICE</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>192</td>
<td>149</td>
<td>mail merge facility, report generation, help screen, on-line tutorial</td>
</tr>
<tr>
<td>SERIES ONE PLUS</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>192</td>
<td>495</td>
<td>graphics module available $295; built-in EXECUBUS Master program</td>
</tr>
<tr>
<td>SMART SET</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>128</td>
<td>475–595</td>
<td>compatibles must emulate IBM PC exactly, pricing varies with module options</td>
</tr>
<tr>
<td>LOTUS 1-2-3</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>256</td>
<td>495</td>
<td>graphics card permits simultaneous graphics/text display, automatic worksheet loading, word processing limited to text editing</td>
</tr>
<tr>
<td>Symphony</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>320</td>
<td>695</td>
<td>open-ended feature allows user to customize or add to product, limited time offer to 1-2-3 users: trade-in 1-2-3 for Symphony at $200</td>
</tr>
<tr>
<td>MARTIN MARIETTA DATA SYSTEMS/IT SOFTWARE</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>128, 320</td>
<td>125–250</td>
<td>IBM SNA capability, price varies with module options</td>
</tr>
<tr>
<td>METASOFT CORP.</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>128</td>
<td>495</td>
<td>price includes spelling checker and administrator modules</td>
</tr>
<tr>
<td>EXECUTIVE BENCHPAK 4.0</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>128</td>
<td>395</td>
<td>includes administrator module</td>
</tr>
<tr>
<td>EXECUTIVE BENCHPAK POWERPAC 1</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>128</td>
<td>595</td>
<td>price includes administrator module, opt. spelling checker</td>
</tr>
<tr>
<td>EXECUTIVE BENCHPAK POWERPAC 2</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>128</td>
<td>795</td>
<td>price includes administrator module</td>
</tr>
<tr>
<td>EXECUTIVE BENCHPAK POWERPAC 3</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>128</td>
<td>995</td>
<td>word processing includes spelling checker, administrator module includes &quot;notebook&quot; and &quot;message&quot; functions</td>
</tr>
</tbody>
</table>

**MINI-MICRO SYSTEMS/May 1984**
INTERMEC introduces SQUARE MATRIX label printing.

WITH THE NEW INTERMEC SQUARE MATRIX PRINTER YOU GET SUPERIOR PRINT QUALITY AND TOTAL FORMAT FLEXIBILITY AT DOT MATRIX PRICES.

The new SQUARE MATRIX 8625 prints bar code and human readable text from a series of tight fitting squares. These squares virtually eliminate the gaps, ragged edges and grayness so common to dot matrix printing. Since the 8625 SQUARE MATRIX is a thermal printer, variations in image density are eliminated giving you superior printing quality with every label. The result: The SQUARE MATRIX 8625 gives you bar code labels with optimum scanning performance plus maximum print format flexibility.

ONE UNLIMITED FORMAT, SQUARE MATRIX 8625 DOES THE WORK OF 10 PRINTERS.

The 8625 gives you the ability to print multiple bar codes in up to 10 different formats: two are pre-programmed and eight are user programmable.

SQUARE MATRIX 8625 PRINTS ANYTHING, ANYWHERE, ANY SIZE.

Print any height label up to 3¾” high. Bar code height can vary up to the full height of the label. Three different text fonts, special graphics, lines, boxes and logos can be printed in any direction or magnification any place on the label.

For Literature, Circle Number 198.
For Demonstration, Circle Number 199.

SQUARE MATRIX PRINTERS OFFER BEST RELIABILITY.

With only one active moving part, a stepper motor, the 8625 eliminates mechanical trouble spots. The 8625’s printhead is warranted up to five years when using INTERMEC’s quality DURATHERM™ label stock.

SMALL SIZE, SMALL PRICE, UNLIMITED FLEXIBILITY AND QUALITY MAKE SQUARE MATRIX THE LOGICAL CHOICE.

The compact 8625 takes very little space at a work station and even less from your budget. To find out more, contact INTERMEC Corporation, 4405 Russell Road, P.O. Box 360602, Lynnwood, WA 98036-9702. Call 206/743-7036. TELEX: U.S. 1524 47, Int’l (ITT) 4740080.

INTERMEC®
The industrial bar code experts.
To add markets as well as profits to your business, add Zaisan to your system.

The ES.1 voice/data workstation offers single-key access to simultaneous voice, data or text. With the touch of a button, users can also access internal and external databases, PBX functions, and electronic mail.

The ES.1 is also upgradeable. So you can add application and communication software to tailor the ES.1 to the individual information needs of your users. Which can add sales to your business. Another plus is the price. And the wide range of service options. Add these all up and you'll see the formula for success is rather elementary. Add Zaisan.

13910 Champion Forest Drive. Houston, Texas 77069. 713.580.6191.
## Multi-Function Software

<table>
<thead>
<tr>
<th>Company/Product</th>
<th>Database</th>
<th>Spreadsheet</th>
<th>Graphics</th>
<th>Word Processing</th>
<th>Communications</th>
<th>Systems</th>
<th>Memory Required (K bytes)</th>
<th>Unit Price</th>
<th>Notes/Features/Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>MICRO SOFTWARE INTERNATIONAL</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>IBM PC, PCjr</td>
<td>64, 128</td>
<td>99/module</td>
<td>each module sold separately, delivery June, 1984</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MICOFT CORP.</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>IBM PC, XT; Corona, Columbia, Compaq</td>
<td>320</td>
<td>495</td>
<td>sixth module performs DEC-VT.52, 100 and IBM 3101 terminal emulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOSAIC SOFTWARE INC.</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>IBM PC, XT; Corona, Columbia, Compaq</td>
<td>256</td>
<td>395</td>
<td>4-function calculator, communications enhancement available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOUMENON</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Apple III, Lisa, Macintosh</td>
<td>395</td>
<td></td>
<td>relational database, form generation, limited spreadsheet capabilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OVESTA</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>IBM PC, XT; Corona, Columbia, Compaq</td>
<td>512</td>
<td>795</td>
<td>all functions can be performed on one screen, utilizes 30 common commands, can transport data from other similar software packages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRENTICE HALL INC.</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>IBM PC/XT; most MS-DOS machines</td>
<td>128</td>
<td>250 &amp; up</td>
<td>21 modules, interfaces to several popular systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PYRAMID DATA LTD.</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>IBM PC, XT; Compaq, Corona</td>
<td>128</td>
<td>695</td>
<td>includes word processing application generator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QUERY COMPUTING SYSTEMS INC.</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>Apple, Commodore, IBM PC, PCjr, Epson QX-10</td>
<td>79.95</td>
<td>modules purchased individually, add-ons range from $19.95-$59.95</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
One UNIX computer manufacturer after another has come to the same decision: UNIFY is the fastest, most powerful, most flexible database management system for users of all skill levels.

By their own investigation and by system integrator requests, computer manufacturers representing some 90% of the market choose to offer UNIFY with their UNIX computers.


The evidence is overwhelming. In independent benchmarks, UNIFY consistently ranks as the top performer.

Completely menu-driven design and industry standard IBM SQL query language make it easy for non-programmers to develop database applications.

The most powerful "back end" design in the industry, including 90 subroutines at the host language interface level, promises that UNIFY can keep adding features, keep adding users, without eroding performance.

Judge for yourself. Our comprehensive 300-page tutorial and 500-page reference manual system are yours for only $95. Together they show you how to build virtually any application of your choice.

To order, contact UNIFY, Department MM-3, 9570 S.W. Barbur Blvd., Portland, Oregon 97219, 503-245-6585.
## MULTI-FUNCTION SOFTWARE

<table>
<thead>
<tr>
<th>Company/Project</th>
<th>Database</th>
<th>Spreadsheet</th>
<th>Graphics</th>
<th>Word Processing</th>
<th>Communications</th>
<th>Systems</th>
<th>Memo/Spreadsheet (K-sizes)</th>
<th>Unit Price ($)</th>
<th>Notes/Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIENTIFIC MARKETING INC.</td>
<td><img src="image1" alt="Database" /></td>
<td><img src="image2" alt="Spreadsheet" /></td>
<td><img src="image3" alt="Graphics" /></td>
<td><img src="image4" alt="Word Processing" /></td>
<td><img src="image5" alt="Communications" /></td>
<td><img src="image6" alt="Systems" /></td>
<td><img src="image7" alt="Memo/Spreadsheet" /></td>
<td>64, 128</td>
<td>under 300</td>
</tr>
<tr>
<td>MARKETFAX</td>
<td><img src="image1" alt="Database" /></td>
<td><img src="image2" alt="Spreadsheet" /></td>
<td><img src="image3" alt="Graphics" /></td>
<td><img src="image4" alt="Word Processing" /></td>
<td><img src="image5" alt="Communications" /></td>
<td><img src="image6" alt="Systems" /></td>
<td><img src="image7" alt="Memo/Spreadsheet" /></td>
<td>64, 128</td>
<td>under 300</td>
</tr>
<tr>
<td>SI TABS</td>
<td><img src="image1" alt="Database" /></td>
<td><img src="image2" alt="Spreadsheet" /></td>
<td><img src="image3" alt="Graphics" /></td>
<td><img src="image4" alt="Word Processing" /></td>
<td><img src="image5" alt="Communications" /></td>
<td><img src="image6" alt="Systems" /></td>
<td><img src="image7" alt="Memo/Spreadsheet" /></td>
<td>64, 128</td>
<td>under 300</td>
</tr>
<tr>
<td>SOFTWARE PRODUCTS INTERNATIONAL</td>
<td><img src="image1" alt="Database" /></td>
<td><img src="image2" alt="Spreadsheet" /></td>
<td><img src="image3" alt="Graphics" /></td>
<td><img src="image4" alt="Word Processing" /></td>
<td><img src="image5" alt="Communications" /></td>
<td><img src="image6" alt="Systems" /></td>
<td><img src="image7" alt="Memo/Spreadsheet" /></td>
<td>64, 128</td>
<td>under 300</td>
</tr>
<tr>
<td>EASYTABS</td>
<td><img src="image1" alt="Database" /></td>
<td><img src="image2" alt="Spreadsheet" /></td>
<td><img src="image3" alt="Graphics" /></td>
<td><img src="image4" alt="Word Processing" /></td>
<td><img src="image5" alt="Communications" /></td>
<td><img src="image6" alt="Systems" /></td>
<td><img src="image7" alt="Memo/Spreadsheet" /></td>
<td>64, 128</td>
<td>under 300</td>
</tr>
<tr>
<td>OPEN ACCESS</td>
<td><img src="image1" alt="Database" /></td>
<td><img src="image2" alt="Spreadsheet" /></td>
<td><img src="image3" alt="Graphics" /></td>
<td><img src="image4" alt="Word Processing" /></td>
<td><img src="image5" alt="Communications" /></td>
<td><img src="image6" alt="Systems" /></td>
<td><img src="image7" alt="Memo/Spreadsheet" /></td>
<td>64, 128</td>
<td>under 300</td>
</tr>
<tr>
<td>SOFTREND INC.</td>
<td><img src="image1" alt="Database" /></td>
<td><img src="image2" alt="Spreadsheet" /></td>
<td><img src="image3" alt="Graphics" /></td>
<td><img src="image4" alt="Word Processing" /></td>
<td><img src="image5" alt="Communications" /></td>
<td><img src="image6" alt="Systems" /></td>
<td><img src="image7" alt="Memo/Spreadsheet" /></td>
<td>64, 128</td>
<td>under 300</td>
</tr>
<tr>
<td>AURA</td>
<td><img src="image1" alt="Database" /></td>
<td><img src="image2" alt="Spreadsheet" /></td>
<td><img src="image3" alt="Graphics" /></td>
<td><img src="image4" alt="Word Processing" /></td>
<td><img src="image5" alt="Communications" /></td>
<td><img src="image6" alt="Systems" /></td>
<td><img src="image7" alt="Memo/Spreadsheet" /></td>
<td>64, 128</td>
<td>under 300</td>
</tr>
<tr>
<td>SORCIM CORP.</td>
<td><img src="image1" alt="Database" /></td>
<td><img src="image2" alt="Spreadsheet" /></td>
<td><img src="image3" alt="Graphics" /></td>
<td><img src="image4" alt="Word Processing" /></td>
<td><img src="image5" alt="Communications" /></td>
<td><img src="image6" alt="Systems" /></td>
<td><img src="image7" alt="Memo/Spreadsheet" /></td>
<td>64, 128</td>
<td>under 300</td>
</tr>
<tr>
<td>SUPERCALC</td>
<td><img src="image1" alt="Database" /></td>
<td><img src="image2" alt="Spreadsheet" /></td>
<td><img src="image3" alt="Graphics" /></td>
<td><img src="image4" alt="Word Processing" /></td>
<td><img src="image5" alt="Communications" /></td>
<td><img src="image6" alt="Systems" /></td>
<td><img src="image7" alt="Memo/Spreadsheet" /></td>
<td>64, 128</td>
<td>under 300</td>
</tr>
<tr>
<td>STRUCTURED SYSTEMS GROUP INC.</td>
<td><img src="image1" alt="Database" /></td>
<td><img src="image2" alt="Spreadsheet" /></td>
<td><img src="image3" alt="Graphics" /></td>
<td><img src="image4" alt="Word Processing" /></td>
<td><img src="image5" alt="Communications" /></td>
<td><img src="image6" alt="Systems" /></td>
<td><img src="image7" alt="Memo/Spreadsheet" /></td>
<td>64, 128</td>
<td>under 300</td>
</tr>
<tr>
<td>WINDOWPAK</td>
<td><img src="image1" alt="Database" /></td>
<td><img src="image2" alt="Spreadsheet" /></td>
<td><img src="image3" alt="Graphics" /></td>
<td><img src="image4" alt="Word Processing" /></td>
<td><img src="image5" alt="Communications" /></td>
<td><img src="image6" alt="Systems" /></td>
<td><img src="image7" alt="Memo/Spreadsheet" /></td>
<td>64, 128</td>
<td>under 300</td>
</tr>
</tbody>
</table>
The only reason you're not using Pioneer's disk drive tester already.

If you still haven't seen the Pioneer hard disk drive tester in action, it's time to take a look. And judge for yourself.

Beginning with the price tag, every aspect of the Pioneer Qualifier™ is designed to meet your requirements for pocketbook and performance.

It's the only tester to interface with any and all SMD drives.

It's the only one with a hefty 20-megabit per second capability. Even at triple the price.

It's the only one that can read and transfer Fujitsu's error map right into your computer. In seconds.

It's the only one that will format to your custom specs. And it does it at one megabyte per second. Over five times faster than by computer.

It pinpoints your errors to a specific media sector. And separates the correctable from the uncorrectable. So you can detect and log either set.

Have you ever seen a tester that does all that?

And also checks the address mark capability of your drive? And isolates intermittents in the output? And works with embedded servos? And can be multiplexed to test four drives at once?

The Pioneer Qualifier does all those things. And easily, at that.

It's almost turnkey. It's totally programmable through the simplified keyboard. And you can input a custom set of drive characteristics with no EPROMS to modify or boards to change.

Plus, there's even a standard RS232 port for remote operation, data printout, uploading and downloading.

Call Pioneer for a demonstration today. It's an eye opener.

Pioneer Research, 1745 Berkeley St., Santa Monica, CA 90404.
(800) 233-1745 (outside California).
(800) 848-1745 (in California). Rep opportunities available.
ESPRIT.
HIGH TECHNOLOGY
WITHOUT HIGH ANXIETY.
Nowadays, technology is advancing so rapidly that today’s latest breakthrough may be replaced as soon as tomorrow by something even more revolutionary.

As this ever-changing technology becomes more and more available, it becomes more and more confusing to choose the precise technology to suit a particular need. All of which makes it difficult for the human mind, which is not programmed to adjust to change quite that quickly, to cope.

**INTRODUCING PEACE OF MIND.**

That’s why Esprit would like to introduce a new concept that can make it easier to cope with this rapidly-changing world: the peace of mind that can give you high technology without high anxiety.

And back it with an extensive nationwide service network and our own special toll-free number (800-645-4508) so you can reach us about anything that might disturb that peace of mind.

Designed right into every terminal in Esprit’s complete line are the features, the functions and the flexibility that make it not only user-friendly but systems-friendly. In other words, the kind of comfort, quality and trouble-free technology that can provide real peace of mind.

**PEACE OF MIND FOR THE NEXT GENERATION IN TERMINALS.**

One look at the Esprit ESP 6310™ and you’ll recognize the next generation of terminals. With performance and features far superior to other terminals in its price category. And the kind of quality you can feel comfortable with.

**DESIGNED FOR PEACE OF MIND.**

From the sleek and stylish lines of its ergonomic design, to the familiar sculptured lines of its low-profile keyboard with its 11 user-programmable function keys—shiftable to 22—in non-volatile memory back-up, that can be programmed directly or downline-loaded from the host computer.

From its high resolution, green phosphor display with a well defined character font, in a large 7 x 11 dot matrix, in an 80 column x 25 line format to its screen-saver feature which deactivates the screen after 20 minutes of inactivity.

From its tilt and swivel monitor to its smooth scrolling and line graphics capabilities.

**PEACE OF MIND PRICE. $695.**

Our ESP 6310 provides enhanced performance and incorporates emulations of the TeleVideo 925/910 PLUS®, ADDS Regent 25/Viewpoint® and Lear Siegler ADM3A®, as well as the popular Esprit series.

But at $695, it’s priced below many far-less featured terminals. That means even our low price is designed to prevent high anxiety.

---

800-645-4508

Esprit Systems, Inc.
100 Marcus Drive
Melville, NY 11747

☐ Yes, for my own peace of mind I would like to receive a brochure on your complete line of Esprit terminals.

NAME

TITLE

COMPANY NAME

ADDRESS

CITY STATE ZIP

---

MMS 5
How can you develop one system and offer your customers a choice of three?

Simple. Develop it around HP's new three-in-one microsystem. That way, you don't have to redesign your system to offer your customers a range of performance. Because the entire power range of HP's new A-Series computers fits into the same small, convenient package. At a slimmed-down starting price of $6110*

So you can offer 1 MIPS performance. Or floating point hardware and microprogramming in either a 1 MIPS or 3 MIPS computer. Whichever one your customer chooses, you can fit it easily into the same space in your system.

Identical software keeps it simple. When you change processors, you don't have to go back to the drawing board with your programs. Because, in addition to compatible hardware, these computers run identical software. That's the best kind of compatibility you can buy.

Our brand new operating system really performs. That's one secret of our success. The new, full-function RTE-A real-time operating system provides the performance you need for your real-time automation applications. Ranging from dedicated machine control to monitoring instruments to supervising a network of computers.

This power, speed and I/O capacity also make our A-Series systems ideal for multi-user, multi-tasking environments.

Of course, these compact new computers are part of our newly expanded OEM program. This includes higher discounts and credits, extended warranties and free training. So you'll make more when you get to market. And you'll also get there faster with our new operating system and newly packaged microsystems.

If you'd like micro, mini or maxi performance in one micro package, call your local HP sales office listed in the white pages of your phone book. Ask for a technical computer representative. Or write for more information to: Hewlett-Packard, Attn. Greg Gillen, Dept. 08171, 11000 Wolfe Road, Cupertino, CA 95014. In Europe, write to Henk van Lammeren, Hewlett-Packard, Dept. 08171, P.O. Box 529, 1180 AM Amstelveen, The Netherlands.

* A600+ microsystem component, 128Kb memory, box, Winchester disc.

Prices are U.S.A. list in OEM quantities of 100 and include integrated peripherals, one interface card, RTE-A and 512Kb of memory for Micro 26 and Micro 27. Micro 29 includes 768Kb of memory.
Micro:
1 MIPS for $7445

Maxi:
3 MIPS, plus floating point hardware and microprogramming, for $16,650

Mini:
1 MIPS, plus floating point hardware and microprogramming, for $13,140

Whatever the level of performance you pick, it fits in this little 7" x 19" x 25.5" package.
CLEAR YOUR DESKS FOR THE PERSONAL TERMINAL BOOM.

Introducing a desktop revolution. The Personal Terminal™ from TeleVideo®. This smart terminal is no bigger than the in-basket it replaces. Yet it costs much less than a full-size terminal. And it will clearly simplify the way your company works.

Use it to send and receive electronic mail. Check inventory and sales figures from the corporate database or tap into outside data services. The 9-inch screen is easy to read. The professional keyboard is easy to use. Standard features include two RS-232 ports and 7 function keys (shiftable to 14). An attached telephone is optional, as well as a 300 or 300/1200 baud internal modem which can autodial up to 28 phone numbers. For a more productive and cost-effective office environment, get in on TeleVideo’s Personal Terminal revolution.

Call us at (800) 538-8725 for more information. (In California call (408) 745-7760) or contact your nearest TeleVideo office:

- California/Santa Ana............................ (714) 476-0244
- California/Sunnyvale.......................... (408) 745-7760
- Georgia/Atlanta................................. (404) 447-1231
- Illinois/Chicago................................. (312) 397-5400
- Massachusetts/Boston......................... (617) 890-3282
- New York/New York............................ (212) 496-4777
- Texas/Dallas..................................... (214) 258-6776
- Central Europe (The Netherlands)......... (31) 2503-15444
- Northern Europe (United Kingdom)........ (44) 9-905-6464
- Southern Europe (France)..................... (33) 1-686-4412

Get in on the BOOM™

TeleVideo® Terminals
TeleVideo Systems, Inc.
Service is available nationwide from General Electric Electronic Instrumentation and Computer Service Centers.

CIRCLE NO. 110 ON INQUIRY CARD
VT200 terminals incorporate higher text speed and multinational features

A direct CRT drive in the VT220 and three processors in the VT240/241 boost performance and save space

Robert E. Huettner, David A. Banks and John F. Elsbree Jr., Digital Equipment Corp.

Digital Equipment Corp.'s VT200 terminals extend the capabilities of the VT100 family by providing higher text speed and full color graphics. They also feature a variety of international characteristics, including a universal power supply, keyboards for 16 languages and compliance with international standards. A variety of ergonomic features, such as a low-profile keyboard; non-glare screens; and white, green or amber phosphors, also differentiates the VT200 family from the VT100 line.

The terminals incorporate unconventional packaging and design to increase performance and reduce size. The VT220, for example, uses a direct CRT drive instead of composite video signals. In the VT240/241, the graphics controller handles bit-mapped planes in parallel rather than in sequence, which doubles display speed. In addition, the VT240/241 uses three processors and implements in firmware many functions usually executed in hardware.

Packaging saves space, cost

The VT200 family comprises the VT220 monochrome text terminal, the VT240 text and monochrome graphics terminal and the VT241 text and color graphics terminal. The terminals use the same keyboard and monitors found in DEC's Professional, Rainbow and DECmate II personal computers.

The low-end VT220 consists of a keyboard and a 12-inch monitor. The monitor assembly contains the CRT electronics, terminal-control logic and power supply. The VT240 and VT241 include 12- and 13-inch monitors, respectively, and a system box containing the power supply; I/O hardware; and terminal, character and graphics display processors.

In the VT220, the CRT electronics, terminal-control logic and power supply are on two boards instead of three, as in traditional terminals. Although three boards would fit into the monitor casing, using two boards saves space and reduces production-testing time. The power supply and monitor electronics are on one board at the base of the monitor's frame, and the terminal-control logic is on a second board at the side of the frame.

The large spacing of etched lines required by the International Electrotechnical Commission (IEC)-380 safety standard contributed to a power-supply/monitor electronics board size of 95 square inches. To obtain additional board area, engineers mounted the fly-back transformer, which is usually located with other monitor circuitry, on the other side of the frame.

The VT220 does not need a cooling fan because its components are positioned for minimal heat concentration. Convective air flows through a rectangular grill in the bottom of the enclosure through slots in the top surface. Another spacesaver is a switching power supply that replaces the large linear power supplies used in traditional terminals. The 35W switching supply operates at 65 percent efficiency compared with

Digital's VT200 family includes the VT220 monochrome alphanumeric terminal (left), the color graphics VT241 (center) and the monochromatic graphics VT240 (right). Prices are $1,295, $3,195 and $2,195, respectively.
The VT240/241 system box (left) contains the system board (three microprocessors, RAM and ROM devices and I/O circuits), an optional integrated modem board and an upper chassis containing the power supply and associated circuits and switches.

Fig. 2. (right) The VT240/241 system board includes three microprocessors. DEC's T-11 handles all I/O operations (including communications protocols), control of the keyboard and GDC 7220 video controller, the setup mode and the color palette. The main function of the 8085 processor is character acceleration, which off-loads time-consuming tasks from the T-11.

The VT220 control logic board (Fig. 1) contains standard IC devices and keyboard interface circuitry that is the same as that in DEC's personal computers. The board implements several functions, including the timing circuitry, in a custom gate array to conserve board space.

The two principal components on the board are the special-purpose Standard Microsystems Corp. (SMC) 9007 video processor and the 8051 microprocessor. The 8051's built-in peripheral functions reduce cost and size and, more importantly, increase the terminal's text speed, which is the maximum number of characters per second (cps) that a terminal can accept from a host computer. The VT200 models have a text speed of 960 cps without restraint or a line rate of 9,600 baud. This speed doubles the 480-cps text speed provided in the VT100 family.

The processor board contains 28K bytes of program ROM, with 4K bytes built into the 8051 and two external chips of 8K and 16K bytes. Without the 8051's built-in ROM, the terminal would require two external 16K-byte ROMs.

The keyboard, printer port and host interface require one universal asynchronous receiver/transmitter (UART) and one dual UART. A separate single UART is unnecessary because the 8051 has an integral UART. The dual-UART package includes two general-purpose registers for communications tasks and miscellaneous functions that would otherwise require additional hardware. Five bit positions in the 8-bit output register provide status signals for display video, 132-column mode, bank select 1 and 2 (memory 20 mA ADAPTER 20 mA ADAPTER

Fig. 1. (above) The VT220 terminal-control logic board includes a special-purpose 9007 video processor and an 8051 microprocessor. The 8051's built-in peripheral functions reduce cost and size and increase text speed.

The two principal components on the board are the special-purpose Standard Microsystems Corp. (SMC) 9007 video processor and the 8051 microprocessor. The 8051's built-in peripheral functions reduce cost and size and, more importantly, increase the terminal's text speed, which is the maximum number of characters per second (cps) that a terminal can accept from a host computer. The VT200 models have a text speed of 960 cps without restraint or a line rate of 9,600 baud. This speed doubles the 480-cps text speed provided in the VT100 family.

The processor board contains 28K bytes of program ROM, with 4K bytes built into the 8051 and two external chips of 8K and 16K bytes. Without the 8051's built-in ROM, the terminal would require two external 16K-byte ROMs.

The keyboard, printer port and host interface require one universal asynchronous receiver/transmitter (UART) and one dual UART. A separate single UART is unnecessary because the 8051 has an integral UART. The dual-UART package includes two general-purpose registers for communications tasks and miscellaneous functions that would otherwise require additional hardware. Five bit positions in the 8-bit output register provide status signals for display video, 132-column mode, bank select 1 and 2 (memory
Kimtron is building the #1 terminal company and proudly presents its KT-7 Display terminal.

KT-7 provides not only technological excellence, but also True Ergonomics, Highest Value and Unique Features to improve user efficiency and comfort.

**True Ergonomics**
- Height Adjustability
- Tilt and Swivel
- Low Profile Keyboard with three level tilt and easy touch
- Sharp Display with High Resolution
- Green or Amber Phosphor

**Small Size and Light Weight**
- Less than 18 inches deep and fits in a Secretarial Return Desk
- Less than 22 pounds net

**Unique Features**
- User-Selectable Hidden or Embedded Attributes

**Best Features**
- 9 X 13 Cell Resolution
- 25th Status/Set-Up/Message Line
- Set-up, 20 Programmable Function Keys and Answerback stored in Non-Volatile Memory
- 4 International Character Sets
- 94 Business Graphics Characters
- Block Mode and Protect Mode
- Up to 4 Pages of Memory
- Optional

**Compatibility**
*Standard: TeleVideo* 910, 920, 925.
*Option: ANSI X3.46 or DEC** VT**
52/100/132 (80 column), or DG***
D100, or OEM Customization for other terminal emulation available

**Only $595**

for all these features.
Call us or your terminal supplier for more information
Like DEC's.

$8,845 system price*

256 KB minimum...
up to 4 MB!

Supports RT-11, RSTS,
RSX-11M-PLUS,
UNIX, and
TSX-PLUS

Two fans in card cage
area (vs. one in
Micro/PDP-11)

8-quad slot
Q-BUS card cage

Cartridge tape
capability

RL02-compatible
5½" Winchester disk;
10 MB, 20 MB, or
40 MB capability

1.0 MB floppy disk
back-up (vs. 2 x 400 KB
for Micro/PDP-11)

Only better.

You can buy DEC's Micro/PDP-11 with its impressive
array of features...or you can get Dataram's A22—an
LSI-11/23 based minicomputer that gives you a whole
lot more...for a lot less dollars! Like an 8" RX02-compatible floppy, 40 MB 5½" Winchester and
¼" cartridge tape capability. And two fans that
provide push-pull air flow in the card cage area.
For more information, forward this coupon to us, or,
for faster response, call (609) 799-0071.

☐ Send information.  ☐ Contact me immediately.

Name__________________________
Company_______________________
Address________________________
City________________            State______ Zip______ Phone______

Dataram Corporation, Princeton Road, Cranbury, NJ 08512

Dataram Corporation □ Princeton Road □ Cranbury, New Jersey 08512 □ Tel: 609-799-0071 □ TWX: 510-685-2542

CIRCLE NO. 112 ON INQUIRY CARD
address groupings) and blink. The three other bit positions are used for communications functions.

The 8051 microprocessor and 9007 video processor use the same bus to access video RAM. The 8051 transfers character codes from the host to video RAM, and the 9007 transfers the codes from video RAM to the line buffer, which generates the video drive.

In conventional video terminals, the general-purpose microprocessor is idle for approximately 10 percent of the time while the video processor controls the bus to video RAM. In the VT220, the 8051 uses that time to perform keyboard processing operations. Eliminating idle processor time is the main reason for the VT220's high text speed. The 8051 also includes efficient firmware (written in assembly language) and a fast clock rate. The 8051 runs at 11 MHz, in contrast to 3 MHz for the 8080 microprocessor in the VT100.

Three processors handle text, graphics, I/O

The system box for the VT240/241 terminals is identical for the monochromatic graphics VT240 and the color graphics VT241. The box contains a 10.4-by-14.8-inch system board that handles all functions, excluding the optional integrated modem and the power supply. The board is mounted in the lower portion of a metal chassis shielded against electromagnetic interference. The communications panel on the rear of the chassis contains connectors for the monitor, modem, bidirectional printer port, 20-mA and EIA interface ports, composite output to slave monitor and an auxiliary keyboard connector. The keyboard can hook up to the monitor or to the system box. The removable upper portion of the chassis contains the A/C power components, including the 75W switching power supply, a 3-inch axial cooling fan, an on-off switch, a fuse and a voltage-selection switch.

The VT240/241 system board includes three processing engines: a T-11, an 8085 and an NEC America Inc. graphics display controller (GDC) 7220 (Fig. 2). DEC's T-11 is a general-purpose, 16-bit microprocessor that has the same instruction set as low-end PDP-11s and a read cycle time of 750 nsec., which is roughly equivalent to...
to that of a mid-range PDP-11/34. The T-11 handles all I/O operations (including communications protocols), control of the keyboard and video controller, the setup mode (using a 128-byte non-volatile RAM), a CRT saver and the color palette (RAM lookup table). The CRT saver extends the life of the phosphor by blanking the screen after 30 minutes of inactivity and returning it at the next keystroke or upon receipt of a character through the communications port.

The 8085 off-loads time-consuming tasks from the T-11 and handles character acceleration, without which the text speed would be reduced to about 180 cps. When an escape sequence informs the T-11 that the VT240/241 is to perform as a text terminal, the T-11 places the ASCII codes of the characters to be displayed in a display list and passes the accumulated display-list characters and position information to the 8085. The 8085 retrieves the character matrices from ROM or RAM and creates a series of GDC commands to write them into bit-map memory. The video controller reads the bit-map memory and creates displays by transferring the data to shift registers. When operating as a graphics terminal, character acceleration is disabled and the 8085 doesn’t participate in generating images.

The 8085 also performs text-oriented tasks which otherwise would have to be done by the T-11, including smooth scrolling and split-screen functions, character attributes (bold, blink and inverse video) and user-loadable character sets. When the VT240/241 is in graphics mode, the T-11 receives commands from the host in either the Tektronix Inc. 4010/4014 graphics protocol or in remote graphics instruction set (ReGIS), DEC’s general-purpose graphics protocol.

The GDC 7220 typically recognizes only one bit-map plane at a time, but color graphics (in the VT241) and shades of gray (in the VT240) require processing two bit-map planes. Conventionally, the GDC processes multiple planes in sequence. The VT240/241, however, includes support logic that permits the 7220 to handle two planes simultaneously, thus doubling display speed. The two bit-map planes provide four color possibilities per pixel, and are used to address the color palette, which has six color outputs and two monochrome outputs. The VT241 can simultaneously display four colors out of a palette of 64, and the VT240 can simultaneously display four fixed shades of gray. The color palette, or lookup table, includes RAM and a digital-to-analog converter.

The GDC’s support logic consists of two identical programmable array logic (PAL) circuits, which select the bit-mapped memory planes that are to be written into at any given instant. The PAL circuits allow the 7220 to modify an image already resident in the bit-mapped planes and eliminate the need for 20 to 25 discrete ICs.

The VT240/241 board contains 96K bytes of ROM for the T-11 and 32K bytes for the 8085. Most of the T-11’s firmware is used for setup, communications protocols, VT100 and VT52 emulation, PDP-11 instruction set and character sets. Implementing the 8085’s split-screen and smooth-scrolling functions in firmware eliminates the extra costs and board space required by 22 to 29 discrete ICs.

Marketing video terminals internationally requires incorporating multiple languages and meeting multiple government or industry standards. While standards’ compliance is built into the basic terminal design, multiple languages have been provided for in the form of language-specific replaceable character ROMs. All models have a 256-character multinational character set. The terminals comply with major international safety standards, including Underwriters Laboratories (UL), Deutscher Elektrotechniker (VDE) and International Electrotechnical Commission (IEC)-380. The VT200s also comply with Class B electromagnetic radiation standards (Federal Communications Commission and VDE).
Ma Bell,  
% Heaven

There's Good News and Bad News

The good news is that Racal-Vadic's fine Scotsman multiplexers (45 versions to choose from) are available for immediate delivery.

The bad news is that, according to USA Today, AT&T is filling only 25% of its private line orders on time, has doubled the waiting time to 10 weeks, and is taking 50% longer to repair private lines than in 1983. They miss you, Ma.

Install Scotsman and Reduce Line Costs

How can data network users avoid these delays? Easy. Reduce the number of private lines by installing Scotsman multiplexers. Scotsman I is a high-quality, low-cost 4- or 8-channel stat mux with optional built-in 2400 or 4800 bps modem. Scotsman II is even more sophisticated, providing system control and monitoring. One customer saw his line costs drop from over $1,000 to $58 a month merely by adding a pair of Scotsman. They paid for themselves in a few months.

Data Compressor Further Cuts Line Costs

Racal-Vadic's new data compressor sends a 19.2 kbit data stream over a single voice-grade line using 9600 bps modems. Or data from 4 bisync or 2 full-duplex 9600 channels can be transmitted over one telephone line. This can add up to great savings for users.

Now, Free Installation

No one has to wait for AT&T — or deal with multiple vendors — because Racal-Vadic can supply the whole system, including multiplexers, modems, data compressors — and accessories.

They're even offering FREE INSTALLATION 'til September!

I doubt if you can find a better deal in heaven, Ma.

Your independent thinking son,

Alexander Graham Jr.

Gone, but not forgotten.

Racal-Vadic

1525 McCarthy Boulevard, Milpitas, CA 95035

Tel: (408) 946-2227 • TWX: 910-339-9297

Phone (800) 543-3000, Operator 507

CIRCLE NO. 113 ON INQUIRY CARD
It measures 5.00"x 6.62"x 14.75". And it fits smartly beside many of today's popular microcomputers. But the case in point, Xebec's new 10-megabyte 9710 Universal Storage Subsystem, has more to do with the components inside—specifically, the controller and the disk drive—than with the dimensions and the aesthetics outside.

Actually, the most important thing on the outside of the case is the name, Xebec. A company whose 5.25" hard disk controllers are found in more business micros—including those of IBM, Hewlett Packard, TI and Eagle—than any other, anywhere. What put us there was—and remains—our ability to engineer in more features and manufacture in more quality—zero defect quality, delivered on time and in quantity.

What puts us here, in the subsystem business, is at once a derivative and encompassing quality issue. The fact is that the more sophisticated we make our controllers, the more obvious become the deficiencies of the disk drives they control—the very drives found in all of the subsystems for small business computers being sold today. And all the more obvious becomes the need for someone to create a new standard for bringing these critical components together.

The Xebec 9710 is that new standard. First, it houses the industry's best selling 5.25" hard disk controller, the Xebec S1410, with its patented architecture, state-of-the-art feature set and VLSI design. But the real key is the incorporation of a disk drive that is "quality matched" to that controller, not just "component compatible." A drive that goes through the most rigorous testing possible before it goes into a 9710.

The results are directed at the serious end users and system integrators of microcomputer mass storage. Superbly matched components that deliver unmatched performance and reliability, right down to a complete range of host adaptors—for the IBM PC, Apple IIe, S-100, Multibus and Q-bus—that give the Xebec 9710 its impressive "universatility."

And lest you think that our case for quality is made at the expense of other important considerations—like price and availability—consider this. The 9710 is founded on a commitment to the processes that optimize all of these factors—computer-aided design, manufacturing and test. A commitment most recently demonstrated by our $20 million investment in advanced robotics equipment.

The case we are making is not, then, an empty one—no high-minded cliche thrown into the promotional fray. It is solid and smart.

It is, bottom line, an open and shut case for quality.
A New Definition for Laser Printing ... Affordable.

Our 8/300 sets exciting new levels of performance and value for electronic page printing systems.

In the office, type font flexibility and the ability to easily merge text and graphics allows the 8/300 to produce high quality reports, documents, letters, and even transparencies. In data processing, the 8/300 delivers higher quality output than line printers, at comparable speeds. For graphic arts applications, the 8/300 functions as a proofing device for typesetting and provides final output for demand publishing. In an engineering environment, the 8/300 delivers exceptional plotting capabilities, and produces high quality output from intelligent workstations.

Text, graphics, plotting, font flexibility—for any application, Imagen’s 8/300 provides a high quality, affordable alternative to traditional printing methods.

Operating at 8 pages per minute, with a resolution of 300 dots per inch, the 8/300 prints on a variety of papers, including your letterhead. The alternate feed facility allows printing odd sizes too. From business cards, to envelopes, to legal size—or any size in between.

The 8/300 delivers all this in a compact, desk-top size, small enough to put just about anywhere—and quiet enough to operate anywhere you put it.

Take a closer look at the 8/300. For less than $10,000 it can open up a whole new world of printing possibilities for you.
Streaming-tape applications extend beyond backup

Besides mirror backup, full-function \( \frac{1}{4} \)-inch-tape cartridges can provide data compression, file backup and software distribution for Winchester disk drives.

A. Sharon and W. Homans, Computer Peripherals Inc.

Streaming-tape drives serving as backup devices can protect data stored on Winchester disk drives from head crashes, computer system hardware and software failure and operator error. Most \( \frac{1}{4} \)-inch cartridge-tape drives, however, can perform only mirror, or image, backup for Winchester drives, copying the entire contents of the disk onto the tape. However, files fragmented on the disk will remain fragmented when transferred to tape. Furthermore, recovery of randomly scattered file segments from tape is difficult and usually involves considerable software overhead. In contrast, full-function, \( \frac{1}{4} \)-inch streaming-tape drives, such as the Control Data Corp. (CDC) model 92190/92192 Sentinel, are not restricted to mirror backup. They can use \( \frac{1}{4} \)-inch streaming-tape-drive software without software modification to implement many of the functions provided by larger and more expensive \( \frac{1}{4} \)-inch cartridge drives, including data compression, individual-file backup, software distribution and archival storage.

In today's multiuser systems, Winchester disk drives typically contain many files that vary in size from tens of kilobytes to tens of megabytes. The operating system's file-management software dynamically allocates the files belonging to different users on the disk. When initially created, file segments are often placed on disk in as contiguous a manner as possible to expedite the backup process. However, additions and changes to the file are usually not adjacent to the original data. This fragmentation can reach the level where no two file segments are contiguous. Retrieving portions of a file that are scattered throughout the disk obviously requires longer and more frequent seek operations and eventually results in degraded system performance.

Disk or data compression, which can be implemented
by using a full-function, ¼-inch streaming-tape drive, can eliminate frequent seek operations and preserve system throughput by rearranging file segments into a contiguous sequence. The segments are copied sequentially from the various disk locations onto the temporary storage of a streaming-tape unit, then transferred back to the disk and stored contiguously. Many multiuser operating systems, such as UNIX, Pick and OASIS, have software utilities for this function, and the tape produced during disk compression can be used as file-oriented backup for the disk.

Disk compression can eliminate frequent seek operations by rearranging file segments into a contiguous sequence.

File-oriented backup can restore single files

Winchester disks can be backed up by image or by file. Image, or mirror, backup can protect against a system failure by dumping the contents of the disk onto a back-up device in exactly the same order as the files were recorded on the disk.

Because image backup is straightforward, image-dump utilities are simple to write, and they execute quickly, as do utilities to restore the disk from the backup media. However, image backup has some disadvantages. For example, it would be impractical to use it to restore files. Because files fragmented on the disk remain fragmented on the backup tape, recovery of randomly scattered file segments becomes a major and time-consuming software undertaking.

The biggest drawback involves restoring the full disk from the backup media when only one file is damaged. Users who update their files after the backup is completed must update their files again, which can be a problem if the updated data is no longer available. Furthermore, both the disk and the system are unavailable to users while the full disk image is being restored.

On the other hand, with file-oriented backup—implemented with a full-function streaming-tape drive—a user can back up individual files to protect them from accidental damage and can keep the backup tape. Implementing file-oriented or -selective backup is similar to disk compression. The file data is selected, and a utility gathers the fragmented data blocks from the disk for sequential recording on the backup tape. On multiuser systems the utility can usually run

![Fig. 1. How hard-disk data rate affects backup streaming-tape drive operation is shown in these timing diagrams. Four 512-byte Winchester disk data sectors transfer to the host computer's 4K-byte main memory data buffer, are compressed into one 2K-byte data block and are then transferred to the backup streaming-tape drive. In A, the Winchester disk supplies data faster than needed by the backup tape, permitting it to stream continuously and allowing the host computer time to support another task. In B, the disk supplies data at exactly the rate the tape drive requires to stream continuously. Data is thus available to the drive at the end of each inter-block gap. Under low disk-throughput conditions, on the other hand, data cannot be supplied fast enough to keep the tape drive streaming continuously (C). No data is immediately available at the end of each inter-block gap, and the tape automatically goes into a reposition sequence—slowly decelerating, stopping, reversing, stopping again and slowly accelerating—greatly lengthening backup time.](image1)

![Fig. 2. File fragmentation can significantly reduce Winchester disk throughput in file-oriented backup operations. With a disk sector size of 512 bytes and an average access time of 50 msec., the average data-transfer rate slows to only about 10K bytes per second when files are 100 percent fragmented.](image2)
AT LAST. IMMEDIATE NETWORK ACCESS IN HEAVY TRAFFIC.

INTRODUCING UniLAN.

Until today, no single access method could give you absolutely optimal performance every minute of every day. Token-passing, for instance, is fine for the heavy traffic of real-time voice or file transfers, but far less effective for asynchronous, bursty traffic. CSMA/CD, on the other hand, handles bursty traffic well but gets bogged down in heavy traffic. So if your traffic patterns change, from day to day or minute to minute, yesterday's networks can hold you back.

Enter UniLAN from Applitek. In one network, it combines the immediate access of CSMA/CD and the guaranteed access of token passing, automatically shifting back and forth according to the character and load of the traffic. And outperforming any single method you have ever seen.

Take the checkered flag on any circuit from the start.

When it comes to performance, UniLAN is first off the starting line with its speed of 10 mega bits per second. This speed gives you more, and more, and more, messages on the network. And they get to their destinations faster.

UniLAN also lets you choose the cable technology that suits you best. Broadband or baseband coaxial cable. Or optical fiber. In fact, UniLAN helps you get more performance out of broadband than other systems. It not only provides variable message length, but it also compensates for loop delay, which dramatically reduces the idle time between messages, and makes for more efficient use of the bandwidth.

The decision you can live with. Long into the future.

The same versatility that optimizes your network minute to minute, also adapts to your long-term changes. So when today's terminals are replaced by tomorrow's personal computers, UniLAN continues to provide peak performance, without the cost and chaos of adding a new network.

In short, UniLAN gives you extra performance today. And eliminates the risk if your needs change tomorrow.

For more information, write or call: Applitek Corp., 107 Audubon Rd., Wakefield, MA 01880 (617) 246-4500.

CIRCLE NO. 116 ON INQUIRY CARD
"Whatever you need to keep your computer system running right, I deliver."

"IBM systems, DEC systems or Control Data systems—whatever you need to keep your system up and running, Control Data will be there—with a full line of services.

More than 2800 customer engineers, like me, maintain whatever needs to be maintained, even on mixed-vendor environments. Our service is responsive, flexible; backed by a national network of parts warehouses; and a Central Support Center full of hardware and software support experts.

One more thing: Control Data has a 26-year track record, and with all that experience, you can depend on us. I wouldn't have it any other way—believe me. Call Control Data Engineering Services. We deliver."

1-800-828-8001 ext. 58.
In Minnesota 612/921-4400 ext. 58. Outside the U.S. call your local office.
CIRCLE NO. 117 ON INQUIRY CARD

CONTROL DATA
simultaneously with other users' tasks.

The backup method employed has a major impact on tape system data rate. Operating the tape in a continuous streaming mode permits the use of smaller, less powerful motors and lowers the cost of operation. To achieve continuous streaming, the disk data-transfer rate must equal or exceed the tape system's recording rate. Operating the tape in a continuous streaming mode permits the use of smaller, less powerful motors and lowers the cost of operation. To achieve continuous streaming, the disk data-transfer rate must equal or exceed the tape system's recording rate. Operating the tape in a continuous streaming mode permits the use of smaller, less powerful motors and lowers the cost of operation. To achieve continuous streaming, the disk data-transfer rate must equal or exceed the tape system's recording rate. Operating the tape in a continuous streaming mode permits the use of smaller, less powerful motors and lowers the cost of operation. To achieve continuous streaming, the disk data-transfer rate must equal or exceed the tape system's recording rate. Operating the tape in a continuous streaming mode permits the use of smaller, less powerful motors and lowers the cost of operation. To achieve continuous streaming, the disk data-transfer rate must equal or exceed the tape system's recording rate. Operating the tape in a continuous streaming mode permits the use of smaller, less powerful motors and lowers the cost of operation. To achieve continuous streaming, the disk data-transfer rate must equal or exceed the tape system's recording rate.

**File fragmentation adversely affects disk drive performance.** Assuming a disk sector size of 512 bytes and an average access time of 50 msec., at 100 percent fragmentation, average disk transfer rate is reduced to 10K bytes per second.

Typical 5¼- and 8-inch Winchester disk drives provide an instantaneous transfer rate of 5M bits per second or 625K bytes per second. Allowing 20 percent overhead for formatting, the average transfer rate is actually 500K bytes per second. Because ¼-inch streaming-tape devices operate at a considerably slower rate—in the 50K- to 100K-byte-per-second range—streaming can easily be sustained.

File-oriented backup is more difficult to analyze in terms of disk drive performance. Drive throughput is directly related to the degree of file fragmentation. With no file fragmentation, throughput is essentially identical to that achievable by image dumping, and backup occurs at the maximum tape data-transfer rate. On the other hand, 100 percent fragmentation would considerably increase file backup time (Fig. 2). Assuming a disk sector size of 512 bytes and an average access time of 50 msec., the average disk transfer rate will equal only about 10K bytes per second. Other factors that can further degrade system throughput include directory and header transfers and host computer delays. In addition, some utility programs incorporate a verify operation that can slow the data-transfer rate to less than 10K bytes per second.

In most fast file-oriented backup utilities, data compression must be used to obtain disk data rates greater than 150K bytes per second (if the tape drive can support it). Superminicomputer systems, in which cache-directory and header information optimize seek time, reach transfer rates between 50K and 150K bytes per second, depending on fragmentation level. Typical minicomputer and microcomputer systems fall in the 20K- to 100K-byte-per-second range. However, if file-oriented backup is not run during off-peak hours, other tasks running concurrently can further reduce throughput.

A ¼-inch streaming-tape drive with limited capabilities and a start/stop duty cycle might be adequate for image backup and restore if used only for that function.
Extending 1/4-inch-streamer applications beyond image backup and restore requires a drive with backspace, forward and reverse file search, frequent start/stop and fast reposition capabilities. Standard functions found in all 1/4-inch cartridge drives—read and write capability—are not included.

Because the drive can be kept streaming most of the time, the long stop and start times usually associated with such streamers do not noticeably affect backup time. File-oriented backup, however, like disk compression, requires the tape drive to stop and start or reposition frequently. How often depends on the extent of file fragmentation, disk and system characteristics, tape speed and the amount of data buffering between the host computer and tape drive. Generally, a streaming-tape drive with a short reposition time requires significantly less time to back up a disk than a speedier streamer with a longer reposition time (Fig. 3). In many configurations, the difference can be dramatic.

A heavy duty cycle consisting of hundreds or thousands of repositions during a single file backup can be disastrous to a 1/4-inch cartridge-tape drive not specifically designed for that application. Cartridge streamers, such as CDC's Sentinel, which can reliably operate under a heavy reposition duty cycle, have motors sized for high torque and heat dissipation and carefully optimized acceleration/deceleration ramps.

A look beyond backup

File-oriented backup/restore applications and other functions beyond image backup and restore require a full-function, 1/4-inch streaming-tape drive (see Table). The ability to backspace, for example, is critical. It is practically impossible to append a file onto a tape without backspacing over a previously written file mark. Backspacing ability is also required for rereading a data block if an error is detected in the initial read operation. Furthermore, most 1/4-inch streaming-tape drive software utilities use the backspace command for read-error recovery. A 1/4-inch streaming-tape drive with backspace and other expanded capabilities can use 1/2-inch-tape-drive software commands without modification.

Full-function, 1/4-inch streaming-tape drives can use 1/2-inch cartridge software commands without modification.

Because the drive can be kept streaming most of the time, the long stop and start times usually associated with such streamers do not noticeably affect backup time. File-oriented backup, however, like disk compression, requires the tape drive to stop and start or reposition frequently. How often depends on the extent of file fragmentation, disk and system characteristics, tape speed and the amount of data buffering between the host computer and tape drive. Generally, a streaming-tape drive with a short reposition time requires significantly less time to back up a disk than a speedier streamer with a longer reposition time (Fig. 3). In many configurations, the difference can be dramatic.

A heavy duty cycle consisting of hundreds or thousands of repositions during a single file backup can be disastrous to a 1/4-inch cartridge-tape drive not specifically designed for that application. Cartridge streamers, such as CDC's Sentinel, which can reliably operate under a heavy reposition duty cycle, have motors sized for high torque and heat dissipation and carefully optimized acceleration/deceleration ramps.

A look beyond backup

File-oriented backup/restore applications and other functions beyond image backup and restore require a full-function, 1/4-inch streaming-tape drive (see Table). The ability to backspace, for example, is critical. It is practically impossible to append a file onto a tape without backspacing over a previously written file mark. Backspacing ability is also required for rereading a data block if an error is detected in the initial read operation. Furthermore, most 1/4-inch streaming-tape drive software utilities use the backspace command for read-error recovery. A 1/4-inch streaming-tape drive with backspace and other expanded capabilities can use 1/2-inch-tape-drive software commands without modification.

<table>
<thead>
<tr>
<th>APPLICATIONS</th>
<th>CAPABILITIES REQUIRED FOR IMPLEMENTATION</th>
<th>INCLUDES BACKSPACE</th>
<th>FREQUENT START-STOP</th>
<th>FAST REPOSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backup</td>
<td>CAPABILITIES REQUIRED FOR IMPLEMENTATION</td>
<td>BACKSPACE</td>
<td>FREQUENT START-STOP</td>
<td>FAST REPOSITION</td>
</tr>
<tr>
<td>- Image backup</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>- Image restore</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>- Selective backup</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- Selective restore</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Other functions</td>
<td>Disk compression</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>- Software distribution</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- Archiving</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- Real-time data collection</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Because the drive can be kept streaming most of the time, the long stop and start times usually associated with such streamers do not noticeably affect backup time. File-oriented backup, however, like disk compression, requires the tape drive to stop and start or reposition frequently. How often depends on the extent of file fragmentation, disk and system characteristics, tape speed and the amount of data buffering between the host computer and tape drive. Generally, a streaming-tape drive with a short reposition time requires significantly less time to back up a disk than a speedier streamer with a longer reposition time (Fig. 3). In many configurations, the difference can be dramatic.

A heavy duty cycle consisting of hundreds or thousands of repositions during a single file backup can be disastrous to a 1/4-inch cartridge-tape drive not specifically designed for that application. Cartridge streamers, such as CDC's Sentinel, which can reliably operate under a heavy reposition duty cycle, have motors sized for high torque and heat dissipation and carefully optimized acceleration/deceleration ramps.

A look beyond backup

File-oriented backup/restore applications and other functions beyond image backup and restore require a full-function, 1/4-inch streaming-tape drive (see Table). The ability to backspace, for example, is critical. It is practically impossible to append a file onto a tape without backspacing over a previously written file mark. Backspacing ability is also required for rereading a data block if an error is detected in the initial read operation. Furthermore, most 1/4-inch streaming-tape drive software utilities use the backspace command for read-error recovery. A 1/4-inch streaming-tape drive with backspace and other expanded capabilities can use 1/2-inch-tape-drive software commands without modification.

Full-function, 1/4-inch streaming-tape drives can use 1/2-inch cartridge software commands without modification.

1/2-inch-tape-drive software commands (Fig. 4). Using a drive without these expanded capabilities forces the system integrator or user to create new utility software.

Reverse file-search utilities that can search for file marks in forward or reverse direction expedite file-oriented activities. A 1/4-inch tape drive able to support reverse file search and multiple backspace commands can use 1/2-inch tape utilities.

Although important, file-oriented disk backup is not the only function a full-function tape drive can perform in a system. It can also be used for system software loading (software distribution), archival storage and other applications, including real-time data collection in factory-floor environments. The drive can also use 1/2-inch-tape-drive software utilities for these applications.

Al Sharon is business/product planning manager at Computer Peripherals Inc., Norristown, Pa., a Control Data Corp. subsidiary. Before joining CPI in 1979, Sharon held marketing and disk product planning positions at Digital Equipment Corp. and engineering and management positions at Honeywell Information Systems Inc. and Xerox Corp.

Bill Homans, principal applications engineer at CPI, came to the company from Leeds and Northrup Corp., where he was a project engineer. He previously worked at Microdata Corp.

The writers acknowledge with thanks the technical assistance of R. Harris of Leeds and Northrup Corp.
Charles River Data Systems OEM super microcomputers just keep leapfrogging the competition. Now it's a knockout combination of operating systems: UNIX System V on one hand, and real-time UNOS on the other.

**UNIX System V for Development**
Derived from AT&T-licensed UNIX System V, our new UN/Linux V includes a full set of UNIX development tools, Bell license, Berkeley extensions, access to UNIX application programs, and support for Fortran, RM/COBOL, C, Pascal, BASIC, and Unify relational database.

**UNOS for Real-Time/Run-Time**
UNOS, our proprietary UNIX-compatible operating system, has real-time capabilities that UNIX can’t offer. Capabilities, like eventcount synchroniza-

tion, priority scheduling, and enhanced file system reliability, that are essential in industrial and scientific applications. And application programs written using UN/Linux V run under UNOS without modification and without a UNIX license, a saving that OEMs can pass on to customers.

**Plus 32-Bit Power**
UN/Linux V and UNOS run on our Universe 68 family of computers. They are true super micros, with a 32-bit, 12.5MHz 68000 processor, a second 68000 front-end processor, 32-bit 4KB cache, 32-bit bus, up to 5Mb of 32-bit RAM, high-capacity disk drives, and 1.25 MIPS performance. Quantity-one OEM prices start under $10,000.

For more on UN/Linux V, UNOS, and Universe 68 computers, return coupon to Charles River Data Systems, 983 Concord St., Framingham, MA 01701. Or call (617) 626-1000.

*UNOS is a trademark of Charles River Data Systems. UNIX is a trademark of Bell Laboratories. Unify is a trademark of Unify Corporation. RM/COBOL is a trademark of Ryan McFarland.*
THE WRIGHT BROTHERS
THEY WERE JUST THE
WEREN'T THE FIRST TO FLY.
FIRST NOT TO CRASH.

December 17, 1903. As Wilbur and others look on, Orville eases the Kitty Hawk Flyer down to the first soft landing in history.

Why did the Wright brothers succeed? Because while others were busy jumping off cliffs, the Wrights were busy conducting experiments. They built a wind tunnel. Collected data. Tested hypotheses. And went down—gently—into the history books.

At Priam, we build high-performance disc drives the same way. Instead of pushing far-out technologies to the very edge, we take the most advanced technology and make sure it works. It's a commitment that has made us the leading U.S. manufacturer of high-quality 8" voice-coil Winchester—from 35 to 500Mb. A commitment we're now making to our new 86Mb 5½" drives as well. It's why we provide total, industry-standard interface support, including ST412, SMD, ANSI, SCSI, IPI-3, and our own Priam interfaces. And it's why we've just opened a new, automated production facility, one of the largest and most modern in the OEM world.

Whatever your disc drive needs, look to Priam. You can trust us not to crash.

JUST THE RIGHT DISTANCE FROM THE LEADING EDGE.
20 West Montague Expressway, San Jose, CA 95134
West Coast (408) 946-4600; East Coast (617) 444-3973
CIRCLE NO. 119 ON INQUIRY CARD
Otari has excelled in the design and manufacture of magnetic tape equipment for over twenty years. Now, Otari redefines excellence in another magnetic medium with the introduction of extraordinarily reliable, high-quality 5¼" Winchester disk drives. Both full and half height drives are built in Otari's sophisticated production facilities in Japan, where the commitment to quality control is absolute. Every phase of production, from base plate machining to burn-in and final testing, is accomplished under one roof.

Standing behind the excellent specifications are the Otari name and the resources to ensure a steady supply of the drives you need, when you need them. The name that sets the standard for reliability and quality in small Winchester drives, Otari now offers a complete family of drives with formatted capacities of 5, 10, 15 and 20 MB. Call or write your nearest Otari office for full details about our excellent line of full and half height 5¼" disk drives.

Otari Electric Co., Ltd.
4-29-18 Minami Ogikubo
Suginami-ku 167 Tokyo
Tel: (03) 333-9631
Telex: J26604 OTRDENKI

Otari Corporation
Data Products Division
2 Davis Drive
Belmont, California 94002
Tel: (415) 592-8311 TX: 910-376-4890

© 1984 Otari Corporation
SCSI bus solves peripheral interface problems

Freeing system integrators from interfacing non-compatible peripherals and subsystems, the SCSI bus promises universal interchangeability, wider device selection, increased integration flexibility and lower cost.

Richard Barrett, Adaptive Data & Energy Systems

Buses represent the “superhighways” of computer systems. They carry data, addresses, control signals and power between system components. The small computer systems interface (SCSI) bus, for example, can lower system-integration costs by providing a flexible and interchangeable mix of peripherals for personal computers and small business systems. Originally labeled the Shugart Associates system interface (SASI) bus, the SCSI bus is the leading intelligent interface for 5¼-inch Winchester disk drives. It is used by an estimated total of 10 percent of installed personal computers and 30 percent of installed small business systems.

Start with SCSI basics

SCSI, a specification for a peripheral bus and command set, is a high-performance peripheral interface that allows data to be distributed among peripherals independently of the host, thus freeing the host for more user-oriented activities.

The SCSI has 50 pins (Fig. 1) and 18 signals—nine for an 8-bit data bus with parity and nine to coordinate inter-device data transfers. The control signals govern bus status, selecting one of four states. Unlike the early non-arbitration SASI buses, SCSI starts in the bus-free phase (Fig. 2), with the “busy” line (number 33), the select line (41) and the data-bus lines (0 to 7) set FALSE. Peripherals seeking bus control activate the busy line to enter the arbitration phase, with the highest-address initiator given priority.

Next, in the selection phase, the highest-priority peripheral, or initiator, selects a device or target, or the target re-selects the initiator because of target disconnect. Once the physical inter-device path is established, the bus enters its information-transfer phase, placing the bus in one of the initiator-to-target transfer modes: data out/in (000/001), command (011) or message out/in (110/111) phases.

Fig. 1. Ribbon-cable signal designations assign ground to all even pins (2, 4, ..., 50). All lines require 220-1330-ohm terminators. To drive several SCSI devices and two terminator resistors, a driver must sink 48 mA at 5V. Daisy-chaining is limited to 6m. Differential bus-drive modes interconnect cables between 6m. and 15m. long to “cancel out” noise caused by electromagnetic interference. Even-numbered pins carry negative-signal waveforms, and pin 1 becomes the shield ground. But, unlike other differential driver/receivers, arbitration uses open-collector devices for wired-OR arbitration. Active high assertion is needed for steep rise times at high data-(block) transfer rates—typically 500K to 1.5M bytes per second for direct-memory access.

<table>
<thead>
<tr>
<th>SIGNAL</th>
<th>PIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATN</td>
<td>1</td>
</tr>
<tr>
<td>Attention</td>
<td>29</td>
</tr>
<tr>
<td>BSY</td>
<td>3</td>
</tr>
<tr>
<td>Busy</td>
<td>31</td>
</tr>
<tr>
<td>ACK</td>
<td>5</td>
</tr>
<tr>
<td>Acknowledge</td>
<td>35</td>
</tr>
<tr>
<td>RST</td>
<td>7</td>
</tr>
<tr>
<td>Reset</td>
<td>37</td>
</tr>
<tr>
<td>MSG</td>
<td>9</td>
</tr>
<tr>
<td>Message</td>
<td>39</td>
</tr>
<tr>
<td>SEL</td>
<td>11</td>
</tr>
<tr>
<td>Select</td>
<td>39</td>
</tr>
<tr>
<td>CID</td>
<td>13</td>
</tr>
<tr>
<td>Cmd/Data</td>
<td>43</td>
</tr>
<tr>
<td>REQ</td>
<td>15</td>
</tr>
<tr>
<td>Request</td>
<td>45</td>
</tr>
<tr>
<td>I/O</td>
<td>17</td>
</tr>
<tr>
<td>Ground</td>
<td>47</td>
</tr>
<tr>
<td>Spare</td>
<td>19</td>
</tr>
<tr>
<td>21</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td></td>
</tr>
</tbody>
</table>

ATN - Attention: indicates initiator has message to send to target
BSY - Busy: indicates bus is busy
ACK - Acknowledge: with REQ, completes asynchronous handshake for data bus transfers
RST - Reset: clears all activity on bus
MSG - Message: indicates bus is in message-transfer phase
SEL - Select: used during device selection phase
C/D - Command/Data: defines type of information on bus—Command/Status or Data
REQ - Request: with ACK, completes asynchronous handshake for data bus transfers
I/O - Input/Output: indicates data-flow direction on bus

MINI-MICRO SYSTEMS/May 1984
Using a bus for a peripheral interface is unconventional. An interface normally connects only two devices, as in the RS232C, because it allows only one sender and one receiver to be connected. The ST-506 (Seagate Technology) specification allows only one disk and one controller on each radial connection. A single controller can support four disk drives but uses four interfaces. In contrast, a bus has multiple independent interchangeable slots, which are critical to SCSI performance advantages.

**SCSI resembles backplane buses**

The SCSI bus is architecturally similar in signal organization, multiple-master capability and operational phases to backplane buses (Fig. 3). First, the SCSI signal set contains an 8-bit data bus and various control/status signals that are on the same pins at all points on the bus. SCSI does not require daisy-chaining or physical positioning.

Second, like many sophisticated backplane buses, SCSI can have multiple masters. But, unlike many backplane buses that establish priority by hard-wired techniques, such as daisy-chaining priority lines, SCSI uses a voting cycle. For user convenience, SCSI establishes master priority exclusively in the voting, or arbitration, cycle and requires no physical modification as devices are added.

Third, like most backplane buses, SCSI defines several operational cycles, or bus phases. It has normal read and write phases for data transfer and several other phases for bus arbitration and message transfer.

**An unconventional approach**

Although both the SCSI and the backplane are computer buses, their goals differ. Backplane buses provide transfers between module types, or printed-circuit boards, with many functions and varying intelligence levels. A CPU module, for example, can have extremely sophisticated bus command and response capabilities, whereas the low-intelligence memory module must quickly respond to a given address with a read/write cycle. To accommodate these opposing functions, a backplane bus provides as few restrictions as possible.

The SCSI bus, in contrast, specializes in bulk data transfers between peripherals and hosts. Because all SCSI bus devices are similar, the SCSI specification assumes sophisticated response capability from each device, allowing the definition of an entire command set. This functional distinction enables SCSI to depart from conventional bus design in implementation, command-set definition, data-rate restrictions and message- and data-transfer sequences.

For mounting, backplane buses are typically plugged at right angles into a printed-circuit motherboard, housed in a card cage. This makes the housing integral to the electronic interconnection and is convenient for the cards because they lack other natural mounting locations. Peripheral controllers, unlike computer cards, fit into well-defined mounting locations atop associated peripherals, with mounting holes on some peripherals almost as standard as electrical interfaces. Thus, the 50-pin ribbon cable SCSI bus is a natural interconnection mechanism for controllers when they are mounted atop the peripherals, since it allows peripheral power, cooling and space requirements to determine the mounting arrangement.

Command-set definition in microcomputer buses differs from that of the SCSI bus. In computers, the command set is a function of the microprocessor CPU rather than the backplane. Many microprocessors are available on microcomputer buses such as the Multibus, the S-100 and the STD bus. The command set, therefore, must be backplane independent. In contrast, the SCSI bus command set is integral to the entire I/O bus concept. Fixing the I/O driver modules in the software's operating system frees system integrators from the traditional constraints imposed by peripheral and controller vendors. The high-level, block-oriented SCSI command set also forces the host CPU to off-load peripheral housekeeping tasks to the controller.

Third, most backplane buses place no restrictions on the minimum-burst data rate. Timing specifies maximum data rate, but idle time between each data transfer remains unlimited. In contrast, a key SCSI feature is its bias toward a HIGH on the average data rate. Each SCSI bus controller is intelligent enough to know when it must stall a transfer when the receiving device is full and when the sending device is empty. To
GET YOUR MESSAGE THROUGH.

EVEN WHEN YOUR MODEM SENDS IT BY WAY OF THE OKEFENOKEE SWAMP.

When you send data by telephone through nasty environments like this, it can run into problems tougher than just alligators. Problems like impulse noise. Chatter from the switchgear. Static from the atmosphere or bad weather. Distortion due to crosstalk or just plain white noise.

To get your message through, your IBM PC or XT needs the advanced performance features of the PC: IntelliModem™. It's got the best receive sensitivity available today—actually down below -50 dBm. So now you can achieve a high level of data transmission integrity. Even with bad connections.

Get patented modem technology. The PC: IntelliModem is elegantly simple. Its patented design does it all on a single microprocessor chip, with just one crystal. Other modems take two, four or more μPs (and even more oscillators), and still accomplish less.

How do we do this? By creating architectural innovations in firmware, and by pushing the chip to its limit, close to 12 MHz. Since it uses fewer parts, the PC: IntelliModem's no-compromise design offers higher reliability, a more compact form factor, and lower costs.

This design elegance leads naturally to more elegant performance. Take line status detection, for example. The PC: IntelliModem's adaptive, decision-directed logic monitors line status more closely than other modems. Even at weak or degraded signal levels. So it can make connections with less chance of error, by detecting signals for dial tone, remote ringback, busy and voice—some of which other modems ignore.

Plan ahead with integrated voice and data. For opening up a whole new world of integrated voice and data applications, there's nothing like the PC: IntelliModem. Literally. Its easy-to-use software package—PC: IntelliCom™—lets you switch repeatedly between talking or listening and sending or receiving data. All at the touch of a single function key. That means now both you and your computer can talk on the same line. Without having to hang up, re-dial or plug and unplug a lot of cables.

So if you're designing microcomputer datacomm products—or just looking for a PC/XT modem for yourself, check out the PC: IntelliModem at your local dealer. You'll get the message. And so will they. Or contact: Bizcomp, 532 Weddell Drive, Sunnyvale, CA 94089; 408/745-1616.

Bizcomp: A history of innovation.
1980 Invented first command-driven modem
1981 Introduced proprietary line-status monitoring
1983 Designed first single-µP 212A-compatible modem
1983 Introduced first integrated voice/data modem for IBM PC
1983 Granted patent on command-driven modem

Make sure your modem has all these PC: IntelliModem features

- Integrated Voice/Data
- Switch between voice and data communications
- Programmable telephone handset jack
- Status Reporting
- Line status detection (dial tone, busy, remote ringback, voice answer, modem answer, incoming call)
- Audio monitor
- Programmable status LED
- PC: IntelliCom™ Software Included
- 99-name on-line telephone directory
- Auto-dial, auto-repeat dial, auto-answer
- Link to another number if busy
- File transfer
- Data capture to diskette
- Programmable auto log-on sequences
- Compatible with Crosstalk™ and PC-Talk III™
- Pulse and Tone Dialing
- Receive Sensitivity: -50 dBm
- Speeds: 110, 300, 1200 baud

Bizcomp®
We've got people talking.
Why buy a **VISUAL 102** instead of a DEC VT102?

**Plus...** graphics now or graphics later.

The new **VISUAL 102** gives full DEC VT102* performance and more features at a much lower price. Plus, when you need it, a Graphics Option card turns the VISUAL 102 into a 768 x 293 resolution graphics terminal emulating the Tektronix 4010/4014. Just insert the card and immediately you have high resolution graphics compatible with a variety of available software packages.

VISUAL 102. The low cost, DEC VT102 compatible terminal that lets you graph now or graph later.

The UL listed VISUAL 102 exceeds FCC Class A requirements and U.S. Government standards for X-ray emissions.

---

**VISUAL**

See for yourself®

---

Thomas R. Foley
President

Andy

**Let's show VISUAL 102 has the same extra features when compared to the DEC VT220!**

Agreed... plus our keyboard is far more compact with user-programmable, non-volatile function keys. And VT100 compatible.

- Andy

VISUAL Technology Incorporated
540 Main Street, Tewksbury, MA 01876
Telephone (617) 851-5000, Telex 951-539
stall a transfer, the intelligent device breaks the transfer and disconnects from the bus, freeing the bus for use by other devices. Interleaving several transfer tasks on the bus increases the total throughput rate. Consequently, processes need not wait for others to complete before starting. Although data-transfer device delays, such as disk latency, still occur, interleaving increases total bus usage by sharing the bus.

Fourth, backplane buses lack identification tags for transferred data. Although some backplane buses do contain a memory/I/O line, the level of differentiation it provides is minimal. The SCSI bus provides a hardware signal for identifying message (pin 39) and data (pin 43) transfers. Controllers communicate with each other via messages, allowing high-level interaction and pre-conditioning for data transfers.

By decoupling peripherals from the system, SCSI makes it easier for distributors and dealers to sell peripherals without interface and reconfiguration problems.

SCSI has advantages galore

The SCSI offers advantages to system integrators, system sellers (distributors and retailers) and end users. It also helps computers evolve into an expandable system of interchangeable components. It benefits system integrators by simplifying software and hardware integration and system performance. In software integration, the command set allows the operating system to work at a high level. Instead of computing head, cylinder and sector-address locations, the operating system simply specifies a logical block number because the SCSI controllers handle all the logical-to-physical mapping. The command set allows the controller to handle differences between disk families; the operating system thus needs only one disk driver, not one for each disk type.

In hardware integration, a system integrator using SCSI need incorporate only one connection to the bus to handle all the system's peripherals. The best approach is to use a dedicated microprocessor for SCSI bus control, communicating with the host memory through direct-memory-access channels. SCSI controllers are mounted on each peripheral, drawing their power from the peripheral rather than from the SCSI cable.

System performance also benefits from use of SCSI. SCSI has a 1.5M-byte-per-second maximum data rate that might eventually be increased. It also reduces error rates: data-bus parity (pin 19) protects all transmissions, and an optional differential bus-driver feature, using 6m.- to 15m.-long cables and the even pins, offers extra protection from noise. In addition, SCSI identifies and recovers from errors.

By decoupling peripherals from the system, SCSI makes it easier for distributors and dealers to sell peripherals without interface and reconfiguration problems. Using the "device ID" command after any system reset, the computer interrogates every address on the SCSI bus to determine which device, if any, resides there. The device responds by describing the functional characteristics of its peripherals. Knowing currently available peripheral characteristics, the operating system can configure the system for optimum performance.

End users benefit the most from using the SCSI as the standard peripheral interface. With SCSI, peripherals become as "personal" as the personal computer or small business system. The advantages of this include convenient expansion with sealed-system peripherals,

---

**Fig. 3.** Multiple-initiator/multiple-target SCSI system configuration provides host-to-host communications, peripheral-to-peripheral data transfer, multithreaded operations to a peripheral controller and concurrent operations (multitasking) on a peripheral controller.
independence from peripheral developments, lower acquisition and maintenance costs, portability, greater reliability, or mean-time-between-failure rates and lower downtime and better fault isolation, yielding lower mean-time-to-repair rates.

Many manufacturers are selling computer products as sealed boxes that prevent users from expanding the system by incorporating peripherals and interface cards. But SCSI will solve that problem: peripheral systems with two plugs—SCSI IN and SCSI OUT will permit users to purchase lengths of 50-lead connector cable to add peripherals. With independence from peripheral developments, users will not have to wait for improved systems. Instead, SCSI guarantees users compatibility with new peripherals. Lower acquisition costs mean higher production volumes, and those in turn mean reduced costs. Controller prices, for example, should drop to less than $150.

Because SCSI uses replaceable modules, it also reduces downtime. Users of SCSI can unplug failed peripherals and reboot the system. The computer reconfigures itself to the reduced configuration, while the peripheral is repaired or replaced. Thus, peripheral failure is not catastrophic; the system simply operates in a degraded mode. Users can more easily isolate faults because intelligent SCSI controllers assume this task from the operating system. Each SCSI controller includes self-diagnostics embedded in firmware and reports failures to the operating system using the message signal.

**Interface allows retrofits and adaptations**

The best time to integrate the SCSI bus is when a system is new. This allows system integrators to implement the SCSI from the start to take advantage of all the bus' features and to plan for expansion. But SCSI can also be retrofitted into systems. This requires an SCSI host adapter. Modifying the operating system means only adding peripheral drives for those on the bus.

Richard Barrett, president and chief executive officer of Adaptive Data & Energy Systems, Pomona, Calif., co-founded the company in 1980. Previously, he was project director for Walt Disney Productions subsidiary Ride Communications and worked under contract to General Motors Corp. He has published several papers in his field and is a member of the IEEE. He obtained his BSEE and MSEE from Rice University, Houston.
Multibus Microcomputer Systems Made Easy

OEMs get products to market faster with SMS Winchester controllers, storage systems and microcomputer foundation systems.

Whether you select 8086, M68000, Z8000 or another Multibus single board computer, you can choose the SMS product to fit your packaging needs.

Small table top applications can use the MDX80000 foundation system with five Multibus slots, 10, 15, or 40Mb of 5-1/4" Winchester storage plus an 8" IBM compatible floppy.

For high volume or unique packaging requirements, the SMS FWD8001/FWD8006 single board controllers are INTEL 215 compatible and support 8" Winchester/floppy or 5-1/4" Winchester and 5-1/4" or 8" floppy disk drives.

If you have your own Multibus backplane, plug in the SMS FWT80000 storage system. It occupies only 5-1/4" of rack space and comes with either 10, 20, 40 or 80Mb Winchester storage plus an 8" IBM compatible floppy.

For large configurations, choose the DSX80000 foundation system with eight Multibus slots, 10, 20, 40 or 80Mb of Winchester storage plus an 8" IBM compatible floppy.

Scientific Micro Systems, Inc.
777 East Middlefield Road Mountain View, CA 94043
(415) 964-5700 TWX: 910-379-6577

SMS SALES OFFICES:
Seattle, Washington (206) 883-8303
Boston, MA (617) 246-2540
Atlanta, Georgia (404) 296-2029
Morton Grove, Illinois (312) 966-2711
Yorba Linda, California (714) 993-3788.

CIRCLE NO. 124 ON INQUIRY CARD
Introducing TI's Climb on the 32-
The Nu Machine™ Computer. The first system in the Texas Instruments Nu Generation Computer family. The only system now available built on a modern 32-bit bus. The processor-independent NuBus™ architecture helps meet your advanced-technology design requirements today. And tomorrow.

First high-performance 32-bit bus
The NuBus technology, designed at M.I.T., is optimized for 32-bit data and address transfers. Its 37.5-Mbyte/sec bandwidth combines with an elegant arbitration scheme to ensure fast and fair data flow.

Innovative, flexible architecture
The NuBus design was developed to support sophisticated system architectures and eliminates the built-in obsolescence of processor-dependent systems. It lets you concentrate on developing applications, not architecture. Your significant investments are protected as new technologies develop.

The Nu Machine's open architecture solves your make vs. buy dilemma. Multiple-processor configuration support combines with the NuBus high bandwidth, high-resolution graphic displays, cache memory, and high-speed disks to make the Nu Machine system attractive to sophisticated end-users, systems integrators, and OEMs in the engineering and scientific marketplace.

Anticipating industry trends, the power and expandability of TI's Nu Machine allow it to accept 32-bit processors of the future.

Open system supporting industry standards
TI's Nu Machine system is currently available with a 10-MHz 68010 processor supporting a UNIX™-based operating system with enhancements for windowing and high-resolution displays.

Those who want to design their own system processors and controllers can now license the NuBus design from Texas Instruments.

Also, a NuBus-to-Multibus™ converter allows the use of existing interface cards and peripherals from third parties.

The system you can build on from now on
Because its high performance and flexibility are designed for the long run, TI's Nu Machine can be updated when other systems are outdated.

And, Nu Machine computers are backed by TI's service and customer-support network and by TI's commitment to quality and reliability.

To climb on the NuBus bandwagon, call toll-free: 1-800-527-3500. Or write Texas Instruments Incorporated, P.O. Box 402430, Dept. DNA203MY, Dallas, Texas 75240.

Combining innovative NuBus architecture with advanced graphics, powerful peripherals, and UNIX-based software, TI's Nu Machine provides the outstanding performance and flexibility required by scientific and engineering systems designers.

TEXAS INSTRUMENTS
Creating useful products and services for you.
TELEVIDEO MULTI-

TO EACH HIS OWN.

If you’ve had your share of sharing a personal computer, TeleVideo® Multi-User Computers mean the end of the line. From two users to 16, and even more, our systems offer the expandability and power to meet your growing needs.

TO EACH HIS OWN PROCESSOR.
A powerful desktop microcomputer system, the TS 806 offers all the conveniences of the TS 804 and even more throughput. With the ability to

3,000 SOFTWARE PROGRAMS AND MAIN-FRAME COMMUNICATION.
Our systems support industry standard software, so you’ll have access to nearly 3,000 very productive programs. And by emulating IBM® 3270 and 3780 terminals with additional TeleVideo software, you can even communicate with IBM mainframes.

However large or small your business, or department, TeleVideo offers a variety of multi-user computers that offer each user all the conveniences of a personal computer. And all the power of a computer network.

THE LOWEST COST PER USER.
The all-in-one system that’s the one for all, the TS 804 is completely integrated into a single desktop enclosure. The system can support up to four users and a wide selection of peripherals. And it’s all available for the lowest cost-per-user on the market: under $1500.

OUR SYSTEMS GROW WITH YOUR BUSINESS.
And with TeleVideo it’s easy, inexpensive and controllable. You can add users to the systems with plug-in simplicity, when and where you need to. Secretaries and bosses can all share the same system without sharing the same computer. And by simply adding to your system as your business grows, your original investment is always protected.

The TS 816: Up to 16 users

IBM is a registered trademark of International Business Machines Corp.
provide true multi-user capabilities for up to six stations, any combination of TeleVideo 8 and 16-bit personal computers can be supported by the TS 806.

UP TO 16 USERS AND 16-BITS.
Up to 16 workstations can be used with the TS 816, creating a flexible multi-tasking system. Any combination of 8 and 16-bit personal computers can be supported, with or without local storage.

THE WORLD'S LEADING MANUFACTURER.
TeleVideo is the leader in multi-user computers and the number one independent manufacturer of terminals. And from systems to peripherals to service and support, only TeleVideo offers you the convenience of a single-vendor solution.

For more information, call 800-538-8725 (in California, 800-345-8008).

TeleVideo Multi-User Computers. To each his own.

TeleVideo Systems, Inc.

MINI-MICRO SYSTEMS/May 1984
CIRCLE NO. 126 ON INQUIRY CARD
Irwin proudly introduces the smallest breakthrough in back-up.

Amazingly small... a 3½ inch form factor!
It was no small achievement.

In fact, no one believed we could fit 10 megabytes of formatted capacity in a minicartridge. And make it function with absolute reliability.

But we did it. Thanks to state-of-the-art, closed-loop servo technology.

We call it the Irwin 210. Some people are calling it a breakthrough in desk-top and portable microcomputer back-up.

It requires only the smallest effort.
The Irwin 210 asks very little of you.

There's no change or addition to the microcomputer hardware. Because the unit has an industry standard minifloppy interface, it plugs right in to your existing controller.

The software required to integrate the Irwin Tape Drive with your computer can be written in as little as 8 hours. Irwin even provides streaming and start/stop software for the IBM PC-XT.

Available at a surprisingly small price.
What may surprise you even more than the size of our tape drive is the price.

The Irwin 210 is available for about the cost of a floppy disk drive. Significantly less than you might expect.

Too small for you? Then check out the Irwin 110—our 5¼ inch half-high.

You'd expect someone with Irwin's experience in magnetics technology to offer you even more.

And you'd be right. Along with the 3½", we have 5¼" half-high tape drives. True 5¼" half-highs, including electronics. Available for evaluation, with 30-day delivery.

Think small.
To see the Irwin 110 and 210 in action—or to find out more about our product breakthroughs—call 1-313-996-3300.
UNIX's place in office automation is assured

System integrators will find a growing array of brands and products from which to select

Paul Sniger, Senior Editor

UNIX-based office-automation systems will experience explosive growth starting next year. The UNIX operating system is a multiuser, 16- and 32-bit standard backed by American Telephone & Telegraph Co. and IBM Corp. As 32-bit workstations enter offices, UNIX acceptance will grow, eclipsing MS-DOS and PC-DOS, just as MS-DOS and PC-DOS overshadowed CP/M.

UNIX-based 16- and 32-bit workstations in offices connected by the AT&T- and IBM-sanctioned local-area networks (LANs) to be introduced this year will replace centralized minicomputer installations for integrated information networks. Software system integrators now offer office-automation products that extend UNIX file-system hierarchy to include other residents on LANs.

AT&T is readying its line of UNIX-based 32-bit microcomputer workstations and portable computers for its invasion of the office arena, and IBM is not far behind with its recent endorsement of UNIX through its Personal Computer Integrated Executive and Columbus, a UNIX-like operating system IBM is rumored to be working on. With these announcements, the future of UNIX in offices and in the personal computer field is assured.

UNIX standardization promises wider selection

The first signals that UNIX would be a driving force for system integrators came more than a year ago when AT&T introduced UNIX System V in January 1983. With System V, AT&T enhanced performance by adding improved spooling, shared memory and semaphores. These enhancements told system integrators that AT&T was aiming directly at commercial UNIX users, specifically automated offices. The licensed version of System V is the same UNIX as that used in-house at AT&T, thus synchronizing internal AT&T and external system integrators. With System V, AT&T offers direct software support for UNIX to system integrators—through the AT&T Technical Systems Group—a significant shift. System integrators

Fig. 1. UNIX text-processing starts with text-entry editing, bidirectionally interacting with the UNIX text files through the text-editing utilities. Text formatting and printing, on the other hand, are unidirectional. After the text editors prepare the text, formatters format it before outputting it in the desired media.
Utilities

Test Data

Qsort sorts into sequence categories and adds a title.

Hist and title plots it on VDT.

Fig. 2. UNIX pipe facilities used by the shell permit pipelining. A vertical bar, the pipe character, instructs the shell to pipe the program output directly to the next input. The five programs shown here are designed to work together, new programs from existing functions need not be written. In this case, several utilities are joined by pipes to make a graphics task convert raw test result data into graphics histograms. Most such file-processing functions are performed without programming.

Licensed earlier versions and enhanced them themselves.

Support is to source licensees that modify and port UNIX, but AT&T's Information Support division will provide end-user support later. To reassure system integrators of its commitment, AT&T promises that upcoming versions of UNIX, such as System VI, will be upwardly compatible with System V's kernel. System integrators can write for System V, safe in the knowledge that their software will run unmodified on upgrades. In addition, AT&T claims its new UNIX documentation is an improvement over previous versions.

Last May, AT&T made agreements with Intel Corp., National Semiconductor Corp., Motorola Inc. and Zilog Inc. to develop AT&T UNIX versions. This will make it easy for integrators to develop UNIX-based systems because generic ports will be ubiquitous industry standards. Integrators will then flood the market with AT&T UNIX-based office systems.

Other forces push office-automation UNIX

UNIX-like features are surfacing in MS-DOS, PC-DOS, CP/M and other operating systems, and the trend is growing. UNIX is still too large for most 16-bit workstations and desktop computers, so MS-DOS and PC-DOS remain dominant, despite their limitations, because they can tolerate limited resources. But 32-bit workstations and 256K-byte RAMs can directly address far more memory. A 16-bit microprocessor directly addresses only 64K bytes, and a 32-bit microprocessor addresses 4,000M bytes. These workstations not only address large amounts of memory but also provide virtual memory, on-chip support for memory protection and sophistication previously limited to superminis and mainframes.

IBM and AT&T have used 256K-bit RAMS extensively in their 32-bit microprocessors. Low cost, removable-cartridge disk drives are more common. Taken together, these trends guarantee that components required for lower-cost UNIX systems will be available.

Minicomputer makers such as Digital Equipment Corp., Hewlett-Packard Co. and Data General Corp. were quick to offer UNIX versions. DEC now offers the Berkeley UNIX for its VAX line and Version 7 for its PDP-11s. DG is trying an Eclipse version of UNIX as an extension of AOS, its current UNIX-like operating system. AOS is not compatible with AT&T UNIX. HP intends to fall in line and center its 32-bit line around UNIX.

More choice for system integrators

UNIX transportability introduces more competition for equipment and computer makers, allowing system integrators to select from a greater array of brands and products, as no single maker can supply all required software and hardware. And, since integrators can easily customize UNIX to a particular user's needs, a richer variety of applications and sophisticated changes become feasible. Existing operating systems too often suffer from a clumsy structure of programs and incorporate numerous interrelated programs with their fixes, all in a confusing jumble of commands that make changes difficult due to the interrelationships. UNIX's small and separate modules, which can be selectively deleted and customized to the specific application, are a refreshing change.

UNIX contains the networking software needed to inter-network various machines and equipment. UNIX-related system makers are creating software and hardware connections to tie their products into these networks.

In office automation, system integrators can often develop new UNIX uses without programming. They combine several UNIX commands to handle simple office workday tasks by using pipes and shell scripts. The shell program connects and interprets system user
We were going to compare Vectrix graphics to IBM's. Unfortunately, there is no comparison.

For the demanding professional, it's not fair to compare Vectrix's Midas Color Card set with IBM's own. Our 512 colors (out of a palette of 4,096) vs. their 16. Our beautiful 672 x 480 pixels vs. their not-quite-precise 640 x 200. Plus the logical, easy to use Vectrix command system. There's really no comparison.

But the IBM PC XT does other things well — like provide a wealth of outstanding software. That's the reason we made sure the Midas two-board set runs all the software that runs with IBM's color card (except in low resolution mode, which even IBM doesn't support). Options include a Siggraph core library, 4010 emulation package, Plot-10 compatible library and the amazingly versatile Vectrix paint program. Get everything the IBM PC XT has to offer.

Plus incomparably better graphics. The Vectrix Midas Color Card set for the IBM PC XT or the IBM PC with expansion chassis. See for yourself — call or write today. Vectrix Corporation, 2606 Branchwood Drive, Greensboro, NC 27408 (919) 288-0520 Telex 574417.

This space reserved for IBM.
commands and interprets user requests, calls programs from memory and executes them one at a time in a series called a "pipe." The kernel program schedules tasks and manages data storage. Utility programs, called "utilities" for short, perform routine and special system maintenance functions.

**Customizing to specific programs is easier**

System integrators are also writing programs for sale to lower-volume users, something not economically feasible before. Many general- and special-purpose programs are being written to connect data from a file or program into a different form. When an integrator needs a new program, he writes it as a shell procedure, not as a C program, by typing command names with specific arguments.

Customizing UNIX, due to its separate modules, is a plus. Other operating systems curse the software integrator with a file structure that adds to the drudgery of file and program manipulation and maintenance. UNIX's unique file structure lets system integrators store programs, data and documents in the file system, protected by the file mechanism or more complex software.

System tools automate common programming tasks and tie them into single-command sequences. Maintaining a library of files is easier, as fewer techniques are needed. Users minimize errors by combining existing small commands into different structures. UNIX can be individualized for a particular office and for separate workstations. UNIX integrators can adapt frequently used programs for the office; individual users can write, shift and change their own programs.

**UNIX supports office automation**

UNIX text-processing utilities support creation, editing and formatting of tabular data, text, equations and documents. They also support messaging, mailboxing, calculating, calendars and appointments, reminding, screen-oriented editing, on-line newsletters and graphics.

In 30 or so utility programs, UNIX supports office functions. These include text editors and formatters, text-processing aids and electronic mail.

The standard UNIX has line and full-screen editors, with editors and word processors added by third parties. The editors enter text and store it as a file and subsequently revise it. There are more than a dozen text-processing utilities, with programming commands like the line-oriented editor "ed" and screen-oriented editor "vi."

Text-processing utilities spell, hyphenate, index and handle other functions. Direct use of these utilities is tedious, so macro packages provide pre-defined formatting commands for functions like page numbering and table of contents formatting. The cost is a loss in flexibility, but it's worth it.

**UNIX links to the world**

With the electronic-mail utility, users send messages over the public telephone network or UNIX communication facilities. Users can route mail through one or more intermediate systems anywhere in the world, as long as they are in the network. The mail utility also enables users to examine their mailbox, dispose of mail, go on to the next message, delete it, save it, forward it or repeat it.

Calendering utilities permit appointment-tracking and reminding. The calendar utility prints any month asked for. It is flexible in formatting: a date can appear anywhere in a line. An on-line newsletter utility permits a quick perusal of news.

In specialized graphics utilities, terminals, printers and plotters are joined by UNIX pipes to create graphics. The utilities analyze data and transfer it into various forms—like scattergrams, pie charts and histograms. Five filter programs take raw data from the file tests and sort it into a sequence. The data is categorized, given a title and converted into a histogram; then it is plotted on the CRT. Some UNIX systems are weak in graphics, but improvements are coming almost daily.
Presenting the first UNIX™ optimized SMD disk controller for Multibus™ Available today from INTERPHASE.

The SMD 2190 is the first high performance disk controller optimized for UNIX and UNIX-like operating systems. Its highly intelligent caching scheme gives you the flexibility to match your disk controller to your operating system. This means optimum performance for all versions of UNIX.

With the SMD 2190, you get high speed cache memory plus all the features you've come to expect from a high performance disk controller.

1:1 Interleave, 20 Mb/S data rate, 32-bit ECC, Automatic Error Correction, Bad Track and Sector Mapping, and Overlapped Seeks for high performance on the disk side.

Ultra-high speed DMA, 8- and 16-bit data transfers, and both Relative and Absolute 24-bit addressing for high performance on the Multibus side.

Easy to use MACRO-level Commands — READ, WRITE, FORMAT — mean simple software drivers.

Most-Primitive Error diagnostic reporting and a low parts count mean minimum integration time and high reliability.

Software compatibility across the Interphase Family of SMD disk controllers means the maximum return on your software investment.

You've come to expect high quality innovations from Interphase ... the most talented intelligent disk controller specialists in the country. And the SMD 2190 is no exception. It is elegant, well designed, affordable and available off the shelf.

But that's not all. We give you full support to help you integrate the SMD 2190 into your system. And we'll even leave some change in your pocket. Call or write us today.

UNIX is a trademark of Bell Laboratories
Multibus is a trademark of Intel Corporation
Child's Play


For the D-SCAN GR-1104, it's child's play. Because this is the compact desktop terminal that thinks it costs twice what it does. And acts that way.

Picture this. A 60Hz non-interlaced 14" display. Bright. Stable. And flicker-free. With 1024 x 780 resolution!

But that's just the beginning. The 1104 lets you display 8 colors from a palette of 512 (not the usual 64). And lets you expand display list memory to a full 512K!

All of which means someone is going to be very happy. Visual cueing is better. And picture manipulation is localized. Which, of course, makes operators faster and more productive. And mainframes less burdened. Two cost-efficiencies every company can live with.

The 1104 will even support ANSI 3.64. And give you a VT100 keyboard (with 16 function keys). So there are no re-learning curves to finance.

What's more, the 1104 is Plot 10 compatible. Which means it can emulate the TEK 401X instruction set. And you can save a lot of time and money on software development.

Now for some impressive technology.

The 1104 uses four (not the usual one) graphic display controllers. So figures are drawn, filled and manipulated faster. There's no drag on the system caused by processor or memory overload.

Next, the video formatter is our own custom-LSI design. A gate array (2000 gates) that reduces power consumption and board space. And provides the video speed necessary for output to our high resolution display.

Which, we hasten to add, is beautiful. Especially with its .31mm pitch shadow mask. And contrast enhancement filter that eliminates screen glare and improves visual acuity.

You'll also be happy to note that the 1104 supports our Graphics Tablets (there are two) and Color Hard Copier (the one that's already taking the industry by storm).

One last item. Because we design, build, sell and service all of our products, you can count on getting the back-up you need. Direct service from 13 offices across the U.S.

So make life easy on yourself. Call today to get the full GR-1104 picture. It's easy. Just call your local Seiko Instruments sales person, or us at (408) 943-9100, or write 1623 Buckeye Drive, Milpitas, CA 95035.

You'll see that getting better resolution from a more user-friendly terminal, for a lot less money, really is child's play.

SEIKO INSTRUMENTS

D-SCAN is a trademark of Seiko Instruments & Electronics, Ltd
VT100 is a registered trademark of Digital Equipment Corp.
TEK and Plot 10 are registered trademarks of Tektronix, Inc.


CIRCLE NO. 158 ON INQUIRY CARD
OEM alert:
The new Perkin-Elmer 3205 packs supermini performance into a micro price tag.

Introducing the Perkin-Elmer 3205. Now OEMs and system integrators can provide 32-bit supermini computing power at micro system economics, without making any compromises.

No micro system can approach the per-terminal cost advantages of the Perkin-Elmer 3205 supermini. Or the migration paths. Or offer access to a common database.

No supermini system can touch the Perkin-Elmer 3205 proven price/performance statistics.

Small investment. Big potential.
A basic 3205 costs just $6,169* and includes a ½ megabyte of memory, eight communications lines, floating point and a lot more. There's even a microprocessor handling just communications support that has more power than you get in most complete microcomputers.

The 3205 can be expanded to 4 megabytes of memory, 16 communications lines and 1.2 gigabytes of disk storage. And every configuration in the broad 3205 range offers a choice of operating systems: our own Real Time OS/32 or one derived from the UNIX** operating system.

Fully configured value.
50 megabytes of fixed/removable Winchester disk memory, 8 communications ports and a full complement of related capabilities are included in a fully configured 3205 computer for only $15,469.* That lets you supply powerful computer systems your customers can afford to buy.

The support you need.
Perkin-Elmer has been an OEM supplier for over 15 years. We know how to support you. We have a worldwide service network, powerful, quality software, reliable hardware and the terms and conditions you need.

Mini/Micro/Maximization.
The Perkin-Elmer 3205 gives you the small purchase price of micro systems, and the power, growth potential and common database advantages of supermini systems.

For the complete story, call or write the Perkin-Elmer Corporation, Two Crescent Place, Oceanport, N.J. 07757. 1-800-631-2154. In N.J., 1-201-870-4712.

*OEM quantity 100, U.S. only.
**UNIX is a trademark of Bell Laboratories.

PERKIN-ELMER
The science and computer company.
Where solutions come first.
CIRCLE NO. 159 ON INQUIRY CARD
An independent survey across the readership of 25 publications shows **Mini-Micro Systems** to be the most useful publication for information about data communications systems and equipment.

On June 15, 1983, Universal Data Systems, a division of Motorola, Inc., asked 25 publications, including those listed below, to provide 200 subscribers’ names for a media preference study. UDS combined these names with 300 UDS customers and 2000 UDS distributors to create the sample audience of over 7000.

**QUESTION:** Of the publications listed, which do you find most useful for information about data communications systems and equipment?

**RESPONSE:**

<table>
<thead>
<tr>
<th>Publication</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINI-MICRO SYSTEMS</td>
<td>9.75%</td>
</tr>
<tr>
<td>Data Communications</td>
<td>9.55%</td>
</tr>
<tr>
<td>Datamation</td>
<td>8.12%</td>
</tr>
<tr>
<td>Computerworld</td>
<td>7.93%</td>
</tr>
<tr>
<td>EDN</td>
<td>6.89%</td>
</tr>
<tr>
<td>Computer Design</td>
<td>6.82%</td>
</tr>
<tr>
<td>Electronic Design</td>
<td>6.76%</td>
</tr>
<tr>
<td>Electronics</td>
<td>5.72%</td>
</tr>
<tr>
<td>Electronic Engineering Times</td>
<td>4.68%</td>
</tr>
<tr>
<td>MIS Week</td>
<td>4.61%</td>
</tr>
<tr>
<td>Computer Decisions</td>
<td>4.03%</td>
</tr>
<tr>
<td>Digital Design</td>
<td>4.03%</td>
</tr>
<tr>
<td>Communications News</td>
<td>3.64%</td>
</tr>
<tr>
<td>Electronic News</td>
<td>3.25%</td>
</tr>
<tr>
<td>Business Computer Systems</td>
<td>3.12%</td>
</tr>
<tr>
<td>Systems &amp; Software</td>
<td>2.99%</td>
</tr>
<tr>
<td>Information Systems News</td>
<td>2.60%</td>
</tr>
<tr>
<td>Telephony</td>
<td>2.14%</td>
</tr>
<tr>
<td>Computer Systems News</td>
<td>2.01%</td>
</tr>
<tr>
<td>TE&amp;M</td>
<td>1.17%</td>
</tr>
</tbody>
</table>

For copies of the complete study, contact your regional sales manager. Listing includes only those publications with greater than 1% response.
DATA GENERAL'S MV/10000
LESS MONEY THAN DEC'S VAX 11/780
AT TWICE THE SPEED.

DATA GENERAL'S MV/FAMILY-TOP PERFORMANCE, NOT TOP DOLLAR

Forget VAX.™
Data General's ECLIPSE® MV/Family of
32-bit computers brings you the best price/performance available for engineering
applications—while running some of the best
electronics engineering software.

TWICE AS FAST AS VAX
Consider the price/performance graph
shown below. On the basis of dollar-per-MIP,
Data General's MV/10000™ gives you twice the performance of the VAX 11/780—at a lower price.
Now compare the MV/8000® II to the VAX 11/780. Same performance. But the MV/8000® II is half the price.
The same holds true when you compare the MV/4000® to the VAX 11/750. And our recently announced
OEM MV/8000® offers almost twice the performance of the VAX 11/750. But it's the same price.

RUNS THE MOST WIDELY-USED SOFTWARE
You can run all of the best software on our ECLIPSE MV Series, including TEGAS®, NCA/DVS®, MicroSet-86®
ECAD's DRACULA, and Mentor's CADISYS®.
And Data General keeps you a generation ahead by bringing you
comprehensive service plans and industry standard software
development environments.

CALL NOW
For more information on Data General's ECLIPSE MV/Family, call
1-800-554-4343 and ask for Operator 06F.

Copyright 1984 Data General Corporation, Westboro MA. ECLIPSE, ECLIPSE MV/4000 and ECLIPSE MV/8000 are
registered trademarks, and ECLIPSE MV/10000 is a trademark of Data General. DEC and VAX are trademarks of Digital
Equipment Corp. Prices based on Data General and DEC price lists and other publicly available information as of Jan. 1984.
TEGAS is a trademark of Calma Co. MicroSet-86 is a registered trademark of First Systems Corp. CADISYS is a registered
trademark of California Automatic Design.
From harsh factory to precision laboratory. OEM microsystems from Motorola.

M68000 performance. UNIX™ portability. VMEbus flexibility. Modern tools for the system integrator.

In a field overrun with specialized, dedicated, and limited OEM micros, Motorola offers the VME/10™ System alternative. It's the only VMEbus based user-configurable OEM 'engine' combining the high-performance mainframe capabilities of the M68010 microprocessor with standard VMEbus architecture and a choice of two powerful operating systems.

From factory to laboratory, the VME/10 System is designed to harness a wide range of demanding applications encompassing robotics, control, CAD/CAM/CAE, and data acquisition.

OEM configurations to meet your needs.
The VME/10 control unit starts with 384K bytes of RAM, a 655K byte floppy disk drive, and 5M, 15M or 40M byte Winchester disk drive unit. High resolution color graphics is also standard. An optional keyboard, plus color or monochrome display unit, means you use only what you need for your applications.

And the VME/10 goes far beyond simple "one-on-one" applications. As a Level II supervisory control computer, multiple VME/10s may be easily networked together for large-scale distributed control usage.

Mainframe performance.
Micro simplicity.

At the heart of the VME/10 OEM System is the MC68010 MPU -- the latest addition to the upward-compatible, 16/32-bit M68000 microprocessor family. The combination of the MC68010 MPU and the MC68451 Memory Management Unit provides processing power permitting multiple tasks to proceed simultaneously with full protection for program code and data in each task. You get fast, efficient application development on the VME/10 System.


VMEbus makes this system highly configurable. It is currently being approved as a global standard 16/32-bit microsystem architecture by working committees of both the IEEE (P1014) and the International Electrotechnical Committee. Increasingly widespread adoption of VMEbus means that you can customize your VME/10 System for your particular applications with a broad array of over 300 VMEbus based hardware and software products from over 80 manufacturers worldwide. You avoid the high cost of specialized custom system designs while still tailoring the VME/10 to your individual situation.

Two powerful operating systems.

With VME/10 you can choose between two powerful operating system packages, both fully supported by Motorola.

For the expanding UNIX™ environment, select Motorola's SYSTEM V/68™ Operating System, the first validated by AT&T through exhaustive functional testing against the original UNIX System V source code. For the system integrator, the emerging standard of UNIX means real "application portability." UNIX System V applications are now portable from mainframe or minicomputer to the M68000 micro world... quickly, efficiently, reliably.

For real-time applications, take VERSAdos™, the original M68000 Family operating system. It has all you need to control multiple real-time application tasks, even in a multiuser environment.

Total VME/10 support:
a Motorola pledge.
The VME/10 System is supported by Motorola's professional field service network, with facilities in over 125 cities nationwide offering technical assistance, parts, repair services, regular software updates, and a problem reporting hotline. Our comprehensive user documentation and technical training seminars are complete and available.

Quality. Standards. Performance. You expect it from Motorola. The VME/10 OEM Microcomputer System is the modern tool for today.

To request more VME/10 information, or to arrange a hands-on demonstration, fill in the coupon and mail to Motorola Semiconductor Products Inc., P.O. Box 20912, Phoenix, AZ 85036, or call our Factory Marketing Team at (602) 438-3501. For local assistance, contact your Motorola Semiconductor Sales Office, authorized systems distributor, or systems representative.

UNIX is a trademark of AT&T Technologies, Inc.
LONG LIVE THE SUPERMINIFLOPPY

3.33MB ON ONE 5¼" DISKETTE. Drivetec’s 3.33MB SuperMinifloppy™
creates new tracks others are sure
to follow. You see, high capacity is
just one benefit of this
drive’s field-proven
(we’ve shipped
thousands) technology advances.
For instance, our track-following
servo instantly responds to servo
information on each sector of each
track. So you get a built-in guarantee
diskette interchange even if you
write in Death Valley and read in
Dubuque.
And 2.78MB of formatted
capacity means your customers
can load very large programs or
files with very few diskettes… one,
for example.
Our high-compliance Gumball
Heads™ are manufactured in-house
and virtually eliminate head and
media wear. That reduces your
service burden and increases
customer satisfaction.
The SuperMinifloppy also reads
48tpi or 96tpi diskettes, and uses a
standard floppy interface and 500
Kbit/second transfer rate. So
integrating the new standard in
flexible disk drive technology will
seem like old hat.
RELIABLY TRANSPORTABLE. If
your system or sub-system is
portable, or easily transportable, the
SuperMinifloppy is perfect.
Our servo and head positioning
system requires no adjustment, just
like old fashioned floppies; only
better. Because we guarantee on-
track performance. It’s easy with
features like our Absolute-Vertical
clamping mechanism which pro-
vides accurate, repeatable diskette
registration.
The 3.33MB SuperMinifloppy
is much more cost-effective than
multiple floppies or low-end
Winchesters, as well. And since
flexible drive technology is designed
for head-to-media contact, you get
near-Winchester
capacity
with-
Drivetec's 3.33MB Half-Height SuperMinifloppy Delivers Guaranteed Diskette Interchangeability And Transportability--Field Proven In Thousands Of Systems.

out Winchester head-aches from head slap during transport. Of course, our half-height 5¼” format provides still more benefits including low power consumption and less weight for a more compact, portable system.

RUGGED BACKUP.
One discussion is sure to get your back-up... back-up. Conventional floppies require multiple diskettes to provide adequate capacity. Tape is old fashioned and much more costly. Winchester cartridges are yet to prove their reliability, and are also quite expensive.

The SuperMinifloppy however, delivers high capacity, random access and guaranteed interchange and reliability. At the same time, typical media cost is less than $10.00 so off-line storage costs are minimized.

It is also perhaps the most manufactureable of your viable back-up selections. We designed the SuperMinifloppy to be assembled with only one size screw. There is no interior cabling to the PCB. In fact, only one adjustment is required in the manufacturing process.

That means your supply of the SuperMinifloppy is assured. And it's backed up by a team that includes the original patent holders on flexible drive head and media technology.

So put life into your system today. Call us at (408) 946-2222. Or write Drivetec, Marketing Dept., 2140 Bering Drive, San Jose, CA 95131.

DRIVETEC Creating New Tracks In Drive Technology

MINI-MICRO SYSTEMS/May 1984 CIRCLE NO. 130 ON INQUIRY CARD
HOW TO CONTROL
THE RISE AND FALL
OF POWER.

Your small business computer can give you the power to raise your productivity. But first you have to control the power you give it. Because even the slightest dip or surge of electricity can result in a shocking surprise. An instant loss of important data or misinformation. Even worse, a total power line failure can create department devastation...a total system crash. You can’t afford errors, delays and other problems. After all, you’ve invested in a computer to increase efficiency. But now there’s a solution you can afford The Sola SPS. This economical, UL listed Standby Power System is designed to protect personal, micro and mini computers from AC line disturbances and failures. Sola SPS provides clean, regulated AC power to your computer when your power line experiences irregular voltage. Line dips or line surges are immediately converted to proper voltage. When the AC line is present, the SPS filters power to eliminate electrical noise. And when the AC line fails, the SPS goes into full action, providing precise AC power to the load from its internal battery. So the only noise you’ll hear is the sound of performance. There’s no maintenance. No installation. No kidding. Just plug it in and turn it on. Why let your productivity rise and fall with your power? The solution is as simple as SPS. The standby system that Sola stands behind.

CIRCLE NO. 131 ON INQUIRY CARD
Write for free literature. 1717 Busse Hwy., Elk Grove Village, IL 60007 (312) 439-2800

SOLA
Wang Professional Computer surpasses IBM PC in performance and ease of use

A fast CPU, an ergonomic display monitor and a powerful editor make the Wang PC an effective software-development environment for end users and system integrators.

Roy R. Friedman, Associate Editor

The Wang Professional Computer from Wang Laboratories Inc. belongs to the growing class of machines that are “almost compatible” with IBM Corp.’s Personal Computer. The Wang PC and machines such as Texas Instruments Inc.’s Professional Computer run Microsoft Corp.’s MS-DOS operating system, and their disk files have the same format as those of the IBM PC. These machines are more nearly IBM PC-compatible than Digital Equipment Corp.’s Rainbow 100 and Hewlett-Packard Co.’s HP-150, which run MS-DOS but do not have IBM-compatible disk formats. On the other hand, the Wang PC and TI Professional do not run off-the-shelf IBM PC software, and they do not support IBM PC expansion boards. They are thus in a different category from the “PC clones” from such vendors as Compaq Computer Corp. and Leading Edge Products Inc.

Total compatibility with the IBM PC is not necessarily an asset, however. What makes the Wang PC, TI Professional and HP-150 attractive are the ways in which they differ from the IBM PC. For example, the TI offers hardware support for voice recognition, and the HP features a touch-screen display. The Wang PC also provides several advantages over the IBM PC:

- Its full 16-bit architecture is based on Intel Corp.’s 8086 CPU. In contrast, the IBM PC incorporates an 8088 CPU, which has an 8-bit-wide external data path.

As a result, a CPU-to-memory data transfer requires two bus cycles on the IBM but only one on the Wang.

- Its internal clock runs at 8 MHz vs. 4.77 MHz for the IBM PC (and 5 MHz for the TI Professional). The combination of a faster clock and a more powerful CPU allows the Wang PC to run 40 percent to 500 percent faster than the IBM PC in CPU-intensive applications.

- Its keyboard contains 101 keys vs. 83 for the IBM PC, allowing dedicated keys for many operations that share a key on the IBM keyboard. The Wang’s keys also are labeled according to their use by the text editor and the disk files have the same format as those of the IBM PC.
word processor, facilitating operation of these programs.
- Its display monitor swivels and rests on an optional arm that moves in three dimensions and clamps to a desk or windowsill. As a result, users can position the monitor at various viewing distances, heights and angles, and the monitor need not consume desk space.

With all these features, it might seem surprising that the Wang PC hasn't attracted more attention. There are two explanations. First, Wang did not ship its PC until early 1983—more than a year after IBM shipped its PC. By early last year, software vendors had written hundreds of applications for the IBM PC, giving it an insurmountable lead in quantity of software supported. Second, Wang decided not to compete with IBM and other vendors for the retail mass market and instead concentrated on selling PCs to major accounts. Although only a few retail outlets carry the machine, Wang claims to have sold more than 75,000 units.

The Wang PC hardware is a “closed system,” so there is no significant OEM market for expansion boards as there is for the IBM PC. However, many OEMs resell Wang PCs with added software. According to Wang, these OEMs account for approximately 20 percent of unit sales. They offer turnkey applications such as vehicle maintenance, equipment leasing, travel planning, court reporting and insurance-policy management.

'Ergonomics' is more than a buzzword

"Ergonomic" is one of the most overworked adjectives in today's computer market. Vendors are using the term to describe everything from software to power supplies. But the Wang PC is one product that truly meets the definition of the word.

The mechanical arm that supports the display monitor is perhaps the PC's most impressive feature. By allowing a user to adjust the monitor's viewing distance, height and angle, the arm significantly reduces screen glare. What most vendors describe as a "non-glare" screen is simply a screen whose surface has been treated with a chemical to reduce reflected light. Such a screen can still reflect an enormous amount of light to a user's eyes if a bright light source, such as the fluorescent bulbs used in most offices, strikes the screen from certain angles. The Wang PC alleviates this problem by providing so many viewing configurations that there is bound to be one that is comfortable. In addition to the PC's arm and swivel base, the monitor has separate brightness controls for boldface and normal-video images. By adjusting these controls and the position of the arm and monitor, a user can comfortably view the PC's display in conditions ranging from direct sunlight to almost total darkness.

Advanced editor aids application development

According to Wang, more than 30 percent of Wang PC users develop applications. This number includes end users who write programs for personal or corporate use, value-added resellers that create turnkey systems and software vendors that port applications to the Wang PC. A key development tool for all of these groups is the Wang PC's text editor. Instead of offering EDLIN, Microsoft's line editor that is standard with most versions of MS-DOS, Wang provides a proprietary full-screen editor called PCEDIT.

What makes PCEDIT so remarkable is its ease of use. This is one program for which a user manual might
BUY NOW AND GET 5 MILLION CHARACTERS OF STORAGE — FREE!

SYQUEST from HAMILTON/AVNET

Five million characters — that’s a lot of storage to get completely free. But it’s yours when you buy a SyQuest half-height Winchester removable cartridge drive (SQ306RD) and one cartridge (5 MB formatted capacity). Your second cartridge is free! That’s why we call it our “Twice As Much Of A Good Thing” offer.

INTERCHANGEABLE WITHOUT FLOPPY RISK: SyQuest removable cartridges not only carry 5 - 10 times more data than floppy disks, they carry it more safely. Rugged graphite-coated media sealed in unbendable cartridges protect against head crashes and external contamination. Complete interchangeability has been proven with thousands of cartridges and thousands of drives.

POWER CUT DOWN TO SIZE: Portable size. The SQ306RD fits on your system by requiring less than 1 amp from your 5V supply. Heat dissipation is only 13 watts.

TAKES THE BACKUP OUT OF BACKUPS: High Winchester to Winchester transfer rates make SyQuest’s removable cartridge ideal for backup and porting of programs between sites — without a long wait!

CALL OUR SPECIALISTS. Our Computer Products Specialists are factory-trained to provide product application assistance so that you get the best price/performance for your system. Call now and ask for the SQ306RDk, to take advantage of our “Twice As Much Of A Good Thing” offer.

CIRCLE NO. 132 ON INQUIRY CARD

Hamilton/Avnet
A commitment to stock and serve your local market!
Finally A Printer
More Advanced than Your Software.
Lear Siegler’s VersaPrint™ 500.

Lear Siegler’s new VersaPrint™ 500 Series printers—professional business printers for micros, minis and mainframes—utilize the full potential of your most sophisticated business software and are ready for even more.

Just one VersaPrint printer spans virtually all business applications: cut sheet letterhead correspondence, high volume continuous reports, financial spreadsheets and even complex color graphics. You can match the broad capabilities of such popular software programs as Lotus 1-2-3.

You can have 75 x 72 and 150 x 144 dot per inch graphics for design applications on the same high volume, dot matrix printer that gives you 136 columns for reports and 224 columns for spreadsheets. All on an NLQ printer that’s quieter than a typewriter.

VersaPrint printers connect to your system via RS232 serial interface or Centronics type parallel interface. You can run it at 180, 90 or 45 cps for draft, memo or NLQ quality. And it’s so reliable, you won’t have to change printheads for 1½ years.

Four VersaPrint models are available. To the basic Model 500, the Model 510 adds cut sheet feed, the Model 520 adds color printing, and the Model 530 adds both cut sheet and color. Short form tear bar option is available.

The VersaPrint Series is from Lear Siegler, world’s favorite terminal manufacturer. It’s backed by full service centers with walk-in Express Depot™ service, on-site service and extended warranty serving 3,000 cities nationwide.

And VersaPrint printers are made in America—designed, engineered, manufactured and shipped from our Anaheim, California facility.

For more information and a complete demonstration call your local Authorized Distributor or, for quantities in excess of 250 units, your Regional OEM Sales Office.

Call Lear Siegler at 800/532-7373 for the phone number of an authorized distributor near you. Advanced Technology • Confidential Resources • The Dataport • Data Systems Marketing • David Jamaison Carlyle • Digital Source, Inc. • Dytek/South • Gentry Associates • Kessulf • Marva Data Services • Peak Distributors, Inc. • Pioneer (Standard, Harvey, Gaithersburg) • Wyle Electronics

Distributor Sales & Service: Boston (617) 458-8228 • Chicago (312) 279-7710 • Houston (713) 780-9440 • Los Angeles (714) 774-1010, ext. 219 • Philadelphia (215) 525-6080 • San Francisco (415) 828-6941 • England (04867) 80666 • From the states of CT, DE, MA, MD, NJ, RI, VA and WV (800) 523-5253

OEM Sales: Atlanta (404) 971-9781 • Chicago (312) 279-5250 • Los Angeles (714) 774-1010, ext. 582 • New York (516) 549-6942 • San Francisco (415) 828-6941 • England (04867) 80666

LEAR SIEGLER, INC.
DATA PRODUCTS DIVISION
901 E. Ball Road, Anaheim, CA 92805
(714) 774-1010

CIRCLE NO. 133 ON INQUIRY CARD
be unnecessary. Because text editing involves many individual operations such as insert, delete, search, replace, copy and move, users of most editors have to remember many sequences of characters and function keys to invoke the operations. But with PCEDIT, all a user has to do is press the one labeled key that corresponds to the desired operation. For example, to initiate an insertion, the user presses the INSERT key, and, to initiate a search operation, he presses the SRCH key. Moreover, there is no command syntax to remember. PCEDIT prompts a user for all the information that's required to perform the editing operation. If this isn't easy enough, there's also a HELP key.

PCEDIT has several other helpful features: it scrolls both horizontally and vertically, highlights the line containing the current cursor position and displays the current text line number, which is useful for move, copy and print operations. PCEDIT isn't perfect, however. It's not possible to save edited changes on disk (an important precaution against unexpected system failure) without leaving the editor and then re-entering it. Also, the user can't edit a line while conducting a search operation. During a search, an occurrence of the desired string may appear beyond the first 80 columns of a line. When this occurs, the display scrolls so the editor can highlight the string, but it forgets to scroll back to the normal position for the remainder of the search, making it hard to see additional occurrences of the string.

The only serious design flaw with PCEDIT is that it lets the user clobber line ends without notification. This problem can happen if the maximum-line-width parameter is smaller than the width of the line the user is editing. Although PCEDIT displays this parameter and users can easily modify it, there's no reason why PCEDIT shouldn't complain when it detects an operation that a user could not reasonably want to do.

Common languages permit portability

Both the Wang PC and the IBM PC support Microsoft's BASIC, Pascal, FORTRAN and COBOL. Thus, software portability between the two systems is relatively easy to achieve as long as programs do not bypass the operating system by directly addressing the basic I/O system (BIOS) or the hardware. Many popular programs, such as Microsoft's Multiplan, Lotus Development Corp.'s 1-2-3 and Software Arts Inc.'s TKISolver, do bypass the operating system, foregoing portability for the sake of performance. As a result, these programs must have separate versions for the Wang PC and the IBM PC. But, for programs that do not

---

The mechanical arm that supports the display monitor is perhaps the Wang PC's most impressive feature.

---

Which software packages run on the Wang PC?

Every Professional Computer from Wang Laboratories Inc. comes with Microsoft Corp.'s MS-DOS operating system and BASIC interpreter. Optional software falls into three categories: core, distributed and evaluated. Core software, which Wang distributes and supports, includes Microsoft's Multiplan; SoftTech Microsystems Inc.'s p-System; Micro Focus Inc.'s Level II COBOL programming environment; and Wang's programs for word processing, database management, business graphics and data communications. Distributed software, which is sold by Wang and supported by a third-party vendor, includes Lotus Development Corp.'s 1-2-3, VisiCorp's Visi+, Software Arts Inc.'s TKISolver and various accounting programs from Peachtree Software Inc. Evaluated software consists of approximately 400 programs from independent vendors. Most of these programs are business-oriented, but Wang PC users should have little trouble finding a suitable software package for common applications.
Only one company can show you so many And it isn't IBM.

Monochrome text. Color graphics. Even a new super display adapter that provides the Best of Both, on one board.

Connect your PC to peripherals like a modem or printer, with the added efficiency of print spooling.

IBM today sets the standard in personal computers. But what happens when you want to expand your PC's capability to something beyond standard? That's when you have to look beyond IBM. To the one company that offers the widest range of products to make your PC work more powerfully, more efficiently. Persyst.

Display adapters. Persyst introduces a significant technical advance.

Now Persyst redefines the basic utility of display adapters for IBM personal computers. Our BoB™ super display adapter provides the sharpest text resolution ever as well as brilliant color graphics—the Best of Both—on one board. Plus a unique option that lets you design and download custom programmable character sets.

Meanwhile, for great basic performance, we also offer PC/Monochrome™ and PC/Color Graphics™ display adapters engineered to deliver the same quality as IBM's own standard adapters. Only Persyst offers you so much choice.

Memory and multifunction boards. Persyst has the most flexible ways to expand your PC.

Here again, Persyst offers a unique array of products to expand your PC beyond the IBM standard.

Want the most capable one-slot multifunction packages available? Choose either Time Spectrum™ with up to 512K, or Time Spectrum™ SB384 with up to 384K RAM. Other functions include a bidirectional parallel port and async serial ports to link your PC with printers, modems and instrumentation. Calendar clock. Game port. Plus, Wait-Less Printing™ print spooling and Insta-Drive™ RAM disk software.

Want to expand function without adding memory? Our Timeport™ gives you a calendar clock, bidirectional parallel port and two async serial ports, as well as capability for ROM and static
Memory expansion to let your PC utilize the most sophisticated software.

Productivity features like a calendar clock to date and time stamp your files automatically.

RAM. Uniport™ offers a calendar clock and bidirectional parallel port. And our Async Card™ provides two async serial ports. You can even add synchronous communications to your PC with our Multiple Protocol Communications™ (MPC) controller.

Quality and documentation. Persyst support is built into every product.

All Persyst expansion products include one important extra benefit—Persyst quality. Each board is fully burned in. Completely system tested. And backed by a limited one-year warranty.*

What's more, award-winning Persyst documentation makes using any Persyst product simple.

Expand all the way from an IBM desktop PC to an IBM intelligent workstation. You can only do it with Persyst.

Persyst is the only resource that offers display adapters. Multi-function and memory boards. And micro to mainframe communications.

The most complete selection of innovative, technically advanced expansion products to meet your needs today. And tomorrow.

For complete information, we invite you to call Nancy Woodard, Product Marketing Manager, Persyst Products, Personal Systems Technology, 17862 Fitch, Irvine, CA 92714. Telephone: (714) 660-1010. Telex: 467864.

IBM is a registered trademark of International Business Machines Corporation. Rainbow and DEC are registered trademarks of Digital Equipment Corporation. TI is a registered trademark of Texas Instruments Corporation. *Limited warranty details available with each product or on request.
require the utmost in execution speed, portability between the Wang PC and the IBM PC means that software integrators can exploit the advantages of the Wang system to develop, test and debug applications that run on the IBM PC.

To determine how easily a program could be ported from the Wang to the IBM, I tested a large BASIC program that invokes many of the features of the language. Using Microsoft's BASIC interpreter, which is standard on both systems, the program ported as long as it was saved using the ASCII option of BASIC's SAVE command. If a user does not specify the ASCII option when saving a file, the BASIC interpreter compresses the source code to reduce disk utilization. The Wang and IBM versions of interpreted BASIC use different compression algorithms, preventing portability of compressed-code files.

Using compiled BASIC, I was able to run a single source-code version of the test program on both systems by compiling and linking the program in each environment. To achieve portability in this way, a user must have a BASIC compiler and a linker on each system, and the two compilers must support the same version of the language.

Another approach to portability is to transfer linked object code (.EXE files) between systems, eliminating the need for separate compilers and linkers. This method works as long as the transported program does not exploit BASIC's built-in capabilities for graphics, sound or cursor control, which are hardware-dependent at the object-code level. Languages such as Pascal and FORTRAN, which do not provide these capabilities, are better suited to object-code portability.

Memory utilization is another important issue in software development. The minimum memory configuration on the Wang PC is 128K bytes, but this number is misleading. To facilitate customer distribution of updates, Wang has located the PC's BIOS and BASIC interpreter in RAM rather than in ROM. Therefore, only about 87K bytes in a 128K-byte configuration are available to users. Furthermore, the 87K must hold a program's run-time support library. In the latest version of Wang's compiled BASIC, the run-time library (BASRUN.EXE) occupies 43K bytes, leaving relatively little memory for user programs. Although most programs require the support of only a subset of the library, there is no facility for linking selectively to the needed modules. As a result of these constraints, most application developers should order the Wang PC with at least 256K bytes of RAM.

For very large applications, the Wang PC can support as many as 896K bytes of RAM. The catch is that users probably can't access that much memory unless they program in assembly language. The version of the BASIC compiler on the evaluated Wang PC supports a maximum of 64K bytes of code and 64K bytes of data. The 64K-byte limit corresponds to the size of one memory segment on an 8086/8088 processor. Some compilers from Microsoft, Digital Research Inc. and other vendors now allow multiple code and/or data segments, allowing users to exploit more memory.

Regardless of the amount of memory on a host system, software integrators may need to fit applications into specified amounts of memory on a target system. For example, a 256K-byte Wang PC might be used to develop applications that run on a 64K-byte IBM PC. For this reason, integrators should have a simple way to find out the memory requirement of an application, but this is not the case. Determining the memory size of user code is easily done by performing a DIR command on the .EXE files. But there is no easy way to determine the size of statically allocated user data. The only guidance the system provides is to tell...
For remarketers, there's still room at the top.

We're looking for new members for the "4300 Club."

If your company creates application software that will run on an IBM 4300, we invite you to consider matching your skills to our systems.

In short, IBM is looking for experienced firms that will remarket the 4300—and become what we call Value Added Remarketers.

The standards are high, but for companies that meet them, IBM has much to offer.

To start with, IBM can add strength to your marketing efforts. We can, for instance, help with product literature, with direct mail and with business show support. IBM also has a wide range of professional classes for VARs.

And thanks to an online referencing system used by IBM's own sales force, we can refer prospects with special needs to VARs who have unique solutions.

In addition, IBM offers to VARs that qualify other highly competitive products: System/36, Series/1, System/38, the IBM Personal Computer and the System 9000 family.

For more information on qualifying as an IBM VAR, simply send in the coupon or call 1-800-IBM-VARS, Ext. 96.

Larry Humphreys
IBM Distribution Channels
P.O. Box 76477
Atlanta, GA 30358

Please send me your free booklet, "Looking for Leaders."

Name
Title
Company
Address
City  State  Zip
Phone  Product Interest
Confused about which Local Network to choose? You're not alone. In today's personal computer environment, new LANs seem to pop up daily, adding even more choices. And more questions.


We Provide The Answer. At Novell, we offer a unique new approach. An approach which answers the multiple choice question. We've taken our field-tested network operating system and made it work on all of today's LANs. ARCnet. Ethernet. OMNINET. proNET. PCnet. G-NET. Even tomorrow's Anynet.

We call it NetWare™.

NetWare is designed to bring the user and software supplier together for maximum performance, security and functionality. No matter which LAN hardware you choose.

Software, Software And More Software. Because each LAN is different, today's leading software companies view NetWare as the single unifying answer to the multiple choice question. Many have become NetWare "Do It Once and For All" affiliates, adapting their software for application in multiuser NetWare environments.

Quickly. Easily. Uniformly. And only once for all LANs.

Novell Means Service. To serve the LAN market better, we've initiated a series of benchmark tests on all the major LAN configurations—both with the supplier's native operating system and with NetWare. The results are available now.

Interested? Give us a call to order your copy of the "LAN Benchmark Report." It's free. We'll also try to answer any questions you might have about personal computer networking. Call us at 1-800-LANKIND.
users at compile time or link time when they've exhausted the memory on the host system.

Sub-directories fail to achieve potential

The Wang PC runs MS-DOS version 2.0, which supports sub-directories and thus allows users to organize disk files into logical groupings. Also, MS-DOS limits a root directory to 128 files, so using sub-directories is the only way to store a large number of files on a hard disk. Unfortunately, users cannot realize the benefits of sub-directories on current versions of the Wang PC software.

There are so many files in the Wang PC’s system code that the 128-file limit in the root directory leaves relatively few files for a user. When the user runs out of space in the root directory, the system generates an unhelpful “file creation error” message. Moving user programs into sub-directories doesn’t solve the problem because Microsoft’s languages do not support sub-directories. For example, if a program needs to read a data file named PROG.DAT, then that file must reside in the root directory. If a user moves PROG.DAT into sub-directory USRDAT, the program can’t access the data file using the pathname /USRDAT/PROG.DAT. Performing a /CD USRDAT command before executing the program doesn’t work either, as the program will still look for the file in the root directory. The only way around this problem is to store data files in a sub-directory and copy them to the root directory when they are needed—a cumbersome procedure.

Another source of frustration is the Wang PM012 letter-quality printer that came with the system I evaluated. The printer is noisy, slow and somewhat unreliable. With the furnished version of the operating system, printing a file by copying the file to device “PRN:” sometimes causes the system to crash. (The latest version of the operating system has apparently solved this problem.) Moreover, attempting to print within BASIC using the LPRINT or PRINT statements also causes system crashes—a problem that Wang blames on Microsoft and vice versa. Another problem is that the printer paper becomes improperly aligned after only a few pages because there are no sprockets to fit into the holes along the edges of the paper. As a result, a user must “stand guard” while hard copy is being printed. The Wang PC also lacks a simple way to print an image of the display screen—an operation similar to SHIFT + PrtSc on the IBM PC.

The printer requires a cartridge ribbon that has a surprisingly short life span. The cartridge bears the Wang name with a part-reorder number. I made several calls to dealers of computer supplies but was unable to find one who knew of the Wang ribbon. When a dealer visited my office and inspected the ribbon, he immediately identified it as a standard Diablo Systems Inc. ribbon that is widely available from office-supply stores. Although Wang may find it advantageous to sell printer ribbons directly, it should not pretend that it is the sole supplier for a standard $5 part.

Menus facilitate general operation

Menus, a feature that some users love and others hate, are easy to use but can be a nuisance. Therefore, Wang has taken the sensible approach of offering menus and allowing users to bypass them.

The Wang PC’s main system menu consists of such choices as “applications,” “communications,” “DOS command processor,” “program development” and “system utilities.” Users can easily modify the list of menu items to correspond to the options in the users’ configuration. To bypass follow-up menus, a user selects the “DOS command processor.”

A nice touch is the way the system remembers how a user invokes an operation. For example, if the user enters the word-processing program by selecting it from the applications menu, the system returns to that menu when done. But if the user enters the word-processing program by typing “WP” from the MS-DOS command level, the system returns directly to the operating system.

Most system integrators and sophisticated end users will probably bypass the menus most of the time. But even for these users, the menus are helpful in carrying out infrequently used operations such as comparing files. Wang’s menus prompt a user for all the information required by an operation, so the user doesn’t have to remember how to spell a command or the kind of delimiter (space, comma or slash) for separating parameters. The Wang PC’s menus are an example of a feature that enhances a product’s utility and costs relatively little for a vendor to implement.
In UNIX™ networking today, Unisoft sets the standard.

With Unisoft's B-NET networking software, true resource sharing networks are up and running. Microcomputers running UniPlus+ System V can talk with any others or to VAXes running 4.2 BSD UNIX. All it takes is UniPlus+ and Ethernet™ hardware.

The state of the art in networking hardware and software led UniSoft to adopt a networking scheme developed at Berkeley for VAX/UNIX systems. This IP/TCP protocol scheme is compatible with ARPA standards which have been in wide use on the ARPAnet. B-NET is a high-performance implementation of the ARPA IP/TCP protocols.

Unlike other networking schemes, B-NET is complete. Applications programs, systems calls, and protocols: nothing is left out. B-NET provides process to process communications, remote file transfer, virtual terminal facilities and much more.

UniSoft has optimized the basic UNIX OS for the 68000 family of microprocessors and named it UniPlus+. Now B-NET is a standard option of the UniPlus+ System V ports. This network software allows any system running UniPlus+ to communicate with other systems running the ARPA IP/TCP protocols.

Incidentally, UniPlus+ has been ported to over 60 different computer systems. If you're building or selling a 68000-based UNIX system and want to expand your network, call UniSoft Systems, the UNIX networking experts.

Berkeley's Port Authority

UniSoft Systems

UNIX is a trademark of the Bell Laboratories.
Ethernet is a trademark of Xerox Corporation.
VAX is a trademark of Digital Equipment Corporation.
Optimizing a dual-processor micro for UNIX

NS16000-based system boasts virtual memory, VAX-compatibility, cache and dedicated slave processors

Robert M. McClure, Unidot Systems Inc.

System integrators can choose from a multitude of microprocessor-based UNIX machines, each claiming to bring the power of UNIX to a low-cost system. However, these systems vary greatly in execution speeds and multiuser support. In contrast to the single-processor approach typical of most of today's "UNIX engines," Unidot Systems Inc. has developed a dual-CPU microcomputer that also includes on-board cache memory, intelligent I/O processors and dedicated slave processors that support demand-paged virtual memory and floating-point arithmetic. Unidot's desire to run application programs compatible with Digital Equipment Corp.'s VAX minicomputer dictated in large part the choice of CPU, architecture and UNIX version.

The on-chip MMU cache memory contains the 32 most-recently-accessed logical addresses and their translated physical addresses.

Choosing the CPU

Several requirements exist for a system designed to run VAX-implemented, UNIX-compatible application packages. These include virtual memory to support large applications, fast disk access to support page swapping from secondary storage to main memory, fast terminal-I/O handling for multiuser applications and data-format compatibility to facilitate portability.

UNIX is available for several established 16- and 32-bit processor families, including Intel Corp.'s 8086, Zilog Inc.'s Z8000, Motorola Inc.'s 68000 and National Semiconductor Corp.'s 16000. However, because of their different architectures, significant differences in performance and ease of UNIX implementation exist in each family. Unidot chose the 16000 for its Cerebra systems because of the chip's high-level language support, VAX-compatible virtual-memory support, matched memory-management unit (MMU), matched hardware floating-point unit (FPU) and code compactness.
The 16000 allows instructions to be used with any addressing mode, any operand length (byte, word or double-word) and all general-purpose registers. This simplifies the compiler code-generator design. In the 8086, on the other hand, not all instructions apply to all registers or to all addressing modes, which complicates compiler design. With the 16000, most data accesses in C and Pascal can be made without doing address calculation into registers (Fig. 1).

In addition, the 16000 allows all addresses and immediate data to be 1, 2 or 4 bytes, which reduces code size. The 68000, in contrast, has no 1-byte addressing. Even external variables, for which addresses must usually be 24 bits, can be accessed indirectly in the 16000 through a local vector table that can often be addressed by a single byte. The most-frequently-used operation codes are also the shortest (i.e., only 1 or 2 bytes long).

Also important for system designers, the 16000 family has both a 16082 MMU and the IEEE-standard 16081 FPU. Like the 8086, the Z8000 does not have an MMU, and the 68000 does not have a matched FPU.

The arrangement of bytes in the 16000's memory is also important. Both the 16000 and the VAX address the least-significant byte of a multibyte item, which is also the lowest numerical address of any of the bytes in the data. This is also the arrangement in the 8086 family. On the other hand, the 68000 and the Z8000 organize data by most-significant byte first. The arrangement of bytes in the 16000 facilitates writing programs that are portable between the VAX and the 16000.

But the most important reason Unidot chose the 16000 centers on its virtual-memory support. A virtual-memory system appears to users as if the entire logical address space were available. If, when the MMU translates a virtual address into a physical address, it finds that the requested page is not in main memory, a page fault (hardware trap) occurs and the operating-system software loads the requested page from disk. The instruction is then executed (re-tried). Called a page swap, this process is transparent to users. The 8086, in contrast, does not provide for restarting an instruction after a page fault and thus does not support virtual memory.

Architecture speeds throughput

A microcomputer intended to support the high-level technical applications running on large minicomputer and mainframe systems must be designed to optimize data throughput. The Cerebra II series increases performance through the use of dual CPUs, on-board cache memory (in addition to, and independent of, the MMU's cache), dedicated slave processors and intelligent I/O processors.

The Cerebra I and II systems are identical, except that the Cerebra II features dual 10-MHz 16032 processor boards. Both models use a Multibus architecture with 24-bit addressing, multiple direct-memory addressing controllers, a 16082 MMU, a 16081 FPU, 16K bytes of 45-nsec. static RAM (for cache and local memory) and a battery-backed time-of-day clock (Fig. 2).

In the dual-processor Cerebra II, one processor board acts as the system master, executing both system (kernel) code and user application programs. The second processor serves as an intelligent slave dedicated to running only user application programs (Fig. 3). This dual-processor system enhances throughput speed in a multiuser environment by 60 percent to 80 percent over a single-processor system.

The on-board cache memory is 4K words deep and contains recently-accessed physical addresses and associated data (2 bytes of data for each address). In internal tests, the hit ratio, or probability of finding requested data in cache, is as high as 95 percent.

Users gain fast memory access at minimal cost with on-board cache memory. If main memory is on separate boards from the main processor, the overhead in accessing a byte, word or double word includes the delay times of physical address decoding on the memory board and routing the data back to the processor board through the drivers and receivers on the main processor board. Due to the memory-bandwidth restrictions of the Multibus, this requires inserting wait states into the processor cycle for every data and instruction fetch or write cycle.

Avoiding this overhead requires extremely fast and expensive main memory on a private bus or a local cache. For a system intended to support only a small amount of memory, the first option might be accept-
HOW THE CEREBRA CACHE WORKS

When a CPU buses a virtual address (VA) to the memory-management unit (MMU), the MMU translates the VA into a physical address (PA). Using low-order, or least-significant, bits of the VA, the MMU checks the cache, which contains PAs and associated data, to see if the data is available on the CPU board. The MMU then reads both the high-order bits of the PA, as well as the 16 bits of associated data.

In the first clock cycle after the MMU has completed its translation, it compares the high-order bits of the PA with the high-order bits of the address stored in cache. If the comparison matches, the MMU signals a "hit," and data is immediately available to the CPU. If the comparison does not match, the MMU signals a "miss" and requests access to the Multibus. This action first requires getting control of the bus, which takes at least two bus cycles—or more if another processor or peripheral is using the bus.

After the PA is sent over the bus, a main-memory read cycle begins. Depending on memory speed, the requested data is later sent to the CPU card. At this time, the CPU updates the cache by storing the data and high-order bits of the physical address in cache. Thus, the system automatically updates the cache to ensure that it contains most-recently-accessed data and that the cache contents are consistent with main memory.

Besides handling memory access when the CPU tries to read data, the cache logic must deal with special cases. For example, if another unit, such as a disk controller or another processor, wants to perform a main-memory write, the cache control uses the PA from the bus to read the cache (right). The MMU compares the PA with those stored in the cache, just as if the address were generated locally on the CPU board. If the comparison reveals a miss, then no further action on the cache is required because the data being manipulated in main memory is not present in the cache. If the comparison reveals a hit, then the data in the cache is marked invalid by writing an "INVALID" bit into the cache at that address. The next time that data is read from main memory, the CPU updates the cache. Thus, cache contents are always consistent with main-memory contents.

---

**CPU READ CYCLE**

1. **CPU VA23-00**
2. **MMU VA13-01**
3. **CACHE**
4. **COMPARATOR**
5. **BUS CONTROL**
6. **READ MEMORY**
7. **UPDATE CACHE**
8. **MAP VIRTUAL TO PHYSICAL ADDRESS**
9. **COMPARE CACHE FOR "HIT"**
10. **ACCESS BUS**
11. **WRITE (TO MAIN MEMORY)**
12. **READ ADDRESS TO CPU**
13. **UPDATE CACHE (100 NSEC.)**

---

**BUS WRITE CYCLE**

1. **CPU**
2. **MMU**
3. **CACHE**
4. **COMPARATOR**
5. **BUS CONTROL**
6. **READ MEMORY**
7. **UPDATE CACHE**
8. **MAP VIRTUAL TO PHYSICAL ADDRESS**
9. **COMPARE CACHE FOR "HIT"**
10. **ACCESS BUS**
11. **WRITE (TO MAIN MEMORY)**
12. **READ ADDRESS TO CPU**
13. **UPDATE CACHE (100 NSEC.)**

---

MINI-MICRO SYSTEMS/May 1984
The first thing ISI International put on this new Multibus card was 2 megabytes...

And that was just the beginning.

Squeezing 2 megabytes of memory onto a single Multibus card is quite an accomplishment in itself. But we believe it takes more than just memory to meet the increasing needs of today's systems. That's why our MCB-2X Multibus card is designed with a number of significant special features. And why ISI International is truly a leader in Multibus memory products.

**Superior Dynamic Memory Relocation.**

The new MCB-2X can relocate up to eight 64K or 256K blocks independently - making it a very powerful tool for "RAM disk," graphics display or multiple table look-up applications.

**Expanded Error Correction Logic.**

All single bit errors are automatically scrubbed during refresh cycles without system interruption. And thanks to the automatic memory initialization feature, software doesn't have to be pre-conditioned.

On-board ECC detects all single and double bit errors, while providing 370ns read access through standard 64K or 256K RAMs. Plus, the MCB-2X has CSR and ESR interrogation capability and software control of ECC enable/disable, allowing users to provide comprehensive system-level diagnostics.

**Flexible Addressing Capabilities.**

Board addresses starting on any 4K boundary can be mapped to cross 1 and 4 megabyte boundaries. The MCB-2X can also occupy a continuous 512K or 2048K memory space within its 16 megabyte range.

Look into ISI International's new MCB-2X. You'll find all the features you need... plus up to 2 megabytes of memory for the largest capacity available on a single card. Or, for non-volatile CMOS requirements, see our MCB-364 and MCB-332 modules. For simpler dynamic requirements, investigate our MCB-512.

Since 1970, ISI International has shipped over 10 billion bytes of memory cards, giving us a level of experience that's hard to match. Put it to work for you. For systems needs just call us in the West at (408) 743-4442, in the East (201) 272-3920, or in the Midwest call (513) 890-6450. For off-the-shelf products, contact your nearest ISI International distributor: Alliance, Anthem, Arrow, Future Electronics, R.A.E., Quality Components or Schweber.

*Multibus is a Trademark of Intel Corp.*
able, but the cache option has several advantages in a multiuser system that can support as much as 16M bytes of real memory. With cache hit ratios expected to be around 90 percent in an actual UNIX environment, bus loading typically will be lower than 50 percent, even with dual processors and a heavy I/O load.

The cache uses a store-through design with bus monitoring to ensure that data in the cache is always consistent with main memory. The CPU automatically updates cache contents at the same time as main memory is updated. It is not necessary to "flush," or "purge," the cache. Thus, the cache is transparent to the operating system (see "How the Cerebra cache works," Page 277).

The Cerebra systems incorporate the MMU and FPU slave processors of the 16000 family, which reside on the CPU board. These dedicated slave processors use the instructions and addressing modes of the main processor. The MMU performs logical-to-physical address translation in 100 nsec. after the first access to a given page. It fully supports demand-paged virtual memory, as does the VAX, but provides several other features including more debugging capabilities. The MMU also marks read accesses (indicating which physical pages have been read) and write accesses (indicating which pages have been modified), which facilitate working-set calculations to reduce paging traffic. Other features not available on the VAX include the MMU's ability to perform virtual and physical memory breakpointing and to "remember" the last two branch points in user code.

The MMU performs logical-to-physical address translation in 100 nsec. after the first access to a given page.

The MMU divides logical memory into 32,768 pages of 512 bytes each. To a programmer, memory appears as a full 16M-byte address space. The programmer works only with one set of addresses—virtual, or logical addresses—while the MMU automatically processes from I/O-handling tasks. Application programs run transparently in the dual-CPU system.
translates virtual addresses into physical addresses (MMS, October 1983, Page 260). If a page does not reside in main memory, the MMU and operating system automatically transfer the page from disk to memory, and the program continues in a manner transparent to users. This means that programs running on VAX or mainframe-level computers and having very large databases, high-resolution graphics or many users can be ported to the less costly Unidot systems.

The lack of hardware floating-point support in most microprocessor systems running UNIX limits those systems in many scientific and technical applications because execution is too slow. The 16081 FPU in the Cerebra systems handles the calculations in these computation-intensive applications. The FPU supports 32- and 64-bit IEEE-format floating-point data and uses all addressing modes of the 16000 family, making it easy for compilers to generate code.

Another performance killer often encountered in UNIX systems is terminal-character handling, a problem that the Cerebra systems solve with an eight-port serial controller called the advanced multoline asynchronous controller (AMAC). The AMAC uses the NSC08032 processor with an 8-bit bus. The AMAC board contains 64K bytes of local memory for data buffering and 16K bytes of ROM for firmware. The board supports all conventional modem signals and baud rates to 38.4K baud.

I/O performance in most UNIX systems suffers because the host must perform a significant amount of processing for each character sent or received and must process all interrupts. The AMAC handles all character processing in the Cerebra system, thus relieving the host.

The interrupt burdens (CPU overhead time) in most UNIX systems can reach 1 msec. per interrupt and effectively limit output to 9,600 baud while consuming available processing power. The AMAC handles all character interrupts and limits them to a maximum of 16 per second, regardless of the character-transfer rate. On-board buffering ensures that overrun do not occur even if an interrupt is not serviced for a long time. In applications such as screen-oriented editing using non-intelligent terminals, the AMAC doubles the number of users that the system can support.

Readily available versions of UNIX include System III and System V from Bell Laboratories, 4.1 and 4.2 from Berkeley, Microsoft Corp.'s XENIX and a variety of look-alikes such as Whitesmiths Ltd.'s IDRIS and Mark Williams Co.'s Coherent. The VAX runs the Berkeley 4.1 edition, which was the base system used by National Semiconductor to develop the GENIX operating system. GENIX includes the standard Berkeley utilities such as the vi screen editor, the source-code control system (SCCS), uucp, inter-system communications support and the nroff text-preparation system.

Like 4.1, GENIX supports demand paging instead of segmented swapping. Segmented swapping requires extensive main memory because memory must contain all the segments that hold the data or routines needed to run a program. Costly operating-system overhead is incurred when the operating system must swap large

Fig. 3. The dual-processor system comprises two 16032 processors. Only the master CPU can run system (kernel) code. The master handles service calls to the UNIX kernel, interrupts and all system housekeeping chores. When the master is idle, it can run application programs as well. The slave 16032 processor can run only user application programs. Both processors execute user tasks in typical operation, resulting in better execution speeds than single-processor systems. Communication occurs via interrupt lines between the two processors. When a user process running in the slave CPU requests operating-system services, the slave CPU stores the user context information in the user block (UBLOCK B), generates an interrupt for the master and then waits. The master receives the interrupt, stores the context of the current user process in the master's U block (UBLOCK A), exchanges U blocks with the slave and instructs the slave to execute what was previously the master's process. Meanwhile, the master services the request that had been generated by the process running in the slave. This approach is required because only one CPU can execute the UNIX kernel. Context switching enables the master to handle system calls without idling the slave.
Enter the high-performance world of VISION. Engineered for VT220 functionality and features unmatched by anyone in the industry.

- **Extensive Multi-Page Format.** Take advantage of four pages of memory with variable lengths from 1 to 97 lines (227 lines optional), and the ability to mix 80 and 132-column pages.

- **Intelligent Function System.** Program up to 64 functions backed by a non-volatile memory. Store forms or menus with the help of a 5-line Message Window. Redefine function keys with a single keystroke or command. Ideal for multi-application and multi-host environments.

- **Dual Set Up Table.** Integrates fully with the Function System. Redefine terminal. Switch between hosts. Log on. And simultaneously change function key attributes to match your new application. All with a single keystroke.

To order a VISION 2200, or to add VT220 capability to your VISION 2000 + CRT's Contact Lanpar today.

---

**FEATURE COMPARISON**

<table>
<thead>
<tr>
<th></th>
<th>VT220 emulation mode</th>
<th>VISION 2200 emulation mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>VT220 Command Set</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Function System Memory</td>
<td>256</td>
<td>1024</td>
</tr>
<tr>
<td>Programmable Functions (PF)</td>
<td>15</td>
<td>64</td>
</tr>
<tr>
<td>PF in VT100 Mode</td>
<td>0</td>
<td>64</td>
</tr>
<tr>
<td>Data Routing From Function Keys</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Non-Volatile Function Memory</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Four-Page Memory</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Eight-Page Memory Option</td>
<td>N/A*</td>
<td>YES</td>
</tr>
<tr>
<td>Bi-Directional Printer Port</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Dual Set Up Tables</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Dual Host Support</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Composite Key</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Graphics Option</td>
<td>NO</td>
<td>YES</td>
</tr>
</tbody>
</table>

**PRICE QUANTITY ONE**

<table>
<thead>
<tr>
<th></th>
<th>VT220</th>
<th>VISION 2200</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$1295</td>
<td>$1245</td>
</tr>
</tbody>
</table>

* Based on latest information supplied by manufacturer. ** Not applicable.
segments from disk to main memory. With demand paging, only those pages of memory actually in use need reside in main memory, which reduces operating-system overhead as well as the amount of required main memory. The 16000 divides virtual-address space and main memory into equal-sized pages of 512 bytes each. Demand-paged, virtual-memory support will not be available from Bell Laboratories until the release of System VI.

GENIX capitalizes on the 16000's ability to restart instructions to speed process creation. UNIX typically creates processes by copying the currently-running process. If this process is large, such as for the shell (command line interpreter), considerable CPU time must be expended in the creation of a memory image (the process "copy") that is immediately discarded. GENIX creates processes by copying much smaller mapping tables instead of duplicating a process. GENIX protects the real pages against writing during process creation, so that an attempt to write into a data page is trapped, and a new, writable copy of the page is supplied before restarting the instruction. GENIX takes advantage of the mapping facilities of the MMU in other ways, such as providing direct access to a bit-mapped display and write protection and demand paging of the kernel.

Robert M. McClure is president of Unidot Systems Inc., Golden, Colo.
Intertec's new HeadStart is the smallest, smartest, fastest, most powerful business computer money can buy or you can sell. And the most expandable (it's networkable up to 255 user stations.)

**Great Ideas Come In Small Packages.**

Instead of three bulky components, HeadStart needs only two—the keyboard and CRT.

There's no need for a cumbersome disk and processor cabinet. With HeadStart, it's all in the CRT enclosure.

HeadStart's small but powerful 3½" disk drive offers as much storage as larger 5¼" disks. Its 8 and 16 bit processors mean software availability is no problem. MS DOS and CP/M 80 are offered standard.

And HeadStart's small size permits easy transportability with no sacrifice in performance. Each VPU comes with its own easy-carrying handle. A portable keyboard option is also available.

**How Fast Is Fast?**

HeadStart's RAM Disk, an electronic emulation of the typical second drive, gives you response that's 50 times faster than conventional microcomputers.

And HeadStart is incredibly powerful too. Up to one megabyte of internal memory can tackle even the most sophisticated applications.

**Join Our Winning Team.**

As a HeadStart reseller, we'll back you up with hardworking advertising, responsive service and technical support. We'll even train your people at our plush Regional Product Centers or Corporate Headquarters. (Ask about our C.A.R.E.™ Cooperative Marketing Program.)

**Some Ideas Are Bigger Than Others.**

We offer one full year of ironclad protection. That's four times as good as you'll get from most of our competitors.

And to supplement your own product support, we offer an on-site maintenance program that's as close to your customer as his telephone.

If all this sounds too good to be true, we'd like to hear from you. For more information, call us at (803) 798-9100 or write: Intertec, 2300 Broad River Road, Columbia, SC 29210.
Brighten up your dumb terminal—
add a UDS 212 A/D

A little outside intelligence can turn your dumb terminal into a data communications genius. And the intelligence you need is built into UDS' new 212 A/D, a smart 300/1200 bps modem with an integral automatic calling unit.

With the 212 A/D you can dial from keyboard or, with a single keystroke, from memory. Five 30-digit numbers in memory are battery backed for 3-5 year retention after shutdown. Built-in test functions allow fast, reliable verification of system operation.

Before you invest in more microcomputers, check the advantages of add-on intelligence. Contact Universal Data Systems, 5000 Bradford Drive, Huntsville, AL 35805. Telephone 205/837-8100; TWX 810-726-2100.

CIRCLE NO. 141 ON INQUIRY CARD

UDS modems are offered nationally by leading distributors. Call the nearest UDS office for distributor listings in your area.

DISTRICT OFFICES: Atlanta, GA, 404/996-2715 • Blue Bell, PA 215/843-2336 • Boston, MA, 617/875-8868 • Columbus, OH, 614/565-3025 • Englewood, CO, 303/694-0043 • Glenview, IL, 708/838-8180 • Houston, TX, 713/988-5506 • Huntsville, AL, 205/837-8100 • Mountain View, CA, 415/969-3323 • Old Bridge, NJ, 732/251-9090 • Richardson, TX, 214/680-0002 • Silver Spring, MD, 301/587-0166 • Tampa, FL, 813/684-0165 • Tustin, CA, 714/689-8001

Created by Dayner/Hall, Inc., Winter Park, Florida
Products unite processing and networking

Mohawk Data Sciences' Hero personal computer and Super 21 communications processor permit 10 programs to operate concurrently so that data can be transferred among mainframe applications and local programs such as spreadsheet analysis and word processing.

Mohawk Data Sciences has introduced the Hero family of networked personal computers and Super 21 communications processors. Targeted at IBM 3270 networks, these products allow users to integrate desktop personal computing with IBM host computer applications.

Super 21 links as many as 16 Hero workstations or other MDS terminals in a local-area network while providing access to mainframe computer programs and corporate and public databases via Intelligent 3270 software. Interaction between the communications processor and the host can be tailored so that a user can retrieve data, process and store the data locally and then return the data to the mainframe for updating the central database. Super 21 software supports all major data-communications protocols. The computer connects directly to an interactive IBM 3270 Systems Network Architecture or IBM 3776 remote-job-entry network. Super 21 also supports binary synchronous, asynchronous and X.25 protocols.

The Hero workstation consists of a video display, a keyboard, a modular processor and textbook-sized floppy or hard disk storage units that snap together for expansion. The central processor module includes a 16-bit 80186 microprocessor, 256K bytes of RAM, two RS232C ports, one RS422 port and one Centronics-compatible parallel printer interface. The workstation permits 10 programs to operate concurrently under the H/OS operating system. It also supports the MS-DOS 2.0 operating system and allows file sharing between the two operating environments. Users can execute programs written in COBOL, BASIC, Pascal and FORTRAN.

A typical entry-level system consisting of four networked Hero personal computers with a keyboard, a display and 256K bytes of memory each and one Super 21 communications processor configured with 5M bytes of disk storage, 236K bytes of memory, a communications controller, two communications ports and Intelligent 3270 software sells for approximately $22,550. Mohawk Data Sciences, Systems Division, Seven Century Dr., Parsippany, N.J. 07054, (201) 540-9080.

Workstation comes in three versions

The desktop model 7350 Professional Computer incorporates a 68000 CPU, a video display unit, a detached keyboard, a 15M-byte Winchester disk drive and two double-sided, double-density floppy disk drives. It is available in a single-user professional workstation, a color graphics workstation and a multifunction cluster controller console. The single-user workstation offers the UniPlus+ (a UNIX System III derivative) operating environment. It comes with 320K bytes of user memory and can be upgraded to a multifunction cluster controller. The color graphics workstation adds a color graphics display featuring a 27-color palette from which 16 can be displayed simultaneously. This version has 448K bytes of user memory and supports the DI-3000 graphics library and Grafmaker data-presentation software. The multifunction cluster console version includes an additional 1M byte of memory and allows the attachment of as many as three terminals to provide a four-user cluster configuration. $8,400 to $11,750. Delivery is 90 days. Perkin-Elmer Corp., Data Systems Group, 2 Crescent Place, Oceanport, N.J. 07757, (201) 870-4768.

Circle No 300

Circle No 301
UNIX micro features
fast disk transfers

Powered by a 10-MHz MC68000 microprocessor, the model 83/80 microcomputer features the UNIX operating system with Berkeley enhancements. The unit conforms to IEEE-696/S-100 bus standards. It is equipped with an industry-compatible SMD disk controller that yields average transfer rates of 800K bytes per second in read mode and 560K bytes per second in write mode. All sectors on a track are transferred within a single disk rotation, regardless of where the head first settles. The controller supports one or two 80M-byte hard disks. The machine's standard 512K bytes of dynamic RAM with parity is expandable to 3.25M bytes. The four-channel RS232C I/O boards use direct memory access for all outputs. The C programming language comes standard with UNIX; optional languages include FORTRAN-77, Pascal, BASIC and RM/COBOL. $20,990 including an 80M-byte hard disk and UNIX. **Dual Systems Corp.**, 2530 San Pablo Ave., Berkeley, Calif. 94702, (415) 549-3894.

Circle No 302

---

**New Products**

**SYSTEMS**

**UNIX**

**micro features fast disk transfers**

**Powered by a 10-MHz MC68000 microprocessor, the model 83/80 microcomputer features the UNIX operating system with Berkeley enhancements. The unit conforms to IEEE-696/S-100 bus standards. It is equipped with an industry-compatible SMD disk controller that yields average transfer rates of 800K bytes per second in read mode and 560K bytes per second in write mode. All sectors on a track are transferred within a single disk rotation, regardless of where the head first settles. The controller supports one or two 80M-byte hard disks. The machine's standard 512K bytes of dynamic RAM with parity is expandable to 3.25M bytes. The four-channel RS232C I/O boards use direct memory access for all outputs. The C programming language comes standard with UNIX; optional languages include FORTRAN-77, Pascal, BASIC and RM/COBOL. $20,990 including an 80M-byte hard disk and UNIX. **Dual Systems Corp.**, 2530 San Pablo Ave., Berkeley, Calif. 94702, (415) 549-3894.

Circle No 302

---

**Heurikon presents Minibox - a multuser UNIX workstation based on its powerful HK68™ single board microcomputer and Uniplus+™ UNIX System III or System V operating system with Berkeley enhancements.**

Designed with the OEM in mind, one size fits all. Both compact and flexible, the Minibox includes within its 10.5"w x 13.9"h x 20.5" frame a 200 or 400 watt power supply, six slot Multibus™ card cage, [4-5 available for user use], single double density floppy disk drive, streamer tape drive, and 31 or 65 Mbyte Winchester drive (expandable to 280 Mbytes). All this within the same cabinet! System status LEDs on the front panel inform the user of CPU and disk drive activity.

With Uniplus+™, Minibox becomes a flexible and affordable tool for program development, text preparation, and general office tasks. Included is a full C compiler, associated assembler and linker/loader. Optional languages are:

- Macro assembler, ISO Pascal compiler,
- FORTRAN-77 compiler,
- RM-COBOL™,
- SYS BASIC (DEC BASIC compatible interpreter),
- SMC BASIC (Basic-Four BB3 compatible interpreter), and Ada™.

Other utilities include UltraCalc™ multuser spread sheet, Unity™ DBM, Ethernet™, and floating point processor. Alternate operating systems available are PolyForth™, Regulus™, CP/M 68K™, and others.

---

**Portable computer has 9-inch display**

The TI Portable Professional Computer, which is hardware- and software-compatible with the desktop TI Professional Computer, features a 16-bit 8088 microprocessor, 64K bytes of RAM, expandable to 768K bytes, five expansion slots and a 5¼-inch, half-height floppy disk drive with space for 320K bytes more storage under MS-DOS 1.1 and 360K bytes under MS-DOS 2.1. The computer incorporates a 9-inch mono-
chrome or color display that furnishes a 25-line-by-80-column format and 720-by-300-pixel resolution. It can also drive an external 12-inch monochrome or 13-inch color monitor. The portable supports communications products for the desktop model, including TTY, 3270 and the EtherSeries of local-area network products. Prices start at $2,395. Texas Instruments Inc., Data Systems Group, P.O. Box 402430, H-689, Dallas, Texas 75240, (800) 527-3500.

Circle No 303

Mono-board micro is VERSAbus-compatible

The VM03 mono-board microcomputer incorporates a 10-MHz MC68010 virtual-memory microprocessor and an MC68451 memory-management unit. The VERSAbus-compatible board furnishes 256K bytes of dynamic RAM with parity check, a dual-port RAM controller, two 28-pin sockets for 64K bytes of user-supplied ROM/EPROM devices, two multiprotocol serial I/O ports with RS232C interfaces for modem or terminal usage, a triple 16-bit programmable timer/counter and a real-time clock. Software support includes the VERSAdos real-time multitasking disk operating system with file-management capabilities, a real-time multitasking ROMable Executive package and a debug monitor. $3,900. Motorola Semiconductor Products Inc., P.O. Box 20912, Phoenix, Ariz. 85036, (602) 828-3501.

Circle No 304

Desktop computer attains 5-MIPS peak performance

The RNA Series 1000 workstation includes a microprogrammable 32-bit CPU with high-level, language-directed architecture. The processor executes an average of 1 million R-codes per second, with a maximum rate of 5 million per second. Implemented on the IEEE-796 bus, the basic configuration provides 1M byte of RAM. The operating system, similar to the UCSD p-system, supports Pascal and FORTRAN. The system's black-and-white display offers 1,024-by-800-pixel resolution. Character display is 60 lines of 84 columns. $20,000, including 1M-byte RAM, a 15M-byte Winchester disk drive, a display, the operating system and a Pascal compiler. RNA Inc., 4377-B First St., Pleasanton, Calif. 94566, (415) 846-1870.

Circle No 305

Workstations offer multiple user modes

The Sun-2 family of workstations features local-area network communications capability, an ergonomic design and an optional hardware floating-point processor. The desk-side Sun 2/120 can be configured as a network node or as a self-contained standalone system. The Sun 2/170 rack-mountable system can act as a file server equipped with high-capacity disk drives, a ¼-inch tape unit and other peripherals. Both models use a Multibus backplane, with nine slots in the Sun 2/120 and 15 slots in the Sun 2/170. They use a 10-MHz MC68010 processor that provides 16M bytes of virtual address space per process. The units run UNIX 4.2 BSD and come with all standard UNIX utilities, C, FORTRAN, Pascal, a graphics library based on the ACM Siggraph Core Standard and a window-based user interface. Prices start at $16,300. Sun Microsystems Inc., 2530 Garcia Ave., Mountain View, Calif. 94043, (415) 960-1300.

Circle No 306
Computer handles numeric calculations

The HP-71B hand-held computer performs numeric computations and calculations. The computer features enhanced BASIC, calculation mode, 17.5K bytes of RAM, 64K bytes of ROM and four plug-in slots for memory expansion. The unit measures 3½ by 7½ by ½ inches and weighs 12 ounces. It has a block QWERTY keyboard and a 10-digit numeric pad. The keypad can be redefined, and overlays are available for customization. A one-line, dot-matrix LCD shows 22 characters of a 96-character line at one time. A plug-in slot in the rear of the machine accommodates the HP interface loop. The information-transfer rate of the HP-IL module is 5K bytes per second. Less than $550. Hewlett-Packard Co., 1220 Embarcadero Rd., Palo Alto, Calif. 94303.

PLUG THIS IBM-COMPATIBLE 9-TRACK TAPE SYSTEM INTO JUST ABOUT ANY PORT

The IBEX Model TS-110 Magnetic Tape system is immediately compatible with any micro- or mini computer, mainframe, modem or special device having a standard port—RS-232, RS-422, or GPIB/HP1B. It appears to that device as a buffered printer or terminal. Simple, transparent ASCII control codes provide tape drive control for any number of functions.

Outstanding features include:

• Universal RS-232, RS-422, GPIB/HP1B compatibility
• IBM-standard format compatibility
• Ease of operation—only 6 ASCII characters required
• Operation at any baud rate to 38.4K baud
• Single system can be alternately used to transfer data from one computer to another

Plug up that missing link in your computer operation today with the IBEX TS-110 Magnetic Tape System.

For complete technical data, call, TWX or write:

IBEX
IBEX COMPUTER CORPORATION
20741 Manila Street, Chatsworth, CA 91311
(818) 709-8100 - TWX 910-493-2071

CIRCLE NO. 144 ON INQUIRY CARD

System operates with three microprocessors

The Omni Convertible multiple microprocessor system contains a variable processor architecture (VPA) that permits concurrent operation with as many as three microprocessors employing CP/M Plus, MS-DOS, UCSD p-system, UNIX, the company’s proprietary Omni-DOS and other operating systems. Forming the VPA’s framework is a shared memory ranging from 128K bytes to 1M byte dual-ported to a pair of 8- and 16-bit buses. The system’s 8-MHz Z80H runs 8-bit application programs. A plug-in CPU board with a TI 9995 microprocessor inserted in one slot of a four-slot 16-bit Multibus controls the system keyboard, parallel printer port and an RS232C port. The TI 9995 runs the Omnitec proprietary word-processing software. The system’s third CPU board, based on an Intel 80186 or 80286 or a Motorola 68000 microprocessor, plugs into a second Multibus slot. Prices start at $6,000. Omnidata, 5717 Corsa Ave., Westlake Village, Calif. 91362, (213) 991-5810.

CIRCLE NO. 308

MINI-MICRO SYSTEMS/May 1984
**New Products**

**DATACOMM**

**Communications board operates at high speed**

The COM-1 communications board enables Multibus systems to communicate with computers and peripherals at high speeds using DMA. Eight on-board Multibus DMA channels handle data transfers between any combination of Multibus RAM and I/O ports. One bidirectional 16-bit parallel I/O port transfers data between a Multibus-based system and a DEC VAX, PDP-11 or LSI-11 computer at speeds as high as 400K words per second. The board includes four high-speed serial channels. Three of the channels conform to the RS232C interface standard and use RS423 line drivers and receivers to accommodate baud rates as high as 307.2K baud. The fourth serial port can be strapped for one of four modes: the RS449 interface standard with RS422 drivers (800K baud maximum), RS449/RS423, RS232/RS423 (300K baud) or as an LAN mode interface. $2,495. Matrox Electronic Systems Ltd., 5800 Andover Ave., Montreal, Quebec H4T 1H4, Canada, (514) 735-1182. Circle No 309

**Full-duplex modem operates at 2,400 bps**

The microprocessor-based model R2424 full-duplex modem operates over the DDD network or two-wire private lines. It operates synchronously or character asynchronously at 2,400 or 1,200 bps. At 1,200 bps, the modem is Bell and Rixon 212A-compatible. A front-panel talk/data switch that allows calls to be answered manually (by telephone) or automatically (controlled by the data-terminal equipment) makes alternate voice/data communications possible. A front-panel switch labeled AN/AUTO/OR (answer/auto-answer/originate mode) permits proper opera-

**BELL LABS FINDS 87% OF POWER DISTURBANCES AT COMPUTER SITES ARE VOLTAGE SAGS!**


Bell Telephone Laboratories monitored commercial electric power at 24 computer sites of Bell Operating Companies, Western Electric, and the AT&T Long Lines Department. Utility-supplied power was monitored for up to 22 months, with an average per site of more than 11 months and total observation time of 270 months. Here is what Bell found:

<table>
<thead>
<tr>
<th>Voltage Sags: 87%</th>
<th>Impulses 7.5%</th>
<th>Power Failures 4.7%</th>
<th>Surges 0.8%</th>
</tr>
</thead>
</table>

Sags Outnumbered Spikes Even During Storms!

Surprising, indeed! Even to the Bell Systems engineers who conducted the study?

**Your Power Is Probably Like Ma Bell's**

Chances are your computer is exposed to the same kind of power line sags, impulses and occasional failures. Nasty, costly events that can cause data loss, faulty computations, disk-head crashes and sudden shutoffs.

**With Sags The Key Culprit, Why Zero In On Surges?**

Is it wise to lay out money for surge suppressors and spike clippers that give no protection against voltage sags? And leave your computer open to the most frequent power disturbances? Think about it!

**Do The Job Right — With ISOREG**

ISOREG power modules block sags, spikes, and surges and deliver good clean power to computers even when line voltages drop to 60% of normal — for minutes.

**Don't Risk Computer Errors Due To Power Line Disturbances**

Get full information, free. Use the Reader Service Card, or call (toll-free) 1-800-225-5078. In Massachusetts, (617) 486-9483. TWX 710-347-6974 ISOREG LTTN.

ISOREG CORPORATION
410 Great Road, Littleton, MA 01460 USA


ISOREG®: Registered Trademark

CIRCLE NO. 145 ON INQUIRY CARD
Tape drive meets QIC-02, -24 standards

Fitting the industry-standard, half-height, 5¼-inch disk drive footprint and offering a formatted data-storage capacity of 60M bytes, the Mini QIC-Stream III ¼-inch streaming digital cartridge-tape drive is compatible with QIC-02 and -24 data-format standards. Using serpentine recording, the drive allows four- or nine-track operation on ANSI-standard 450-, 555- or 600-foot, ¼-inch data cartridges. When operating at the standard 90-ips tape speed, the drive can accept or transfer 5M bytes of data per minute. Recording format is GCR, and data density is 8,000 bpi. The basic drive becomes an intelligent drive with the addition of a formatter/controller module. $425 to $875. Data Electronics Inc., 10150 Sorrento Valley Rd., San Diego, Calif. 92121, (619) 452-7840. Circle No 311

3.9-inch Winchester packs 30M bytes

The half-height SQ38F 3.9-inch Winchester disk drive stores 30M bytes of data (formatted). The unit, measuring 1.625 by 4.8 by 8 inches, allows users to increase storage capacity by placing two drives into the space of one 5¼-inch Winchester or minifloppy drive. The three-platter drive offers the pin-outs, timing, data-transfer rates and track/sector formatting of industry-standard 5¼-inch Winchester disk drives. The drive features a data-transfer rate of 5M bps and an average access time of 85 msec. It uses controller interfaces designed for ST506/412 drives, a closed-loop, embedded digital servo mechanism and graphite-coated thin-film metallic alloy disks. $1,100 (1,000 units). SyQuest Technology, 47923 Warm Springs Blvd., Fremont, Calif. 94538, (415) 490-7511. Circle No 312

Floppy disk drive stores 1M byte

The microprocessor-controlled TM551D-4 half-height, 5¼-inch floppy disk drive uses LSI circuitry and a brushless DC direct-drive motor. The 96-tpi, double-sided drive stores 1M byte. Employing a split-band head positioner driven by a stepper motor, the drive achieves a 3-msec. track-to-track access time. Average access time is 94 msec. The data-transfer rate is 250K bps. Approximately $200 in OEM quantities. Tandon Corp., 20320 Prairie St., Chatsworth, Calif. 91311, (213) 993-0644. Circle No 315

Information devices store 5M, 10M or 16M bytes

The JD-5006, JD-5012 and JD-5020 5¼-inch hard disk drives store 5M, 10M and 16M bytes of formatted information, respectively. The units provide data-transfer rates of 5M bps and average access times of 85 msec. for the JD-5006 and JD-5012 and 120 msec. for the JD-5020. The MDP-1 and MDP-2 5¼-inch floppy disk drives accommodate 1M byte and 500K bytes of unformatted information, respectively. The MDP-1 is a double-sided, 96-tpi drive with 80 bps; the MDP-2 is a double-sided, 48-tpi drive with 40 bps. Data-transfer rates are 250K bps. All the drives measure 1¾ inches high. Prices are available from the vendor. US JVC Corp., 41 Slater Dr., Elmwood Park, N.J. 07407, (201) 794-3900. Circle No 313

Microfloppy drive packs 1M byte

The models 321 and 322 microfloppy disk drives feature single-sided, 500K-byte and double-sided, 1M-byte storage capacities, respectively, on 3¼-inch flexible media. Average access times are 282 msec. for the model 321 and 175 msec. for the model 322. Data-transfer rates are 250K bps. The drives are plug-compatible with standard double-sided, double-density, 96-tpi, 5¼-inch floppy disk drives and use a standard 5¼-inch interface. They also share their 80-tps media format with 5¼-inch floppy disk drives. Model 321: $155, model 322: $190. Micro Peripherals Inc., 9754 Deering Ave., Chatsworth, Calif. 91311, (213) 709-4204. Circle No 316

Winchesters boost system throughput

Aimed at multiuser microsystems, the models 3075 and 3065 5¼-inch Winchester disk drives store 75M and 65M bytes (unformatted), respectively. Both feature a 24-msec. average access time and have MTBF rates of 18,000 power-on hours. Model 3075 employs five platters and eight heads, and model 3065 uses four platters and seven heads. Both have closed-loop servo systems and voice-coil linear actuators. They adhere to industry-standard form factors and use the ST412 interface. Model 3075: $1,950 (1,000 units), model 3065: $1,800 (1,000 units). Evaluation units will be available in the second quarter. Atasi Corp., 2075 Zanker Rd., San Jose, Calif. 95131, (408) 985-0235. Circle No 314
More than A Memory
A Commitment To Quality

Every department, every person in our organization is dedicated to one goal—to deliver the finest in disk memories.

At Century Data Systems, we see quality as a pervasive, company-wide attitude. And our customers share this perspective.

Leading OEMs continue to rely on Century Data Systems disk memories for superb reliability, year after year. That's the real payoff from our total approach to quality.

At Century Data Systems, quality is much more than a memory. It's a living company commitment. And it can work to your advantage. Write or call for specifics.

Century Data Systems
A Xerox Company

Marketing Communications
1270 N. Kraemer Boulevard
Anaheim, California 92806
(714) 999-2660
New Products

PRINTERS

Dot-matrix printer supplies graphics mode

The model 7065 dot-matrix printer operates at 300 cps in draft mode, 250 cps in compose mode, 125 cps in near-letter-quality mode and 65 cps in letter-quality mode for word processing. The graphics mode offers 144-by-144-letter-quality mode using a 14-by-18 matrix at a repetition rate of 1,500 dtp per activated needle. The printer also features down-loadable proportional spacing, right-margin justification, automatic underline, overprint and boldface fonts and an expandable 4.7K-byte input buffer. It can store as many as three letter-quality fonts on-line. A host computer can down-load printer parameters to the model 7065 using escape-code sequences. The unit is compatible with Anadex, Epson and DEC LA120 escape codes. A Centronics interface and an RS232C current-loop interface are standard.

$1,995. North Atlantic Industries, Qantex Division, 60 Plant Ave., Hauppauge, N.Y. 11788, (516) 582-6060 or (800) 645-5292. Circle No 318

Printer provides quiet operation

The VersaPrint model 530 serial dot-matrix impact printer features color printing, cut-sheet feeding, continuous-form feeding, graphics, multiple speeds with selectable print-quality modes and quiet operation. Printing modes and speeds include a draft-quality mode using a 7-by-9 matrix at 180 cps, a memo-quality mode using a 14-by-9 matrix at 90 cps and a near-letter-quality mode using a 14-by-18 matrix at 45 cps. Character formats range from 8-lpi vertical spacing. They accommodate one- to six-part forms from 3 to 17 inches wide and from 3 to 15 inches long. Each model is available with a Centronics, Dataproducts or RS232C interface. MTBF is 4,000 hours at 1,200 lpm and 6,000 hours at 600 lpm.

1,200-lpm model: approximately $8,000 (OEM quantities). Fujitsu America Inc., 3075 Oakmead Village Dr., Building 3, Santa Clara, Calif. 95051, (408) 988-8100. Circle No 318

Band printers feature 6,000-hour MTBF rating

The M304X series band printers come in four models that print at 300, 600, 900 and 1,200 lpm with a 64-character set and 210, 420, 670 and 910 lpm with a 96-character set. They automatically identify three standard print bands and one optional print band and automatically select the associated ROM. Operating noise level is 55 dB. The printers have 136 print positions and switchable 6- or 8-lpi vertical spacing. They accommodate one- to six-part forms from 3 to 17 inches wide and from 3 to 15 inches long. Each model is available with a Centronics, Dataproducts or RS232C interface. MTBF is 4,000 hours at 1,200 lpm and 6,000 hours at 600 lpm.

$795, $1,200, $1,200-lpm model: approximately $8,000 (OEM quantities). Fujitsu America Inc., 3075 Oakmead Village Dr., Building 3, Santa Clara, Calif. 95051, (408) 988-8100. Circle No 318

Dot-matrix units print 140, 120 or 100 cps

The D-300, D-200 and D-100 dot-matrix printers print at 140, 120 and 100 cps, respectively. Model D-300 has a 132-cpl column width at 10 pitch and comes with a 2K-byte buffer, parallel and serial interfaces and friction- and tractor-feed paper-handling capabilities. It operates bidirectionally with short-line seek and offers vertical and horizontal tabs. Its character-matrix size is 9 by 8 in the standard mode and 17 by 16 in near-letter-quality mode. Other features include six pitch sizes, emphasized or elongated print, proportional spacing, an italics character set and a 96-character ASCII set. The printer also has bit-image graphics capabilities with horizontal resolutions of 60, 72 and 120 dpi. Models D-200 and D-100 have 80-cpl column widths at 10 pitch. D-300: $795, D-200: $595. Smith-Corona, 65 Locust Ave., New Canaan, Conn. 06840, (203) 972-1471. Circle No 321

Matrix printer employs 24-pin head

With a 24-pin head and printing speeds of 200 cps for high-volume drafts and 60 cps for letter-quality correspondence, the LQ-1500 serial dot-matrix printer forms characters with matrices ranging from 9 by 17 dots to 37 by 17 dots. In graphics mode, resolution ranges from 60 to 240 dpi. The printer's built-in character sets provide 96 ASCII characters, 13 international character sets and 96 italic characters. Printing is bidirectional with logic seeking. Centronics, RS232C and IEEE-488/GPIB interfaces are available; additional 2K-byte buffers are available with the RS232C and GPIB interfaces. MTBF is 6,300 hours at 25 percent duty cycle.

$1,200 to $1,500. Epson OEM Products Division, 3415 Kashiwa St., Torrance, Calif. 90505, (213) 393-8277. Circle No 320

Dot-matrix printer supplies graphics mode

The model 7065 dot-matrix printer operates at 300 cps in draft mode, 250 cps in compose mode, 125 cps in near-letter-quality mode and 65 cps in letter-quality mode for word processing.
THE PRINTER TO PICK WHEN THE PACE QUICKENS.

It's happening all over the value-added world.

Your multi-user customers are getting hit with a ton of increased throughput requirements and they need more printer speed. A lot more.

They're also looking for more professional-looking presentations so they need better print quality. A lot better.

Where can you find the best of both worlds for them? And at the same time find some margins that'll look real good to you?

With Okidata's Pacemark 2350 and 2410 dot matrix printers.

Take throughput. The 2350 and 2410 can quickly get your customers out of the waiting game to where they're really cranking it out.

But wait. Cranking what out, you may ask? A single, restrictive printing mode? No way. The 2410 can give your customers DP, draft, and correspondence quality that truly rivals the daisy-wheel. And with flexibility, too: up to 5 pages per minute.

And the 2350 and 2410 can both print at up to 350 cps. While producing 120 to 420 lines a minute for them. With bidirectional printing and short line seeking logic. And both high speed and vertical slew.

SYSTEMS COMPATIBILITY. SOFTWARE COMPATIBILITY.

The 2350 and 2410 use industry standard interfaces making them hardware compatible with most mini and microsystems on the market today. In addition, they are supported on the menus of most of the important software being offered to microsystem users.

You also get an outstanding graphics capability with 144 x 144 dots per inch resolution.

Two color printing for highlighting. Down line loadable font sets for flexibility. Subscripts and superscripts so your scientific and technical usage won't bog down. Six-part forms handling.

The capability to print 132 columns on eight-inch paper using 17.1 characters per inch to save paper costs and make output easier to handle.

And—so that your customers can depend on getting all that good stuff, all the time—a mean time between failure of 2200 hours. A mean time to repair of only 30 minutes. An average print-head life of 200,000,000 characters. And an industry low warranty claim rate of less than 2%.

No doubt about it, the quicker the pace at your customers' place, the more you need Pacemark from our place. For more information, call toll free 1-800-OKIDATA. In New Jersey, 609-235-2600. Or write OKIDATA, Mt. Laurel, NJ 08054.

OKIDATA
an OKI AMERICA company
We're keeping pace with your business.
CIRCLE NO. 147 ON INQUIRY CARD
Relational DBMS interfaces with Multiplan

The R:base Series 4000 relational database-management system provides a direct interface to Multiplan and dBase II and is compatible with Lotus Relational interfaces with features management of branching to direct commands; customization and reports; data validation; automatic 1-2-3, and union. An updated change command transfers to R:base for modification prompts and commands. Information from any productivity program can be transferred to R:base for modification. The Image Monitoring (IMON) utility for DEC VAX/VMS systems gathers samples from a running FORTRAN, BASIC, C, COBOL, PL/I, BLISS or MACRO program and produces a bar-graph display of the program's location. The display indicates routine names and program line numbers within those routines. IMON can also display the time a program spends in scheduling states and processor modes. Users can run IMON from any terminal on the VAX by specifying the process ID, the process name or the image name. A terminal-independent screen package supports non-standard terminals as well as VT100 terminals. $2,500. MIDCOM Corp., 1940 N. Tustin -117, Orange, Calif. 92665, (714) 998-6041.

Circle No 322

Tools form software facility

The Softool set of software tools for software management, development, maintenance and conversion operates on Hewlett-Packard Co.'s HP9000 computers running the HP-UX operating system. Softool is composed of two environments: the change and configuration control (CCC) environment and the programming environment (PE). The CCC environment allows software managers and programmers to track all software and documentation changes and versions automatically. It supports automatic reconstruction of previous versions, problem-tracking, difference reports, management reports, access control, archiving, compression, encryption and automatic recovery. It can handle programs in FORTRAN, C and Pascal. The PE environment allows a user to compose an application program from prefabricated code. Tools include shorthand language, structured languages, a source-code auditor, a source-code documenter, an interface documenter, error detectors, a code generator and libraries of prefabricated code. PE supports FORTRAN only. CCC or PE: $5,045 to $20,180; CCC and PE: $7,570 to $30,270. Softool Corp., 340 S. Kellogg Ave., Goleta, Calif. 93117, (805) 964-0560.

Circle No 323

Utility analyzes program performance

The Image Monitoring (IMON) utility for DEC VAX/VMS systems gathers samples from a running FORTRAN, BASIC, C, COBOL, PL/I, BLISS or MACRO program and produces a bar-graph display of the program's location. The display indicates routine names and program line numbers within those routines. IMON can also display the time a program spends in scheduling states and processor modes. Users can run IMON from any terminal on the VAX by specifying the process ID, the process name or the image name. A terminal-independent screen package supports non-standard terminals as well as VT100 terminals. $2,500. MIDCOM Corp., 1940 N. Tustin -117, Orange, Calif. 92665, (714) 998-6041.

Circle No 324

Software lets IBM PCs emulate HP terminals

PC 2622 emulation software enables IBM PC and IBM PC-compatible microcomputers to work and look like intelligent HP2622A terminals. The software matches the features of the HP2622A and emulates some features of the HP2624, including security fields, two communications ports and substituting of tables. The package offers selectable data-transfer rates as high as 19.2K baud, a printer buffer that can be configured to store as much as 320K bytes, “type-ahead” with HP3000 host computers, a system for transferring files between the PC and an HP3000 minicomputer, support of parallel and serial printers and horizontal scrolling of lines as long as 10,000 characters. $295. Walker Richer & Quinn Inc., Lake Union Place, 1914 N. 34th St., Suite 201, Seattle, Wash. 98103, (206) 634-0503.

Circle No 325

Database-management system is easy to use

ASAP Five, a universal relational database-management system for IBM PC, PC XT and compatible computers, features variable-length fields and records. Users define data fields by identifying the item name, type (text, number, date, money or calculation) and length. The program automatically puts all data fields in the appropriate files and databases. The same screen can be modified to delete, add or change data items. With integrated word-processing functions such as header, automatic page numbering and automatic page breaks, users can generate mailing labels, form letters and custom-designed invoices. $575. ASAP Systems Inc., 2425 Porter St. Suite 14, Soquel, Calif. 95073, (408) 476-3955.

Circle No 326

Tool kit increases graphics capabilities

The GSS-Toolkit, a collection of subroutines and utilities for programming FORTRAN, Pascal, Compiler BASIC and C, aids software writers and system integrators in developing microcomputer graphics applications for MS-DOS machines. It comprises a plotting system, a kernel system and a window manager. The plotting system supports non-standard terminals as well as VT100 compatible screens. $2,500. MIDCOM Corp., 1940 N. Tustin -117, Orange, Calif. 92665, (714) 998-6041.

Circle No 327

Database-management system is easy to use

ASAP Five, a universal relational database-management system for IBM PC, PC XT and compatible computers, features variable-length fields and records. Users define data fields by identifying the item name, type (text, number, date, money or calculation) and length. The program automatically puts all data fields in the appropriate files and databases. The same screen can be modified to delete, add or change data items. With integrated word-processing functions such as header, automatic page numbering and automatic page breaks, users can generate mailing labels, form letters and custom-designed invoices. $575. ASAP Systems Inc., 2425 Porter St. Suite 14, Soquel, Calif. 95073, (408) 476-3955.

Circle No 326

Tool kit increases graphics capabilities

The GSS-Toolkit, a collection of subroutines and utilities for programming FORTRAN, Pascal, Compiler BASIC and C, aids software writers and system integrators in developing microcomputer graphics applications for MS-DOS machines. It comprises a plotting system, a kernel system and a window manager. The plotting system supports non-standard terminals as well as VT100 compatible screens. $2,500. MIDCOM Corp., 1940 N. Tustin -117, Orange, Calif. 92665, (714) 998-6041.

Circle No 327
Word processor works with spelling corrector

WordPlus-PC for the IBM PC, TI Professional, DEC Rainbow and Victor 9000 features the built-in on-line spelling system (BOSS). The BOSS combines word processing with a system that checks and corrects spelling. During document editing, the BOSS locates and highlights misspelled words on-screen and displays as many as eight spelling suggestions in order of probable phonetic correctness. An auto-correct feature enables users to fix misspelled words directly in text with one keystroke. The BOSS relies on a standard dictionary of 90,000 words.

WordPlus-PC features built-in mail merge, invoice generation and the ability to merge information from programs such as Lotus 1-2-3 and dBase II. Users can print bar graphs and other charts, move columns, scroll horizontally, execute global search and replace and print boiler-plate text and, on some printers, proportionally spaced text. $495. Professional Software Inc., 51 Fremont St., Needham, Mass. 02194, (617) 444-5224.

CAD software speeds image construction

Plot 10 computer-aided drafting software enables users without extensive computer training to create engineering drawings, illustrations and presentation overheads. The software runs locally under the CP/M-86 operating system in Tektronix Local Programmability on Tektronix 4100 series display terminals. The tablet menu and English-language prompts aid beginners and experienced users. File utilities organize and archive drawings. The software allows users to enter text and geometry on-screen using thumb wheels and a cross-hair cursor. Users can specify as many as 250 levels on one drawing and use 15 pens for color assignment to various items. Individual drawing items or groups of items, defined as "worksets," can be modified, rescaled, rotated or mirrored in one operation. $1,600. Tektronix Inc., P.O. Box 500, Beaverton, Ore. 97077, (503) 644-0161.

More Room... More Multibus® Cages.

ONLY FROM ELECTRONIC SOLUTIONS!

More Models
We have more models than all our competitors combined. Choose a cage with:
3. 4. 5. 6. 7. 8. 9. 10. 12. 14. 15. 16. 20. 24 or 26 SLOTS for the right solution to your problem. We have models with either 0.6" or 0.75" card centers and can even accommodate wire-wrap cards.

All models are electrically and dimensionally interchangeable with Intel's iSBC-80® Cages.

More Room
You get more room for extra cards without increasing overall size. Because our design gives you greater inside dimensions.

More Reliability
All cages are constructed of sturdy, durable anodized aluminum with a single mother board backplane...a concept that increases reliability and minimizes interconnections.

THREE YEAR WARRANTY

More Information?
CALL OUR TOLL FREE NUMBER
(800) 854-7086

In California Call Collect: (619) 292-0242

Electronic Solutions
9255 Chesapeake Dr., San Diego, CA 92123
(619) 292-0242 Telex 11 910-335-1109

CIRCLE NO. 148 ON INQUIRY CARD

Fully Multibus Compatible, Terminated Mother Board.

MULTI-CAGE®

Make it snappy.

When a printed page has to represent your whole company it'd better look sharp. Our DP-35 and DP-55 daisywheels rival the finest office typewriters for crisp clean impressions. And they zip along at just about a page a minute. Call your printer distributor. Or contact Dataproducts at (213) 887-3924. 6200 Canoga Avenue, Woodland Hills, CA 91365. In Europe, 136-138 High Street, Egham, Surrey, TW 20 9HL England.

Dataproducts Daisywheel Printers

CIRCLE NO. 149 ON INQUIRY CARD
New Products

TERMINALS

Terminals interface packet-switching networks

The Series TDV 2200S editing terminals are enhanced versions of the company's TDV 2200 series. The terminals feature business graphics, a 70-Hz refresh rate, extended character sets and an add-on communications controller that enables communications through packet-switched networks using the X.25 protocol. The terminals can be equipped with 56K bytes of memory. They transmit by character, page, block or line/field. A plug-in card turns the TDV 2200S into a bit-mapped raster screen display with 684-by-384-point resolution. This configuration emulates the Tektronix 4010 and 4014 terminals for vector drawing and point plotting. The character generator can store as many as 1,024 characters. Latin, Cyrillic and Greek alphabets and mathematical and semi-graphics symbols are available. Characters are displayed on a 15-inch green screen. $1,875. Tandberg Data Inc., Box 99, Labriola Court, Armonk, N.Y. 10504, (914) 273-6400.

Circle No 330

Display provides multiple emulations


Circle No 332

Display models boast user-friendly features

Aimed at multiple-database timesharing and dedicated, direct computer-connected applications, the APT series terminals provide programmability and menu-controlled operation. They feature a built-in, direct-connect, 300-baud modem, automatic dialing of as many as 26 stored telephone numbers and automatic log-on. With an optional 12-inch, non-glare, green phosphor display monitor, the terminals supply video output for an 80- or 40-character, 24-line display on a standard monitor or an RF output for a 40-character display on a television screen. Full-stroke and flexible-membrane keyboards are available. A 48-hour battery-less power backup furnishes non-volatile storage of the telephone directory, log-on sequence-

Terminal Announces A State-of-the-Art Advance in Debugging Software on the IBM PC

PC PROBE

- REAL TIME HARDWARE BREAKPOINT
- REAL TIME TRACE
- 8 CHANNEL LOGIC ANALYZER
- SYMBOLIC DEBUGGING
- HIGH LEVEL LANGUAGE SUPPORT
- PROGRAM PATCHING
- ENHANCED HUMAN INTERFACE
- FULL SPEED EXECUTION
- PROGRAM CRASH RECOVERY

PC PROBE IS AVAILABLE NOW. SO WHY WASTE TIME. CALL US TODAY. (408) 741-5900

Atron

CIRCLE NO. 150 ON INQUIRY CARD
es and communications parameters. A Centronics-type parallel printer port and an RS232C port are standard. Without monitor: $399, with monitor: $598. RCA Microcomputer Products, New Holland Avenue, Lancaster, Pa. 17604, (717) 397-7661. Circle No 333

Color graphics terminal is DEC-, Tektronix-compatible

The CIT-467 color graphics terminal allows simultaneous use of DEC alphanumeric software commands, the Tektronix 4027A color graphics command structure and the Tektronix 4010/4014 emulation mode. In addition to its DEC VT100 compatibility and ANSI X 3.64-standard control sequences, the terminal’s Tektronix personality provides rectangle, polygon, circle, arc and pie command functions. The unit has a 572-by-480-dot resolution, an addressable 4,096-by-4,096-dot plot area, a cross-hair cursor, five vector variations, incremental and point plotting and 20-mA current-loop interfaces. Video features include a 7-by-9-character matrix, 80- or 132-column display, eight colors with 64 programmable combinations, variable-speed smooth scroll, split-screen operation and window erase. $2,995. CIE Terminals Inc., 2505 McCabe Way, Irvine, Calif. 92714, (714) 660-1421. Circle No 334

Better letters.

We can’t help your spelling or grammar, but we can help your important correspondence look a little brighter than the next guy’s. In less than a minute our DP-55 daisywheel dashes out a letter-perfect page. Throw out your white out, call your printer distributor. Or contact Dataproducts at (213) 887-3924, 6200 Canoga Avenue, Woodland Hills, CA 91365. In Europe, 136-138 High Street, Egham, Surrey, TW20 9HL, England.
Synchronous serial board replaces DEC DUV-11

The model 315 single-channel serial I/O port interfaces DEC's Q-bus to synchronous serial data channels requiring Bell 201 synchronous modem compatibility. The product directly replaces DEC's DUV-11 and is compatible with software used by DEC to support the DUV-11. It is packaged on an 8.9-by-5.2-inch DEC-style dual-height board and is electrically and mechanically compatible with DEC's LSI-11, 11/2 and 11/23 microcomputers. The board consists of a synchronous transmitter and receiver in which operating modes are program controlled. These modes include synchronous or isochronous character transmission and reception, character length, parity, sync character and half of full duplex. Model 315: $695, DMA option: $300. Grant Technology Systems Corp., 11 Summer St., Chelmsford, Mass. 01824, (617) 256-8881. Circle No 335

DMA controller employs multifunction channels

The two-channel model 316 universal DMA controller is a DEC Q-bus peripheral that provides data block transfer between memory and other peripherals. Packaged on an 8.9-by-5.2-inch DEC-style dual-height board, the product is electrically and mechanically compatible with DEC's LSI-11, 11/2 and 11/23 microcomputers. Each of the controller's two channels can also perform peripheral-to-peripheral and memory-to-memory transfers with byte or word data sizes. $595. Grant Technology Systems Corp., 11 Summer St., Chelmsford, Mass. 01824, (617) 256-8881. Circle No 337

Graphics controller meets GKS standard

The Graphcard model 100 circuit board and utility software for IBM PC and PC XT microcomputers implements the ANSI GKS virtual-device interface standard. It runs IBM and third-party software by emulating and replacing IBM's monochrome and color graphics adapter boards. Features include serial and parallel printer ports and a serial port for a mouse. Using its Intel 80186 coprocessor, the controller provides graphics displays at 720-by-352-pixel resolution and an intensity level for highlighting. Through its multitasking operating system, Graphcard 100 outputs high-resolution text and graphics to dot-matrix printers while other applications functions are executing. $1,250. Concept Technologies Inc., P.O. Box 5277, Portland, Ore. 97208, (503) 684-3314 or (800) 547-4000. Circle No 338

Graphics card colors IBM PC

The IDEAgraph color graphics card for the IBM PC is available in 28- and 40-MHz versions with 128K or 256K bytes of memory. It furnishes automatic line, circle, vector and space-filling functions; a hardware-controlled zoom factor of 1 to 16; and a software-controlled feature that can display blinking on a pixel-by-pixel basis. With 256K bytes of memory programmable to eight planes, the card offers 256 colors from a palette of 4,096. It can reach speeds of 80 nsec. per pixel and is programmable to a resolution of 1,024 by 1,024 pixels. At lower resolutions such as that of the IBM-standard PC monitor—640 by 200 pixels—the card can generate 16 colors. Each board comes with software, including IBM-compatible BIOS, IDE-extended BIOS and virtual-device interface to link with GSX, $895 to 1,895. IDE Associates Inc., 7 Oak Park Dr., Bedford, Mass. 01730, (617) 275-4430. Circle No 340

System enhances IBM PC graphics

Matrigraph, an interactive color graphics system for IBM PC and XT computers, furnishes a 16-color, bit-mapped, 640-by-400-pixel resolution display. A four-color display mode with color prioritization is also available. The system uses a NEC 7220 graphics display processor that handles all video display functions. Display memory consists of 128K bytes of RAM mapped into four color planes. Direct hardware support allows users to zoom, pan and scroll through display memory. An IBM-compatible serial interface permits connections with two RS232C devices such as graphics tablets, mice, plotters and printers. A resistive interface connects to devices such as mice, joysticks and paddles. A light-pen input is also supplied. The system occupies one expansion slot. A library of 13 color graphics routines in ROM can be called from high-level languages such as BASIC. $1,395. Matrification Inc., 26 Beacon St., P.O. Box 377, Burlington, Mass. 01803, (617) 272-7203. Circle No 336

VME bus board handles 32 analog inputs

The MVP901 12-bit resolution, 32-channel analog input, two-channel analog output board is electrically and mechanically compatible with and interfaces to the VMEbus. The analog-input section includes an analog multiplexer selectable for 32 single-ended or 16 differential channels, a resistor- or software-programmable amplifier, a sample/hold amplifier and a 12-bit A/D converter. An optional analog output section consists of two 12-bit D/A converters and control logic. Gains of 1 to 1000 V/V are software-selectable from the on-board programmable gain amplifier and can be stored in an on-board RAM. Analog-input signal ranges—jumper selectable for each channel—are +/−10 mV, +/−100 mV, +/−1 V and +/−10 V. Analog-output signal ranges are 0 V to 5 V, 0 V to 10 V, +/−2.5 V and +/−10 V at 5 mA. Prices start at $1,485. Burr-Brown, Box 11400, Tucson, Ariz. 85734, (602) 746-1111. Circle No 339
Learn how systematic development techniques can improve software quality and help you stay within your budget.

**Software Engineering...**

_A First Course_

Twenty 30-minute color videotapes from Colorado State University.

---

Folder describes video course

A collection of 20 half-hour videotapes for software engineers, showing how to cut the costs of software development and maintenance is described in a folder. Software engineers can use the course as an introduction to tools and techniques or as an introduction to modern programming practices. W.L. Somervell Jr., Director, Engineering Renewal & Growth Program, Colorado State University, Fort Collins, Colo. 80523, (800) 525-4950.

---

Catalog describes Multibus products

This 200-page Multibus products catalog describes the company's line of more than 70 products, including single-board computers, memory modules, I/O extenders and peripheral controllers. The catalog briefly describes the IEEE STD 796 bus, iSBX bus and Multibus II specifications. Symbicon Associates Inc., 89 Route 101A, Amherst, N.H. 03031, (603) 673-8988.

---

CAE workstation described in brochure

An eight-page brochure describes the DASH-1 (Design Aid Schematic Helpmate), a CAE workstation based on an IBM PC or XT. The brochure includes step-by-step illustrations of a schematic being created on-screen. The brochure also describes available proprietary software as well as design parts and flowchart/project-plan symbol libraries. FutureNet Corp., 2018 Osborne St., Canoga Park, Calif. 91304, (818) 700-0691.

---

Application note discusses data bus

This 12-page application note on the Manchester coding bus describes Manchester coding and its use. The note explains the differences between Manchester and NRZ coding. It discusses using Manchester coding in information transmission under MIL-STD-1553. It also describes coaxial- and transceiver-cable Ethernet interfaces. The note concludes with the advantages of using Manchester coding for MIL-STD-1553 and Ethernet. Figures and tables illustrate various formats, architecture, interfaces and comparisons. ILC Data Device Corp., 105 Wilbur Place, Bohemia, N.Y. 11716, (516) 567-5600.

---

Catalog covers datacomm equipment

This 14-page, illustrated short-form catalog and price list covers the company's data-communications equipment. The booklet briefly describes local networking equipment, voice/data multiplexers, data concentrators, data PABXs, modems, multiplexers, miniature local datasets and protocol converters. It also provides information on prices and volume discounts. Micom Systems Inc., 20151 Nordhoff St., Chatsworth, Calif. 91311, (213) 998-8844.

---

In the business machine torture chamber most of us call the office, one word processing printer shows true grit. We build our DP-Series daisywheels to keep turning out letter-perfect documents month after month. In the face of adversity and in the hands of a secretary. Call your printer distributor. Or contact Dataproducts at (213) 887-3924. 6200 Canoga Avenue, Woodland Hills, CA 91365. In Europe. 136-138 High Street, Egham, Surrey. TW 20 9HL England.
NEW PRODUCTS

**LITERATURE**

**THE BASICS BOOK OF DATA COMMUNICATIONS**

The 270-page book explains data-comm concepts. Taking a humorous approach to the complexities of networking, the 100-page reference covers such topics as terminals (One Size Does Not Fit All), choosing a circuit (Wats My Line?), expanding a network (Playing Connect-the-Dots) and network control (When the Chips Are Down). The last chapter describes and solves various application problems (Configuring Things Out). $14.95. Codex Corp., Catalog Sales Program, Department 713, Mail Stop 5-10, 20 Cabot Blvd., Mansfield, Mass. 02048, (617) 364-2000. Circle No 347

**Study forecasts low-end printer market**

This two-volume, 403-page report analyzes and predicts the low-end computer output printer market in the United States. It focuses on general-purpose and 80-column printers that attach to microcomputers and retail for less than $2,000. The market is forecast in unit shipments and dollars for serial dot-matrix printers, serial fully formed character printers and serial non-impact printers. The study provides in-depth profiles of 25 major vendors and describes their products, market thrust and competitive strategies. $1,650. Frost and Sullivan Inc., 106 Fulton St., New York, N.Y. 10038 (212) 233-1080. Circle No 348

**Guide helps entrepreneurs raise R&D funds**

Forming R&D Partnerships: An Entrepreneur's Guidebook is the third in a series of guidebooks serving the computer, software, electronics, medical and biotechnology industries. The 112-page guidebook, prepared by Anthony P. Spohr and Leslie Wat, explains the general concepts behind partnerships, including how investors and partners can get tax deductions, what an R&D contract is, how to implement a successful R&D program and how to avoid common pitfalls. High Technology Industry Group, Deloitte Haskins & Sells Executive Office, 1114 Avenue of the Americas, New York, N.Y. 10036, (212) 790-0500. Circle No 349
Progress, the by-product of innovation, is an Intel tradition. This leadership quality is well documented on the components side. Now, we're putting that same tradition to work in the area of systems with advancements such as our super-powerful, supermicro system for OEMs, the 286/310, to date the most powerful we've ever made. When it comes to systems integration, we're out in front with our iDIS Database Information System. Our iTAPS Transaction Processing System handles up to 16 users and allows for the development of individual application software 50% faster.

While we have grown in size, strength and technology, we have not lost sight of the qualities that put us out in front. You will still find a highly charged atmosphere of discovery and mutual respect. We still place a high premium on finding people who have inquiring minds, strong technical skills, and the ability to adapt quickly to changing situations. If you're an engineer involved with SOFTWARE EVALUATION, PRODUCT MARKETING, HARDWARE SYSTEMS, DIAGNOSTICS, CUSTOMER SERVICE, SYSTEMS SOFTWARE, CAD, PRODUCT EVALUATION, GRAPHICS, HIGH LEVEL LANGUAGES, OPERATING SYSTEMS, COMPILER, RELIABILITY, TECHNICAL MARKETING, or DATA BASE MANAGEMENT SYSTEMS, and want to see your work integrated into sophisticated new systems, let's talk.

Intel offers competitive compensation, advancement based on achievement, and the chance to work with some of the best minds in American industry. For consideration at Intel sites in Phoenix, AZ; Santa Clara, CA; Portland, OR; and Austin, TX, please direct your response to: Mike Gore, Intel Corporation, Dept. 8824, 2402 W. Beardsley Rd., Phoenix, AZ 85027. All inquiries will be answered promptly and held in strict confidence. An Equal Opportunity Employer M/F/H.

CIRCLE NO. 241 ON INQUIRY CARD
RESEARCH INSTITUTE
UNIVERSITY OF PETROLEUM & MINERALS
DHAHRAN, SAUDI ARABIA

NEEDS

Digital Electronics Repair Technicians for expansion of the facility for instrument repair, maintenance and calibration. Candidate background shall include:

* Bachelors or Associate Degree or equivalent military/technical training
* Minimum four years on-hand digital experience on micro-mini computers, peripherals, data acquisition systems, micro-processor controlled test instruments
* Trouble-shooting and repair capability to component level (Experience with current model minis, micros, and GPIB a big plus.)

Salary is competitive. Benefits include annual repatriation, housing and transportation allowance.

Candidates possessing the above requirements, need only apply to the address listed below within one week of the release of this advertisement, furnishing detailed resume of educational qualifications and experience, attaching copies of degrees and transcripts, giving names and addresses of four referees, including present employer, if possible, and present position held.

University of Petroleum & Minerals
Houston Office
5718 Westheimer, Suite 1550
Department 188
Houston, Texas 77057

CIRCLE NO. 242 ON INQUIRY CARD

COMPUTER

UNIX/C
$27-$65K

We are currently recruiting for 35 Washington, D.C. and nationwide based client companies who are offering challenging positions for UNIX/C Computer Professionals. Positions exist in both Systems Software and Applications Software Development. Our clients are working in the State of the Art in the areas of data communications, office automation, LANS, image processing and interactive graphics. Opportunities exist for professionals from entry level through Senior Systems Programmers with some positions in project and program management. A BS degree in CS, EE, Math or the equivalent plus at least 1 year of C programming experience is required. Knowledge of UNIX OS internals and Berkley UNIX a plus. For more information call or send your resume to:

800-336-3755
in VA call (703) 790-1284

STAFFING CONSULANTS
8027 Leesburg Pike, Vienna VA 22180

ALL FEES PAID BY CLIENT COMPANIES

CIRCLE NO. 243 ON INQUIRY CARD

EMPLOYMENT SERVICE FOR PROGRAMMERS AND ANALYSTS

National Openings With Client Companies and Through Affiliated Agencies

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. We guide; you decide.

RSVP SERVICES, Dept. MM
Suite 700, One Cherry Hill Mall
Cherry Hill, New Jersey 08002
(609) 667-4488

RSVP SERVICES, Dept. MM
Suite 211, Dublin Hall
1777 Walton Road
Blue Bell, Penna. 19422
(215) 629-0595

From outside New Jersey, call toll-free 800-222-0153

RSVP SERVICES
Employment Agents for Computer Professionals

CIRCLE NO. 244 ON INQUIRY CARD

More and more advertisers of minicomputers, microcomputers, CRT terminals, printers, disk drives, memories, modems, distributed data processing systems, etc., are consistently turning to MINI-MICRO SYSTEMS. Call Peggy Gordon at 203-328-2550.
CAREER OPPORTUNITIES... WE'RE CHANGING THE PACE OF BANKING!!!

Local Interviews

ISC Systems Corporation, the leader in microprocessor-based terminal systems for the financial industry, has outstanding opportunities for SOFTWARE AND HARDWARE PROFESSIONALS to join our expanding Spokane operation.

We are seeking:

SOFTWARE ENGINEERS with 2-4 years' microprocessor experience preferably in assembly language.

BANKING APPLICATIONS SPECIALISTS with 4+ years' experience on credit systems, deposit systems, commercial lending systems and branch banking administration.

SOFTWARE DEVELOPMENT ENGINEERS with 5-7 years' microprocessor experience with operating systems, networks, data communications, languages and file-server.

INTERNATIONAL SOFTWARE SPECIALISTS with 4-5 years of software design experience, preferably using Z-80 assembler on financial applications. Commercial banking experience and data communications experience a definite plus.

SOFTWARE INSTRUCTORS with 2-4 years' experience developing and presenting technical courses to technical people. You must have software experience.

SENIOR DIGITAL DESIGN ENGINEERS with 5-7 years' designing with microprocessors for a high volume production environment. Must have project management experience.

PRODUCT SAFETY MANAGER with a BSEE or equivalent plus 5-10 years of experience in the computer industry. You will be responsible for EMI/RFI design and testing of modular microprocessor-based systems. You must have a strong background in VDE/FCC agency requirements.

COMPONENTS ENGINEERS with 3-5 years' components engineering experience in state-of-the-art microprocessing technology.

RELIABILITY ENGINEERS with 5+ years in micro design analysis, MTBF calculations and failure analysis.

TEST ENGINEERS with 5+ years' experience in product design and qualification testing.

ISC offers and excellent salary, extensive fringe benefits and plenty of room for advancement. To explore these unparalleled opportunities, please send your resume today to: Bill Baumann.

ISC SYSTEMS CORPORATION
P.O. Box TAF C8
Spokane, WA 99220
equal opportunity employer
When All Systems Must Be Go!

Computer efficiency keeps you in business and when you need the very best computer disk and tape drives, just remember one thing: Count on Kennedy.

And while we're busy setting new standards in technology, we're also proud to maintain our eminent reputation for precise and dependable products. If you're a professional looking for a company with the inside track in technology and room for individual creativity and growth, you should consider these opportunities:

- Read/Write Engineers with 3-5 years experience in tape or disk products.
- Sr. Digital Design Engineers with 3-5 years experience with microprocessors, TTL, ECL, or related logic.
- Sr. Mechanical Designers with 10+ years experience including 5 years of precision mechanisms design and knowledge of plastic injection molding.
- Sustaining Engineers with 3-5 years design and value engineering related experience.
- Sr. Manufacturing Engineers with 5-7 years experience in tool and fixture design or mechanical design.
- Software Design Engineers to develop real-time programs for microprocessor based circuits. 3-5 years experience.
- Engineers to develop power supplies, servos, motors, drive amps, and sensors. 3-5 years experience.
- Sr. Mechanical Engineers to do electro/mechanical R&D design on tape and disk products. 5-10 years experience.

ATE Test Engineers to design and develop in-house ATE and test procedures for microprocessor based circuits. 2-4 years experience.

Now is the time to take advantage of the professional and personal rewards we offer our people. In addition to your valuable growth potential within our company, we provide a generous starting salary, the kind top professionals in your field expect to make, plus outstanding benefits including 100% tuition support. For immediate consideration, please send your resume and salary history to: Jason S. Munoz.
National Business Employment Weekly

Are you looking for a really good EDP position?

Start Your Job Hunt Right Here... with the National Business Employment Weekly

Every week, it includes hundreds of the best executive, managerial and professional positions available across the country. Jobs in every field, including data processing and virtually every area of technical expertise. Jobs at salaries from $25,000 to $250,000.

PLUS... weekly editorial features covering every aspect of career advancement. Articles on writing resumes, interviewing, salary statistics, regional employment trends, and much more.

LOOK FOR OUR SPECIAL OCTOBER 30TH "DATA PROCESSING" ISSUE WHICH WILL INCLUDE ADDITIONAL EDP OPPORTUNITIES AND RELATED EDITORIAL.

Pick up a copy of the National Business Employment Weekly at your newsstand today. Or we'll send you the next 8 issues by first class mail. Just send a check for $32.00 to:

National Business Employment Weekly
Dept. MM
420 Lexington Ave., NY, NY 10170

Software Engineers

For the experienced engineer, Sperry in Reston, Virginia offers an environment that is challenging and innovative. Because of our ongoing contracts, we are constantly looking for talented Software Engineers with the following experience to join our technical staff:

- UNIVAC AN/UYK
- VAX 11/780
- PDP-11
- SEL-32/77
- FORTRAN
- CMS-2 M
- Design, code, debug
- Test computer programs
- Simulation/Stimulation

Reston offers the finest in family living... small town amenities with big-city accessibility. Only 18 miles from the nation's capital, Reston is recognized as one of the best neighborhoods in America.

For complete information, send your resume to: Sperry Employment Department BH-4/327, 12010 Sunrise Valley Drive, Reston, VA 22091. U.S. citizenship and technical degree required. We are an equal opportunity employer.

TRW LSI Products in San Diego has led the industry in technology development and unique product introduction. We currently have opportunities on the ground floor:

THE JOB:

Design and develop a commercial product line of high speed digital signal processing equipment based on advanced integrated circuit devices soon to be available from TRW LSI Products Division. This equipment will address the growing image processing market including high precision medical instrumentation.

THE ADVANTAGES OF TRW LSI:

- A commercial market.
- Start-up organization focusing on board products within LSI.
- Board products will use DSP chips produced at LSI, which are state-of-the-art.
- LSI is part of TRW — an advanced technology, highly resourceful company.

CANDIDATE REQUIREMENTS:

- BS in Electrical Engineering or Computer Science. MS preferred.
- 3 or more years' experience in circuit design using bit-slice and/or microprogramming techniques in TTL, ECL and CMOS technologies.

Please send resume, including salary requirements to:

TRW LSI Products
Human Resources
Section 8433
P.O. Box 2472
La Jolla, CA 92038

Principals only, please.
We are an Equal Opportunity Employer.
No doubt during 1983, you knew that many organizations took a hard line on awarding liberal salary increases. Yet, on the other hand, did you know that salaries for some computer professionals soared right on through the uncertain business outlook?

Our 1984 Computer Salary Survey and Career Planning Guide will explain why many computer professionals are able to advance their careers more successfully than others:

- How some professionals—performing the same work and having a similar amount of experience—are earning significantly more than their peers.
- Why some professionals now earn as much as 25% more than they did last year.
- What emerging skills are most in demand and which positions command high salaries now and in the future.
- How size of firm and computer

Find out in our new, free Salary Survey.

Call Source™ today for your free copy

Is your salary still frozen? Call the Source Edp office nearest you for a free copy of our new 32-page report. We’ll mail a copy to you in strict confidence, without obligation. If unable to call, write:
Source Edp
Department MM1
P.O. Box 7100
Mountain View, CA 94039

When writing, please include your title.

United States:
Alabama
Birmingham 205/322-8745
Arizona
Phoenix 602/279-1010
Tucson 602/792-0375
California
Northern
Mountian View 415/969-4910
Sacramento 916/446-3470
San Francisco 415/634-9410
Walnut Creek 415/945-9190
Southern
Fullerton 714/738-1313
Irvine 714/933-1730
Los Angeles/Downtown 213/688-0041
Los Angeles/South Bay 213/540-7500
Los Angeles/West 213/203-8111
San Diego 619/231-1900
San Fernando Valley 818/781-4800
Colorado
Denver 303/773-3700

Colorado
Ft. Collins 970/482-7777
Grand Junction 970/243-4500
Meadows 970/243-4500
Cheyenne 307/632-6000
Denver 303/292-2000
El Paso 915/947-4000
Flagstaff 928/774-7000
Golden 303/740-1000
Greeley 303/645-2000
Las Vegas 702/267-1000
Loveland 970/668-4111
Mesa 928/632-4400
Montrose 970/243-4500
Omaha 402/391-2000
Pueblo 509/935-4000
Reno 775/323-2000
Salt Lake City 801/323-2000
San Jose 408/295-2000
Santa Fe 505/984-2000
Techno City 303/598-3000
Tulsa 918/291-2000
Utah 801/328-0000
Vallejo 707/291-2000
St. Louis 314/362-6500
Minneapolis 612/331-3400
Wisconsin
Madison 608/291-6000
Milwaukee 414/277-0000
Source Edp

MINI-MICRO SYSTEMS May 1984

Installation greatly affects compensation levels.

The new Survey is based on contacts with more than 44,000 computer professionals and 35,000 organizations. Not only are salary averages for fifty-eight positions reviewed (including ten new ones which we have never before covered), but high and low compensation ranges are also covered.

Included are positions in programming, software, systems design, database/data communications, Edp auditing, operations, computer sales, marketing, marketing support and management. You owe it to yourself—especially if most of your career lies ahead—to call or write for your free copy today.
MAY

5-18 **"International Study Mission on Electronic Printing Technology,"** Tokyo, sponsored by Technology Transfer Institute (TTI) and Dataquest Information Services Inc. Contact: Hideaki Hashizume, General Manager, TTI, 1 Penn Plaza, Suite 1411, 250 W. 34th St., New York, N. Y. 10019, (212) 947-2648.


21-24 **Boston Computer Showcase Expo,** Hynes Auditorium, Boston, produced by The Interface Group Inc. Contact: Linda M. Yogel or Peter B. Young, The Interface Group, 300 First Ave., Needham, Mass. 02194, (617) 449-6600 or (800) 325-3330.

22-25 **COMDEX/Spring,** Georgia World Congress Center, Atlanta Apparel Mart and Atlanta Merchandise Mart, Atlanta, produced by The Interface Group Inc. Contact: Linda M. Yogel, Peter B. Young or Lori Robak, The Interface Group, 300 First Ave., Needham, Mass. 02194, (617) 449-6600 or (800) 325-3330.

24-27 **Anaheim Computer Showcase Expo,** Anaheim Convention Center, Anaheim, Calif., produced by The Interface Group Inc. Contact: Linda M. Yogel or Peter B. Young, The Interface Group, 300 First Ave., Needham, Mass. 02194, (617) 449-6600 or (800) 325-3330.

MAY 31 - JUNE 2

**"Personal Computer and STD Computer Interfacing for Scientific Instrument Automation" Workshop,** Virginia Polytechnic Institute, Blacksburg, Va., sponsored by Virginia Polytechnic Institute and State University. Contact: Dr. Linda Leffel, CEC, Virginia Polytechnic Institute, Blacksburg, Va. 24061, (703) 961-4848. Also to be held Sept. 6-8 in Washington.

JUNE

6-8 **Display Terminal Conference,** Newport Beach, Calif., sponsored by Dataquest Inc. Contact: Gail van Tubergen, Conference Coordinator, Dataquest, 1290 Ridder Park Drive, San Jose, Calif. 95131, (408) 971-9000.

DON'T BLAME THE SOFTWARE!
Complete Hi-Tech Equipment Protection: Write for Free Catalog!
• Power line isolators
• Spike/surge suppressors
• Power line filter/suppressors
• Twist type socket protection
• Line voltage regulators
• Line conditioners
• Modem protectors

Electronic Specialists
171 S. Main, Natick, MA 01760 (617) 655-1532
Toll Free Order Desk 1-800-225-4676

IEEE-488 ½-inch and ¼-inch cartridge magnetic tape recording systems. Recording solutions for users of H-P, Tektronix, and other instrumentation and data logging systems.
- Dual density, speeds up to 75 ips.
- Worldwide computer data interchange.
- Data Acquisition, ATE, CAD, disc back-up and more.
- IBM & ANSI compatible formats.
- Transfer rates to 100,000 bytes/sec.
- Dual buffer to 24K bytes.
- Over 40M bytes of storage.

Fast 488!
IEEE-488 ½-inch and ¼-inch cartridge magnetic tape recording systems. Recording solutions for users of H-P, Tektronix, and other instrumentation and data logging systems.
- Dual density, speeds up to 75 ips.
- Worldwide computer data interchange.
- Data Acquisition, ATE, CAD, disc back-up and more.
- IBM & ANSI compatible formats.
- Transfer rates to 100,000 bytes/sec.
- Dual buffer to 24K bytes.
- Over 40M bytes of storage.

OMEGA Your Source
- TEMPERATURE
- HUMIDITY
- STRAIN
- PRESSURE
- INTERFACE
- SENSORS TO YOUR COMPUTER

Call or Write Today for your FREE copies of the OMEGA Temperature Measurement and Control Handbook and Encyclopedia™, the OMEGA Pressure and Strain Measurement Handbook™, and the OMEGA Computer Interface Handbook.

MINI-MICRO SYSTEMS/May 1984 To Advertise: Call Lorraine Komar 617-536-7780
RS232 or 8 BIT PARALLEL MINI CASSETTE SYSTEM

- LOW COST - $388 @ 100 UNITS
- Microprocessor Controlled
- >200K Bytes Formatted/Tape
- Variable Baud Rate (110-9600)
- Error Rate 1 in 10 to the 9th
- Small - 3" x 3.5" x 6" W/O Case

21 OTHER CARTRIDGE, CASSETTE, FLOPPY SYSTEMS WITH STORAGE TO 12 MEGABYTES

Basic Drive with R/W Electronics

ANALOG & DIGITAL PERIPHERALS INC
815 Diana Drive
Troy, Ohio 45373
513/339-2241
TWX 810/450-2685
Branch Off. Oklahoma City OK - Factory, Yucca Valley, CA
NCC. CASEY BOOTH S6600
CIRCLE NO. 207 ON INQUIRY CARD

ADVANCED COMPUTER SYSTEMS:
The RSX-11M+ SPECIALISTS
ANNOUNCES THE ARRIVAL OF THE LSI11/73 BASED
CP/C822 COMPUTER SYSTEMS WITH RSX-11M+
SUPPOR TRATING SUPERVISOR/MODE LIBRARIES AND
SEPARATE I AND D SPACE

CRYPTIC command systems can now be configured
with the NEW LSI11/73 CPU, giving three systems 1/20
PERFORMANCE OF LSI11/73s. CP/C822 systems cache
configured with up to 1280KB of fixed Winchester disk, up to 40K
of main memory and up to 512KB dynamic. System back-up is pro-
vided by an industry standard 9 track 1/2" (800 Mbps) tape drive or a
DEC RLOEM. Optional software packages include accounts receiv-
er, inventory, billing, financial reports, and a full range of standard
order entry, mailing list, FORTAN 77, BASIC 2.

CALL FOR FREE BROCHURE
250 Prospect Street
Waltham, Massachusetts 02154
617-894-3278
CIRCLE NO. 208 ON INQUIRY CARD

DEC COMPATIBLE WINCHESTER DISK SYSTEMS
DEC RLOI/RLO2 EMULATION USING 5 1/4" WINCHESTER DISKS
10 Megabyte (1 RLO1/2 RLO1) $2850
15 Megabyte (3 RLO1) 2950
30 Megabyte (3 RLO1/4 RLO1) 3100
40 Megabyte (4 RLO2) 3900

THE II CONNEXION
1815 Peterson Lane
Santa Rosa, CA 95401
(707) 545-7778
DEC is a registered trademark of
OMNIBYTE CORPORATION
CIRCLE NO. 209 ON INQUIRY CARD

Like-new products
For free catalog, phone toll-free (800) 225-1008
In Massachusetts (617) 938-0900
Genstar REI Sales Company
CIRCLE NO. 212 ON INQUIRY CARD

Uninterruptible Power Supply
Clean power is critical to the operation of computers, sensitive electronic equipment and telecommunication systems. The ICS, Inc. UPS systems assure uninterrupted operation with zero transfer time. Constant voltage output is maintained during severe line fluctuations or voltage drops. In addition, the UPS acts as a buffer between the AC line and computer at all times. Batteries provided from 5 minutes to specified time. LIFELINE Series: 200VA, 500VA, 1 kVA. "E" Model: 2 kVA to 20 kVA, single phase. OEM inquiries invited

ELECTRO-PAC
520 INTERSTATE ADDISON, ILLINOIS 60101
TEL (312) 543-6200 TWX 910-991-5945
CIRCLE NO. 214 ON INQUIRY CARD

OMNIBYTE CORPORATION
245 W. Roosevelt Road
West Chicago, IL 60185
(312) 231-6880
CIRCLE NO. 206 ON INQUIRY CARD

STD-BUS System Components
The FDC-I is a low cost, highly reliable floppy disc controller for the STD Bus. The FDC-I interfaces directly with 5 1/4 or 8 inch drives. The FDC-I is the ideal solution to mass storage requirements of test, data acquisition and development systems. For more information on the FDC-I or other STD Bus Products, Contact: Custom Micro Controls, P.O. Box 410, Hatfield, Pa. 19440 (215) 362-5617. Unit price $190.00 which includes documentation. (DEALER INQUIRIES WELCOME)
CIRCLE NO. 210 ON INQUIRY CARD
CIRCLE NO. 213 ON INQUIRY CARD

To Advertise: Call Lorraine Komar 617-536-7780
MINI-MICRO SYSTEMS/May 1984
Copy Deadline:
Space reservations and advertising copy must be received by the 10th of the month preceding the issue date. Camera-ready mechanicals must be received by the 15th of the month preceding the issue date. For example, to appear in the February issue, copy must be received by January 10; mechanicals by January 15.

Linda Lovett
(617)536-7780

CLASSIFIED ADVERTISING ORDER FORM

Mini-Micro Systems classifieds reach more mini-micro people

Rates: $0.00 per column inch (non-commissionable)
8x program earns 5% discount; 12x program earns 10% discount.
There is no charge for typesetting classified listings. Plan approximately 50 average words to a column inch, 8 lines of approximately 38 characters per line (3 inch maximum). Please send clean typewritten (double-spaced) copy.

Category: The following categories are available; be sure to specify the category you wish to be listed under: Business Opportunities, New Literature, Selling, Buying, Trading, Seminars, Services, Software, Supplies & Accessories. (Other categories may be employed at our discretion.)

Run this ad in ______ (number issues) Reader Inquiry No. YES □ NO □
Ad size 1 col. wide by ______ inches deep Under ______ (category)
Check enclosed for $ ______ (Pre-paid orders only)

Signature ______________________________ Title ______________________________
Company ______________________________ Telephone No. ______________________________
Address ______________________________
City ___________ State ___________ Zip ___________

MAIL TO: Linda L. Lovett, Classified Advertising, Mini-Micro Systems, 221 Columbus Ave., Boston, MA 02116
<table>
<thead>
<tr>
<th>Advertisers Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Able Computer</td>
</tr>
<tr>
<td>Advanced Digital Corp</td>
</tr>
<tr>
<td>Advanced Electronic Design</td>
</tr>
<tr>
<td>Ampex Corp., Memory Products Div</td>
</tr>
<tr>
<td>Applitek</td>
</tr>
<tr>
<td>Archive Corp.</td>
</tr>
<tr>
<td>Atasi Corp.</td>
</tr>
<tr>
<td>Atron</td>
</tr>
<tr>
<td>AT&amp;T Technologies</td>
</tr>
<tr>
<td>Bizcomp</td>
</tr>
<tr>
<td>Cahners Exposition Group</td>
</tr>
<tr>
<td>Calcomp</td>
</tr>
<tr>
<td>Callan Data Systems</td>
</tr>
<tr>
<td>Cambridge Digital Systems (Div of Compuart)</td>
</tr>
<tr>
<td>Century Data Systems</td>
</tr>
<tr>
<td>Charles River Data Systems</td>
</tr>
<tr>
<td>Chrislin Industries, Inc.</td>
</tr>
<tr>
<td>Cie Systems</td>
</tr>
<tr>
<td>Cie Terminals</td>
</tr>
<tr>
<td>Cincom Systems</td>
</tr>
<tr>
<td>Cipher Data Products, Inc.</td>
</tr>
<tr>
<td>Clapp &amp; Poliak, 136, 176, 176A &amp; B</td>
</tr>
<tr>
<td>Cogito Systems Corp.</td>
</tr>
<tr>
<td>Commerce Tours</td>
</tr>
<tr>
<td>Compaq Computer Corp.</td>
</tr>
<tr>
<td>Compupro</td>
</tr>
<tr>
<td>Computer Corp. of America</td>
</tr>
<tr>
<td>Control Data Corp.—Engineering Services</td>
</tr>
<tr>
<td>Control Data Corp.—OEM</td>
</tr>
<tr>
<td>Convergent Technologies</td>
</tr>
<tr>
<td>Craig Data Cable</td>
</tr>
<tr>
<td>Cromemco Inc.</td>
</tr>
<tr>
<td>Danish Data Electronics</td>
</tr>
<tr>
<td>Data General Corp.</td>
</tr>
<tr>
<td>Dataproducts</td>
</tr>
<tr>
<td>Dataram</td>
</tr>
<tr>
<td>Datasouth Computer Corp.</td>
</tr>
<tr>
<td>Date Systems Design Inc.</td>
</tr>
<tr>
<td>Data Technology Corp.</td>
</tr>
<tr>
<td>Davidge Corp.</td>
</tr>
<tr>
<td>Digital Equipment Corp.</td>
</tr>
<tr>
<td>Dilog (Distributed Logic Corp.)</td>
</tr>
<tr>
<td>Dragon Industries</td>
</tr>
<tr>
<td>DriveTec</td>
</tr>
<tr>
<td>Dysan Corp.</td>
</tr>
<tr>
<td>Electronic Solutions</td>
</tr>
<tr>
<td>Emulex Corp.</td>
</tr>
<tr>
<td>Epson America, Inc.</td>
</tr>
<tr>
<td>Esprit Systems, Hazeltine Terminals Div</td>
</tr>
<tr>
<td>Excelan</td>
</tr>
<tr>
<td>Facit Inc.</td>
</tr>
<tr>
<td>Formaster Corp.</td>
</tr>
<tr>
<td>Fujitsu America, Inc.</td>
</tr>
<tr>
<td>Genicom Corp.</td>
</tr>
<tr>
<td>Genisco Computers</td>
</tr>
<tr>
<td>Gould Inc SEL Computer Systems Div.</td>
</tr>
<tr>
<td>Hamilton/Avnet Electronics</td>
</tr>
<tr>
<td>Heurikon Corp.</td>
</tr>
<tr>
<td>Hewlett-Packard, 135, 218-219</td>
</tr>
<tr>
<td>Houston Instruments Div. of Bausch &amp; Lomb</td>
</tr>
<tr>
<td>Human Designed Systems Inc. (HDS)</td>
</tr>
<tr>
<td>IBC/Integrated Business Computers</td>
</tr>
<tr>
<td>Ibex Computers Corp.</td>
</tr>
<tr>
<td>IBM Corp.</td>
</tr>
<tr>
<td>Illbruck/USA</td>
</tr>
<tr>
<td>Imagen</td>
</tr>
<tr>
<td>Intel Corp.</td>
</tr>
<tr>
<td>Intermec Inc.</td>
</tr>
<tr>
<td>Interphase</td>
</tr>
<tr>
<td>Intertec Data Systems Corp.</td>
</tr>
<tr>
<td>Iomega Corp.</td>
</tr>
<tr>
<td>Irwin Magnetics</td>
</tr>
<tr>
<td>ISI International</td>
</tr>
<tr>
<td>Iosreg Corp.</td>
</tr>
<tr>
<td>JMI Software Consultants</td>
</tr>
<tr>
<td>Kel, Inc.</td>
</tr>
<tr>
<td>Kennedy Co.</td>
</tr>
<tr>
<td>Kimtron</td>
</tr>
<tr>
<td>Lanpar Technologies Inc.</td>
</tr>
<tr>
<td>Lear Siegler, Inc.</td>
</tr>
<tr>
<td>Liebert Corp.</td>
</tr>
<tr>
<td>Linkdata</td>
</tr>
<tr>
<td>Lockheed Getex</td>
</tr>
<tr>
<td>Logical Business Machine</td>
</tr>
<tr>
<td>Mannessmann Tally</td>
</tr>
<tr>
<td>Marksoftware Int. Inc.</td>
</tr>
<tr>
<td>Maxtor Corp.</td>
</tr>
<tr>
<td>MDB Systems Inc.</td>
</tr>
<tr>
<td>Megatek Corp.</td>
</tr>
<tr>
<td>Method Systems Inc.</td>
</tr>
<tr>
<td>Micom Systems, Inc.</td>
</tr>
<tr>
<td>MicroCraft</td>
</tr>
<tr>
<td>Micro Five Corp.</td>
</tr>
<tr>
<td>Micro Focus Inc.</td>
</tr>
<tr>
<td>Microsoft</td>
</tr>
<tr>
<td>Mini-Micro</td>
</tr>
<tr>
<td>Motorola Semiconductor Products</td>
</tr>
<tr>
<td>Mupac Corp.</td>
</tr>
<tr>
<td>National Semiconductor Corp.</td>
</tr>
<tr>
<td>Navtel</td>
</tr>
<tr>
<td>NCR Corp.</td>
</tr>
<tr>
<td>NEC Peripherals</td>
</tr>
<tr>
<td>Nova Graphics International Corp.</td>
</tr>
<tr>
<td>Novell Data Systems</td>
</tr>
<tr>
<td>Okidata Corp.</td>
</tr>
<tr>
<td>OSM Computer Corp.</td>
</tr>
<tr>
<td>Otari Electric Co.</td>
</tr>
<tr>
<td>Perkin Elmer</td>
</tr>
<tr>
<td>Persyst</td>
</tr>
<tr>
<td>Pioneer Research</td>
</tr>
<tr>
<td>Plexus Computers</td>
</tr>
<tr>
<td>Priam</td>
</tr>
<tr>
<td>Pyramid Technology</td>
</tr>
<tr>
<td>Quality Micro Systems</td>
</tr>
<tr>
<td>Quantum Corp.</td>
</tr>
<tr>
<td>Qume</td>
</tr>
<tr>
<td>Racal-Vadic Inc.</td>
</tr>
<tr>
<td>Ridge Computers</td>
</tr>
<tr>
<td>Rodime</td>
</tr>
<tr>
<td>Scientific Micro Systems</td>
</tr>
<tr>
<td>Seagate Technology 171, 173, 175</td>
</tr>
<tr>
<td>Seiko Instruments</td>
</tr>
<tr>
<td>Selanar Corp.</td>
</tr>
<tr>
<td>Shugart Corp.</td>
</tr>
<tr>
<td>Sola Electric</td>
</tr>
<tr>
<td>SyQuest Technology</td>
</tr>
<tr>
<td>Tandberg Data Inc.</td>
</tr>
<tr>
<td>Tandon Corp.</td>
</tr>
<tr>
<td>Televideo Systems Inc.</td>
</tr>
<tr>
<td>Texas Instruments Inc. 52, 248-249</td>
</tr>
<tr>
<td>Texwico Co.</td>
</tr>
<tr>
<td>Transcorp.</td>
</tr>
<tr>
<td>Trilog Inc.</td>
</tr>
<tr>
<td>Ungermann-Bass</td>
</tr>
<tr>
<td>Unify Corp.</td>
</tr>
<tr>
<td>Unisoft Systems</td>
</tr>
<tr>
<td>Unitronix</td>
</tr>
<tr>
<td>Universal Data Systems, Inc.</td>
</tr>
<tr>
<td>Vectrix</td>
</tr>
<tr>
<td>Versatec Inc., A Xerox Co.</td>
</tr>
<tr>
<td>Visual Age</td>
</tr>
<tr>
<td>Visual Technology</td>
</tr>
<tr>
<td>Western Digital</td>
</tr>
<tr>
<td>Winterhalter</td>
</tr>
<tr>
<td>Wyse Technology</td>
</tr>
<tr>
<td>Xebec</td>
</tr>
<tr>
<td>Zaisan</td>
</tr>
<tr>
<td>Zilog Inc.</td>
</tr>
<tr>
<td>See P. 301-306 for Career Opportunity Advertisers</td>
</tr>
<tr>
<td>See P. 309-310 for Mini-Micro Marketplace</td>
</tr>
<tr>
<td>See P. 311 for Classified Advertisers</td>
</tr>
</tbody>
</table>

This index is provided as an additional service. The publisher does not assume any liability for errors or omissions.
Our IBM Protocol Converter is not the same under the skin.

MICOM's new Micro7400 is very, very different. It not only provides a Gateway for dumb asynchronous terminals to access IBM mainframe applications, but goes far beyond the basic capabilities of IBM 3270's and other protocol converters. It's even easy to use.

Since MICOM is the world's largest volume manufacturer of data concentrators—thanks to its Micro800/2 "Orange Box" family—it's only natural that MICOM's protocol converter should include the same features and capabilities that made the data concentrators so popular. And fortunately for asynchronous terminal users wishing they could connect to IBM mainframes, and for mainframe DP managers looking for less expensive terminals, adding concentrator features to a converter makes for a surprisingly effective hybrid.

**All Standard IBM 3270 Features**

Functioning as an IBM 3274 Model 51C Cluster Controller using either Bisync or SNA/SDLC protocol, the Micro7400 allows ASCII terminals (or personal computers emulating terminals) to perform as 3270s. Display terminals emulate IBM 3278s; printers emulate IBM 3287s. And special software allows printer terminals to interact with full-screen programs originally developed for ctc's.

**Plus Extra Functions**

The Micro7400 also offers features not available in the IBM 3270 line, including dial-up access to the protocol converter, terminal-controlled diagnostics, and do-it-yourself channel configuration for setting terminal-related parameters like parity.

**Support for IBM Personal Computers**

IBM PCs connected to the Micro7400 can emulate IBM 3270 terminals, too, for communicating with mainframes. Diskette-based MICOM software makes it easy.

**Switching Between Multiple Hosts**

Users can switch between two IBM hosts, or between an IBM host and asynchronous ports on one or more minicomputers—completely under terminal control.

**Command Port**

Unique among protocol converters, the Micro7400's Command Port allows a network manager to dynamically alter operating parameters like priority assignment, as well as providing monitoring, diagnostic, and control facilities.

**As Low As $400 Per Channel**

Even the pricing is more like a concentrator. Standard models are available to support from two to 12 channels, at prices as low as $400 per channel. A budget-minded 2-channel "LTD" model is also offered, as are cost-saving versions with built-in modems. And there's much more. Call our toll-free (800) number below for a 12-page color brochure and price list.

For protocol conversion without tears, think MICOM.
INTRODUCING THE EXTRAORDINARY
EPSON OEM FAMILY OF FLOPPY DRIVES

Extraordinary is the best word we could find to describe the new Epson family of 3½" and 5¼" floppy disk drives. Because there is nothing ordinary about them.

The 3½" drives, for instance, feature two-sided capacities up to 1MB. And some draw so little power they can operate on batteries.

The half-height 5¼" drives offer capacities from 500KB to 1.6MB and access times down to 3 msec. And the one-third height 5¼" drive is the industry’s slimmest.

But that’s only part of the story. What really makes them extraordinary is the fact that they’re Epson drives. Designed and built by the people who have made “quality in quantity” their trademark around the world.

That means they’re designed and engineered with such state-of-the-art features as noise and RF shielding, ultra-high precision head positioning and loading, perfect disk centering, reduced power consumption and heat generation. But, even more importantly, it means they’re manufactured by the people who have established the lowest rejection rate in the industry. When you buy Epson, you buy confidence.

If you’d like more information about the extraordinary Epson family of floppy drives and how they can solve your storage problems, write or call us today.

SW Region (714) 751-1919  •  NW Region (408) 985-8828  •  SE Region (404) 458-9666
NE Region (617) 245-8007  •  CENTRAL Region (815) 338-5810