VOLUME 10, NO. 5 MAY 1980

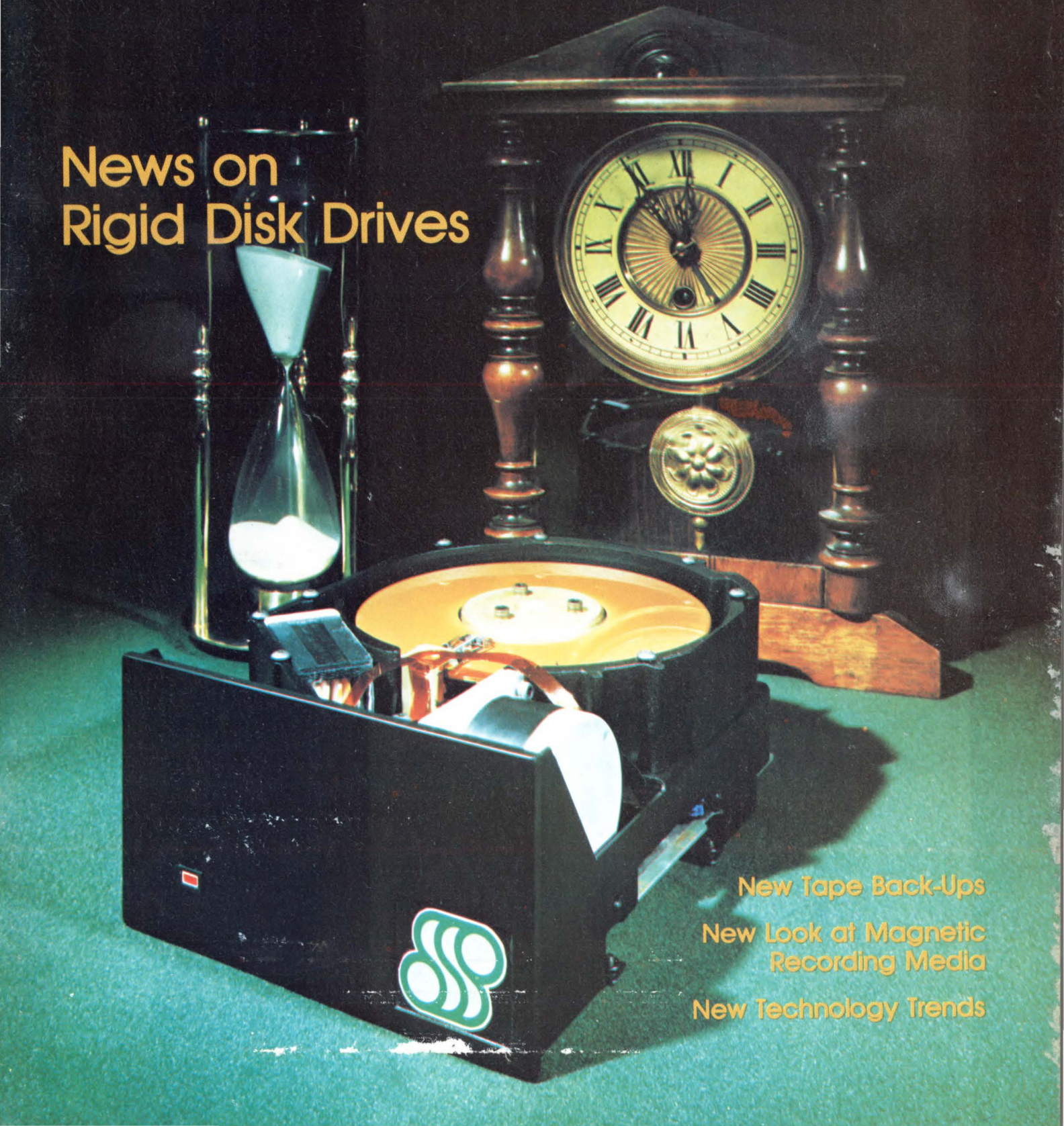
Digital Design

Computers • Peripherals • Systems

Inside! Starts on page 86

NCC 80 Over 100 New Products

News on Rigid Disk Drives



New Tape Back-Ups

New Look at Magnetic Recording Media

New Technology Trends

We take calls from Venus...

and Mars, Sweden, Switzerland, Norway, Brazil, Great Britain...

and virtually every other country on Earth. Kennedy Company and its digital tape products were pioneers in such demanding applications as telephone toll-ticketing, usage analysis, message switching control and electronic switching systems.

These years of reliable operation are one of the reasons NASA installations throughout the world utilize Kennedy tape recorders to telemetrically record and digitally reproduce such significant data and photographs from the Viking, Pioneer and Voyager probes of Mars, Venus and Jupiter.

Whether recording your call to a friend in Europe, or displaying the wonder and beauty of outer space, Kennedy digital tape transports can be relied upon.

Photo courtesy of NASA and
Jet Propulsion Laboratory, Pasadena, CA

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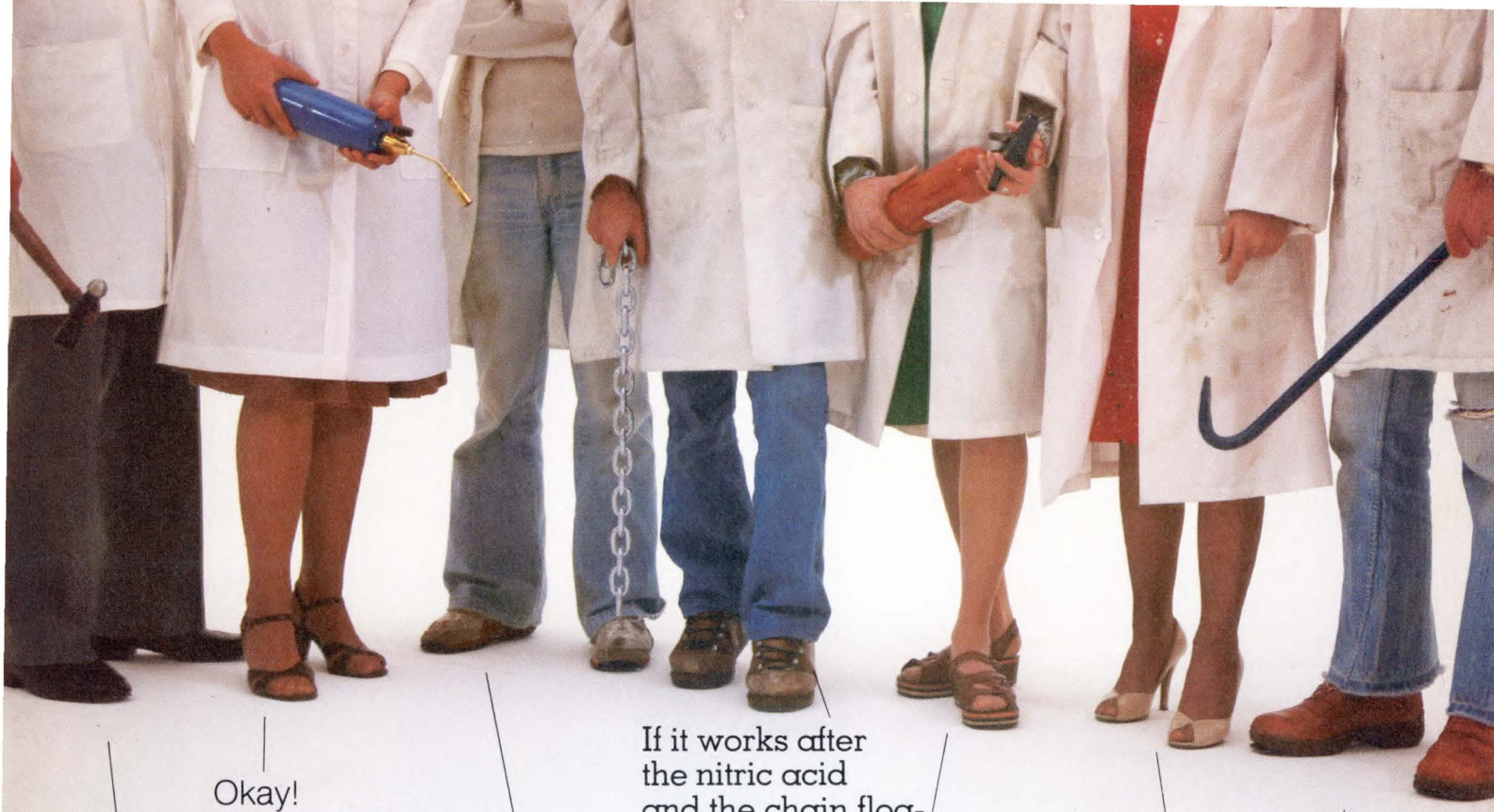

Okay!
Can I help it if nothing happens when I burn it with the blowtorch?

Nobody leaves until we prove something here. I want heat, I want cold, I want wet, I want... *violence!*

I don't think this will work. No matter how tough our tests are, you can't prove reliability in an ad.

If it works after the nitric acid and the chain flogging, what more could they want?

Come on. The pressure's gone down in the fire extinguisher.

They'll probably want us to *prove* it still works. Now, how are we going to do that?

Why don't they just call or send the coupon and we'll show them in person?

I can't take this any more.

MiniComputer Technology.
Our quality controller is your quality control.

Disk and tape controllers for DEC, Data General, and Interdata.

All right. I've seen your cruel and unusual ad. Now show me your controller.

Name _____

Title _____

Company _____

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See Us at NCC, Booth #'s 519 A & B, Disneyland Hotel. Hospitality Suite, Conestoga Inn.

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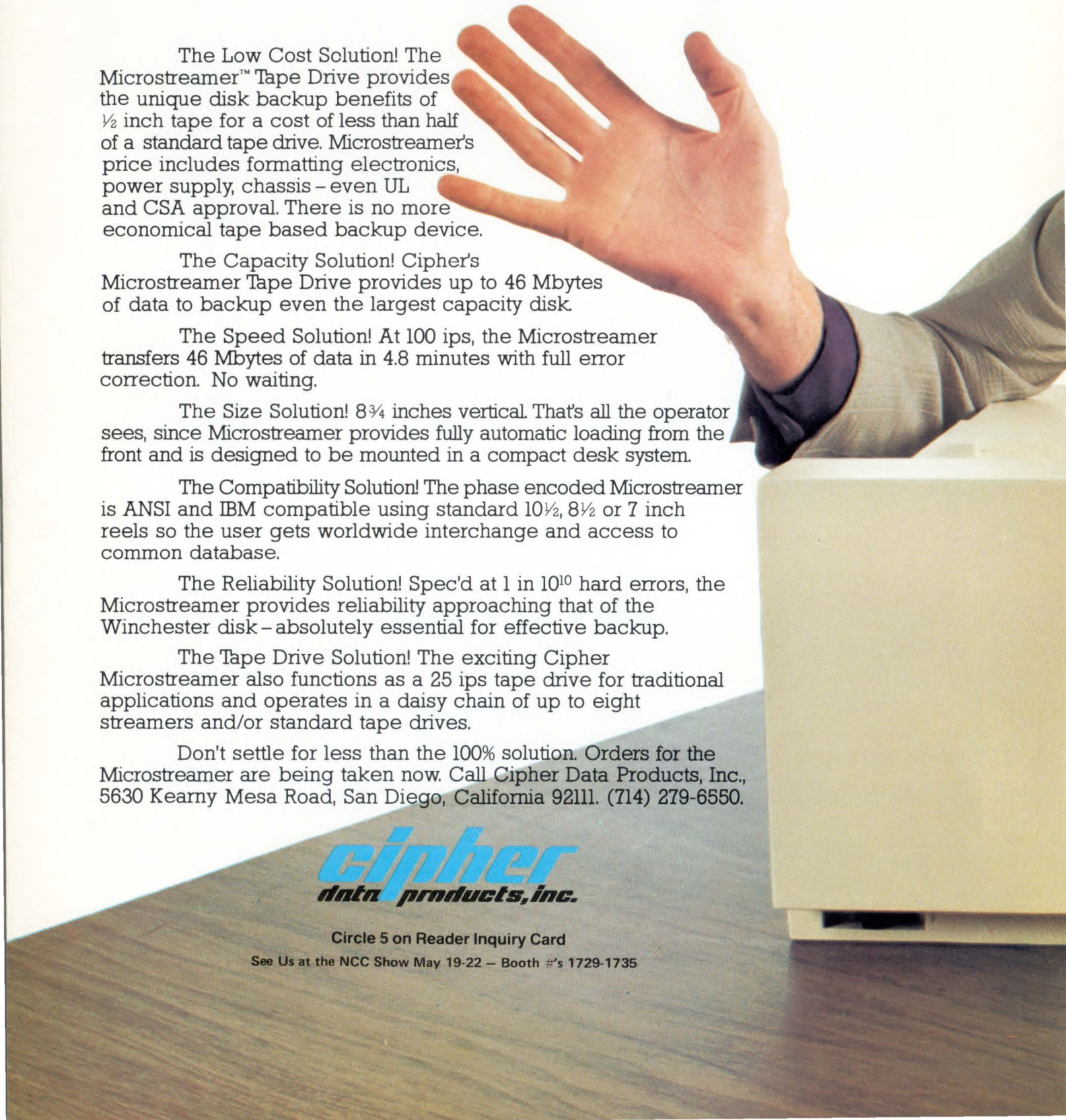
Introducing Microstreamer.™ The 100% solution to disk backup.



The Low Cost Solution! The Microstreamer™ Tape Drive provides the unique disk backup benefits of ½ inch tape for a cost of less than half of a standard tape drive. Microstreamer's price includes formatting electronics, power supply, chassis – even UL and CSA approval. There is no more economical tape based backup device.

The Capacity Solution! Cipher's Microstreamer Tape Drive provides up to 46 Mbytes of data to backup even the largest capacity disk.

The Speed Solution! At 100 ips, the Microstreamer transfers 46 Mbytes of data in 4.8 minutes with full error correction. No waiting.

The Size Solution! 8¾ inches vertical. That's all the operator sees, since Microstreamer provides fully automatic loading from the front and is designed to be mounted in a compact desk system.

The Compatibility Solution! The phase encoded Microstreamer is ANSI and IBM compatible using standard 10½, 8½ or 7 inch reels so the user gets worldwide interchange and access to common database.

The Reliability Solution! Spec'd at 1 in 10^{10} hard errors, the Microstreamer provides reliability approaching that of the Winchester disk – absolutely essential for effective backup.

The Tape Drive Solution! The exciting Cipher Microstreamer also functions as a 25 ips tape drive for traditional applications and operates in a daisy chain of up to eight streamers and/or standard tape drives.

Don't settle for less than the 100% solution. Orders for the Microstreamer are being taken now. Call Cipher Data Products, Inc., 5630 Kearny Mesa Road, San Diego, California 92111. (714) 279-6550.

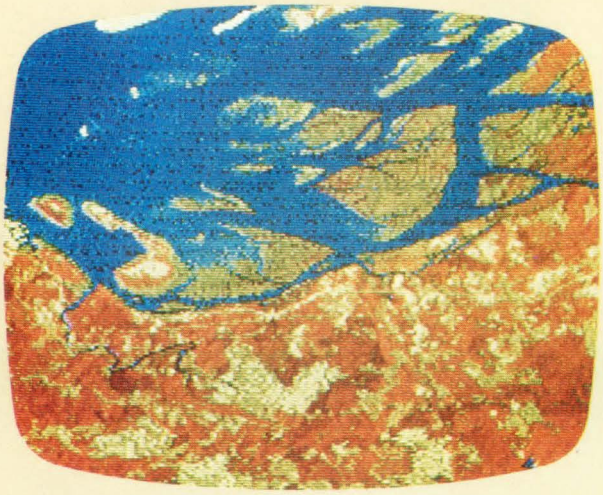
cipher data products, inc.

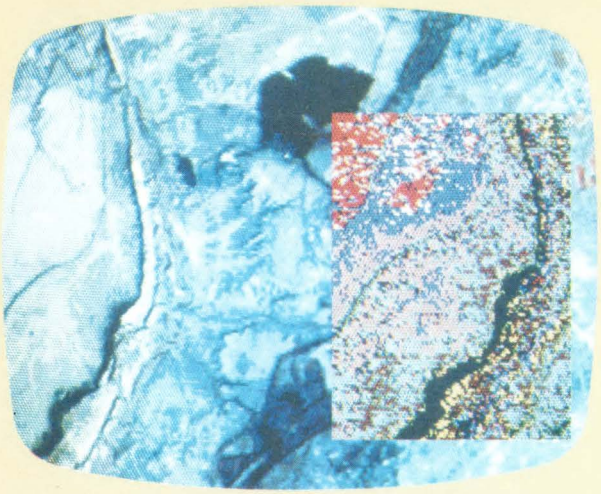
Circle 5 on Reader Inquiry Card

See Us at the NCC Show May 19-22 – Booth #'s 1729-1735


Now, that's
excitement!
Cipher

Image processing. Your way.





Now, with the Grinnell GMR-270 Image Processing System, you can have pipeline image processing tailored to fit your application.

The GMR-270 combines the best features of our proven GMR-27 line of high speed graphic display systems with a special package of sophisticated image processing features. The result is a modular image processing system that can be furnished with any or all of the following:

- Convolution
- Image multiplication and ratioing
- Zoom and pan
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- Function memories
- Pseudo-color tables
- Video digitizers with frame averaging
- Split screen and image toggling
- Full graphics and alphanumerics
- Up to four overlay memory planes
- Independent cursors
- Trackballs and joysticks
- External synchronization
- Plug compatible interfaces for most minicomputers

In addition, the GMR-270 has a display resolution of 512 x 512 pixels and a video format that is RS-170 compatible. It is housed in a rack-mountable chassis and drives standard TV monitors.

Besides the GMR-270, Grinnell manufactures two complete lines of graphic television display systems: the GMR-27 Series and the GMR-37 Series. GMR-27 units are high speed, graphic and image display systems; GMR-37 units are low cost graphic display systems. Both are available with display resolutions from 256 x 512 to 1024 x 1024.

So, whether you want to analyze images from outer space or monitor a process in a plant, Grinnell has a system that can do it. For detailed specifications and/or a quotation, call or write today.

Photographs provided by Stanford University Department of Applied Earth Sciences, Palo Alto, California.

GRINNELL SYSTEMS

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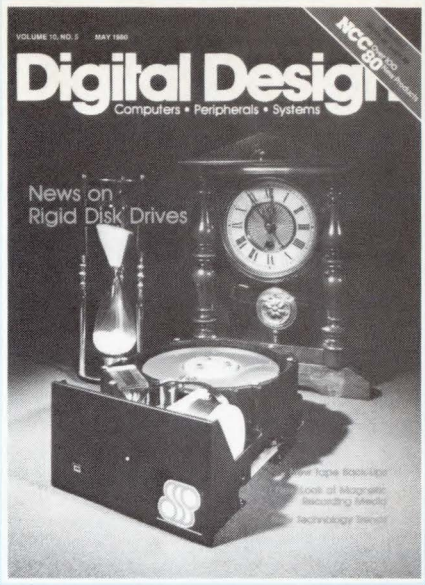
VOLUME 10, NO. 5 MAY 1980

Digital Design

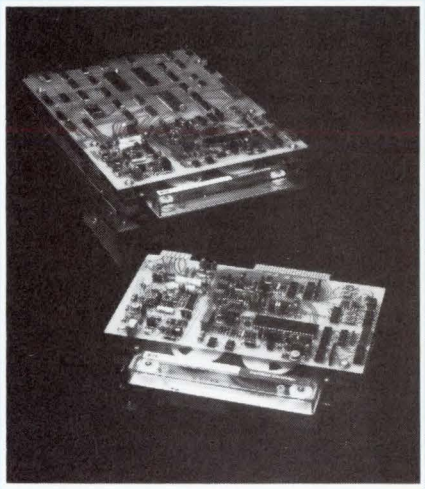
Computers • Peripherals • Systems

Departments



ON OUR COVER

This month's report covers 8″ Winchester drivers like Shugart's (shown above) and other types of hard disks as well as tape streaming and other backup memory systems. Photo courtesy of Shugart Technology.



p. 80

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DIGITAL DESIGN
Publication number: USPS 407-010

Published monthly by Benwill Publishing Corp., a Morgan-Grampian Company, 1050 Commonwealth Ave., Boston, MA 02215. Controlled circulation paid at Long Prairie, MN 56347.

Digital Design

Computers • Peripherals • Systems

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AND THERE'S MORE

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*Trade name of Digital Equipment Corporation

Letters

High Quiescent Current Draw

Dear Editor:

I'd rate Austin's "Battery Backup Provides No-Break/Automatic Shutoff Operation" (February, pgg. 78-79) as low. In the final design, he includes a level detector. In a battery-powered system, how can he afford the 14 mA or so current draw (quiescent) brought about by the circuit? However, if it's a high-current system, where he can afford such a draw, shouldn't he have mentioned this?

Thomas L. Panian
Essex Group, Inc.
Pittsburgh, PA

Getting Things Done

Dear Editor:

I have posted your February Speakout, "Getting Things Done," for frequent review. It is apropos to many engineers and useful as a reminder.

C. S. Anderson
Wichita Information Systems Co.
Wichita, KS

Wants New Society

Dear Sir:

It is about time to get after the IEEE. Maybe we need a society for "professional" engineers.

Gary Kravetz
FORTH, Inc.
Hermosa Beach, CA

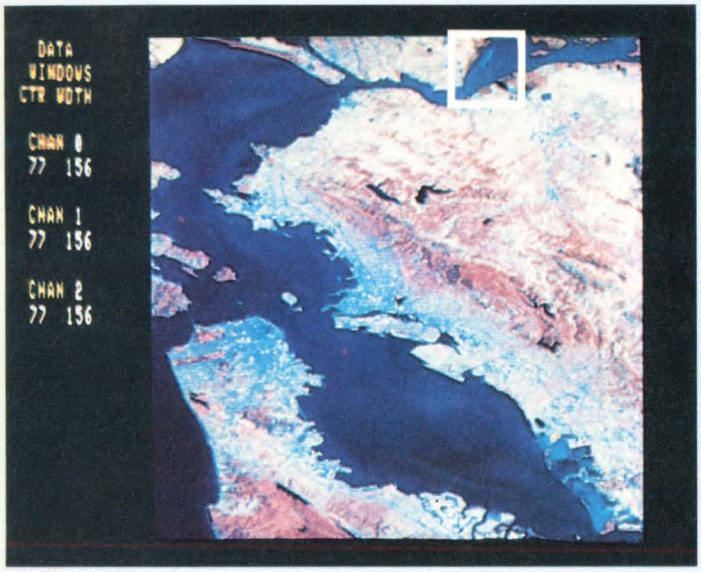
Was IBM's Virtual Storage First?

Dear Editor:

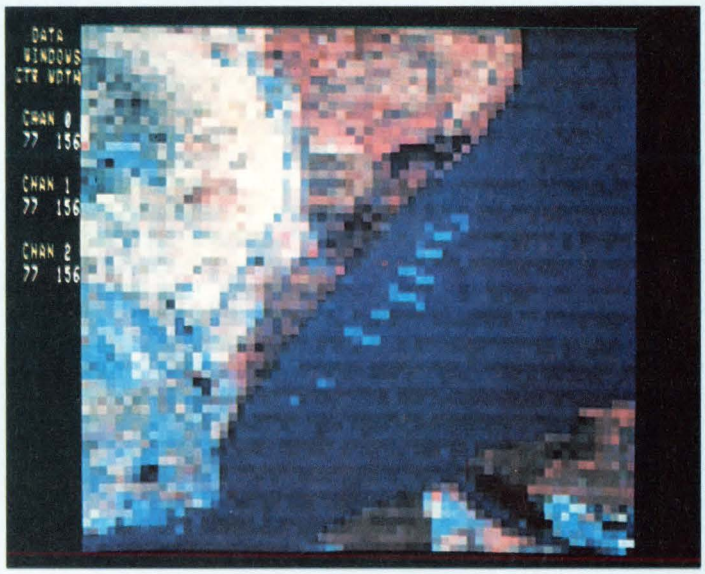
In the January issue on Page 46 in the Special Report on Add-In/Add-On Computer Memories, Mr. Snigier states: "Virtual storage, a storage management technique first used in 1974 on the IBM 370, allows the CPU to have storage capacity many times that physically in the CPU . . ." This is commonly accepted, but is not so. IBM was NOT the first to introduce virtual storage as is so commonly believed. As with most IBM "firsts" others had been doing it for years.

R. A. Lovestedt
Weherhauser
Tacoma, WA

THE IMAGE ARRAY PROCESSING SYSTEM



Three band LANDSAT image of San Francisco Bay



Eight-to-one zoom of Suisun Bay

If image analysis and aquisition is your problem, you need the IP 5000 Image Array Processor.

The display system that:

- Stores up to one megabyte of data for single or multiple image arrays.
- Has complete independence between refresh memory (raster scan output) and host computer addressability of memory.
- Includes memory management and data control for direct high speed access to refresh memory.
- Includes a powerful, pipe-line processor to perform high speed image array processing and statistical analysis.
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- Can selectively change format between 525 line and 559 line video formats with external sync capability for 525 line formats.
- Is capable of scrolling, in any direction, a pixel or line at a time or multiple pixels and lines without causing tearing of the visible image.
- Digitizes video signals up to 8-megahertz bandwidth with true 8-bit precision.
- Has multiple intensity transformation tables for grey scale, color or pseudo color displays.
- Has proven reliability with field installation at some of the top names involved in image processing and display.

For further information and a list of satisfied users, contact DeAnza Systems, Inc., 118 Charcot Ave., San Jose, CA., 95131, (408) 263-7155.

De Anza Systems Incorporated

GIVE YOURSELF A BETTER IMAGE

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Letters

Secondary Theme

Dear Editor:

I take exception to Irwin Feerst's letter in the February issue. I did not like his reference to technicians. I realize that this was a secondary theme to Feerst's plea to make the engineering community more eliteist. I would not normally express concern over this. However, your editorial may reflect a similar attitude. Do engineers resent their skills being wasted on lesser tasks that techs can do? This seems to endorse the formation of such attitudes.

Timothy P. Froehlke
Houston, TX

Designers' Notebook

Dear Editor:

Designers' Notebook is very helpful. Review and survey articles are great, too, but the Designers' Notebook has little twists and unique solutions worth their weight in gold.

Edmund M. Buras, Jr.
Gillette Research Institute
Rockville, MD

Except One . . .

Dear Editor:

I read your special report on "Add-In/Add-On Computer Memories" (by Paul Snigier, January, 1980) with great interest. You did an excellent job on the report and covered all the bases, except one – us. We were not included in your list of memory manufacturers on page 57. Our Memory Systems Division, 1275 Hammerwood, Sunnyvale, CA 94086, has developed, delivered and installed more than 2 billion bytes of add-on memory since the company was founded in 1968 as Advanced Memory Systems (AMS). The Memory Systems Division designs and manufactures add-on and add-in memories for the IBM 360, 370 and 303X sereies of CPUs, in addition to add-in memory boards for the DEC PDP-11 and the Data General NOVA 3 minicomputers. The division contributed more than $50 million to Intersil's sales of over $140 million for fiscal 1979. By any measure – systems shipped or megabytes installed – we are one of the largest independent manufacturers of semiconductor memory systems in the industry.

Robert Landon
Intersil, Inc.
Cupertino, CA

DNB Enthusiast

Dear Editor:

The January article, "Self-Contained Professional/Personal Computer offers BASIC/CAD," by Mr. Snigier on the HP-85 was excellent. One criticism on the issues, though: I'd like to see even more Designers' Notebook (DNB) material.

W. Bartels
SEI
Rolling Meadows, IL

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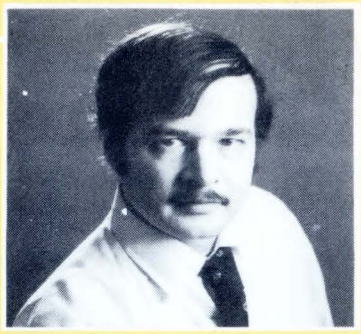


Speakout

Paul Snigier, *Editor*

When Is A ROM Not A Piano Roll?

Software can be copyrighted. It's not an absolute form of protection, since what is protected is an expression and not the approach taken or the program's content. Can programs in ROM be protected under copyright laws? You'd think so.

But, now comes news from Chicago, where a Federal judge held that an object program held in ROM *cannot be copyrighted.* The stage for this ludicrocity was set early in 1977, when a microcomputer consultant was hired to generate flow charts and a program for a six-level, chess-playing microcomputer. The source program was converted into an object program for the ROM. A copyright notice was written into the program, but was not on the DIP, accompanying customer literature, nor stamped onto the enclosure. A certificate of copyright registration was issued to the plaintiff in November 1978.

Shortly thereafter, the defendent, a well-known mail-order firm marketing electronic-based consumer products, introduced a similar chess-playing computer. Although everyone is befuddled as to how *the same ROM got into both competing chess-games,* everyone agrees that they both came from the same Hong Kong firm. Most likely, this overseas firm simply decoded the plaintiff's ROM, and then dumped the coded program into a PROM and sent this to a ROM maker for the second firm – and collected from both.

Quite upset at this point and hoping for a preliminary injunction against the defendent, the plaintiff filed an action for copyright infringement and unfair competition early last year. What happened next shocked everyone.

The judge denied the claim of unfair competition and ruled that the ROM is not a copy of the program protected under common law or the 1909 Copyright Act, stating that "Both in common law and under the 1909 Act, a 'copy' must be in a form which others can see and read." In other words, if someone looking at the ROM can't see it's an identical copy, then tough luck, pal.

The most learned judge's analogy? You wouldn't believe it. He said that since it's O.K. to make unauthorized piano rolls of a composer's composition, and that since this didn't infringe on the right to copy, that this had something to do with ROMs. Incidentally, the precedent he cited was a 1908 case in the heyday of piano rolls. Not content with this, he cited several decisions from the construction industry. That's right – from the commercial and residential home-building industry! (Perhaps he thinks computer architectures have something in common with architects who design buildings – or something.) Since a completed building is not a copy of the architect's plans, it's not a copyright violation; hence, according to this judge's reasoning, programs in ROM cannot be copyrighted. He then cited the precedent of artists' paintings and sculptors' statues as artistic creations and not being writings, so they cannot be copyrighted. (I was totally confused at this point, wondering what precedent the judge would dare conjure up next.)

At any rate, I understand that, at the plaintiff's request, the Federal judge is reconsidering his opinion. (With his footprints all over his mouth, the judge will most likely change his mind.) But whether he changes his mind or not by the time you read this is not so much the point as that of the potentially stupid situation of monumentally disasterous proportions that nearly took place. Like a potential explosion at Three Mile Island, we nearly had a disaster here that could have wiped out a portion of the computer industry!

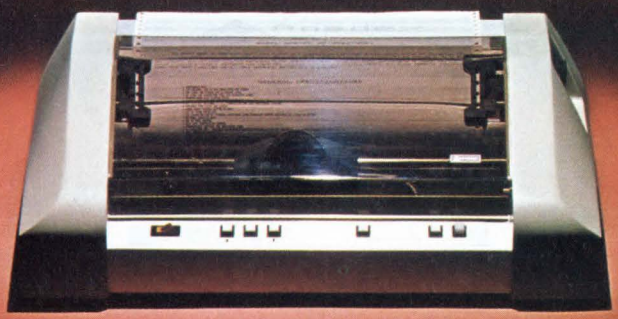
A question arises like an ugly spectre over the computer industry, and indeed, over all of modern society: Can we afford to entrust important engineering matters to legal, accounting and political experts who know ziltch about these complex matters? Increasingly, top legal, political and management personnel are incompetent to handle these complex decisions without messing up (perhaps not openly, since they are experts at sweeping their mistakes under the rug and blaming us or others).

Can we afford to do things in the 1980s as they did them in the 19th century? We are. But, today, times are changing so fast, the stakes are higher, and entrusting the management and decision-making processes of nuclear power plants, software and electronics to the lawyers, politicians and accountants we now have will guarantee more "Three Mile Islands" throughout the entire technology-base of society. The problem of technologically incompetent legal, accounting and political personnel in a society based more on technology will guarantee stupid decision-making. It's a problem that will worsen.

There is only one sensible and reasonable alternative: We must create a formal nationwide training structure to deliberately re-train experienced engineers in law, accounting and politics, and then let them enter the decision-making segments of these legal, business and political fields that they are so expert in. (Perhaps IEEE can push for such a Federal program, but don't hold your breath waiting.) The alternative is to let the unknowledgeable legalmen, accountants and politicians run tomorrow's "Three Mile Islands." It's frightening.

Meet two new Printers from Anadex:

Resolutionary!



Introducing two totally new line printers from Anadex – Models DP-9500 and DP-9501 – offering 132/158/176 and 132/165/198/220 columns, respectively, and featuring true high-density graphics under direct control of the data source.

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The full standard ASCII 96 character set, including descenders and underlining of all upper and lower case letters, is printed bi-directionally on the original and up to 5 crisp copies at speeds up to 200 CPS. Print densities are switch- or data-source selectable from 10 up to 16.7 characters/inch, and all can be printed double-width by communications command.

The three ASCII compatible interfaces (parallel, RS-232-C, and Current Loop) are standard in both models; so interfacing is usually a matter of "plug it in and print." Also standard is a sophisticated communications interface providing control of Vertical Spacing (6 or 8 lines/inch), Form Length and Width, Skip-Over Perforation, Auto Line Feed, and full point-to-point communications capability.

Other standard features are: forms width adjustment from 1.75 to 15.6 inches, shortest-distance sensing logic, self-test, quick-change ribbon cartridge with 6 million character life, and a 600 character FIFO buffer. (An additional 2048 character plug-in buffer is optional).

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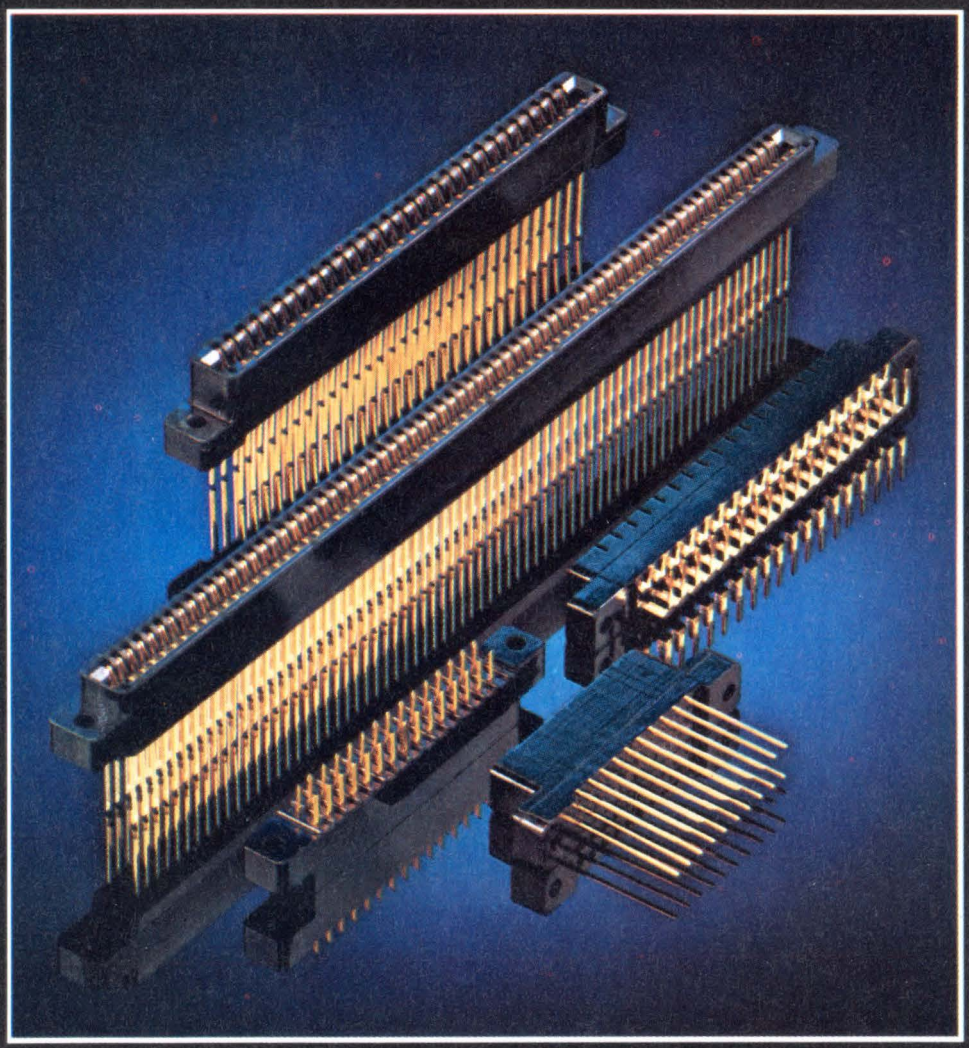
How to make sure you've specified absolutely the best P/C connector.



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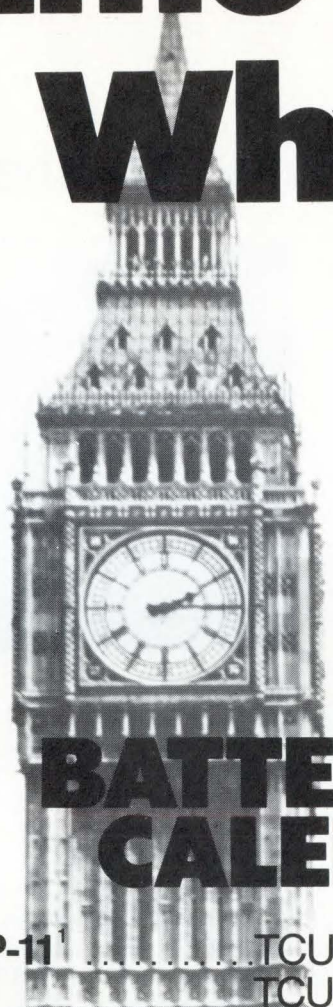
Time is precious Why lose it?



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DIGITAL PATHWAYS

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Technology Trends

Over 100 New Products

NCC 80

NCC '80: Effervescence At Anaheim

The photos on these pages are scenes from NCC '79 at New York. The same sort of turmoil is expected at NCC '80 at Anaheim with one big difference: the conference activity which was described as "hectic" in 1979 is expected to be termed "frenzied" for 1980. The reason: continued expansion of computer business in this country.

Like a giant sun rising up on the morning horizon, the computer industry grows and expands. Slowly it is reaching a position as the nation's primary business activity (replacing autos, steels and communications) and its followers are creating huge lines of "sunbathers." Many of these followers will be seen under the beach umbrellas at Anaheim.

A barometer of the rapid and continuing growth of the computer industry can be seen from convention statistics. The NCC was **big** in 1977 (35,000 visitors,) it was **large** in 1978 (53,000;) it was **huge** in 1979 (80,000;) and this year it is expected to be **gigantic** (more than 100,000 – greater than the population of a medium sized city!) The

Anaheim show is already so big that exhibition space has spilled out of the large Convention Center into 22,000 extra square feet at Disneyland to accommodate an additional 400 exhibitors. A total of more than 1600 exhibitors are already listed. The 40,000 rooms that were available in the Anaheim area were all gobbled up by late March. A breathless spokesman of AFIPS says that last year's pre-registrations arrived at the rate of 1856 per week. This year that figure has zoomed to 2970 per week!

The theme of NCC '80 is "New Directions for a New Decade". One of the principal topics being explored this year is "Computers in Animation" as used in productions like "Star Wars" and Walt Disney movies. The Conference will sponsor 100 learning sessions, 22 professional development sessions and 23 personal-computer meetings.

One reason why the NCC continues to grow out of its pants is that the boundary lines that once separated

mainframe, minicomputer and microcomputer manufacturers are slowly disappearing. They all have their fingers in each other's pies. This country now has one large computer industry; just as it has one large automobile industry which includes small cars, medium cars and large cars. The only serious problem that is emerging is that convention sites in the US are becoming too small for the ballooning NCC. When 100,000 people show up for a single exhibition at the same time, there's bound to be a lot of crowding and shoving. That number of people, by the way, is approximately 50 times greater than the number of delegates expected at the 1980 Republican National Convention. So, if you lived in a medium sized city of 100,000 people, and decided to transport your whole population to the Madison Square Garden and tried to squeeze them all in at the same time, you would see the massive problems lying ahead for NCC planners. – **Harry Shershow**

Technology Trends

Bipolar VLSI Achieves 0.8-nsec Switching Speed

Experimental VLSI circuits fabricated with new structures at IBM show high switching speed, high packaging density (a twofold improvement) and low power consumption.

The new structure is a modified version of the silicon bipolar junction transistor that has been the mainstay of the mainframe computer industry. Recently, a type of logic circuit based on that technology has been gaining importance because of its high packing density and its low power dissipation. Merged transistor logic (MTL) or integrated-injection logic (I^2L), the circuitry seemed promising for implementation in VLSI – except for one serious drawback: MTL circuits built with the conventional bipolar technology and device microstructure have relatively slow switching speeds (a few nanoseconds at best).

Achievement of this breakthrough required the resolution of conflicting design requirements. Low-resistance paths are required for current flow. When constructing those paths, large areas that store electrical charge are usual by-products. But, such charge storage limits circuit speed. The IBM group found a way to provide low-resistance paths without increasing the storage of electrical charge (that is, without increasing capacitance).

The new structure is self-aligned, which leads to an additional reduction of capacitance, hence a further improvement in circuit speed. Self-alignment means that the locations of openings in certain critical areas of the surface layers that make up the microstructures are automatically defined – that is, such openings do not require precise alignment tolerances for their location. The result of self-alignment is reduced circuit dimensions and capacitance, and greater speed. And as a bonus, the circuits can be packed twice as densely, with improved wireability.

In the new self-aligned I^2L/MTL structure that top collectors of the npn transistors are doped from and contacted by arsenic-doped n^+ polysilicon lines. The collectors are butted against the recessed oxide isolation. The extrinsic base regions between n^+ collectors are stitched together with an aluminum overlay in such a way that the base contacts are self-aligned to the collector edges. Parasitic base rails that connect the npn transistors in conventional I^2L/MTL structures are thereby eliminated. The resulting structure provides a more favorable ratio of collector area to emitter area without increasing collector size. Since stored charge in the extrinsic base of the npn transistor is minimized, circuit speed is enhanced at a lower power-dissipation level.

The stucture also provides a low-resistance base-current path between npn transistors, thereby equalizing the speed among the fan-out transistors by eliminating voltage drop along the base connection.

The circuits were evaluated using a 17-stage ring oscillator. For a fan-out of three, with 2.5-μm design rules, these I^2L/MTL circuits show 0.8 nsec gate delays at 0.1-mA collector current. A power-delay product of less than 0.1 pJ is realizable, according to the researchers.

IEEE Suspends Major Technical Exchange With Soviets; Individuals Unaffected

The suspension of its annual IEEE program of technical exchange with the Popov Society (the leading Soviet electrical engineering society) resulted in the suspension of the IEEE's official program with the Popov Society delegation at the IEEE's technical conference and exhibition, Electro/80 and withdrawal of the ten-member IEEE delegation to the Popov Society Congress in Moscow. The Board cited the "current world condition" as the reason for the suspension of technology exchange, but empowers the IEEE's Executive Committee to "reinstate the exchange as appropriate." The action does not affect the IEEE's open attendance policy.

Add-On Minicomputer Peripherals Growth Accelerates

World wide shipments of non-impact printers and page printers will reach 33,600 units in 1983, achieving a compound annual growth rate of nearly 28%. During the same forecast period, sales of non-impact serial printers will see a somewhat slower unit growth rate of 22%, according to the results of a four-volume multiclient study on the computer printer industry recently released by Creative Strategies International, a San Jose, California-based market research firm.

Within the non-impact line and page printer market, ultra high-speed printers will be the most dynamic segment and will account for the largest dollar value. By 1984, revenues from this segment will attain a growth rate of 32.8%, compounded annually.

High-speed page printer usage is clearly increasing but is not replacing as many impact printers as might be expected. The extensive end-user survey conducted by Creative Strategies shows that the total cost of the printer and related supplies is a very significant concern. Skepticism regarding product reliability is also a problem.

Xerographic technology will dominate high-speed non-impact page printers and line printers in the near future. Further product developments will result in faster page printers.

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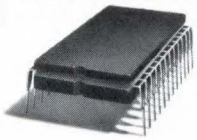

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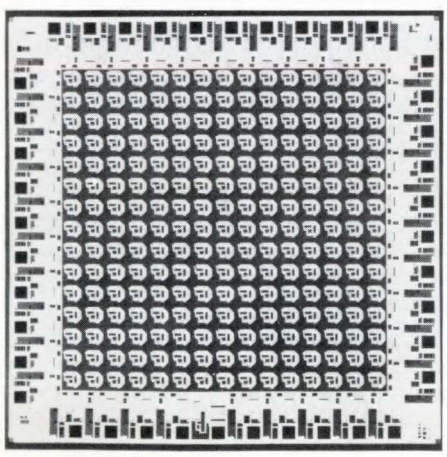


Typical Applications

Disk and CRT Controllers

Dynamic and Static Memory Controllers

Keyboard Scanners

Memory Interface Logic

Control Logic — CPU Boards

ALU Accumulators

D/A — A/D Controllers

Interdesign is a Ferranti Company

Add-On Minicomputer Peripherals Growth Accelerates

In the minicomputer market, dynamic growth continues, although unit growth will decline steadily over the next few years – with demand from OEM customers dropping. But, all is not gloomy: Despite shrinking shipments, revenues will continue to show healthy, although slower, growth – increasing 29% per year through 1983. At that point, the minicomputer market will be worth some $13 billion (with unit shipments forecast to reach 235-k units).

Some manufacturers (DEC, for example) have already taken steps to prepare for the expected downturn by cutting back on their production and building new plant facilities. What will the next few years see? There is a trend to an increasing emphasis on service, software and add-on peripherals. Many minicomputer manufacturers are enhancing their peripheral equipment operations to the point where many are actively marketing these products on an independent basis.

Marketing to end-users is more costly than to OEMs, but International Data Corp. (Waltham, MA) has seen more manufacturers choosing the former – hoping for a share of revenues from services, software and peripherals. The most successful vendors will be those with a strong base of end-user customers rather than OEM accounts. It is expected that a 60/40 (end user/OEM) revenue split will become the norm.

Demand for distributed processing will continue. New applications are becoming more important to every minicomputer manufacturer, and many suppliers see the market being primarily application-driven. Another factor vendors have been able to capitalize on has been IBM's announcements of new products, later followed by delivery problems. Those manufacturers who can provide a solution to an impatient IBM user may find this to be a lucrative area.

IBM Invades Minicomputer Markets

IBM has moved forcefully into this heretofore neglected market, offering users a number of alternatives through its DP and General System Divisions. The 4331, 8100, and System/38, plus enhanced System/34 and Series/1 offerings, have put IBM squarely into the satellite processor/distributed computing market. Using the 4331's unique advantage (370 program-compatibility), IBM has attempted to divided the market into two distinct sectors – the 4300 in one segment, all other minis in the other. How important is the 4300's host program-compatibility – now and the future? How will IBM take advantage of it to propitiate its network development strategies and what will be 4331's impact on other minis in IBM host environments?

The 8100 is one of the four uniquely-architected, solution-oriented minicomputers that IBM is now offering to address different user requirements – all of which fit into a particular network niche. The 8100 is intended to be an SNA satellite node/communications controller/concentrator, but it has excellent potential as a dedicated application machine. What are IBM's plans and what are the 8100's shortcomings? When and how will these be addressed was discussed at the Yankee Group's (Cambridge, MA) conference on IBM's evolving network strategy.

GSD's System/34 is a well-supported application-oriented processor for small-to-medium-sized business users. The System/34 is a large applications processor embodying state-of-the-art technology and facilities, including a Relational DBMS. The Series/1 is a general purpose "naked mini" that is attracting numerous OEMs and software houses with its quantity discounts and excellent performance in a variety of applications.

Exactly how IBM will sell these diverse systems and what IBM will offer for quantity discounts on the 8100 and 4331 will determine what the opportunities will be for plug-compatible peripheral makers, software/systems houses and for other minicomputer vendors.

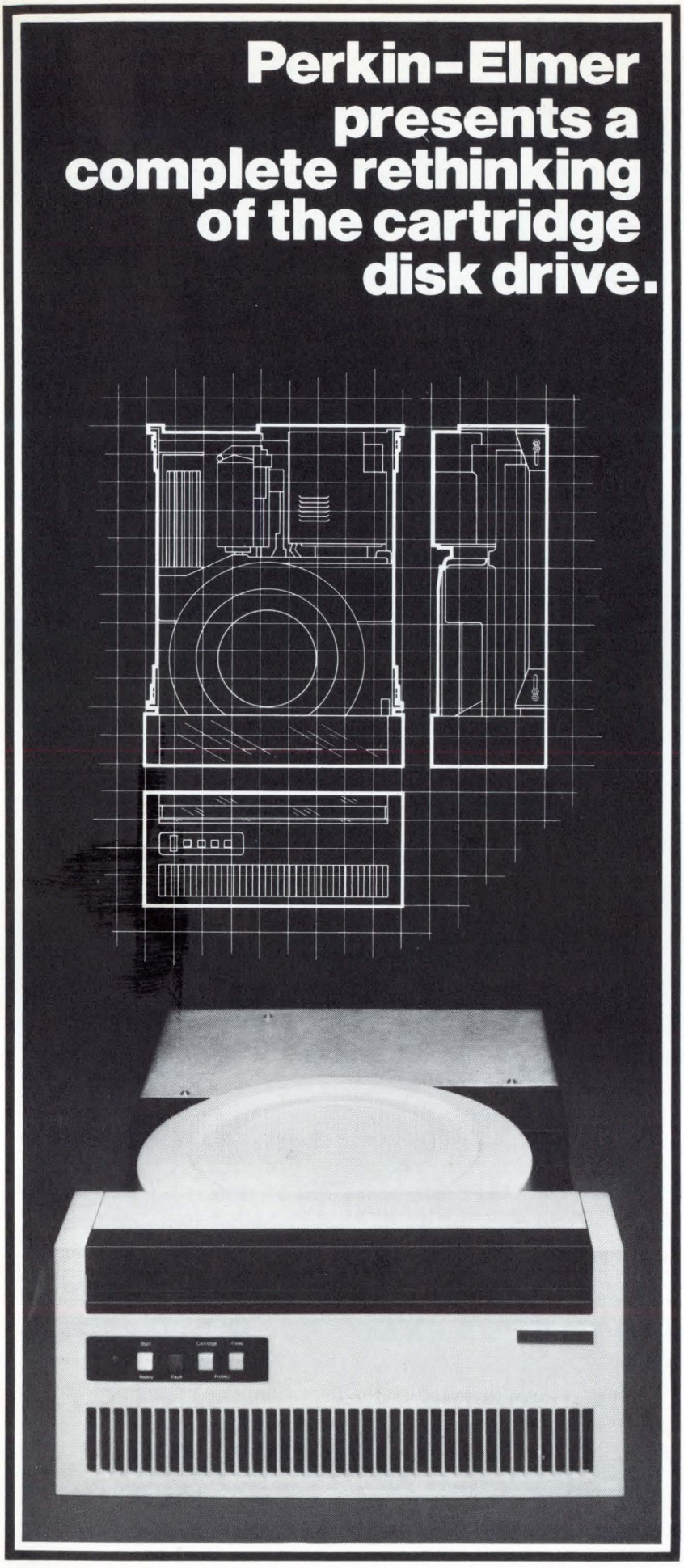
Micros Shave Inventory Costs

Microprocessor-based products and systems minimize inventory costs. The cost of carrying an inventory is over a third (36%) of what it was a year ago. Worse, the longer the product is held in inventory, the higher the final selling cost; and, today, for each month an item remains in stock, its selling price (or portion of the final system) rises between two and three percent. The primary culprit in this increase is the soaring rate of interest. This is creating an even more rapid shift to micro-based products and systems that use one board (or product) to serve several uses or functions (with slight modification, such as changing ROMs.) This trend to universality in product lines can be expected to accelerate under recessionary/inflationary forces.

Scarcity of EEs to Worsen In 1980s

Electronic engineers, particularly those that have both microcomputer hardware and software experience, can literally "write their own tickets" – a situation that is not likely to change during the next five years, except that the situation is more likely to get tighter. In fact, so tight is the market for these engineers, that by 1982 to 1983 there will be a 50% shortage or more in New England, the West Coast and other sections of the U.S. These figures, released by the Massachusetts High-Technology Council, outlines the crisis, stating that "there is just no way we can get enough engineers into the educational pipeline fast enough to offset this shortfall." Last year's electronic engineering graduates with BSEEs typically commanded starting salaries in excess of $22,000 per year – despite no practical experience. The trend will worsen, and there is no way that today's universities and engineering colleges can possibly meet the demand for the next five to eight years.

Perkin-Elmer presents a complete rethinking of the cartridge disk drive.



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That would offer the compactness needed for desk-mounted peripherals.

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And to reduce the need for maintenance we gave it an air moving system designed for maximum cleanliness and minimum temperature rise in the media chamber.

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Crackdown Sought on Diploma Mills

In a strongly worded letter, Irwin Feerst ("IEEE's Ralph Nader") urged IEEE's Board of Directors to take strong and prompt action to "alert the public and the profession to the proliferation of non-accredited engineering schools." He urged that the 200,000-member organization "pursue the indictment and prosecution of such "institutions" by alerting the postal authorities to the provisions of the existing mail fraud statutes."

Specifically citing Clayton University (formerly American International Open Univ.), Pacific Western Univ. and the Univ. of Beverly Hills, Feerst reminded IEEE's Board of Directors that they have a duty to the "great majority of engineers who have earned their degrees in the conventional, difficult, time-consuming and expensive manner."

Feerst noted that a former president of IEEE and another former member of IEEE's Board had both received so-called Doctor's "degrees" from AIOU. These are two of the six IEEE members who serve on the Board of Advisors of Clayton University! One of Feerst's recommendations is that IEEE give these six ten days to choose between IEEE and their affiliation with Clayton U.

Noting that IEEE's president in 1979 uses the title "Dr." for his honorary degree, Feerst also recommends that the title "Dr." be reserved (in IEEE activities) only for those who have earned it from legitimate, accredited institutions.

Feerst, an unsuccessful candidate for IEEE president in the past, has been involved in efforts to reform IEEE for the past eight years. He earned the undying hatred of IEEE's hierarchy for his efforts.

Fresh Ink For Old Ribbons

Rising energy costs will accelerate the trend away from ribbons in printers to image-producing techniques.

Ribbons are the second most important supply item for computer printers. The nylon used in nearly all computer printer ribbons is petroleum distillate derivative. This, coupled with the huge quantities of fuel required for both the impression fabric manufacturing or weaving process and fabric converting, make the industry extremely energy-sensitive. The cost of ribbons to end users will increase 15-25% as a result of this relationship; and, according to CSI (San Jose, CA), there will be a trend toward more ribbon reinking and recycling to offset the increased cost. Although some potential demand will be displaced by non-impact printers, the ribbon market will still show a compound annual growth rate of 29%, reaching 15.1 million dozen by 1984.

Many of the non-printers use image-producing materials such as toner, developer and ink rather than ribbons. Rising use of these non-ribbon printers over the next five years will result in significant growth in these market segments. There will also be improved growth rates for plain and specialty papers (dielectric, thermal and electrosensitive).

Software DESIGN SERIES

Dr. Lance A. Leventhal
Emulative Systems Co.

Using PASCAL In Industrial Applications

During the past year, the PASCAL language has received considerable attention as a valuable tool in microprocessor applications. Most development systems now offer PASCAL and numerous independent suppliers, courses, and books describe PASCAL as a solution to the high cost and poor quality of microcomputer software. But is PASCAL practical for industrial applications that are now largely programmed in assembly language? When is PASCAL cost-effective? What special features are necessary for small ROM-based applications that involve more input/output than data processing, require detailed manipulation of hardware, and have time and memory constraints? We will describe PASCAL's advantages and disadvantages and mention some of the special compilers that are now available. We will then describe an actual case history of a microprocessor-based industrial inspection system that was developed using one of the special PASCAL compilers. Finally, we will present some criteria for choosing between PASCAL and assembly language in industrial applications.

What are the advantages of PASCAL? The major ones are the following:

1) Faster software development, since a line of PASCAL code generates many machine instructions. PASCAL has the typical advantages of high-level languages in that it is procedure-oriented rather than machine-oriented and does not require the detailed manipulation (or understanding) of the computer's resources.

2) Programs are easier to understand and to document. Again, this is a typical advantage of a procedure-oriented language. However, PASCAL's control structure makes programs written in it easier to understand and document than those written in BASIC or FORTRAN. Judicious use of comments, indentation, and meaningful names can make a PASCAL program remarkably readable.

3) Easier maintenance, since PASCAL programs are not only more readable but can more easily be constrained to follow the rules of structured programming and top-down design.

4) Better control over software development. Not only can good programming practices be enforced, but the PASCAL program is far easier for the manager to understand. This advantage is particularly important in larger projects involving several programmers.

5) Greater portability, since PASCAL compilers are available for most popular microprocessors and programmers.

6) Direct implementation of the control structures required by modular programming, structured programming, and top-down design. All these methods have been shown to greatly increase programmer productivity.

7) Wider availability of programmers, since many universities teach PASCAL programming. The general shortage of engineering talent is particularly pronounced when one begins to look for a competent assembly language programmer for even the most popular microprocessor.

8) More standardization, since PASCAL compilers are far more similar than are assemblers or translators for language like BASIC or FORTRAN.

9) Applicability to a wide range of tasks. PASCAL does not assume the algebraic approach that is fundamental to BASIC and FORTRAN.

10) Ability to handle data structures such as lists or tables in ways that must be manufactured in BASIC and FORTRAN.

11) Ability to handle complex logical structures that are parameterized so as to perform a variety of tasks.

How about the disadvantages? These, too, form a sizable list:

1) Relatively inefficient use of time and memory, typical of compilers that do not have many optimizing features. Presumably, compilers can be optimized but such optimization also tends to make them less standard and slower.

2) Slow-executing code, since most versions of PASCAL are not true compilers. Instead, they translate the PASCAL language into an intermediate language (called P-code) that is much like a series of instructions for a programmable calculator. The run-time package for a particular microcomputer must then translate the P-code into actual computer instructions. The advantage of this approach is that the translator can be virtually the same for all computers, regardless of the underlying instruction sets. The differences are in the run-time packages. The disadvantage is that the run-time package must be included in the application, requiring extra memory and execution time.

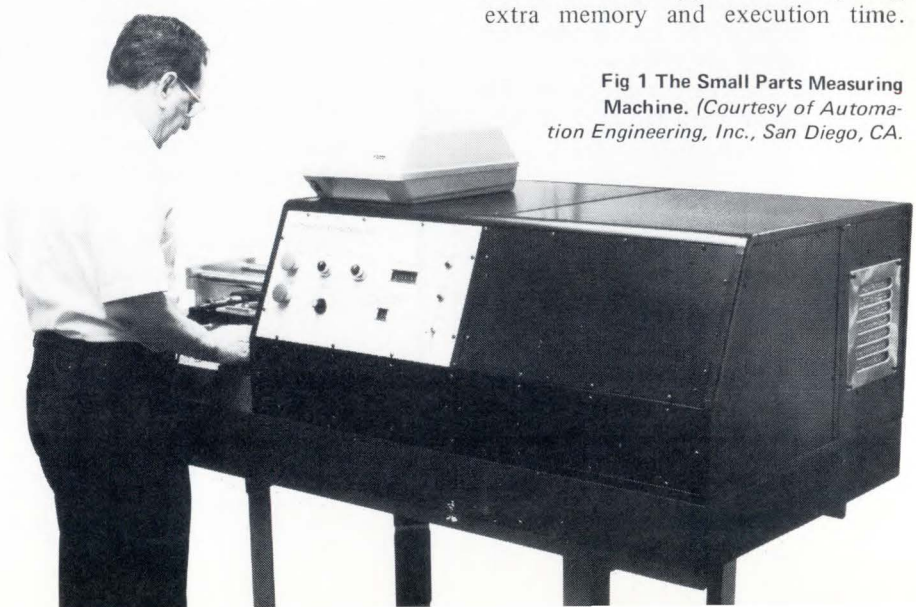

Fig 1 The Small Parts Measuring Machine. *(Courtesy of Automation Engineering, Inc., San Diego, CA.*

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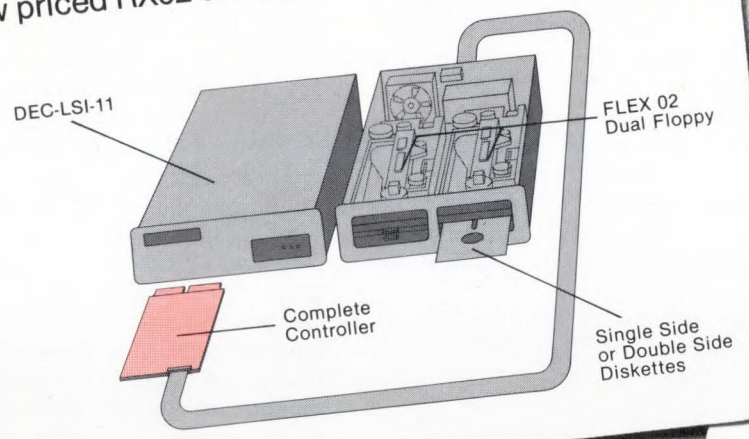

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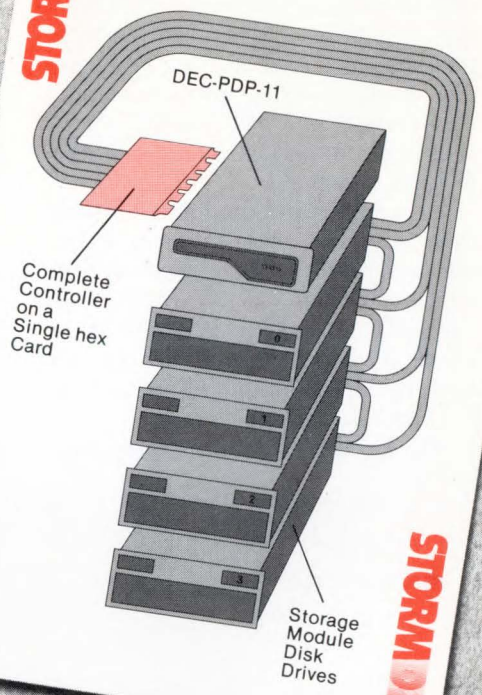

WINC 01

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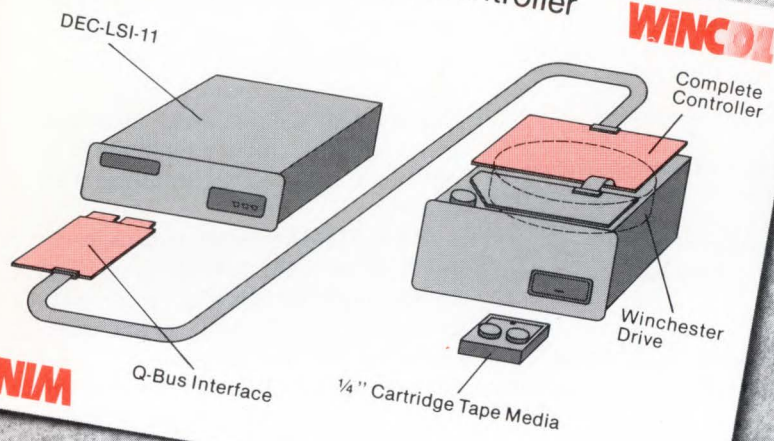

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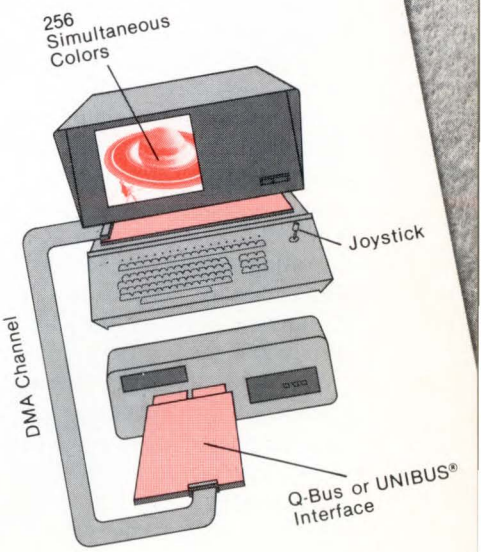

Controller features

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

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

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Also, the program can only execute out of RAM, although the run-time package may be ROM-based. Note that this approach is intermediate between the traditional compiler which translates high-level language programs directly into machine instructions, and the interpreter, which translates line-at-a-time into machine code while the program is running.

3) Limited I/O capabilities. As is usual with high-level languages, I/O is not a simple problem, since specific implementations vary so greatly. This one must either extend PASCAL, making it less standard and less easy to read, or depend on the I/O facilities of the operating system.

4) Limited control capabilities. functions. However, many microprocessor-based systems require low-level manipulation of hardware. A program may be syntactically or logically correct and yet not operate properly in a particular environment. The programmer then must work like a machine operator who is trying to position something by remote control; the compiler's automatic features stand between the programmer and the actual hardware. The programmer has to find out exactly what the compiler is doing and discover by trial and error how it reacts to changes in the program.

These problems are well-known to PASCAL users and implementors. Suppliers have therefore recently made available versions of PASCAL that overcome some of these difficulties by providing extensions or modifications

```
(*PROCEDURE FLAT LOOKS TO SEE IF UPPER OPTICS SEES DKLT AT EXPECTE
  FLAT LOCATION.  IF UMOT SEES ALLDK (NO FLAT), THEN ROTATES BOLT
  180*)

PROCEDURE FLAT;

  VAR SLCD:COORD;
      I:INTEGER;

  BEGIN
    SLCD[UMOT]:=150;
    SLCD[LMOT]:=0;
    SLCD[CMOT]:=MOTPOS(CMOT)-100;
    MOVEABS(SLCD);
    WAITULCMOT;
    SMEAS;
    IF SCANTYPE[UMOT]<>DKLT
      THEN SMOVEREL(RMOT,433);
  END(*FLAT*);
```

Fig 2 A typical procedure from the program for the Small Parts Measuring Machine. This procedure establishes a set of coordinates (SLCD), moves the motors to those coordinates (MOVEABS), waits for the motors to stop (WAITULCMOT), takes a measurement (SMEAS), checks to see if the part is in the standard position (SCANTYPE(UMOT) = DKLT), and rotates the part (SMOVEREL) if it is not. *(Courtesy of Automation Engineering, Inc., San Diego, CA.)*

Again, as is usual with high-level languages, PASCAL is better suited to data processing than to detailed timing and bit manipulation. Unfortunately, most microprocessor applications contain a lot of detailed hardware manipulation.

5) Need for a costly development system, PASCAL will not run on simple microcomputers or even on development systems with insufficient memory or peripherals. Most versions require a dual-floppy or hard-disk system with close to 64K of memory. An operating system like CP/M or ISIS is also necessary. This creates problems in moving between the development system and the prototype.

6) Separation from the underlying hardware. The advantage of a high-level language is that it handles the detailed implementation of the program, automatically assigning memory locations and performing other overhead for more efficient use in industrial applications. In particular, we should mention:

1) Texas Instruments' Microprocessor PASCAL for 9900 processors. This version has many extensions and modifications and produces optimized code.

2) Ithaca Intersystems' PASCAL/Z for the Z-80 microprocessor. It produces Z80 assembly language as output and runs under CP/M. Of course, a companion assembler must be used to produce machine language.

3) MT Microsystems' PASCAL/MT for 8080 or Z-80 based computers. This compiler produces machine code; one version runs under CP/M.

There are numerous other versions, from suppliers such as Intel, Process Computer Systems, and Zilog. All of these solve some of the difficulties of using PASCAL at the cost of standardization and generality. Remember that each additional convenience and special feature takes one further away from the goals of standardization, portability, and easy documentation and maintenance.

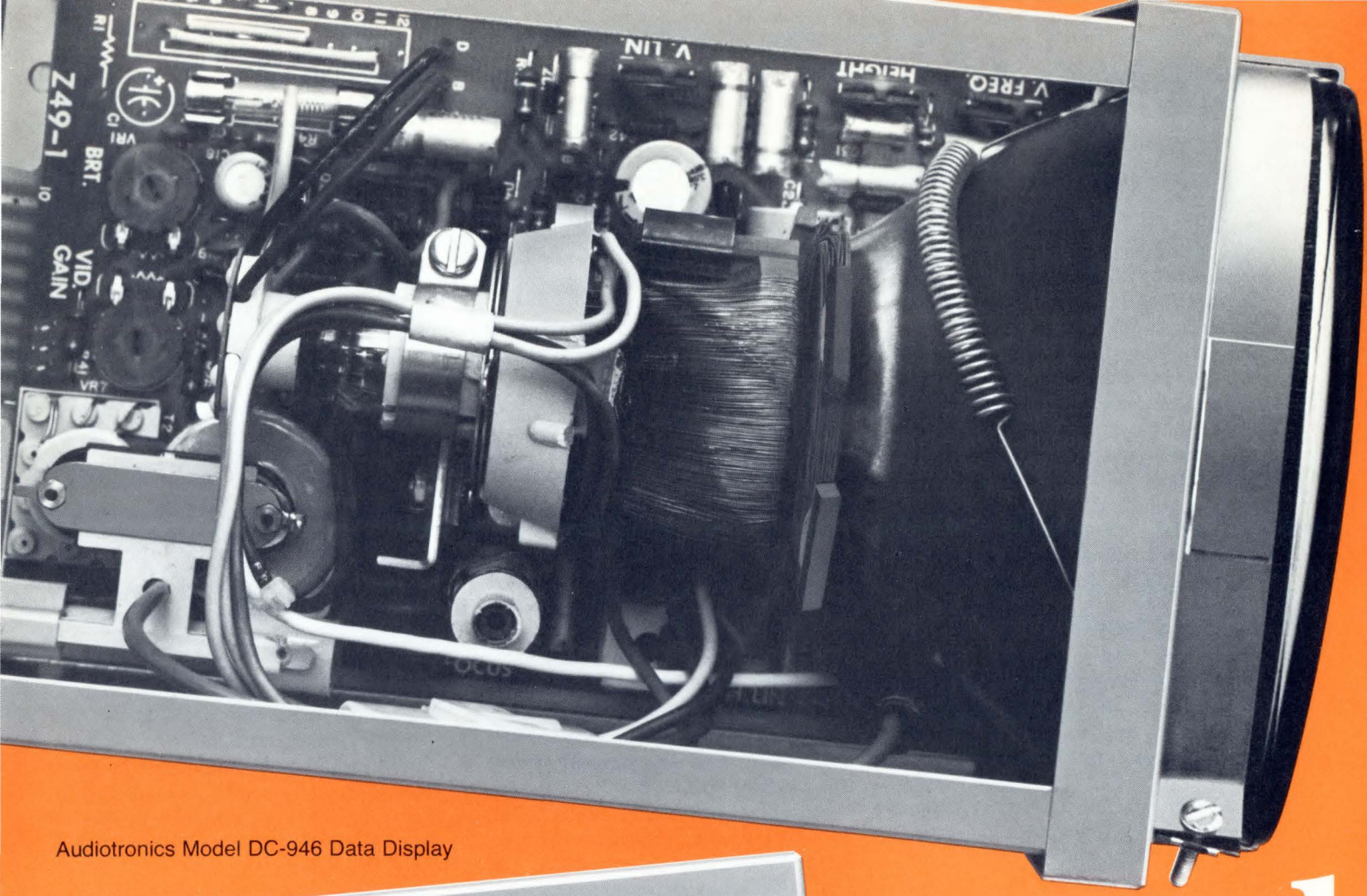
A specific compiler

Of course, much of what we have said so far is meaningless until we describe a specific compiler and a specific application. We will therefore proceed to describe the PASCAL/MT compiler (a product of MT Microsystems) and the Small Parts Measuring Machine (a product of Automation Engineering, Inc.). We will begin with the compiler.

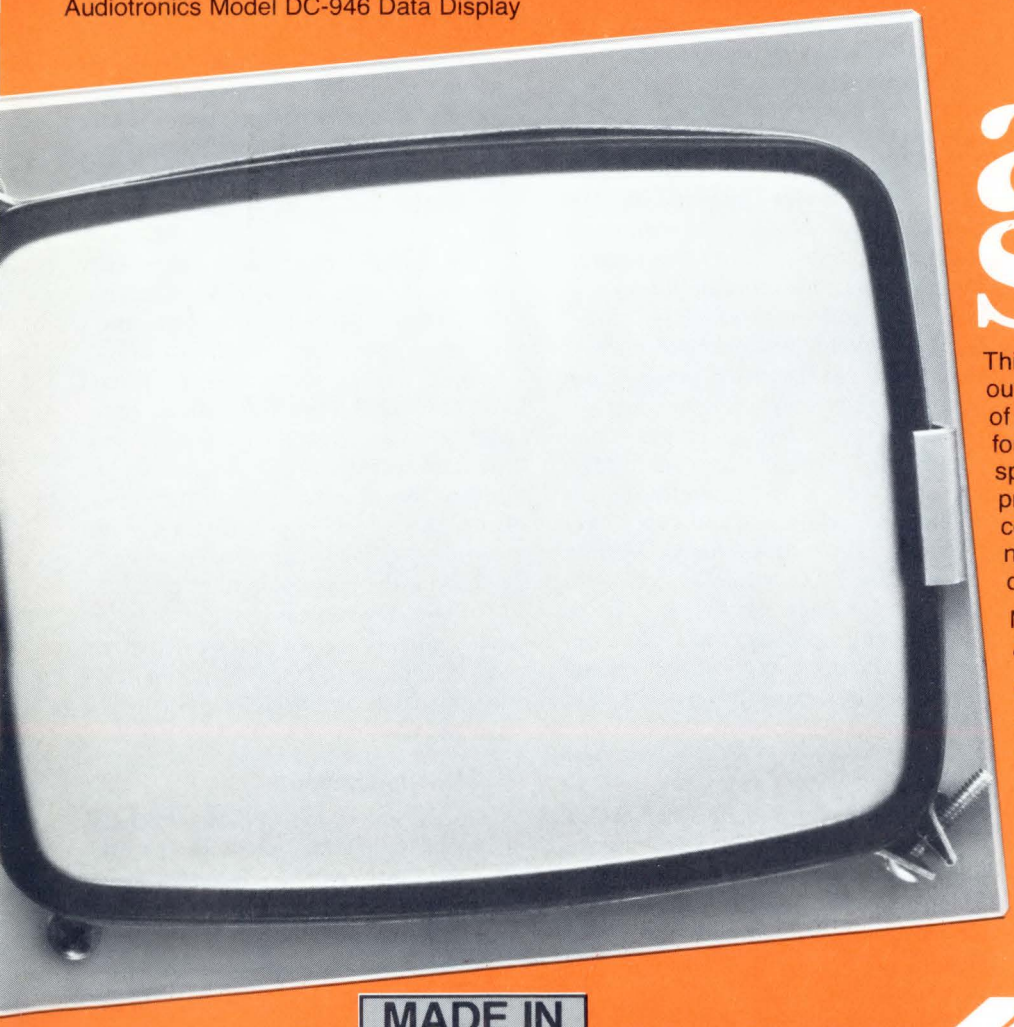
PASCAL/MT, as we mentioned, is a PASCAL compiler for 8080/Z80 systems that produces object code that can be placed in ROM. Its special features are direct production of machine code (with no P-code or assembly language intermediate state), directly executable output (no linking with the run-time package is necessary), identification of actual memory addresses, support for floating point arithmetic (both software and 9511 versions in compatible form), and an interactive symbolic debugger that allows the programmer to debug at the PASCAL level rather than at the machine level. The compiler will run on any 32K system operating under CP/M or its derivatives, including the Advanced Micro Devices AMSYS8/8 development system and most Intellecs (although it will not run under the ISIS operating system).

PASCAL/MT's run-time package requires 6K or RAM or ROM. It includes 16-bit multiplication and division, 16-bit two's complement comparisons, formatted I/O for integers, reals, and characters, and CP/M file interface (allowing the opening, closing, reading, and writing of CP/M disk files). A 2.5K symbolic debugger may be included if the user wishes (the choice is made at compile-time; the debugger is obviously unnecessary in the final version).

The compiler allows direct manipulation of I/O ports through INPUT and OUTPUT statements; the programmer may use specific port addresses or refer to the addresses symbolically. The user may specify an interrupt procedure, in which case the compiler will automatically generate the code required to save and restore the processor's registers. Bit and byte manipulation are simplified by 8 built-in procedures that allow for testing, setting, and clearing bits; shifting right or left; and moving data to the low or high byte or swapping bytes.



Audiotronics Model DC-946 Data Display



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The user can include assembly language subroutines in a program by declaring external procedures at absolute addresses. However, the I/O port manipulation and bit and byte procedures make assembly language generally unnecessary. The compiler provides simple optimizing features and produces code that is typically 0 to 50% larger than that produced by an assembly language programmer.

We should note that PASCAL/MT is a product of MT Microsystems, 8672-I Via Mallorca, La Jolla, CA 92037. Their future plans include extensions to 16-bit machines (8086, Z-8000) with capabilities for handling memory sizes exceeding 64K.

A specific application

What does this mean in a specific application? Here we shall look at the Small Parts Measuring Machine, a product of Automation Engineering, Inc., 11689 Sorrento Valley Road, San Diego, CA 92121. This machine **(Fig 1)** inspects machined parts for dimensional accuracy, correct geometry, and flaws. It is intended for use in a production or inspection line or in a quality control laboratory. Typical applications include the inspection of automobile engine parts and artificial heart valves. The machine will inspect up to 20 different parts with varying characteristics and tolerances.

The final product includes an 8080 overall controller and four 8085 microprocessors that control the stepping motors. The system includes 64K of memory, 60K of ROM program (including the PASCAL run-time package) and 4K of RAM.

Why was PASCAL chosen? Clearly the size of the program would make it unwieldy in assembly language. Furthermore, the algorithms required to analyze the video data and perform the inspection are both logically and mathematically complex. Algorithms had to be developed and tested as the system was developed. So not only were hardware and software developed at the same time, but so were the algorithms that defined the system. BASIC was too slow because of its interpretive nature while FORTRAN was inadequate because of the logical complexity of the system.

Useful features of PASCAL include its ability to provide compile-time checks on whether the proper types of data are being used. Not only does the system require Boolean, real, floating point, and integer data, but the specification of the parts involves the manipulation of character strings. The program performs a parameterized sequence of operations, thus providing different sets of operations in different orders for different parts. Bit manipulation is necessary for analyzing the video data and controlling the stepping motors.

The end product (a 60K program) took 1 man-year to develop. PASCAL programmers were hired from a nearby university or trained on-the-job; no engineering background was necessary and undergraduate students could be used. The readability of the PASCAL program is obvious. For a typical procedure **(Fig 2)** that rotates the part into its standard position, imagine what this same program would look like in assembly language. Not only does this readability contribute to future extensions and system maintenance, it also meant that managers could review the work of programmers and help in design and debugging from observation. The development system was an SBC-80 based computer with dual floppy disks running under CP/M. Although assembly language was readily available, only 100 bytes of the final program (a data movement routine) is written in assembly language; all the rest of the application is written in PASCAL.

Special features of PASCAL/MT that were useful include its fast compile time, ROM-based code, debugging capabilities, I/O commands, logical operations, and ability to support real numbers using the AMD 9511 Arithmetic Processing Unit. Note that small changes in a program can take a large amount of time when the program itself is large – editing, compiling, and executing a small change typically took 5 to 10 minutes in this application, while it could easily have required many times longer with a slower PASCAL compiler or with assembly language. Clearly, the size of the run-time package was also important, since the application used the entire memory space (64K) of an 8080 processor.

When to choose PASCAL

When should you use PASCAL rather than assembly language? Consider the following guidelines suggested by Robert Clarke, Manager of Software for Automation Engineering, and Michael Lehman, President of MT Microsystems:

1) If your program is more than 4K bytes in length, you should consider a high-level language.

2) If you are developing a low-volume application or a special system in which the cost of the software is significant, programs can be written much faster in a high-level language and are more likely to be useful in future systems.

3) If you do not need maximum performance, the gains from assembly language will not be important.

4) If your application involves floating point numbers, complex formulas or algorithms, functions, or complex data structures, you are far better off in PASCAL than in assembly language.

5) If the problem is poorly defined, remember that changes will be much easier to make in PASCAL than in assembler. If you are performing problem definition or algorithm development together with system development, the high-level language allows you to try new approaches in days rather than in weeks or months.

6) If you expect to make many modifications, you should also prefer the high-level language, particularly if there may be a large number of additions or if compatibility over a wide range of system is necessary.

Some problems to watch out for are the difficulty of fine-tuning applications, slower programs, larger memories (particularly in low-end applications), and some separation from what is actually going on at the hardware level.

We should note finally that events are on the side of PASCAL. Clearly, the size and complexity of microprocessor applications are increasing. Trained programmers and engineers are becoming more difficult to find. Memory is becoming cheaper and processing speed is increasing, thus reducing the disadvantages of high-level languages. The need for software maintenance and management control is constantly becoming more obvious. All these developments mean that far more microprocessor system designers will be looking to PASCAL in the next decade as an approach to system design and development.

Acknowledgements

I would like to thank Mr. Michael Lehman of MT Microsystems and Mr. Robert Bible and Mr. Robert Clarke of Automation Engineering, Inc., for their assistance.

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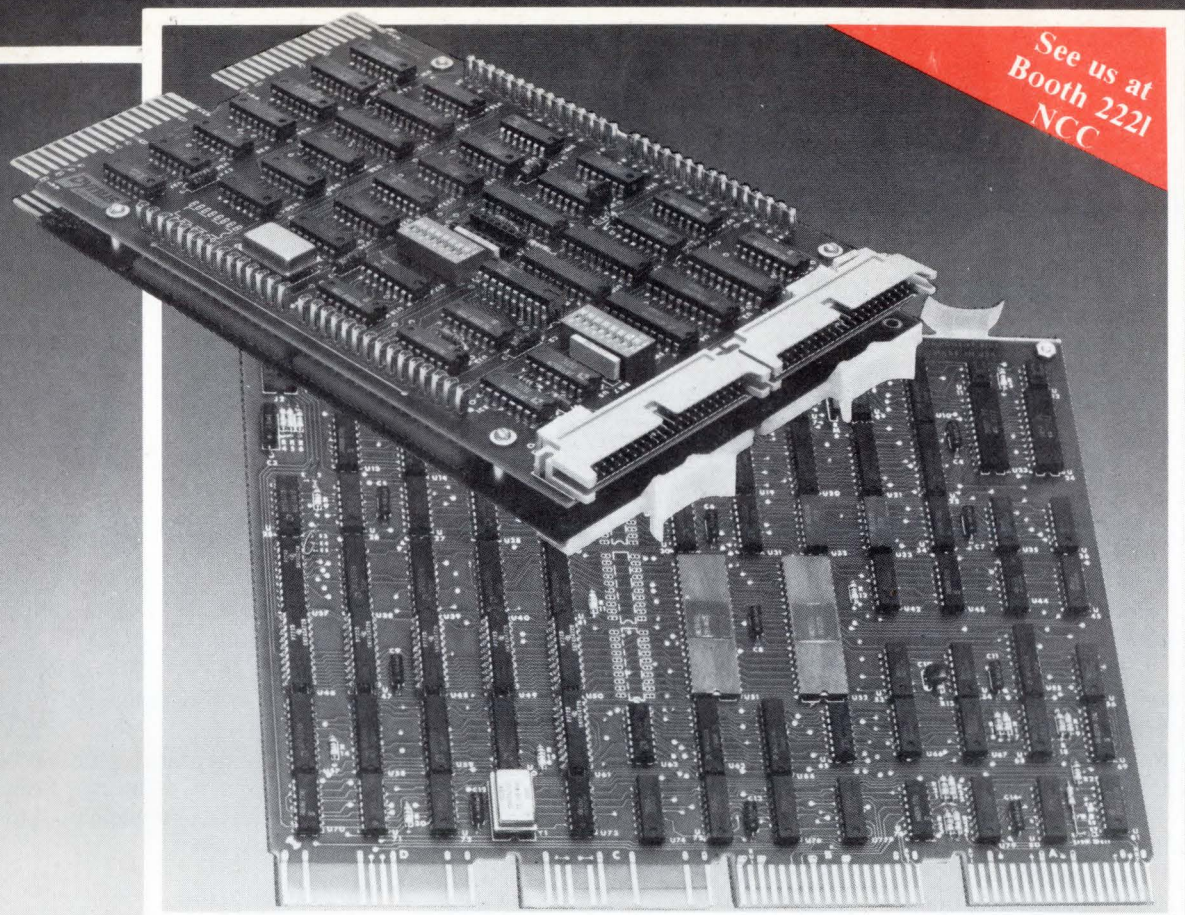

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Programmable Interval Timer

Frees μPs to Perform More Complicated Tasks

Dave Wicker
Microprocessor Ops.
National Semiconductor Corp.

Engineers are designing systems that require microprocessors to perform more and more complicated tasks. Consequently, a need for new peripherals has arisen that will relieve the CPU of most of its simple functions and allow more time for it to do the complex tasks. One function normally performed by the CPU is the timing of internal or external events.

A single μP bus-compatible device, the 8253 programmable interval timer, can now supply the functions usually performed by software timing loops, such functions as time-out delays, event counting, or variable frequency generation. With a minimal amount of software overhead, this device can free the CPU of the tedious task of counting, and it can do it faster. The 8253 is actually three separate 16-bit counters that can count at rates up to 2 MHz in six different modes, in binary or BCD, in repetitive and single-event modes – all synchronous to an external clock. It is compatible with almost all common CPUs.

For example, this device can perform: programmable baud rate generator for USARTs, time-out interrupts for program delays, event counting, complex motor control, frequency synthesis and real-time clock.

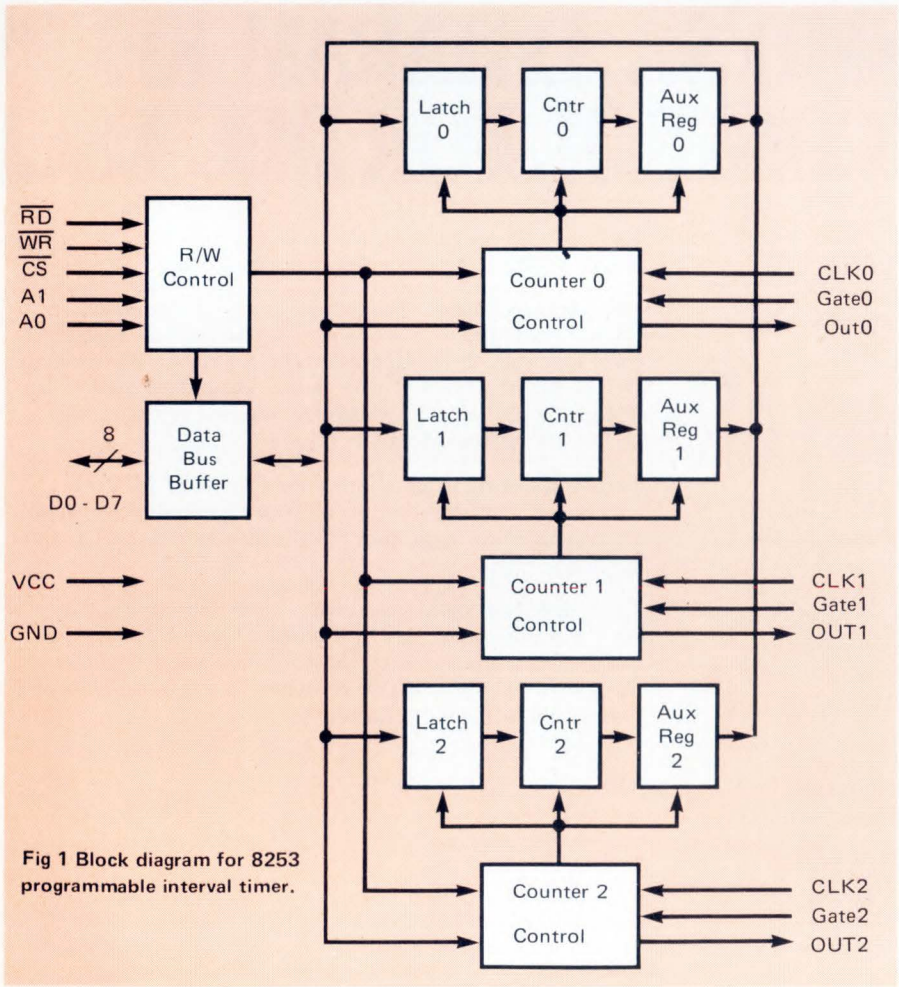


Fig 1 Block diagram for 8253 programmable interval timer.

Part description

The 8253 consists of three 16-bit down counters, three pairs of 8-bit counter latches, three control registers and read-write logic. Each independently programmable counter has a separate clock input, gating input and multifunctional output.

Since it is Microbus compatible, you can use it with almost any CPU, including the 8080, SC/MP, PACE, 6800, 6502, Z80 and 8085. Interfacing is simple, because it requires only an 8-bit data bus, two bits of address, a read and write strobe and a chip-select generated from the address bus (**Fig 1** and **2**).

Programming

Associated with each of the three counters of the 8253 is one 6-bit write-only control word register and two 8-bit write-only counter latches. Programming a counter simply consists of initializing the control register and then programming the counter latches. The three counters are programmable in any order, as long as each control word is programmed before the counter latches for that particular counter. (**Table 1**).

Control Word Register

The 6-bit control word register controls the counter mode and the read/-write sequencing of the counter latch-

Table 1 Addressing the 8253.

A1	A0	
0	0	Counter 0
0	1	Counter 1
1	0	Counter 2
1	1	Control Word

Table 2 Control word register accessing.

A1	A0	D7	D6	
1	1	0	0	Counter 0 CW
1	1	0	1	Counter 1 CW
1	1	1	0	Counter 2 CW
1	1	1	1	Illegal

es. When A0 and A1 are both high, D6 and D7 select the control register for each counter. To the user, it appears that he is programming only one register, because the address is the same for all the control word registers. In actuality, the upper two bits of the data word select the individual registers; the lower six bits are register information (**Table 2**).

D4 and D5 (RLO and RL1) of the control word determine how the two counter bytes are to be accessed when the counter address is selected. They are also decoded to send a special instruction which latches the counter contents. (See counter reading and latching.) D1, D2 and D3 (M0, M1 and M2) of the control word determine in which of the six modes the counter is to operate, while D0 selects binary or BCD counting (**Tables 2** and **3**).

Counter Latches

A0 and A1 in conjunction with RL0 and RL1 of the control register access the counter latches. A0 and A1 determine which of the three pairs of counter latches are to be accessed; the read/load (R/L) bits of the control word register determine the upper/lower byte selection. If only RLO is set, the least significant byte is being programmed. If only RLI is set, then the MSB is being programmed. If both bits are set, then a sequence of two writes programs first the LSB and then the MSB latch. Using this read/load format then requires the performance of two writes in sequence, if the device is to operate correctly.

Note that it is not necessary to program all 16 bits of a counter, when either the lower or upper byte is a zero. Both latches are automatically cleared when the control word is programmed and remain zero until otherwise programmed.

Operating Modes

You may use any of the six available modes of counting. Modes 2 and 3 are repetitive and all others are single event modes. Table 4 contains a gate summary for the different modes and Fig 3 shows the timing for the six modes.

Mode 0, Interrupt on Terminal Count. In this mode, a control word write or writing to any counter latch forces the output low. After the write to the counter is completed, it begins counting. At completion of the count (counter equals zero), the output goes

Table 3 Control word register format.

D5	D4	D3	D2	D1	D0
RL1	RL0	M2	M1	M0	BCD

RL1	RL0	
0	0	Counter latching command
0	1	Read/Load LSB latch
1	0	Read/Load MSB latch
1	1	Read/Load LSB, then MSB latch

M2	M1	M0	
0	0	0	Mode 0
0	0	1	Mode 1
x	1	0	Mode 2
x	1	1	Mode 3
1	0	0	Mode 4
1	0	1	Mode 5

BCD	
0	Binary counting
1	BCD counting

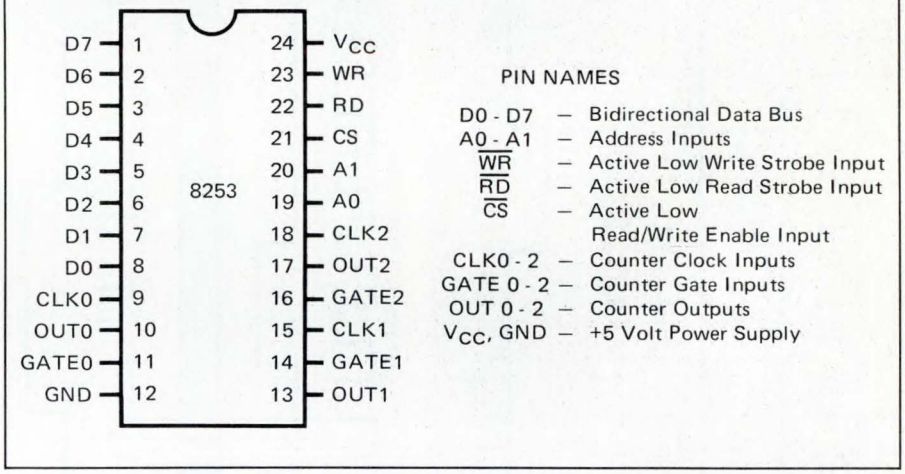


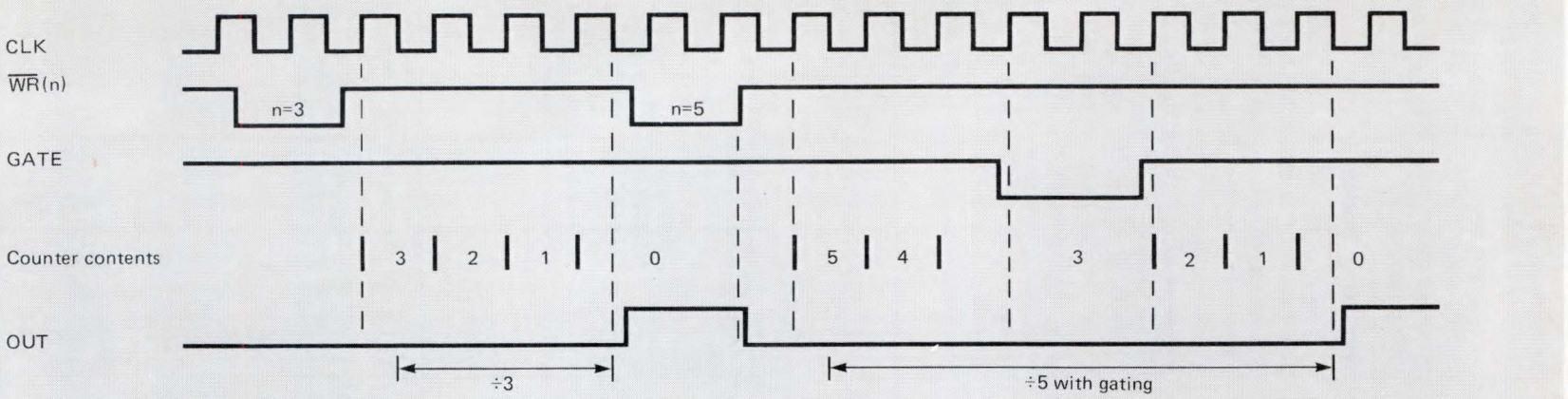
Fig 2 Pin configuration of 8253 interval timer.

Table 4 Gate summary.

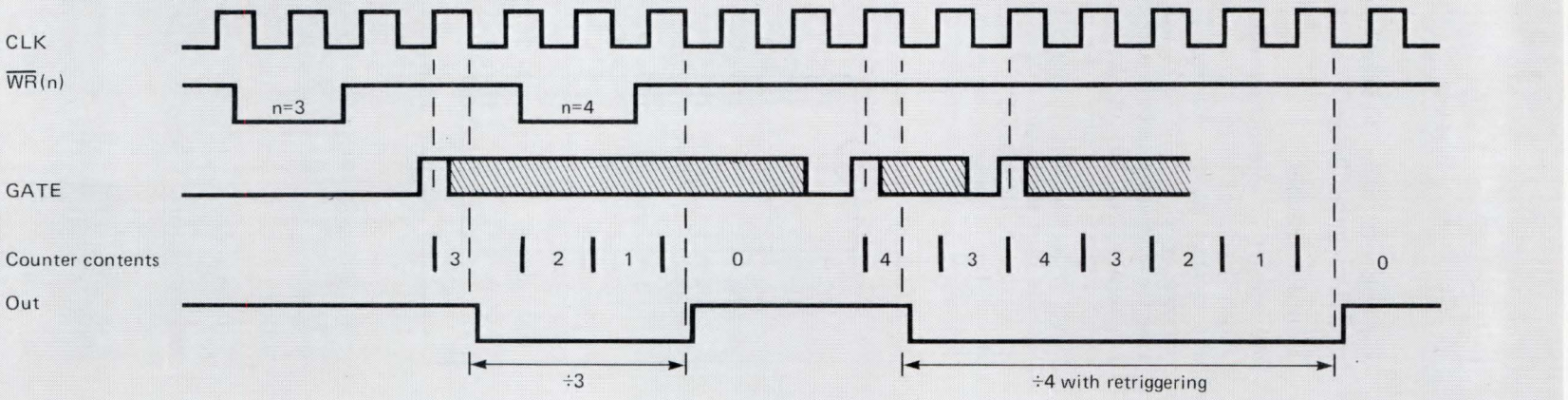
MODE	0	1	2	3	4	5
↑ initiate count		x	x	x		x
low inhibit count	x		x	x	x	

Table 5 Latch command.

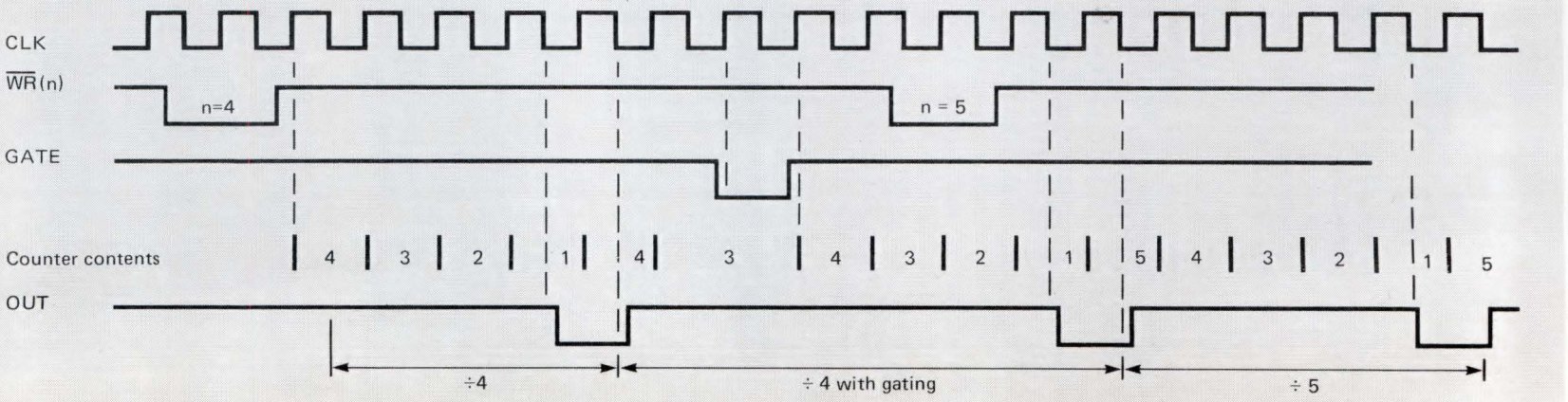
A1	A0	D7	D6	D5	D4	D3	D2	D1	D0	
1	1	0	0	0	0	x	x	x	x	Latch counter 0
1	1	0	1	0	0	x	x	x	x	Latch counter 1
1	1	1	0	0	0	x	x	x	x	Latch counter 2



Mode 0



Mode 1



Mode 2

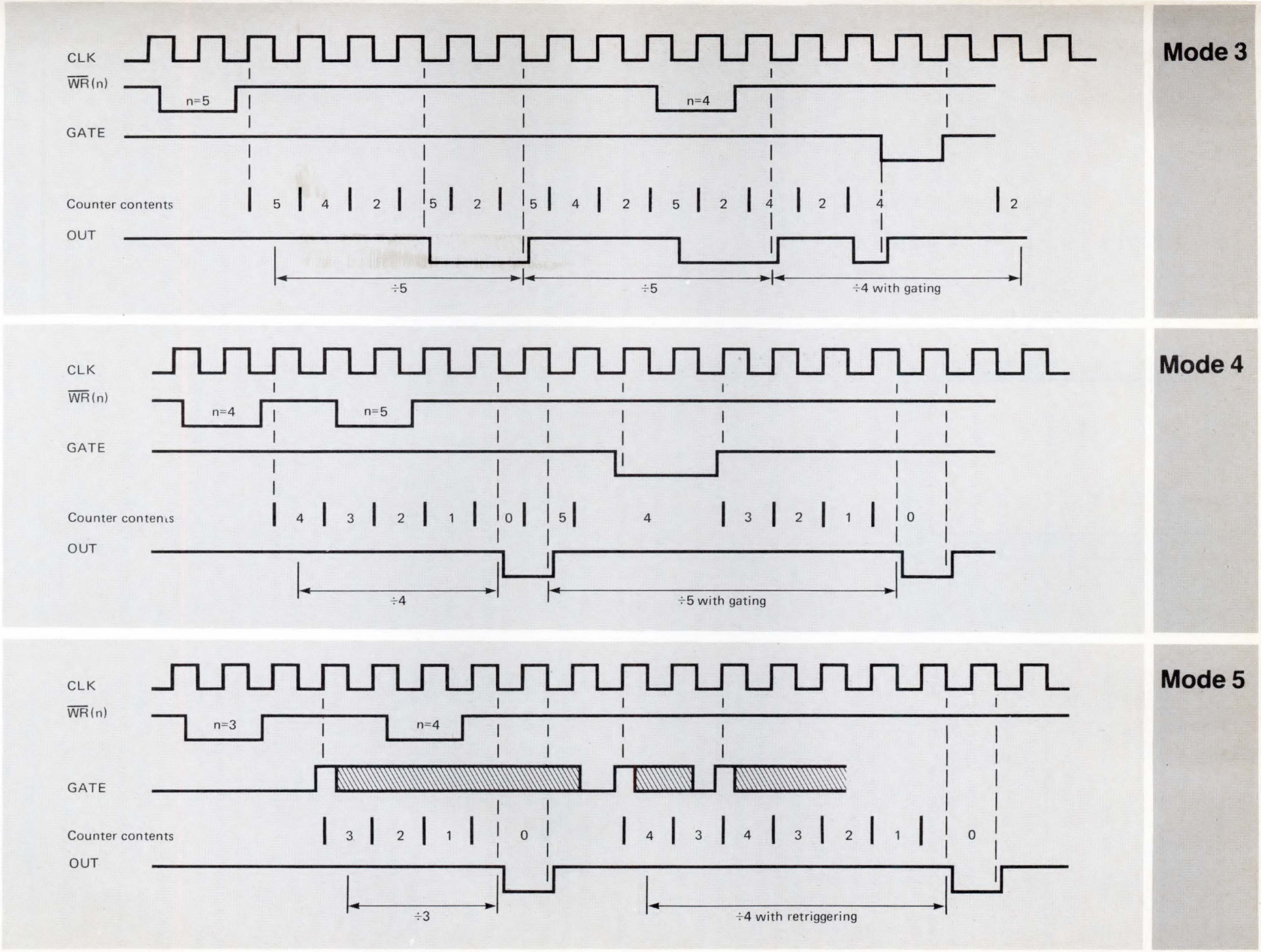


Fig 3 Counter mode timing diagrams for 8253 timer.

high and remains high until a new control word or count is loaded. Reloading the counter latches during counting suspends the current count. At the end of reloading, the counter begins counting with the new divisor. The gate input suspends counting when low, and enables counting when high.

Mode 1, Programmable One-Shot. In this mode, the output is high when the counter is not counting. A rising transition of the gate input triggers the counter to begin counting, which forces the output low. Upon completion, the output goes high. Since the counter is retriggerable, hence any rising edge on the gate causes the counter to restart at the beginning. The counter can be reloaded at any time. Any subsequent trigger initiates the new count.

Mode 2, Rate Generator. After initialization, the counter begins counting. The output is normally high and goes low for one clock period, when the counter contents equals one. If the counter latch is reloaded while counting, the subsequent period reflects the new value. The gate input suspends counting when low, and reinitializes counting when forced high.

Mode 3, Square Wave. This mode is similar to mode 2, except that the output remains high for half the count and low for half the count for even divisors. For odd numbers, the output is high for (N+1)/2 counts and low for (N-1)/2 counts. In other words, the remainder of division by 2 is added to the output high time. If the counter is reloaded while counting, the new divisor becomes effective after the next output transition. The gate input functions identically to mode 2.

Mode 4, Software-Triggered Strobe. In this mode, the output is normally high. Loading the counter latch(es) initiates counting. If counting is in progress at the time of the load, the current count runs to completion and the subsequent count reflects the new value. Upon completion, the output goes low for one clock period.

Mode 5, Hardware Triggered Strobe. This mode is identical to mode 1, except that the output is normally high and goes low for one clock period upon completion of counting.

Counter Reading and Latching

The 8253 counters can be read in two ways. In one of them, issuing a normal read to the counter's specified address transfers the counter outputs directly to the data bus. If the counter is counting, the contents are changing continuously. For an assured reading of the actual counter contents, the counter must be inhibited by disabling the clock or alternatively by forcing the gate low, if it is in modes 0 or 4. Note that the counter latches are write-only and that the counter itself is read. In reading, as with writing, the read/load bits of the control word register determines the accessing of the counter contents.

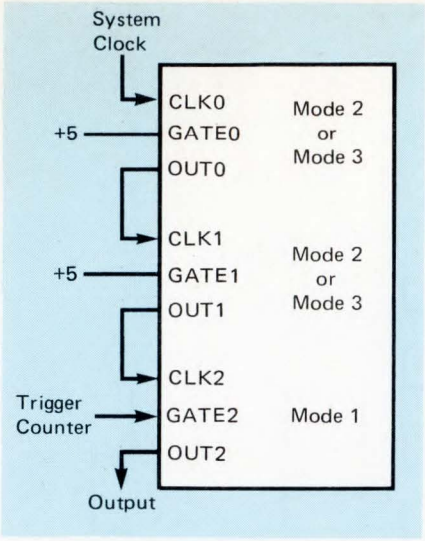


Fig 4 Cascaded 8253 programmable interval timer.

The second method of reading the counter uses the counter latching command. Issued like a control word, this command performs a counter latching operation, freezing the contents in an auxiliary register and giving a stable, readable value. Once latched, the contents can be read at any time without affecting the counter operation. In operation, the user simply issues the latch command for the particular counter **(Table 5)** at the desired point in time to latch the current contents. The saved counter contents are now read as though one were reading the counter latches. Note that the latch command does not affect the programmed read/load format or mode, so that the bytes read remain as previously programmed by the control word.

Designing with the 8253

Here are a few tips to help a designer use the 8253 efficiently, as well as help avoid using it incorrectly:

- Since the maximum count possible is a modulus of zero, binary mode counting maximum is 2^{16}; BCD mode counting, 10^4.
- A divisor of one in modes 2 or 3 results in the counter division by the maximum divisor after the first clock transition has occurred.
- A divisor of 3 in mode 3 also results in an incorrect counting sequence.
- The first rising transition on a clock after a write to the counter latches transfers the contents to the counter; the subsequent clock begins decrementing the counter.
- In the repetitive modes (2 and 3), the counter never reaches zero, but is reloaded from the counter latches instead of being decremented to zero. To prevent the counter latches from being modified during this reloading time, an internal provision suspends the reloading operation until any write in progress to the latches is completed. At that time, the new latch information is transferred to the counter. What this means to the user is that if a latch write is performed at the same time that the counter is waiting for reloading, the count is suspended (output remains unchanged) until the write is complete. At worst, this suspension of counting occurs during one or two clock periods and is independent of the write pulse width. In most cases, this suspension does not affect the user. However, if it is a problem in your application, you can avoid it by reading the counter and making certain that adequate time is available to complete the write before the counter reaches its reload point.
- In mode 3, the counter internally counts by 2s. If the divisor is odd during the first half of a cycle (output high), the counter initially decrements by one and then by 2s. During the second half of a cycle (output low), the counter initially decrements by three and then by 2s. Thus, every time the output changes state the counter is reloaded twice in each cycle.
- You can cascade counters to as many bits as desired by using a counter as a prescaler for the next stage counter. For example, you can cascade all 3 counters in **Fig 4**, so that when the gate of counter 2 goes high, it takes a maximum of 2^{48} system clock cycles before the output goes high. At 2 MHz, this change takes place in 1.4×10^8 sec. or approximately 4.5 yrs.

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Floppy Disk Provides Backup For Winchesters

E. Chuck Ouellette
Remex Div., Ex-Cell-O Corp.

The speedy and economical floppy is a natural

The road block for the Winchester is backup. While some manufacturers claim the Winchester doesn't require backup due to its spectacular 1×10^{11} data reliability spec, systems designers don't buy that argument. Winchester is still subject to power failure, natural catastrophe and operator error, and users will only feel safe when their data is resting securely on a non-volatile shelf. As a result, a lot of peripherals manufacturers are betting their devices will suceed in the coming backup bonanza. Major contenders are the 1/4″ tape cartridge the 1/2″ streaming tape drive and the floppy disk drive. The relative data capacities of the three categories of devices – cartridge pushing its upper limits at 40 Mbytes, 1/2″ streaming tape at 40 and about to make the easy jump to 80 Mbytes, and floppy at a mere 1 Mbyte per disk with future higher capacities just now appearing – have lead some observers to apportion the backup market according to Winchester size. Floppy they say can handle Winchester disk backup up to 5 Mbytes and may stretch the limit to 10. Quarter-inch cartridge takes the field from 5 to 20, hands down, with serious contention up to 40 Mbytes and 1/2″ streaming has it sewn up above 40 with inroads down to 20 Mbytes. That's if the system designer accepts this capacity formula without a serious analysis of his application, he may be limiting his system and get into cost/performance problems when he takes his product to the user.

RJE vs DDP

There is no doubt that floppy disk and various tape technologies all have a part to play in the backup market. But, the division of labor is not so simple as dividing along Mbyte lines: it is a question of application. To oversimplify somewhat, it can be said that the important future Winchester applications fall into two major categories: (1) RJE (remote job entry) type uses and (2) DDP (distributed dp) functions as represented by general purpose minicomputers and small business systems. WP constitutes a third important division.

Backup for the types of applications is quite different. RJE requires regular (if not daily) backup of the entire database because of the current make-up of the operating system software architecture. DDP- and WP-type functions, on the other hand, are based on an updated file premise and require transactional backup. Such backup can be seen implemented in RT-11 and LSI-11 type operating systems. When a file change is made, a "flag" is raised by the software. At the end of each day the system utility program is employed to copy onto the backup device all of the flagged (i.e., changed) data.

The table shows the relative market segmentation of the DDP vs. RJE applications. Obviously, the DDP represents a significantly larger market share and all indications are that DDP is on the rise while RJE is declining.

What's the point? Just this: tape backup devices (with their high capacity, serial recording) are indicated for RJE type backup of the complete database; but for the burgeoning field of transactional backup, the speedy and economical floppy disk is a natural.

The capacity question

Before the reader raises an eyebrow asking "How can you do large capacity backup with a 1-Mbyte device?", let's look at the real world. Take a 20-Mbyte Winchester, for example. First, what is the real amount of data stored on the disk? Formatting reduces the total data storage to about 17 Mbytes. The operating system uses up to 2 Mbytes of the disk, and it is unchanging and requires no backup; therefore, data has dropped to 14 or 15 Mbytes. Chances are the user is employing no more than 10 Mbytes (or less) of that available space at any one time. (If he's using all 15 Mbytes he should move to a larger disk drive immediately.) If he wants to backup that entire database on floppy disk, it will take him only 7 or 8 diskettes – less than a box. And, at floppy's high speed transfer rates, even with changing diskettes, the total offloading will take under one hour. This is too time consuming if it was done everyday; but, in fact, backup of the entire database even in the most security-conscious DDP system) is only done about once a month. All other backup happens transactionally.

Even the busiest single operator

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

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

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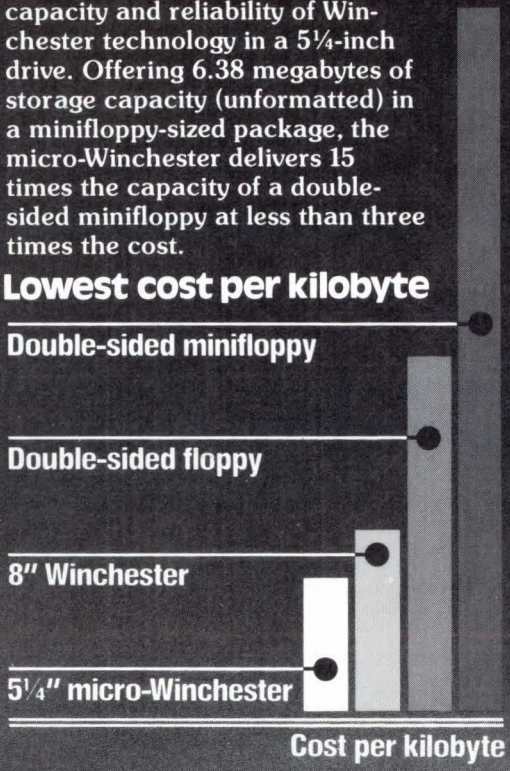
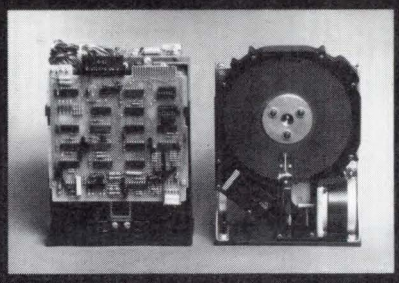


The perfect marriage– Minifloppy and micro-Winchester



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

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

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

Shugart Technology

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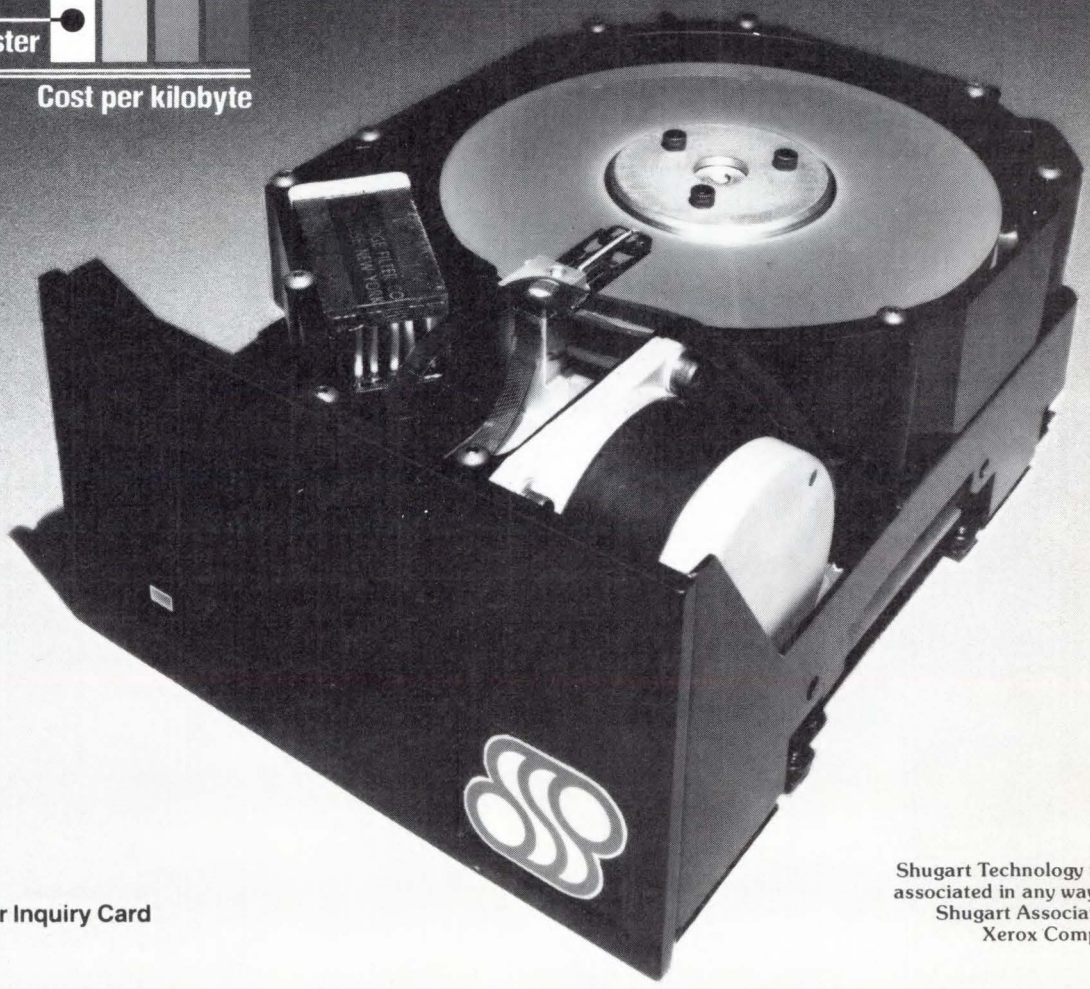

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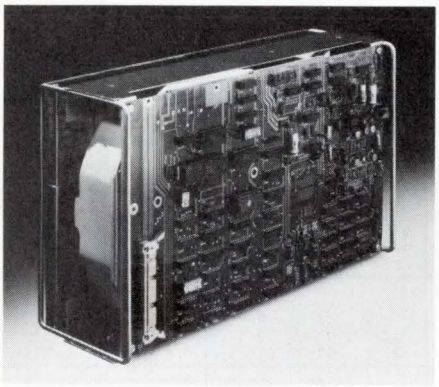
VARIATIONS ON A THEME BY PRĪAM

DISKŌS 2050 AND 3450 8" WINCHESTER DISC DRIVES

This Tune May Sound Familiar . . .

Variations are created from the elements of a composition, changed to create a new and interesting idea. PRIAM's DISKOS 2050 and 3450 are variations on a Winchester disc drive design theme that has been proved in concept, performance, and production.

PRIAM design engineers followed the same design composition that has made the 14-inch-disc DISKOS 3350 efficient, reliable and cost effective. They scaled the DISKOS 2050 and 3450 to fit exactly into the space required by a standard floppy disc drive. This noteworthy accomplishment provides capacities of 20 and 34 megabytes, with 40 and 68-megabyte capacities to follow, with the same size and weight.



Interface Harmony

PRIAM's DISKOS 2050 and 3450 play from the same interface music as the DISKOS 3350, so that a single controller can be used with PRIAM Winchester disc drives covering the capacity scale from 20 to 154 megabytes. Head positioning times, data transfer rate, data and command functions and lines . . . every pin connection is the same. And *data separation is included* in all PRIAM drives, saving you expense in interfacing.

Sing Along With SMD

An optional interface permits you to use PRIAM drives with existing controllers for CDC Storage Module Drives. You can stretch the life of your SMD controller and get on the air more quickly with the low cost, high capacity, and splendid reliability of PRIAM Winchester disc drives.

See us at N.C.C., booth #347 & 349, Disneyland Hotel underground exhibit facility.

Presto Positioning

PRIAM's proprietary linear voice coil head positioner provides fast access to data and still lets the DISKOS 2050 and 3450 exactly replace a standard floppy disc drive. Positioning is fast and precise, with an average access time of 50 milliseconds, and a track-to-track time of only 10 milliseconds. Because of the exact positioning provided by PRIAM'S voice coil system, data recovery is positive and reliable. DISKOS drives will tolerate the harsher environments in which computers, word processors, and communications systems of the future will operate.

Brushless DC Spindle Motor

A brushless DC spindle motor provides reliable operation with a simple, low-cost design, doing away with belts and pulleys and extra bearings. PRIAM's DC spindle motor eliminates alternating current entirely from the DISKOS 2050 and 3450. They will operate anywhere in the world without change.

Microprocessor Maestro

Economy, flexibility and reliability result from PRIAM's use of a microprocessor to control head positioning and to perform self test and diagnostics. The number of parts and electrical connections in the system are reduced to lower cost and improve reliability.

Welded Steel Rod Frame

PRIAM's DISKOS 2050 and 3450 mainframe castings are mounted in sturdy welded steel rod frames that permit ready circulation of cooling air. These frames also reduce weight and cost. Heavy metal is used only where it is needed, so the DISKOS 2050 and 3450 weigh only 20 pounds. Shock mounts protect the drives and isolate them from system ground.

Air for Reliability

PRIAM disc drives use a unique air management system to prevent contamination. Valuable data is protected by creating positive air pressure at the spindle bearings, where contamination is most likely to enter. PRIAM drives include permanent absolute filters that constantly purge the air inside the sealed disc assembly.

Specifications

DISKOS 2050 Capacity (unformatted)	20 Megabytes
DISKOS 3450 Capacity (unformatted)	34 Megabytes
Transfer rate	1.03 Mbytes/Sec
Track-to-track positioning	10 milliseconds
Average positioning	50 milliseconds
Tracks per inch	480
Bits per inch	6646
Height	4.62 inches
Width	8.55 inches
Depth	14.25 inches
Weight	20 pounds

Interface Efficiency

Interfacing DISKOS 2050 and 3450 disc drives to your controller is economical and efficient because it is designed for connection to the most widely used 8-bit and 16-bit microprocessors. Daisy chaining is easy and functional, and overlapped seeks may be used. Data separation is included in drive electronics, so controller design is simplified and reduced in cost.

Smart Interface

PRIAM's SMART Interface Adapter provides serialization and deserialization of data, disc formatting, sector buffer,polled or interrupt operation, defect mapping, overlapped commands, implied seek, selectable sector sizes and microdiagnostics. Up to four drives can be interfaced easily to the I/O bus at the byte level.

For a brief and handy history of Winchester technology and its advantages, call or write to PRIAM and ask for a copy of WHO'S SELLING RIFLES TO THE INDIANS? A Winchester Disc Drive Technology Primer. It's FREE!

PRĪAM

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Telephone (408) 946-4600 TWX 910-338-0293

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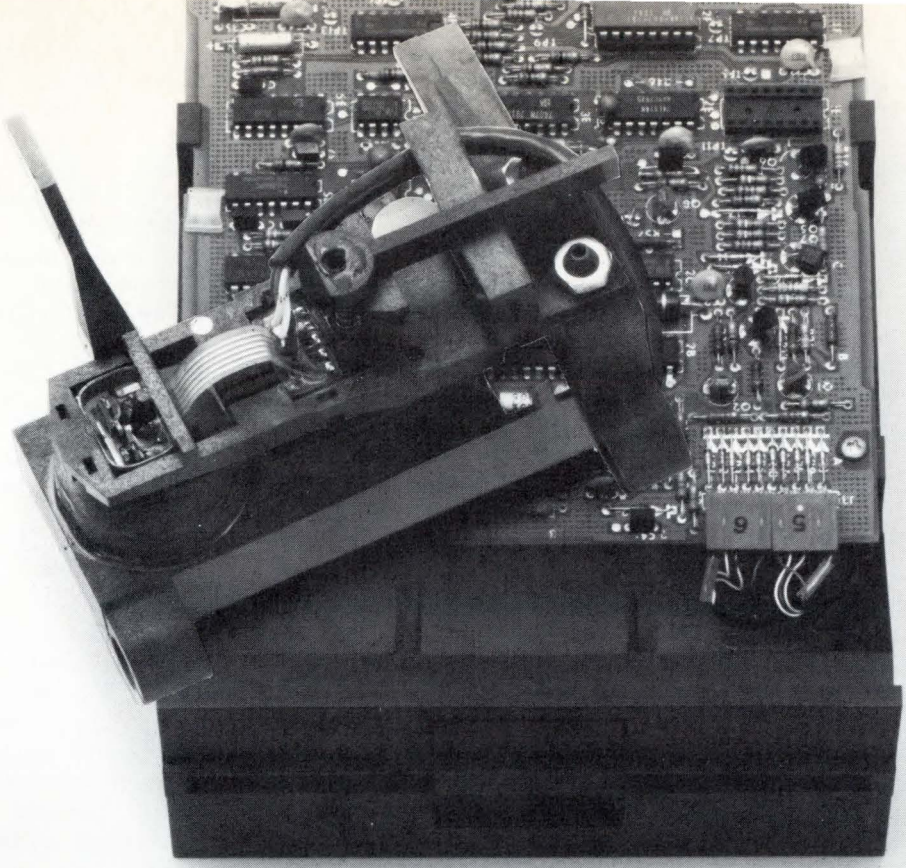
INDUSTRY SEGMENT / DISTRIBUTION CLASS	CPU Manufacturer	Add-on Memory	Software Houses	Dedicated Systems	General Purpose Systems	End User System Subsidiary	Sophisticated End User	Typical End User	TOTAL
General Purpose Minis	10	10	2	10	10	5	7	1	55
Small Business Systems	10	6	1	9	10	4	7	1	48
Data Entry/ Remote Batch	8	5	1	8	8	4	4	1	39
Intelligent Terminals	6	5	1	5	6	5	5	1	34
Special Data Acquisition	5	4	1	5	5	5	4	1	30
Scientific and Medical	5	4	1	5	5	3	3	1	27
Word Processing/ Text Editing	8	4	1	8	8	6	6	1	42
Communications	5	4	1	5	5	3	3	1	27
Graphics	6	5	1	6	6	3	3	1	31
Process Control/ Test Equipment	7	5	1	7	6	5	5	1	37
Time Sharing/ Educational	3	2	1	3	3	3	3	1	19
High End Calculators	3	2	1	3	3	2	1	1	16
Microcomputers	10	10	2	10	10	8	7	1	58
PCM	8	10	1	1	5	1	1	1	28
TOTAL	94	76	16	85	90	57	59	14	

DDP type system does not generally enact more than 500-1000 file changes per day; operator can't work much faster. At 256 Mbytes per file all the changes made in a full day's transactions can be stored on one-quarter or less of a diskette. Therefore, in most systems, a single diskette will record a full week's files. The diskette is then stored on the shelf next to the 7-8 floppies containing the database. At the end of the month, 4 or 5 diskettes have been accumulated and the file is perfectly secure. At this time, the user may choose to spend 45 minutes or so offloading the entire database (a function which may require no computer intervention, as will be seen below) and the four diskettes containing file changes are recycled for daily transactional use.

This transactional backup capability is not limited by total capacity but by number of file changes per day. If a system incorporates a 40-Mbyte drive with four users, total transactions will still not exceed one Mbyte per day. Therefore, files can be recorded on a single diskette and will not make floppy backup impractical. Only when total transactions are in excess of 1 Mbyte (a figure about as accessible as a 3-minute mile) does the



Tandon Drives. Heads above the Rest

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

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

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

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

Tandon

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Heads above the rest in disk technology.

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use of today's floppy become impractical. And, the upper limit for floppy is already being pushed by the announcements of high-capacity diskette drives. While the 5-Mbyte floppy may be cost prohibitive for some time, the 2-to-4 Mbyte drive is within easy reach at competitive prices.

The systems device

Despite floppy's suitability for transactional backup, a DDP user might still opt for tape if all else were equal. Afterall, 20 Mbytes is 19 more than one – no matter how you use it. But, of course, all else is *not* equal.

Many (indeed, most) of the new Winchester users came from the floppy world. The user understands the floppy, his operators are trained to use it, he has a large investment in both floppy hardware and software, and his system is designed around the use of diskettes. Chances are in his present system, the floppy is the systems device, and all applications programs are on diskettes. Where does that software go if the floppy is removed from the system? If the software is placed on tape, the user is faced with a time-consuming interaction problem each time applications are loaded or unloaded. This interaction may require more than 10 computer interrupts for completion, unlike the one or two needed with the floppy. And, of course, if the floppy is eliminated from the system, what does the user do for I/O? Tape is a non-interactive device. And, all major operating systems have their file structure based on disk on-line file storage. In a low-cost system this means floppy disk.

Consider costs

Chances are good that when the application is evaluated, a user is going to need to keep the floppy in his system for I/O and/or systems device requirements. What then does this do to the cost of tape backup? Tape becomes not a replacement, but an additional cost in the system. Also, the user must retrain his personnel to use tape, and foot the bill for extra media expenses. This is not a justifiable expense when the floppy can effectively be used for backup as well as I/O.

When Winchester/tape and Winchester/floppy systems are considered head-to-head without provision for keeping floppy in the system, the floppy disk is still the price winner. Taking initial costs, retraining and media conversion costs into consideration, a user (who has been using floppies) may save as much as $3500 in moving up to floppy/Winchester vs. tape/Winchester. And, he doesn't have to face the hassle of new media/device usage.

Keep it under control

But cost is not the only thing the floppy saves; it also saves the computer time and memory. One major advantage of disk vs. tape usage in a Winchester system is controller design. Because tape and disk have no interactive capability or software commonality, the CPU must become in effect the controller and data buffer. All commands to both devices must pass through the CPU. While performing backup, the host is so busy toggling command lines and buffering data that it is effectively shut down to all other functions.

A floppy/Winchester system, however, can be controlled with a single controller and software package. Because file management for the disk and diskette drives is almost identical, the Winchester is treated simply as a third logical device with more files. Software design is a snap. A controller for the disk devices can be designed to house the backup buffer and to perform all backup off-line in a background mode.

For example...

Great system flexibility is possible with a Winchester/floppy combination. While our Data Warehouse, a highly sophisticated, intelligent DMA mass storage system, is designed to be considerably more than a simple disk backup device, it does demonstrate a disk backup capability. The controller handles all functions of a 20-Mbyte Winchester and two Remex dual-head, double-density floppies (single head, single density may also be used). The controller's operational mode is a protocol called Channel Command Control, which makes it possible to transfer large amounts of data via DMA with only one command from the host. The system greatly reduces the strain on a programmed I/O bus and thereby permits a system to perform more tasks without requiring CPU upgrade.

The on-board intelligence divides commands into immediate, foreground and background prorities; and because the system has three logical interactive disk units, it is possible to perform more than one task at a time. The system's "copy" function is a background command. This function permits data to be copied from disk to diskette, diskette to disk or diskette to diskette; and most importantly, the copy is performed completely *off-line* to the computer. The third logical unit, be it the Winchester or a floppy, remains on-line to the computer for foreground functions while the background copy function is being performed. Therefore, in any such system, backup can be performed without using CPU time and without shutting down CPU/disk communications. Obviously, this system flexibility is only possible with an on-line interactive device like the floppy.

The little, fast, reliable, removeable disk

There should be mention of the more obvious (and only slightly less momentous) advantages of the floppy disk for Winchester backup. For example, floppy drives are the smallest available backup devices. The biggest floppies are as small as the smallest cartridge tape drive; and, in fact, some cartridge manufacturers advertise their products as "fitting into a floppy slot" in the system chassis. Therefore, unlike the larger sized 1/2″ tape drives, there is no problem integrating a floppy disk into even a compact, desktop Winchester system.

Data reliability is also a consideration for the systems builder and the floppy shines. Today's best flexible disk drives offer a specified data reliability rate of 1×10^{10} and this figure is proven in both test and customer experience. Even the 1/2″ streamer drives do not exceed this reliability factor and they are unproven devices in field operation. Of course the floppy's reliability far exceeds the spec of cassettes and cartridges at 1×10^{8} or 1×10^{9}. The floppy's bonus to the user is a 6000-hr. MTBF. Of course the best known advantage of the floppy disk is speed. With a 3-ms track random access time and transfer rates to 62.5 Kbytes/sec, the floppy greatly extends system design flexibility.

It is significant that a new system announced by a major mini/microcomputer manufacturer incorporates a Winchester-with-floppy-backup; one of the preeminent small business system builders is also expected to enter the market with a disk-plus-diskette system shortly. DDP-oriented manufacturers are making their choice.

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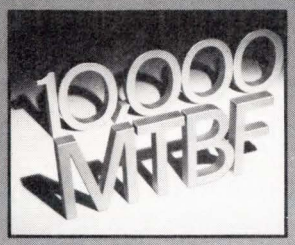
RELIABILITY. IT'S WHAT MAKES FUJITSU THE WORLD'S LARGEST MANUFACTURER OF OEM WINCHESTERS.



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

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

80 and 50 MB cartridge drives with SMD interfacing

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

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

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

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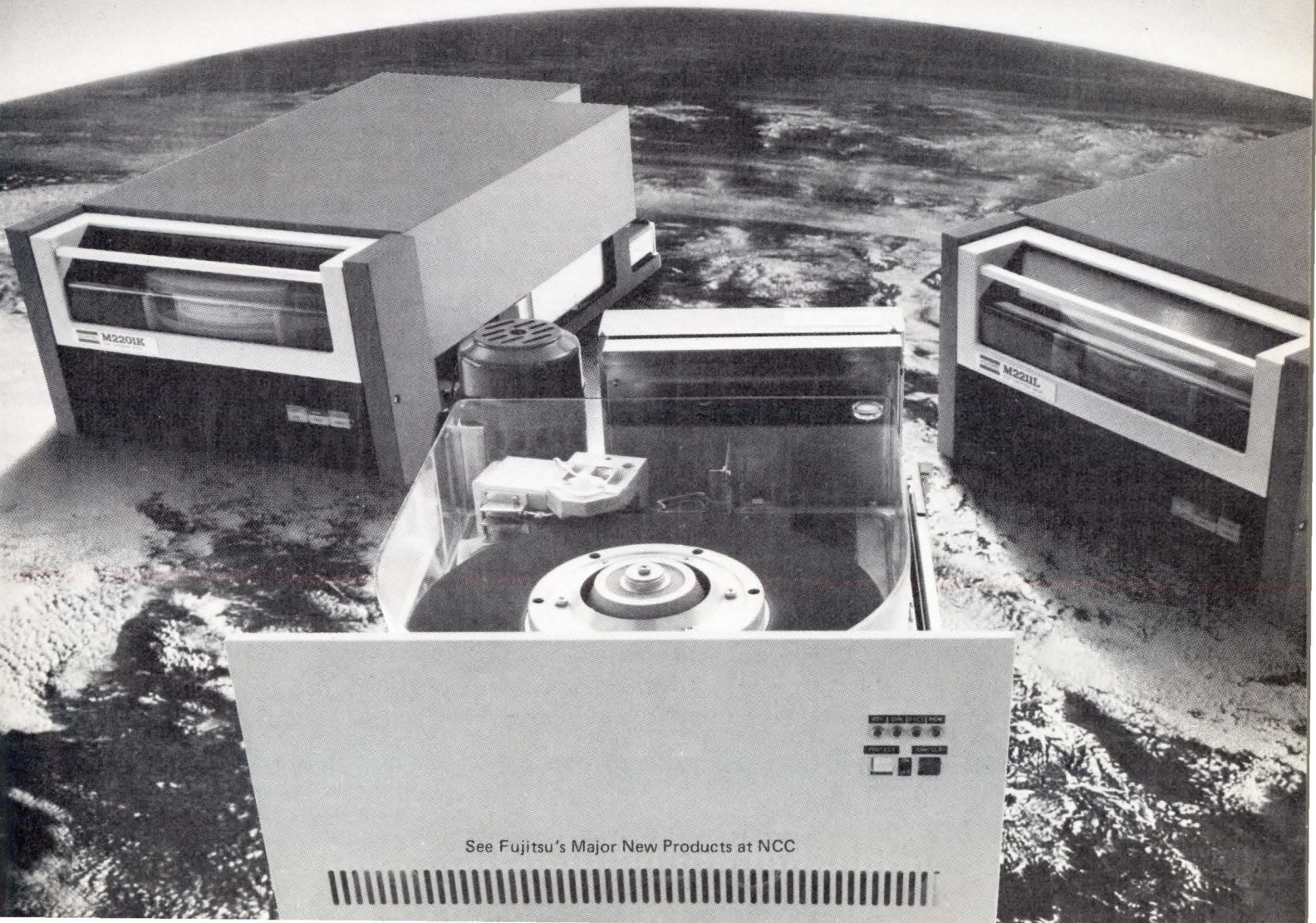


See Fujitsu's Major New Products at NCC

Roy Ford
Cipher Data Products, Inc.

Half-Inch Tape Provides 8" Winchester Back-up

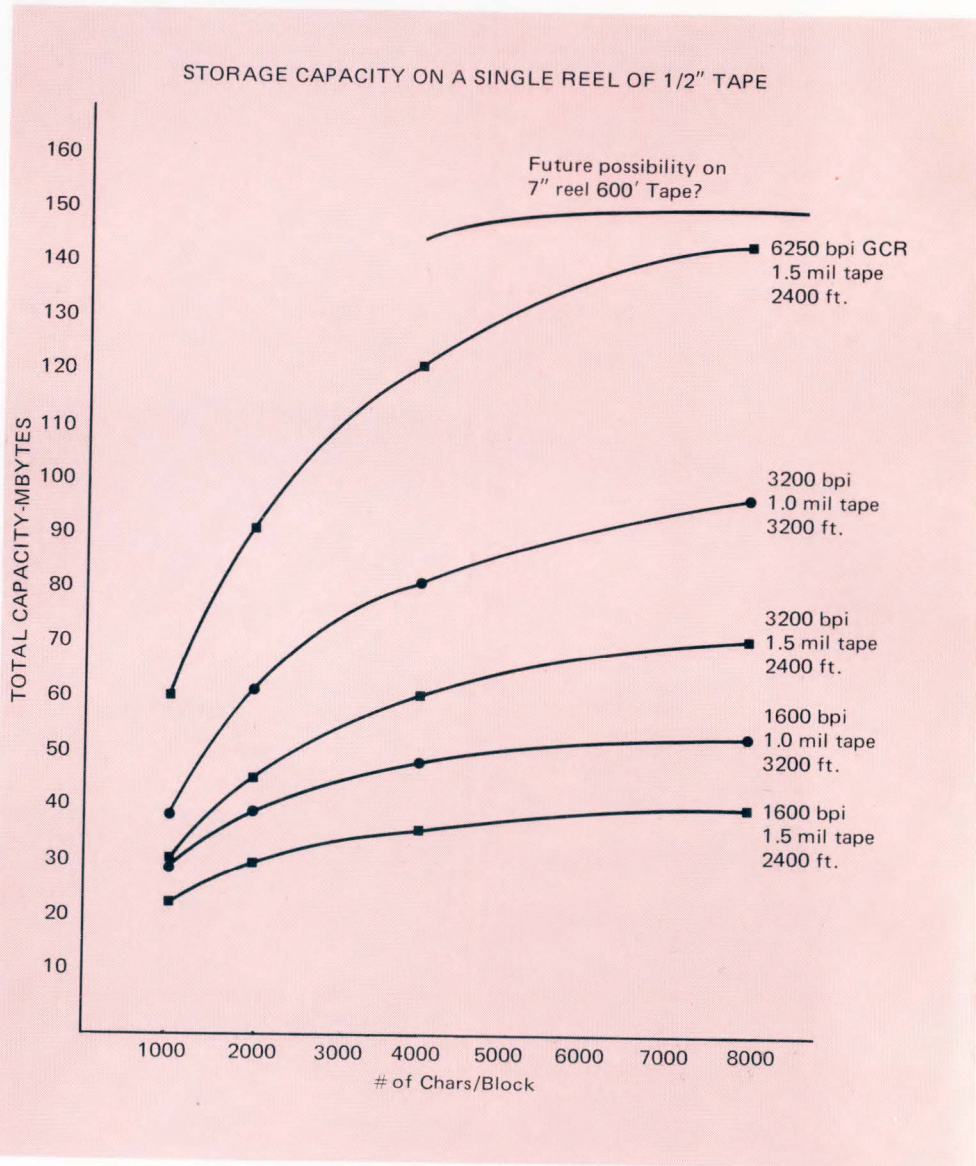
Why use half-inch tape drives for backup? Unlike languages, which, although saying the same thing, cannot be understood by all of us, the established ANSI and IBM compatability standards that exist in our industry allow different computers to exchange information. The half-inch tape drive is a proven technology, providing known data reliability and performance that has been measured in the industry for many years, and it's cost effective.

The issue

In every computer journal one picks up these days "the issue" is the method of backup for the emerging 8" and more established 14" Winchester technology disks. To read these articles you would think that backup had never been an issue before and that it was some black magic technology that everyone was waiting for to save their souls. The truth is that backup has been around for a long time and successfully used by most computer systems in the past.

In the past, drums were the main memory system; and even then, we needed backup and I/O. In those days, you certainly did not remove the drum at the end of the day. A half-inch tape or even paper tape provided backup.

But the "issue" is not just backup. When you had a fixed memory system such as was the case with the drum, and is now becoming so with the advent of systems having only Winchester non-removable disks, some ability to remove data was (is) essential. Backup, the saving of a data base at regular check points, insures that you can go back to the last check point in the instance of a catastrophic failure and not lose all that has gone before. But, let's consider other uses: (a) program interchange (ie, new system releases, updates, etc.), (b) exchange of data bases and (c) archival storage, the real history copy.



What does it offer?

Stability. The half-inch tape drive is a known technology with a track record. The error rates are well established and proven. Using the 1600-bpi, phase-encoded format, single-channel error-correction and compensation for speed variations demonstrates and attains hard error rates of 1×10^{-10}. This means that close to 200 10.5" reels of

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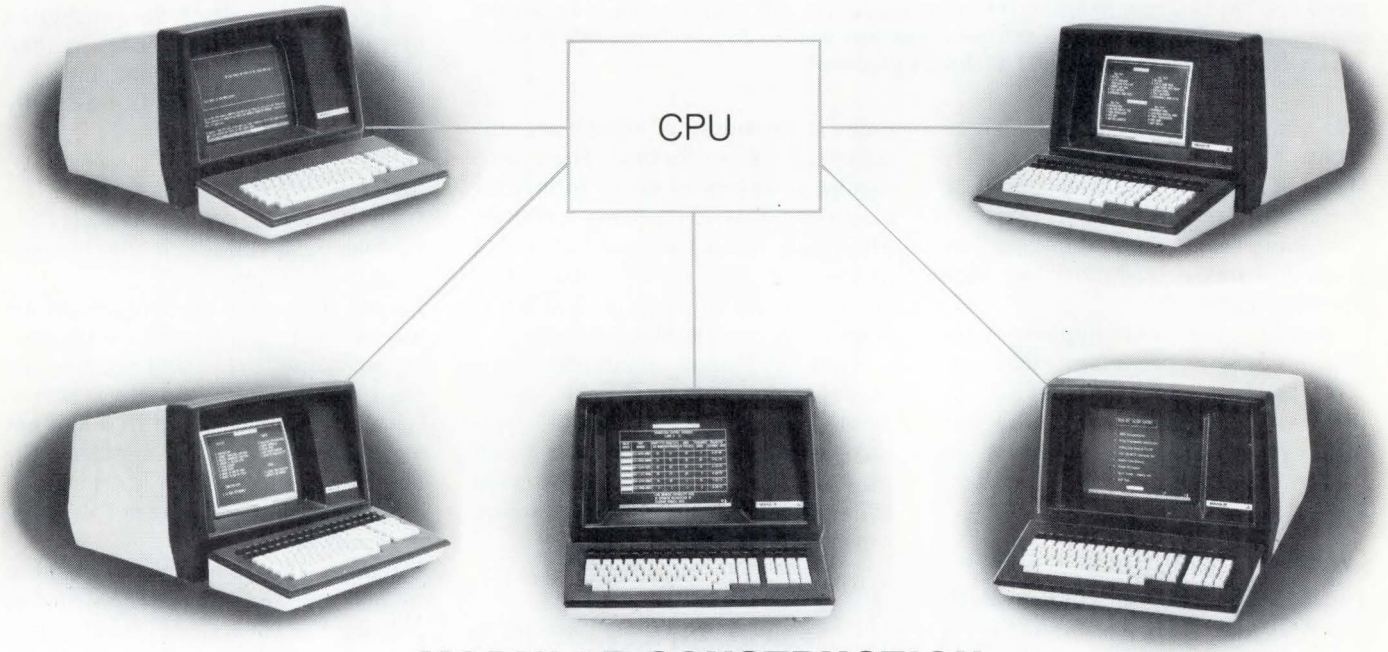

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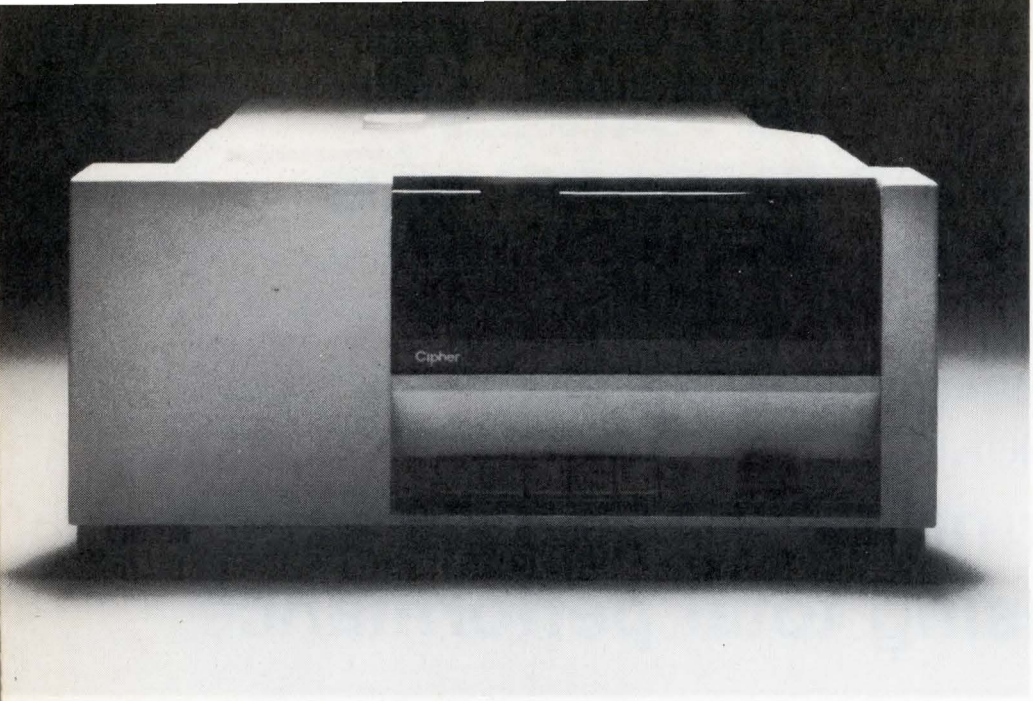

CIPHER'S "MICROSTREAMER": This streaming back-up 1/2″ tape drive is self-loading and self-threading. Streaming mode is 100″/sec. Stop/start mode is 25″/sec. Stores 46M of unformatted data and can handle any of 3 differently sized reels.

tape can be handled and only experience one non-recoverable read error.

Media Sources. The availability of media for half-inch tape usage is abounding. There are multiple sources available, and competition has kept the price reasonable.

Quality continues to improve. More than 40 Mbytes of storage media for $9.00 is good value – particularly at today's inflationary prices. Think about media availability today as well as the future before getting locked into back-up devices.

Capacity

The half-inch tape can cover a much wider range of disk capacities requiring backup and intermediate support than other backup devices.

Using a 10.5″ reel of standard 1.5-mil tape approximately 46 Mbytes of data can be stored on a single reel. By using 1-mil tape, this capacity can be increased close to 60 Mbytes on a single reel. Additionally, without any major technological breakthrough it is possible to substantially increase the storage capacity of a single reel by using a new recording density of say 3200 bpi. True, it is not an approved interchange standard, but that may not always be necessary. **Fig 1** indicates capacity capabilities and increases that one could anticipate becoming available on half-inch tape.

The 6250-bpi GCR method of recording on half-inch tape also offers greater capacities, however, the GCR drives have not proven to be an economical proposition except on the larger systems at this time. These units require an expensive set of formatting electronics that add a heavy premium. The future could see some lowering of costs in this area if some enterprising company were to create an LSI set of chips for the formatting algorithm.

Over 100 Mbytes on one reel of tape as **Fig 1** indicates is feasible today. What of the future? Better head technology, and willingness to accept new standards on the half inch tape could easily produce a 150 Mbyte storage capacity on a 7″ reel of tape.

New developments

The new buzz words are "streaming tape drives". When IBM announced their new low cost 8809 tape drive, they also opened Pandora's box to the tape drive designer. With this new drive, gone were some of the "holy-of-holies," i.e. having to start and stop in the gap, the capstan and motor. All of this was accomplished without using vacuum columns, but still providing a high performance at 100-ips tape speed.

Streaming tape drives as such are not new advances in technology. Rather, they are the results of taking a good hard look at what's not needed and tossing it out. Then, with what one has left, some massaging of the packaging and what evolves is a low cost product, very capable of meeting most of the performance standards of its predecessors, but not being asked to start and stop so suddenly. By reducing the parts and maximizing the design to make full use of today's μPs, the price/performance ratios are greatly improved and product reliability is also enhanced.

Streaming tape drives write tapes that are completely ANSI compatible and can read tapes that have been written on conventional drives. The phase encoded (P.E.) method of recording is the only one used. Recording and reading from streaming tape drives is most economical if written or read "on the fly". By avoiding stopping and starting frequently, transfer rates of 160K bytes/sec are standard.

Most streaming tape drives offer two speeds. The top speed is 100 ips and the second speed is either 25 ips or 12.5 ips. This second speed is used for more conventional intermittent data collection but can also be used for dumping disk data.

To fully use all of the capabilities of the streaming tape drives at their optimum conditions some improved software techniques will eventually have to be applied.

Consider alternatives

What does the system designer do? First he must consider his alternatives. They are as follows . . .

Floppy disks. Today, floppy disks are used on many small systems as the main memory, and backup and variable data for other medium capacity systems. Generally, a range of up to 5 and not more than 10 Mbytes is considered the limitation. Fine within its range of capabilities, but certainly not the common answer.

Cartridge. This term is generally applied to 1/4″ tape cartridges. These devices utilizing the 3M style of cartridge have been successful at the low end of the system spectrum both as backup and in some instances as input/output. In the range of 10-20 Mbytes they have been relatively successful.

Much talk is being made about 75 Mbytes on a single cartridge. There is no history or experience to determine how successful this approach will be. Certainly it is pushing the technology and there is no multiplicity of vendors supplying the media. The transfer rates and time to transfer large amounts of data will certainly be questionable.

Removable disk packs

Obviously no designer is going to look at the 2315 style of module today. Also the SMD, although very popular at present, is itself an expensive approach due to the high cost of the modules.

The Ball Family Plan

Winchester. The new Ball Centennial Series offers more reliable Winchester drives with lower parts count, simplified head/disk assemblies, and the precision of true linear motor actuators. Our first two Winchester 14-inch drives offer capacities of 90 and 158 megabytes. Future upgrades will double those capacities to help you meet growing storage requirements.

Removable. Ball backs up Winchester with a compatible family of SMD/Trident-type removable storage modules in 50, 80, 100 and 160 megabyte capacities. All moving parts in actuator and disk pack are sealed to maintain a clean environment. Constant voltage power supply prevents premature component failures and recording errors produced by line variations. Deck plate, logic and power chassis butterfly open from top and sides for faster servicing.

Controllers. Ball controllers for PDP-11, Nova and other popular computers complete your data storage system. Each controller directs up to FOUR Ball Winchester or SMD-type drives in any combination. Controller features include ECC, overlapped and implied seeks, sector interleaving, multiple sector transfers, offset and strobe, bad sector flagging, and write protect.

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There is again much speculation in the area of a hybrid system of 8″ Winchesters and one removable pack either Winchester or a subtechnology. Even if this becomes a reality, one has to think of the cost of each module and the number of modules required for each system it backs up.

Half-inch tape

This workhorse really offers potential, due to its proven track record and data reliabilities. There is a large number of tape drive vendors and media suppliers. It offers a greater potential for future storage capacity and its technology has hardly been stretched. At the 20-200 Mbyte range, it is quite capable of economically backing up any disk. The transfer rates are such that 40 Mbytes can be transferred in less than five minutes (and there is nothing to stop that from going higher).

The new streaming drives, as illustrated by the Cipher F880 **(Fig 2)** offering modern packaging, horizontally profiled requiring only 8-3/4″ of rack space and completely automatic tape loading for easy and inexperienced operator use. These drives offer the solution to backup, but also to the other requirements of handling a system that has a fixed, non-removable Winchester memory system such as program load, archival storage and data base exchange. All this and the cost is considerably lower than anything on the market today.

No perfect choice exists

There is no real encompassing product that satisfies everyone's needs of capacity, performance and cost. You must carefully consider your needs.

The emerging streaming drives are the first real breakthrough of recent years in tape drive design approach and they are certainly cost effective, when one considers that a fully formatted P.E. drive can cost around $2,000 in OEM quantities.

There is also much expandability in the half-inch drive in the way of increased capacities and transfer speeds that have not been stretched at all. And what's more, if the ANSI formats and the IBM compatibility requirement restraints are taken away from the designer, it is my belief that a 150-Mbyte capacity on a single 7″ reel is not beyond the realm of possibility and all for an OEM price of $1,000.

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Special Report:

The Flexible Future of Rigid Disk Drives

Harry Shershow, *Associate Editor*

Where, on the graph of the nation's business forecasts, are disk drives going? It can be discerned from the exploding productions and technologies of the whole computer industry. In 1972 only 5% of minicomputers (one level down from the mainframes) had disk-memories. By 1978 half the minicomputers on the market had such systems. In a year or two from now, the minicomputers in this country will be 100% attired in disk systems. Furthermore, the microcomputers, some of which are smaller in size than disk drives themselves, are all going through the same metamorphosis that affected the minicomputers. One can now order a microcomputer with a limited, built-in core memory of 4K, or a casette-tape-drive 16K memory or a disk operating system going up to the megabyte ranges. And the micro DOSs, which originally emerged as a 5-1/4" floppy, are now attaching themselves to the 8" rigid double-sided, double-density dual drive systems, which makes the $3000 units today more powerful than the million-dollar mainframes of a decade ago. In short, the direction, on any graph that any computer manufacturer can envision, is a sharp vertical slope heading smack into the middle of a multi-billion dollar a year market with at least a 20% annual growth rate.

Development of memory storage devices for the computer began with "ENIAC" and the use, at that time, of a mercury memory. This was followed by electrostatic memory (burning bits onto an oscilloscope screen) and then by ferrite core memory. Memory development continued with the magnetic drum and then with tape. In the mid 1960's IBM introduced the disk which it called "2314 technology." In 1970 IBM's improved "3330 technology" debuted. The third development came in 1973 with the introduction of IBM's "Winchester Technology."

Principal objectives in designing technology to replace earlier methods were increased capacity, faster speed, improved reliability and lower cost. Unlike mercury or electrostatic memories, the three technologies have not obsoleted each other. They co-exist today in the computer world and are undergoing constant improvements. End users of disk drives have established their own, individual appetites for the three systems. No one can argue persuasively why he prefers one disk drive over another, just as no man can justify a preference for brown suits over blue, or vice versa.

The 2314 drives use disks that hold up to 60M of data. These disks have 200 tpi and rotational speeds of around 2,000 RPM. Flying height of the 2314 head is 100 μinches. It has slow access and seek times of 12 msec track/track over the disks. The 3300 technology has storage capability ranging from 10M to 80M provided by 400 tpi with a rotational speed of 3600 RPM. Height of head to surface is 45 μinches. Track to track access time is 6 msec.

The Winchester system has characteristics similar to the 3300. However, its head height has been reduced to only 20 μinches.

Magnetic flux is the inhibiting factor in bringing the head closer to the disks. This force, flowing from surface bits of magnetism, spreads like an umbrella over the disk. The closer the head is brought to the disk surface the closer can bits and tracks be squeezed together without danger of crosstalk or magnetic static. Optimal condition would be to have the head in direct contact with the surface, as in tape recording or playback. With a rigid surface like the disk, which is spinning about 3600 rpm, contact of the head with any contaminant on the surface might cause a crash. A Winchester head riding 20 μinches high colliding with a smoke particle 250 μinches high would be like smashing into a mountain. Therefore, sealed environments and filtered atmosphere are used to protect the head and allow it to be brought closer to the surface. Eventually, when surface contact is achieved, as in tape drives, ultra-packed densities of data will be possible. Now, users must live within the limits of the system which means transfer rates of up to 600 K/s for the 2314; up to 1 M/s for the 3300 and more than 1 M/s for the Winchester.

Manufacturers of the 8" hard disks have been beating the drum for their products since the new size first appeared last year. The 8-inchers can be used for everything from table mats to

complete replacements for the 14", they say. The small disks are capable of functioning as on-line mass storage for micros, minis and some mainframes. They are useful as cache memory reservoirs or disk swapping in data base systems. They offer quick access and high throughput.

The 8" drives on the market have many things in common. Those not in common nevertheless resemble each other closely. They are like a clan of brothers and sisters from the same family all of them wearing different clothes but all with similar facial features. Average access time, for example, for most drives is around 50 milliseconds. They're all about the same size, approximately 5" X 9" X 18". Pay-your-money-and-take-your-choice-capacity varies from 2 M/s to 45 M/s depending on make, model and price. Transfer rates are in the range of 700 to 800 K/s. Bits per inch vary from 6000 to 8000; tracks per inch are 350 to 500; and the unit price begins around $3000.

Winchester operation begins when the featherweight head lifts off from the disk surface. As the disk begins its spin, air currents from the surface set up a turbulence and launches the head into its flight pattern. The 20 gram weight of the head (not much more than the weight of water in a tablespoon) permits it to respond to aerodynamic forces generated by air friction at the surface of the disk.

Winchester Technology currently dominates all marketing strategies and designing goals. Computers of all categories are growing at about a 30% annual rate, and most shipments are now using Winchester technology. The demand, therefore, is increasing dramatically. Chief characteristc in Winchester Technology is the head/disk assembly operating in a sealed, filtered environment.

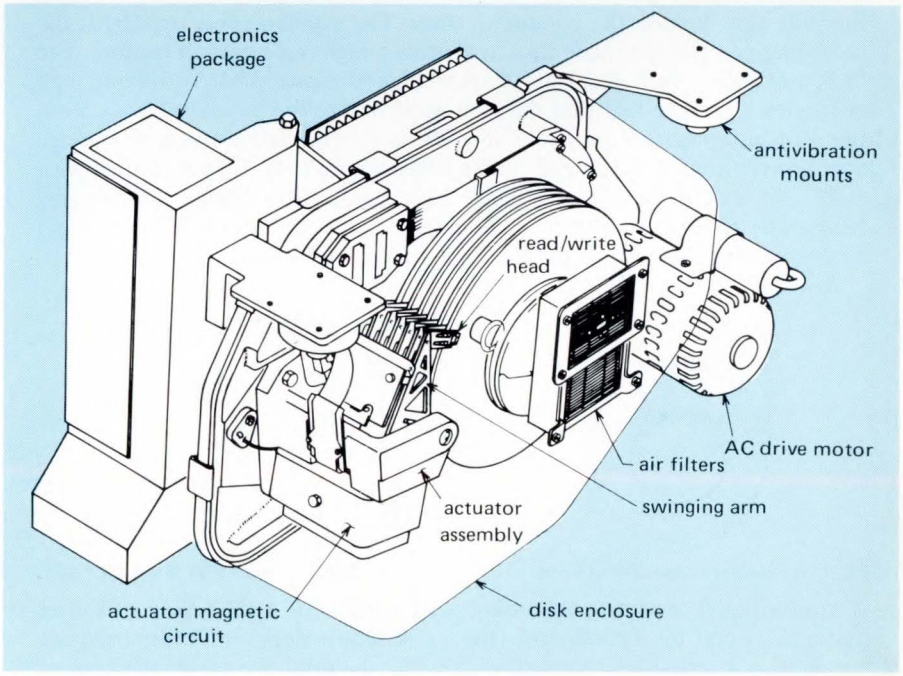
Air filtration in the closed Winchester system is usually self-generating and is performed by the rotation of the disk. A control pate, positioned slightly above the disk surface, divides the drive unit into an upper and lower plenum. Turbulent air currents produced by disk rotation are converted to laminar flow (streamlined flow at control-plate boundary.) The rotating disk acts like a centrifugal pump. It forces air currents around in continuous loops from the disk surface, through the cleansing filter in the control plate, into the upper chamber, then back into the lower chamber where the disk surface continues the motion. This continuous one-way flow, which ends when the disk stops turning, produces a constant-flow, constantly-cleansed air current. The environment surrounding the disk is kept contaminent-free by trapping foreign particles in the filter. (Larger and more expensive systems have independent blowers which produce a continuous, clean air flow even when the disk is not spinning.)

Mind and muscle of the whole disk system is a relatively small component called the controller. This interface, which makes disk drives operational, determines coding technique, selects proper disk in a disk pack, establishes sectors in the write mode, positions head to proper sector in the read mode, corrects errors without stopping, and most importantly, supervises communications with the host computer. The controller is a sophisticated and expensive component but it is the necessary master in a technology where all other functions are its slaves.

Because disk data is stored in many concentric tracks (800 in some big systems) the cost of providing individual read/write heads for each track would be prohibitive as well as physically cumbersome. So, one or more heads are provided for each disk surface and these ganged heads move as a unit across the tracks either in linear or rotary motion, making many tracks accessible to each head. The more heads, therefore, that can be included in the system, the higher the performance. The New World Computer Company, for instance, is currently marketing a unit containing 20 heads that can read/write data on an .008" wide track. These 20 heads, when mounted over the 8" Winchester disk, can each monitor eight tracks for a total of 160 tracks. With each track containing 13 K of data, the head can tolerate a total disk capacity of 2.1 M. This 20-head unit moves a total of 0.070" to cover all positions on the disk and requires a maximum of seven steps from the drive motor, with each step carried out within 5 ms. Another option on some controllers is multiple porting which allows two or more processors to access the same disk – a feature that removes the possibility of an entire system crashing.

Small-disk controllers sell for around $3000. Larger units (80M and up) require more sophisticated and more expensive ($8500) devices. The costs of these controllers is the key to the varying costs of disk-drive units.

The actual positioners of the control units differ in the industry. Linear voice-coil actuators operate in a closed-loop servo system. This type is used by manufacturers like BASF, IMI and Priam. Rotary voice-coil actuators are part of the Micropolis and Pertec drives, among others. IBM has a linear voice coil positioner that swings a band arrangement of multiple heads across the disk surface. Stepper motor actuators, as used by Shugart, don't al-



An overall view showing the six disks of an IBM 62PC disk file. Besides the disk, the drive has a swinging-arm head-positioning actuator inside a sealed enclosure, a-c drive motor, air filters, electronics package, and antivibration mounts.

Thin Film Heads

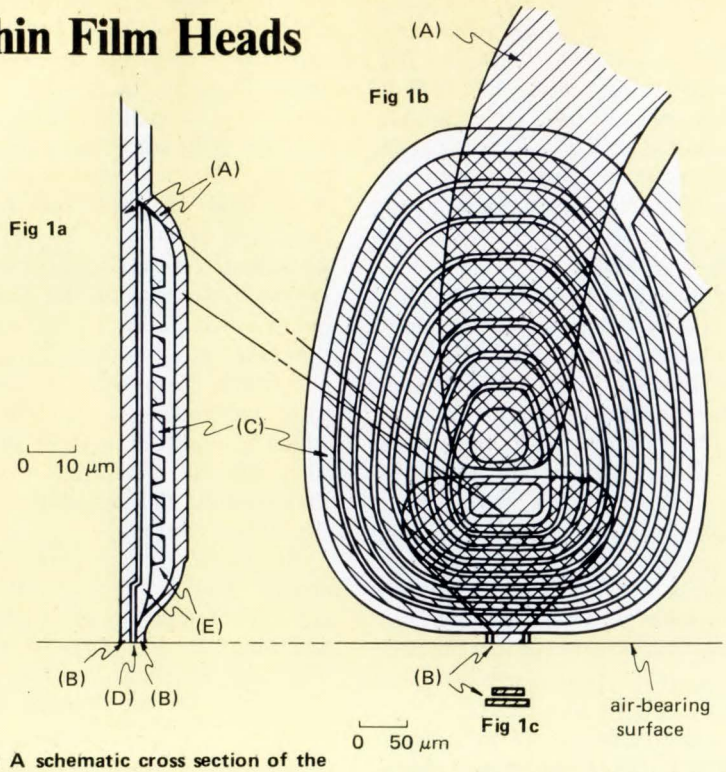


Fig 1a A schematic cross section of the thin film head showing the magnetic layers (A), pole tips (B), conductor turns (C), gap layer (D) and insulation layers (E).

Fig 1b A planar view of the film head.
Fig 1c Pole-tip structure at the air-bearing surface.

Design and Technology of the Thin Film Structure

The cross section of the IBM 3370 head **(Fig 1a)** shows its basic structure. A top and bottom (pair of) NiFe magnetic film (A), in the form of an elongated split ring, provides a path for the magnetic flux which creates fields between the pole tips (B) for writing. This flux is generated by currents flowing in the eight conductor turns (C). In reading, flux induced by magnetic transitions in the disk media travels around the magnetic circuit between the pole tips, linking the conductor turns. The magnetic pole tips (B) at the recording gap (D) are made thin to provide a high resolution in reading. The back portions of the head are thicker than the pole tips to provide high efficiency [2]. The fact that the pole tip structure can be moved away from the air bearing surface precisely at a 90° angle **(Fig 1b)** offers an advantage over conventionally machined ferrite heads whose pole tips are formed with a 45° sidewall slope [3] and hence have significantly higher side fringing fields. The second pole tip is made narrower than the first pole tip to avoid wraparound at the edge of the first pole tip edge **(Fig 1c)**.

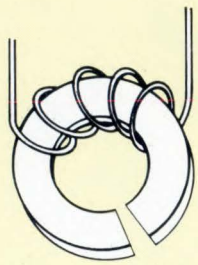


Fig 1 An inductive recording head.

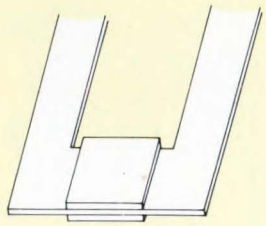


Fig 2 Simple film magnetic head.

A conventional inductive recording head consists of a slit toroid of ferrite material wound by a conductor **(Fig 1)**. A simple design of a film head is a conducting stripline surrounded, except for the magnetic gap at the edge of the conductor, by permalloy. This results in a single-turn head with the gap defined by the conductor thickness, and the magnetic pole-tip defined by the thickness of permalloy surrounding the conductor **(Fig 2)**.

low high-track density, but cost less.

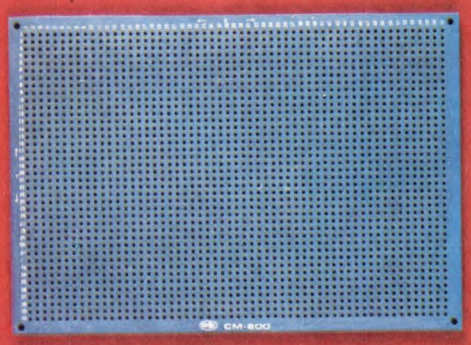
Earlier generations of disk files positioned the recording heads by using various independent mechanical or optical sensors. The errors between actual and assumed head positions were acceptable, then, when densities were only 5 to 10 tracks per mm. As the number of tracks increased it became necessary to position the head accurately to avoid cross talk. This was accomplished by dedicating one of the multiple heads to function as the slave-driving servo head. This head provides track information. Other heads on the actuator follow accurately the guidance of the servo head. Prime task of the servo head is to place a selected data R/W head accurately over the desired data track in the presence of such disturbances as disk spindle run-out, vibration, and aerodynamic forces due to airflow from rotating disks. If the R/W head is not positioned accurately above the track (to within a small fraction of the band track width) readback data errors occur from interfacing signals from adjacent tracks and from old information (data previously recorded on the selected track but not completely erased by more recently written information.)

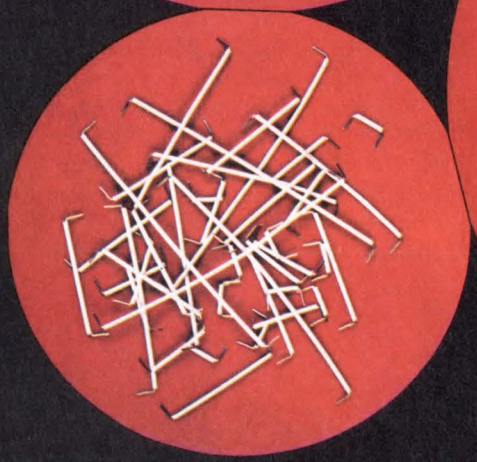
Track to track access time (a measure of the efficiency of a computer system) is also controlled by the servo head. Early track widths were about 0.007″ wide. Tracks in the new Winchester system are only 0.001″ wide. This reduction in track width, which brings the flying heads closer to the disk, reflects a 7X decrease, which, in turn, reflects a proportional increase in computer response and efficiency.

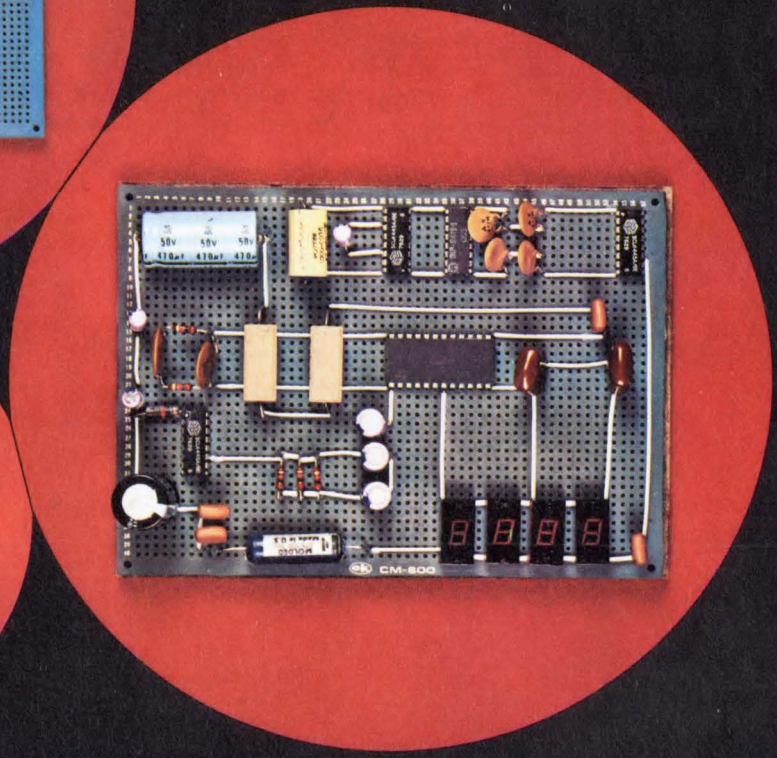
Older disk drives have the smallest storage capacity and are slow in transfering data from disk to main memory. Also, older cartridge drives have only 200 tracks per surface while the new Winchesters have more than 800. Lower costs of older drives are their one big advantage over newer technologies. These older units are limited to between 1000 and 4000 bits per inch; Winchester drives can squeeze more than 6000 bits into an inch of track. The transfer of data from disk into the computer varies from 185,000 bytes per second (older units) to one million bytes per second on Winchester units.

"Seek time" (moving the heads across the surfaces in search of the target track) and "latency time" (waiting for the rotating disk to bring the beginning point of the track under the R/W head) vary from system to system.

CM-600 Circuit Mount







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Obviously, the faster are these times, the more efficient is the throughput.

Two methods for improving disk technology, other than electro-mechanical methods have been increase in packing densities of the disk and reduction in height of the flying R/W head above disk within the limits of magnetic flux.

The easier solution for reducing megabyte costs has been density packing. Density is gradually being increased with no additional costs to head, controller, motor, etc. Lately, disk formatters are beginning to mimic sardine packers as the squeeze gets tighter with more tracks per inch, more bits per track and more surfaces per spindle. Track densities will increase further in the next few years, and track-embedded servo control information will grow. Servo feed back positioning will appear on the surface tracks of each disk, between data sectors.

In this effort to increase data storage capability as parameters approach the 2 million characters per second data rate and the areal density begins to exceed 8 million bpi, new techniques are being developed. Most promising is the photolithographic methods already introduced by IBM in its 3370 thin-film-head disk drive of 570M for each of its two spindles. This new technique has the basic goal of offsetting some limitations of ferrite heads imposed by magnetic flux. These limitations determine the density at which bits can be stored on the surface of the disk. Thin film techniques allow recording-gap dimensions to be the thickness of a film layer.

Arrays of film heads can now be fabricated with accurate alignment and reduced EM noise susceptibility. The film heads permit higher performance with decreased physical dimensions.

Some future alternatives to Winchester drives that will be popping up in the next few years will be Charge Coupled Devices (CCDs); Magnetic Bubble Memories (MBMs) and Optical Disk Memories (ODMs). They will all offer faster access times and higher capacities.

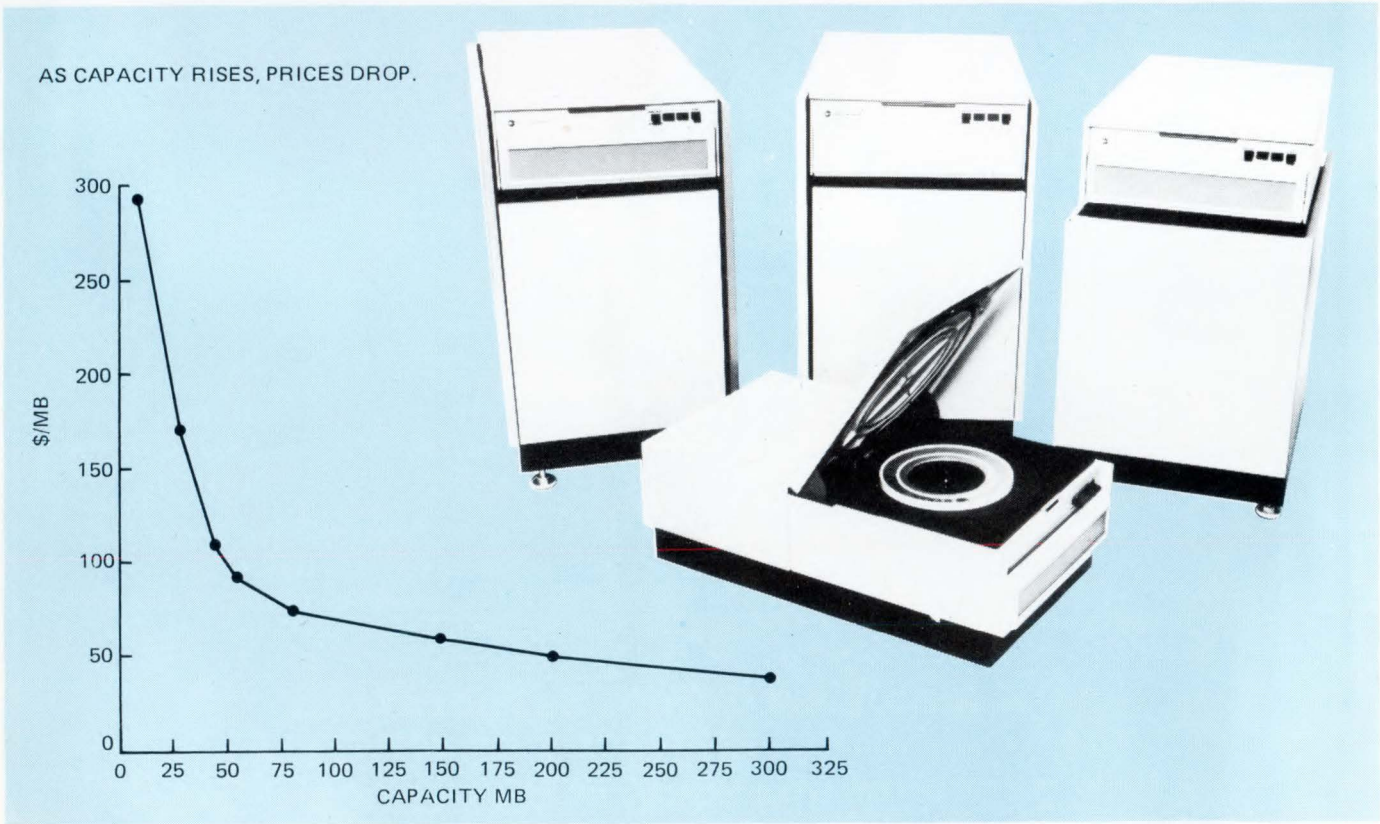
Optical disks will have 6000 M capacity on one side of a 12″ disk. The drawback to that enormous amount of stored data is that none of it will be alterable. It will be permanently burned into the disk. The optical technique is sure to find some worthwhile applications but none of it in data processing where data is written, read, changed, erased then rewritten.

Magnetic bubble memories will be smaller in size and will boast fast access times. The data will be non-volatile (no loss of information.) At first the MBMs will have lower capacity than the Winchesters. Later improvements are sure to appear that will increase this capacity if they are to be competitive with Winchesters.

Stored data in CCDs will be volatile and can be lost when power is removed. Furthermore, they have higher costs. They will be used as cache memories for large Winchester-based disk systems. These CCDs will enhance Winchester devices, not compete with them as alternatives.

And also waiting in the wings and about to make its big market debut is the new 5.25″ Micro-Winchester hard disks such as the ST 500 by Shugart Technology (not to be confused with Shugart Associates.) It will sell (beginning around June) for $925 in unit quantities, will have 6.38 M capacity, a data rate of 5 Mbits per sec, recording density of 7690 BPI and 254 TPI.

With all the advances in Winchester technology taking place at a steady rate, the most important aspect of its future growth will still be in the market place. No matter how sophisticated



Costs of many of the most expensive elements in a disk subsystem (the motor, head actuator, and control electronics) are largely independent of the storage capacity of the disk platters. The platters themselves are much alike regardless of capacity. As a result, higher capacity units are generally more cost effective. Physical dimensions of disk drives increase as capacities increase. Century Data Systems' Trident drives, shown above, start with smallest 220 lb. unit (27.3 MB) and end with largest 480 lb. drive (312.1 MB.)

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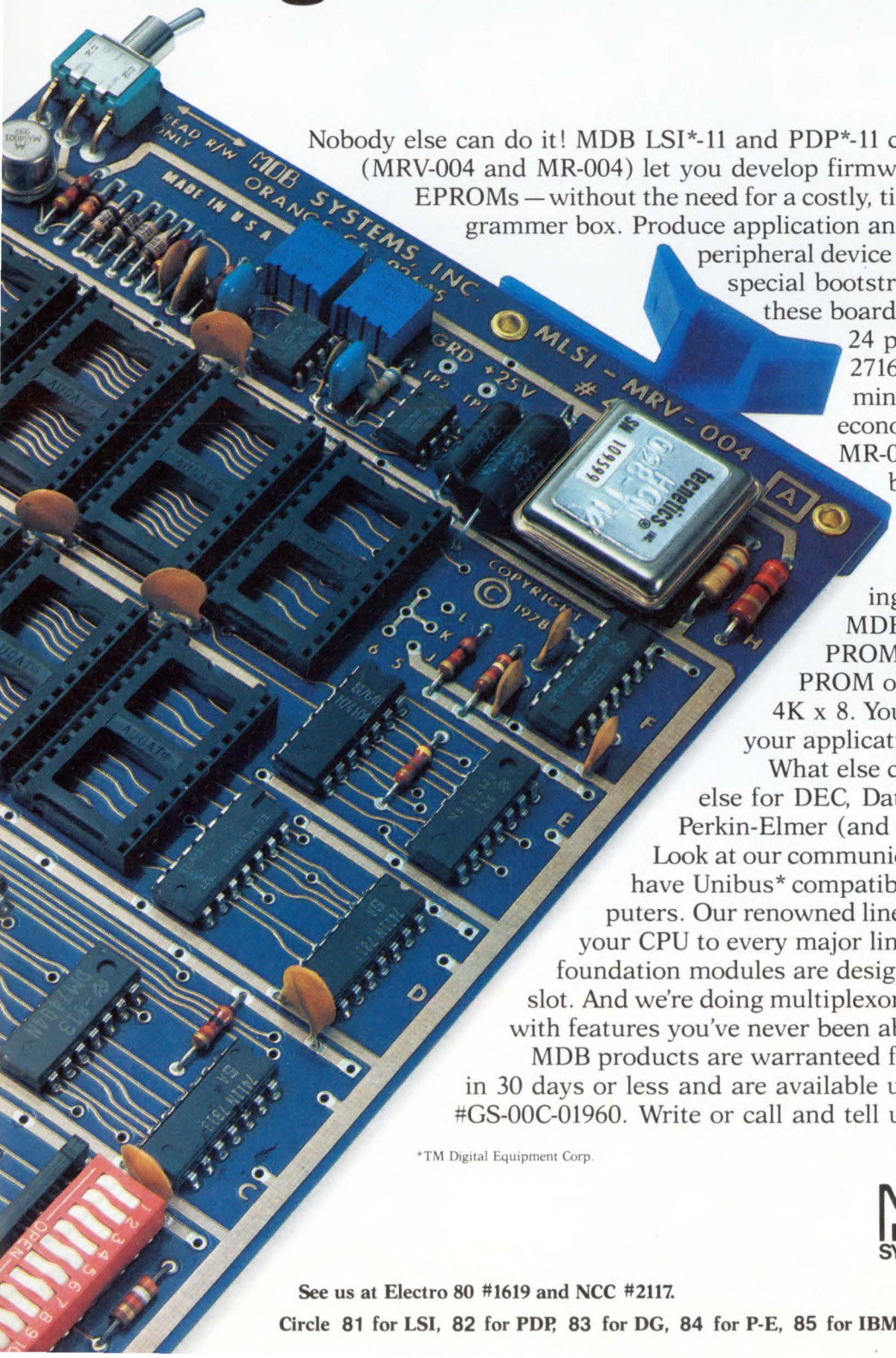

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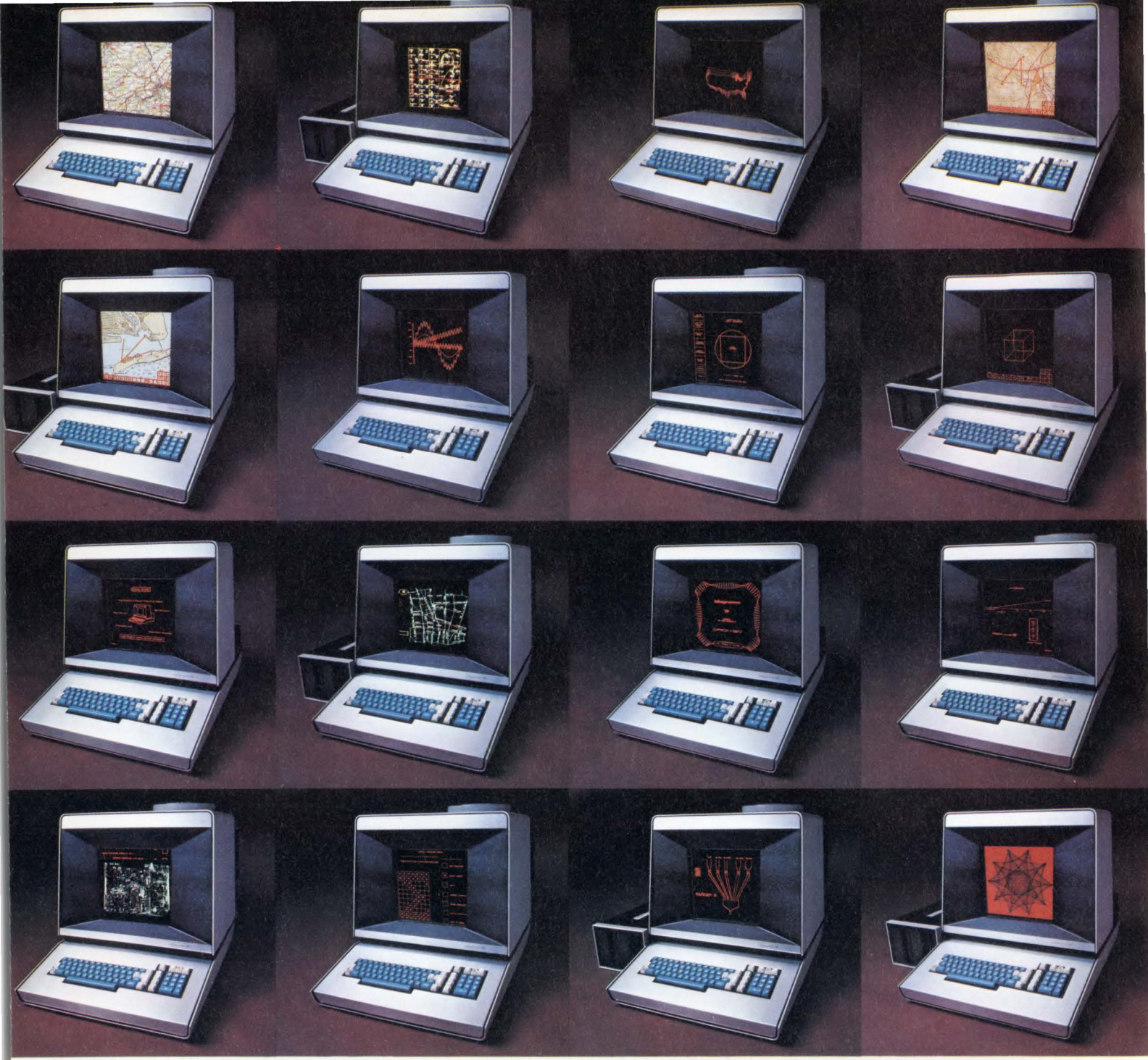

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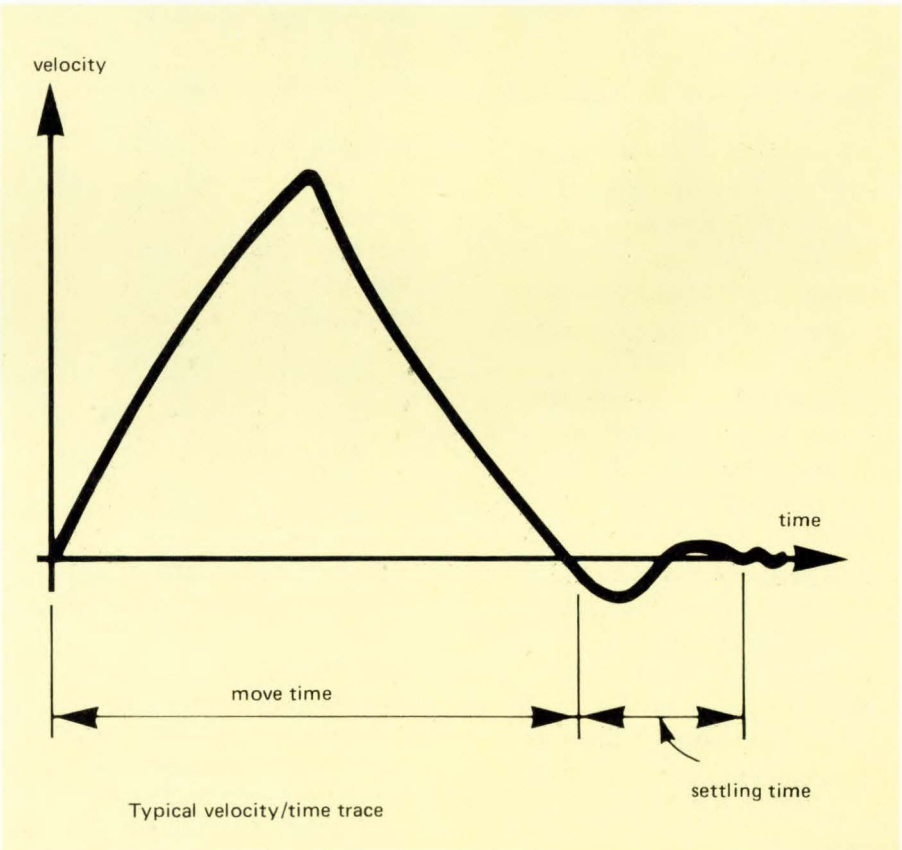
or how efficient disk drives become, their very existence depends on sales. Technological advances indicate that future small data bases using 8″ Winchesters will have a 20 M capacity; large data bases, using 14″ Winchesters, will have as much as 600 M mass storage. Market willingness, meanwhile, to accept this increased storage is being estimated at $3 billion for the 14″ Winchester by the end of this year, while the 8″ will be nibbling at the $2 billion mark. Currently the market for 14″ is about $1.5 billion, and the 8″ is about $0.5 billion. Entire worldwide estimated sales of all US made disks and tape drives is expected to reach $10 billion by 1985 (it is now about $5 billion.)

These are shaky moments in the US as well as in the world economy. One hears both optimists and pessimists chattering in their beards and prophesizing either doomsday or rainbows. Theodore Brophy, for example, optimistic chairman of General Telephone and Electric has a vision of a pot of gold sitting on the horizon. "The US data communications industry," he said at a recent Data Communications conference in Miami Beach, "can expect vast and rapid growth during the 1980s. The reason is that we have the solutions to three of this country's critical needs: 1) automation to improve office productivity; 2) conservation of energy; and 3) handling massive amounts of information being generated in an increasingly complex society. To realize the growth anticipated and to maintain our world leadership in data communications, we must resolve our differences and tear down barriers like technical system incompatibilities; out-of-date regulatory structures and costly time-consuming litigation!" Data communications, of course, is the major key to future markets for computers and disk drives. As data communications go, so goes the rest of the computer industry.

A less than optimistic view of the situation was expressed by William S. Anderson, chairman of NCR Corporation, in a recent employee magazine. (If you haven't seen that report, and if you want one of the best insights into what's wrong with the country and what lies ahead, get a copy of NCR WORLD, Vol. 15, No. 1. It is published by NCR Corporation, Dayton, Ohio, 45479. They only have a limited number on hand and you might get lucky.) Chairman Anderson gathered five knowledgeable people who discuss inflation, energy, productivity decline, deterioration of US business on the world market and crisis in political leadership. The five participants were Dr. Paul Craig, Prof. of Economics, Ohio State; Dr. Chauncey Starr, Vice-chairman of Electric Power Research Institute and former Dean of UCLA's School of Engineering; Willard Butcher, president of Chase Manhattan; William E. Simon, former Treasury Secretary; and Jack Kemp, US Congressman. Typical of the views of these pundits are the warnings of Dr. Craig. "We are apparently moving into a recession. It is a recession brought on by government policies and inflation is its principal cause. I blame everyone for inflation: business, government, churches, and educational establishments. Part of the high cost of living is the cost of living high. In 1950 the average house in Columbus, Ohio was 960 square feet and had one bathroom. Now new houses in the same area average 1640 square feet, have an attached garage, central air conditioning and 2-1/2 baths. We are somewhat like uncontrolled kids eating candy. We eat it until we get a stomachache. Inflations never hang around 15%. They either get worse or they get better. We either bring it down, or it will go up. If we don't care enough to stop it, I seriously believe our children will not live under a democracy."

Former Secretary Simon: "By the beginning of the 1970's, a profound shift in industrial power had taken place. In the 1950's and 1960's, Japan's growth rate had been 13% and Europe's 7%. The US rate was around 3%. Evidence of the sliding American position can be found in technological innovation. The US share of worldwide spending on R&D is estimated to have fallen from 50% to 20% in the past 10 years. Fewer high technology companies are being formed and there is less innovation and less growth. What is required, most, is a more practical and accepted dividing line between responsibilities of the market and responsibilities of the government. We must dedicate ourselves to practical solutions within our traditional foundation of economic strength. If we fail to heed the dangers through ignorance,



Typical velocity/time trace

Transfer function — The time for an access from one track to another comprises two main parts, move time and settling time. The move time is the time taken to arrive in the vincinity of the target track (say, within a quarter of a track) and is mainly dependent on torque inertia ratio of the motor and its actuator. Following this, a settling time is required, to allow positional errors to die away to the point where data transfer can be safely allowed. This settling time is a function of both the servo loop crossover frequency (i.e., the frequency at which the open loop gain is 0 dB) and of the phase characteristics around the crossover frequency.

apathy or politics, then we will all pay the price."

Bankers in the Boston area, financial center of the whole northeast computer industry, also see trouble ahead in the world market as well as on our own doorsteps. However, these bankers believe that the computer industry, with all its supporting services, will be relatively safe from increasing inflation and growing recesssions (if they come.) In fact, they see this high technology industry growing at even a faster rate than ever before.

No matter which reports you read, or which prophets you hear, the future growth of the disk drive industry, like the computer industry, will depend on how many people will want to buy the finished product. As the Chrysler Corporation has already learned to its sorrow, the increasing number of saleable products coming off the assembly line are meaningless if there is no one waiting at the end of the line to buy.

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Rigid Disk Drive Directory

The following manufacturers have been listed in the past as producers of rigid disk drives (5-1/4", 8" and 14".) Because of the many variations in specifications of different drives, and because of the numerous models of drives offered by manufacturers, it would be cumbersome at this time to accurately list the individual characteristics of each unit. The US manufacturers, therefore, are listed in order – more as a directory than as a catalog.

Advanced Electronic Design, Sunnyvale, CA
Alpha Data, Chatsworth, CA
Ampex, Redwood City, CA
Ball Computer Products, Sunnyvale, CA
BASF, Bedford, MA
Basic Four, Tustin, CA
Business Systems Technology, Carson, CA
Burroughs, Detroit, MI
Business Systems Products, Carson, CA
Cascade Data, Grand Rapids, MI
Century Computer, Dallas, TX
Century Data Systems, Anaheim, CA
Computek, Burlington, MA
Computer Hardware, Sacramento, CA
Computer Labs, Greensboro, NC
Comten, St. Paul, MN
Control Data, Minneapolis, MN
Cromemco, Mountain View, CA
Daconics, Dallas, TX
Data General, Southboro, MA
Dataflux, Sunnyvale, CA
Datapoint, San Antonio, TX
Datum, Anaheim, CA
Davis-Smith, San Diego, CA
Diablo, Hayward, CA
Digimetrix, Hayward, CA
Digital Equipment, Maynard, MA
Digital Development, San Diego, CA
Diva, West Eatontown, NJ
Dynex, Phoenix, AZ
Electronic Associates, West Long Branch, NJ
Electronic Memories & Magnetics, Encino, CA
Foxboro Co., Foxboro, MA
General Automation, Anaheim, CA
Fujitsu America, Santa Clara, CA
General Logic, Santa Ana, CA
Harris, Fort Lauderdale, FL
Hewlett Packard, Palo Alto, CA
Hitachi America, San Francisco, CA
Honeywell, Minneapolis, MN
IBM, Armonk, NY
Imsai, San Leandro, CA
Inforex, Burlington, MA
Intel, Santa Clara, CA
International Memory Systems, Scottsdale, AZ
Kennedy, Altaden, CA
Logicon Intercomp, Torrance, CA
Media III, Anaheim, CA
Megadata Computer, Bohemia, NY
Memorex, Santa Clara, CA
Microcomputer Systems, Sunnyvale, CA
Microdata, Irvine, CA
Micropolis, Canoga Park, CA
Modular Computer Systems, Ft. Lauderdale, FL
Mylee Digital Sciences, Maryland Heights, MO
Nanodata, Buffalo, NY
National Semiconductor, Santa Clara, CA
NCR, Dayton, OH
NEC Information Systems, Lexington, MA
New World Computer, Costa Mesa, CA
Nashua Corp., Nashua, NH
Nixdorf, Chicago, IL
Northern Telecom, Minneapolis, MN
Northrop Data Systems, Carson, CA
Okidata, Morrestown, NJ
Pacific Micronetics, San Diego, CA
Perkin-Elmer, Randolph, NJ
Pertec, Chatsworth, CA
Plessey Peripherals, Santa Ana, CA
Plotter Instruments, Melville, NY
Priam, Sanjose, CA
Prime Computer, Framingham, MA
Quantel, Hayward, CA
Raymond Engineering Co.
Raytheon, Norwood, MA
Rockwell-Collins, Dallas, TX
Rolm, Santa Clara, CA
R2E of America, Minneapolis, MN
Sagem, Derry, NH
Sanders, Nashua, NH
SDSI Peripherals, Wycoff, NJ
Shugart Associates, Sunnyvale, CA
Shugart Technology, Scottsvalley, CA
Singer, Glendale, CA
Sperry Univac, Blue Bell, PA
Storage Technology, Louisville, CO
The Supply Depot, Woodland Hills, CA
System Industries, Sunnyvale, CA
Systems Engineering, Ft. Lauderdale, FL
Tandem, Cupertino, CA
Telefile, Irvine, CA
Telex, Raleigh, NC
Texas Instruments, Dallas, TX
Varian/Graphics, Palo Alto, CA
Vermont Research, North Springfield, VT
Wang, Lowell, MA
Xebec, Santa Clara, CA
Xylogic, Burlington, MA

(Contact Digital Design if there are any omissions, additions or corrections to above list.)

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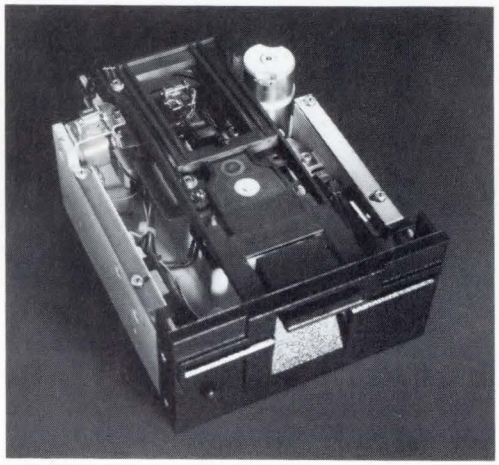

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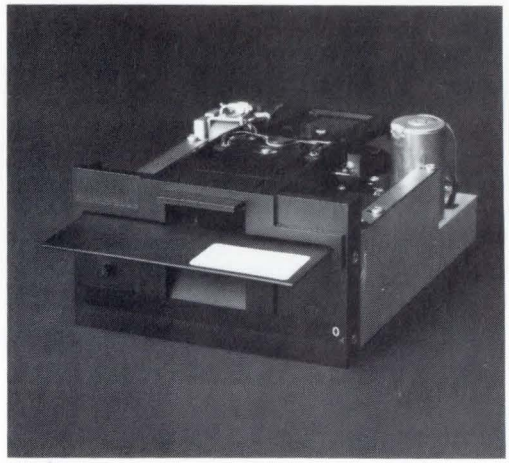

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Eight-Inch Hard Disc Drives:

New Focus In The Small Systems Marketplace

A. Keith Plant
Memorex, San Jose, CA

During the 1970s, dramatic improvements in the price/performance of mini- and microcomputers significantly broadened the market for small computer systems, both in terms of the number of units sold and of user applications. Improvements in data storage devices for small systems, however, were less dramatic and slower in arriving in the marketplace. This has tended to restrict the full potential of small systems, and has even held down demand among the more cost-sensitive buyers.

New focus

With the introduction of 8-inch rigid disc drives, a new focus has been brought to the small systems marketplace. Systems designers now have much greater freedom to pursue their objectives of higher system performance, lower system cost, improved reliability and further simplification of the user/system interface.

Although the possible benefits are numerous, the process of adopting this new generation of disc drives presents many challenges to the systems designer and user alike. The widely debated issue of selecting an appropriate back-up device for 8-inch disc drives, for instance, is only one of the new challenges to be faced.

In addition, with more than 30 companies having announced, or indicating their attention to announce, 8-inch disk products, the task of evaluating both product and vendor will be difficult. The ultimate choice, must be made on the basis of clearly defined criterion that extend well beyound system-driven, disc drive specifications.

This article will discuss the current state of 8-inch rigid disc drive technology, will suggest some general parameters for evaluating and selecting the proper drive for specific applicatios, and will comment on some of the competitive dynamics of the 8-inch marketplace that should be important to OEM buyers of these new storage devices.

Small system data storage. an evolution

A number of data storage devices have been available to the mini- and microcomputer system designer. In particular, flexible disc drives are now so widely employed as either input/output devices or as on-line storage that they are often viewed as a universal storage product for small systems.

This popularity is based primarily on two factors: the cost of both the disc drive and media is very low (under $500 in OEM quantities), and the flexible disc is removable. But the flexible disc drive has its shortcomings. Reliability problems have plagued the higher-capacity, double-headed design, and the media wears down due to the constant contact between heads and disc.

More importantly, storage requirements for the large and still-growing number of applications where flexible disc drives have commonly been used have steadily diverged. As a result, the appeal of this deivice as a universal solution has sharply diminished.

This is not to say that flexible disc drives will wane in importance as a storage device, or become obsolete. They will continue to have their market share (which may shrink in percentage, but still grow in terms of sheer number of units sold). Rather, the 8-inch rigid disc drive will be increasingly employed where it is clearly the better solution – better able, that is, to cope with greater demands for reliability, capacity, cost-effectiveness and higher performance.

A proven technology repackaged

The 8-inch rigid disc drive is an innovative application of a proven technology. It utilizes Winchester-type technology to achieve enhanced performance and reliability in a much smaller package than is offered by 14-inch Winchester drives.

This technology employs a sealed environment for discs, heads and head actuators to protect them from contamination. This is important as the read/write heads fly at something like 20 microinches above the disc surface, and contamination by dust or other particles can cause head crashes.

This Winchester technology, widely used in 14-inch disc drives (a size that will continue to remain in widespread use for certain OEM applications and for large systems application), has transferred well to the smaller 8-inch drive. In the process, it has gained from the refinements through which the larger drives have progressed over a number of years.

The transfer of 14-inch Winchester technology to the 8-inch drive does not represent a technological breakthrough,

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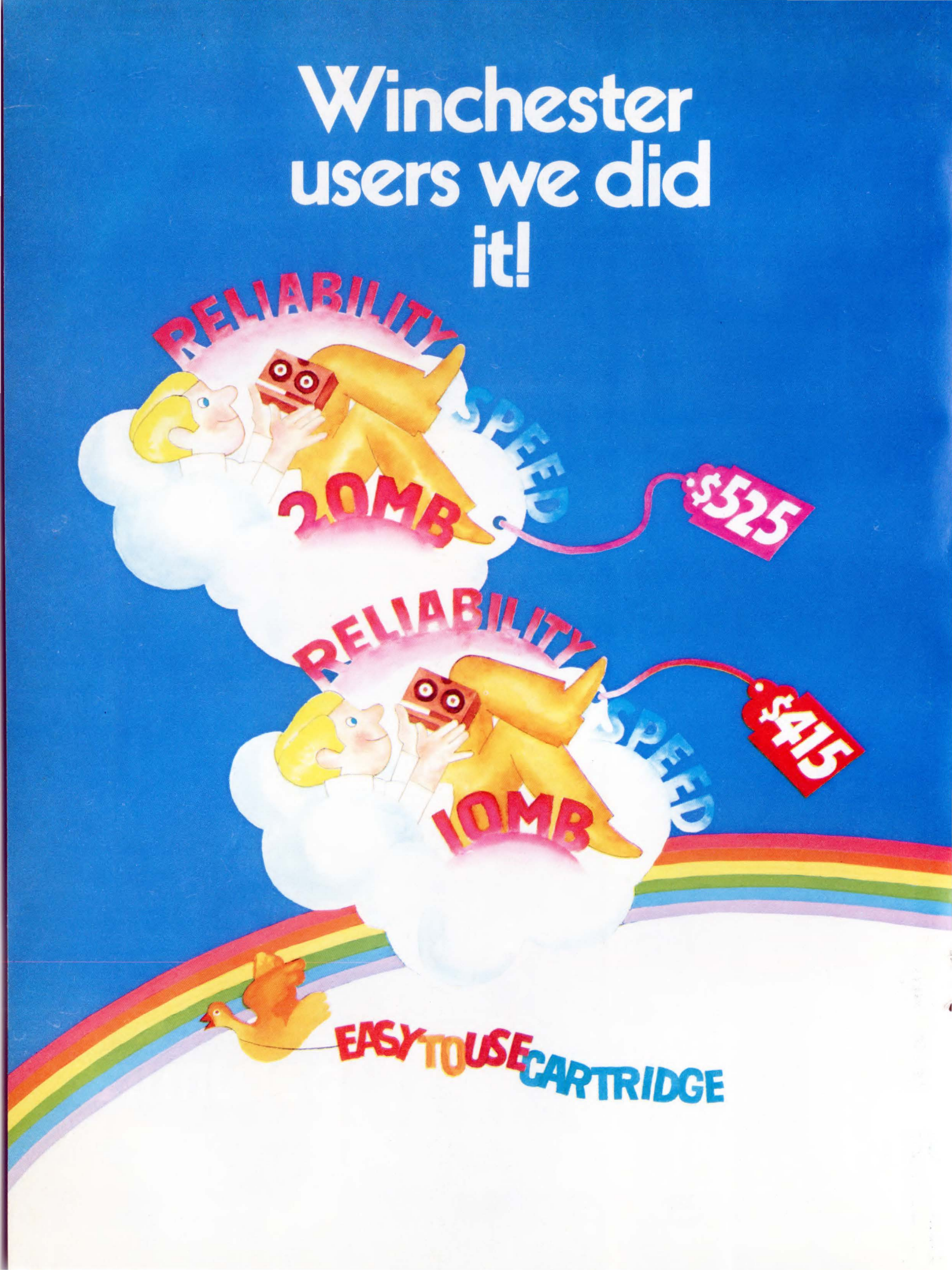

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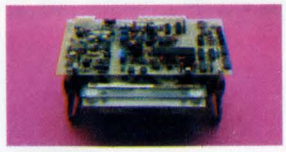

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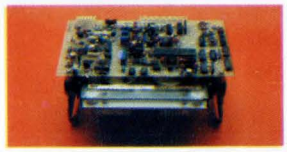

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as was stressed earlier, but rather the evolutionary transfer of a proven technology. And for system builders and users, a proven technology has many advantages in terms of reliability and maintenance characteristics.

The chart included here attempts to provide a pragmatic classification of the general characteristics and specifications of 8-inch disc drives now being offered by a wide variety and a growing number of vendors. Such parameters as price, performance in terms of access times, capacity and probable usage have been grouped in terms of a few basic categories: low, medium, and high price/performance, and fixed or fixed/removeable media.

Some companies have chosen *to limit their initial market offerings to either the low or high end of these scales.* Others, like Memorex and Control Data Corporation, intend to compete in both the low-end and medium-range market segments, with likely future product introductions at the high-cost, high-capacity end of the spectrum.

The OEM who contemplates use of an 8-inch rigid disc drive in his small computer system can quickly narrow down the list of potential suppliers that can satisfy his product requirements on the basis of capacity, for instance, and drive access times. Price-per-box and price-per-bit, too, can be easily compared. We will discuss some of these factors later, but for now it is enough to say that the OEM searching for an 8-inch drive does not need to shop across the entire market, but can narrow vendor options early on the basis of a small set of some system-driven, storage requirements.

Future trends in 8-inch disc drive technology

It is not startling to predict that small computer systems will become increasingly sophisticated in the future – almost every week sees technological refinements and physical and environmental upgrades reported by industry journals. The development of better storage devices, of course, contributes to this growth in capability and flexibility. But it is also apparent that increasing sophistication will make it easier to use the systems, which is not as paradoxiccal as it might seem. Sophistication in equipment and software will be built in, not added on, to the system, making them simpler, not more complex to the user. This increasing sophistication and resultant ease of use will work together to expand the marketplace for small computer systems even faster than it has expanded heretofore. Therefore, the small system making use of an 8-inch rigid disc drive will offer the user not only more storage capacity and higher system reliability, but also, through major advances in user languages, which will consume large amounts of high performance on line storage, offer systems that are much easier for him to use.

But even beyond the benefits now available with 8-inch disc drives, transfer of technology from the 14-inch Winchester-type area will continue to impact beneficially on 8-inch technology. Higher performance will be the hallmark of this impact, with thin film heads and thin film media serving to increase storage capacity, access times and data transfer rates. Higher reliability will also mark future 8-inch disc drives, as sophisticated servo-systems and head positioning devices become available. These trends will also bring much greater storage cost-efficiencies as well.

The future of 8-inch disk drive technology is a bright one – higher performance, better reliability, and lowered costs will assure 8-inch disc drives an expanding market share.

User guidelines

Let's assess the 8-inch marketplace and examine some user guidelines for vendor choices. Up to this point we have dis-

Price	Low	Low		Medium		High
Performance (access time)	High	Low	Medium/High	High	Medium	High
Media	Fixed	Fixed	Fixed	Fixed/Removable Cartridge		Fixed
Typical Drive	New World NWC-211	Memorex 101/102 Shugart 1002	IMI 7710 BASF 6171	Memorex 201 (25 MB)	CDC Lark**	IBM 3310
Capacity (MB)	2	5-25	10-40	25-50	16-50	65+
Typical Price*	$1200	$1300 (11.7 MB)	$1500 (12MB)	$2200 (25 MB)	–	$9000 (end user)
Performance (access time/MS)	20	70	30-50	30	50	25-30
Back-Up	Flexible Disc Drive	Flexible Disc Drive 1/4" Tape Drive	1/4" Tape Drive	Integral		1/4" or 1/2" Tape Drive
Performance:	Low	Low/Medium	Medium	High		Medium/High
Cost:	Low	Low/Medium	Medium	Low		Medium/High
Typical Computer System Price	–	$10-25K	$15-50K	$20-100K		$100K
Drive Usage	Main Memory Extension	Multiple Flexible Disc Drive Replacement	Multiple Flexible Disc Drive (Multi-User Environment And Cartridge Replacement)	Cartridge/Storage Module Replacement		High Capacity 14" Drive Replacement (Both Fixed And Removable Media)
Drive Availability	1980	1980	1980	1981	1981	1980

Table lists 8-Inch mini-disk drives in terms of their price/performance classifications, with breakdowns in these basic groupings. * signifies OEM quantities; ** signifies anticipated drive attribute.

cussed the general aspects and impacts of the 8-inch rigid disc drive used with the small computer system. We have indicated the nature of the technology involved and the fact that it is a logical growth from a proven technology. We have stressed that there are some general parameters which make selection of an 8-inch drive not an entirely hit-or-miss proposition. As we have pictured a future for 8-inch disc drives that is characterized by increasing sophistication and rapid growth.

There are two steps in the process of selecting an 8-inch disc drive vendor for OEM system use. The guidelines we will suggest deal with the specific and tangible product specifications, and the more intangible aspects relating to a disc drive supplier's capability to compete in this competitive marketplace.

Product-based guidelines

The choice of an 8-inch disc drive vendor must first be made by comparing product attributes offered by various suppliers, as those attributes relate to system needs. With the 8-inch disk drive, the system specification will force the choice of a particular kind of 8-inch storage device, a different set of circumstances that prevailed with flexible disc storage, where the offerings were not so diverse.

The product attributes that will be most important to the OEM when making a drive choice are: capacity (both now and in the future), performance in terms of access times and data transfer rates, cost, availability of back-up if not integral, reliability, overall measures of data availability, and finally, such physical and environmental specifications as weight, heat output and dissipation, power requirements, space and aesthetics.

Once these choices are made and a smaller group of possible disc-drive vendors is identified, the capability attributes of each vendor must be carefully compared.

Manufacturer-based guidelines

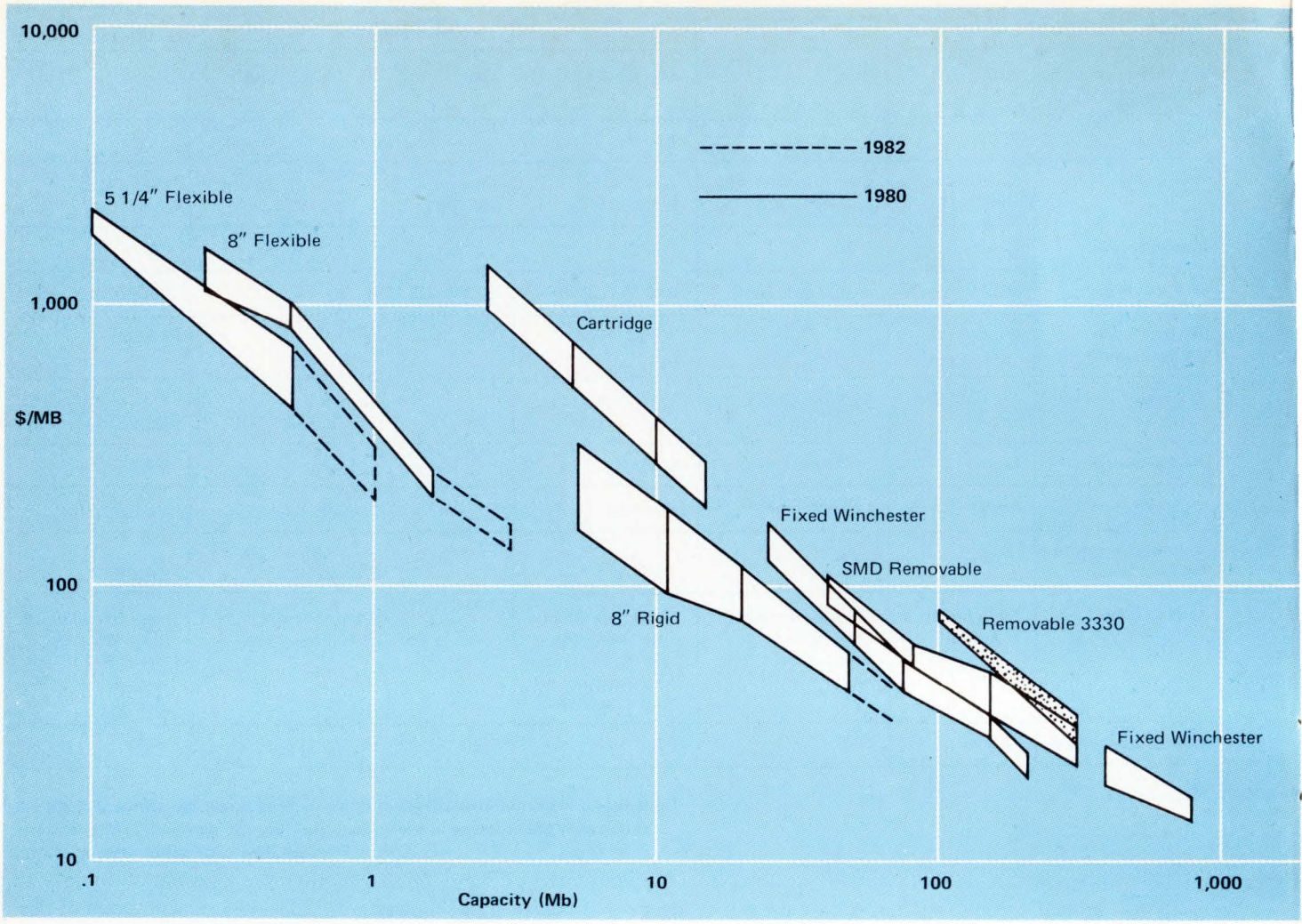
The product technology underlying the first wave of 8-inch drives is not new. Important components such as media, heads, and positioning mechanisms, have all appeared previously in either the larger 14-inch rigid disc products, or, as in the case of the stepper motor employed in low performance drives, in the widely-successful flexible disc drives

With many segments of the small computer system market growing at annual rates near 30%, and the technology barriers to entry into this market fairly easy to overcome, it is not surprising that the 8-inch market opportunity has captured the interest of a very large number of established storage peripheral firms and aspiring entrepreneurs. However, the ease with which a company can enter the competitive market can easily mask the very great hurdles that must be cleared in order to achieve and maintain a strong competitive position over the long haul.

These points warrant emphasis . . .

(1) Competitive advantage will largely be based on the ability to **produce 8-inch drives, efficiently and at high levels of production** – while maintaining high quality standards. Only those competitors which have a superior production capability will be able to realize this competitive advantage.

(2) Since product design also determines eventual product costs, the dual challenge for the 8-inch drive designer is both to create a product that **satisfies system storage requirements** and to ensure that the design is buildable and cost-effective at high production volumes.



This chart shows cost as a function of capacity in megabytes of storage for various mass-storage devices in terms of 1980 levels (solid lines) and anticipated in 1982 (dashed lines.)

(3) The design challenge will soon become sharply more difficult. Successive generations of drives will employ many more "state-of-the-art" components and subassembly technologies. Fixed/removeable drive designs have already **increased the level of design complexity** and, therefore, the competitive pressures.

Why are these comments important to the OEM buyer of 8-inch disc drives? First, product availability is tied directly to production capability and product design. Second, the long-run price an OEM will pay for an 8-inch drive is determined by the supplier's cost to manufacture – which, in turn, is tied to his product design and production capability. Finally, in order to satisfy future OEM 8-inch disc drive requirements, the vendor must be capable of meeting the challenge of developing more technologically-advanced products.

As yet there is no second-sourcing of 8-inch disc drives, which means that the OEM who makes a vendor choice cannot easily switch to another supplier if his first choice cannot deliver a reliable product in the quantities needed. Therefore, vendor choice must also be made on the basis of proven track records and visible resources to back up production and reliability commitments. A proven track record can be measured in terms of overall production capacity, ability to stand behind reliability claims, product line investments, field operation and maintenance support systems, the extent and sophistication of product testing, and the production-consciousness of research and development teams – all in all, the vendor who can demonstrate full-scale capabilities in these and related areas will prove to be the better choice.

Vendor resources must also be taken into account in other ways. Business stability, based on capital resources, will be a factor in the choice of 8-inch disc drive suppliers. In that regard, *Business Week* (January 14, 1980) has pointed out that the "high cost of money. . .will put increasing pressure on small producers, especially those that sell in the office and small-business markets. If such companies have to delay their expansion plans, they will find it much tougher to provide the service and support that their larger, full-line competitors already provide." Trying to finance product expansion, continuing R & D, field support, and other necessary business operations out of direct sales, in an era of tight credit, is going to put many smaller, newer companies in an impossible situation.

Other factors in vendor selection that are useful to the OEM might also be mentioned, but the point is already clear. The choice of an 8-inch rigid disc drive supplier, although initially bewildering, can be made more logical by the application of a few guidelines that relate to both product attributes and the resources and capabilities of possible drive suppliers.

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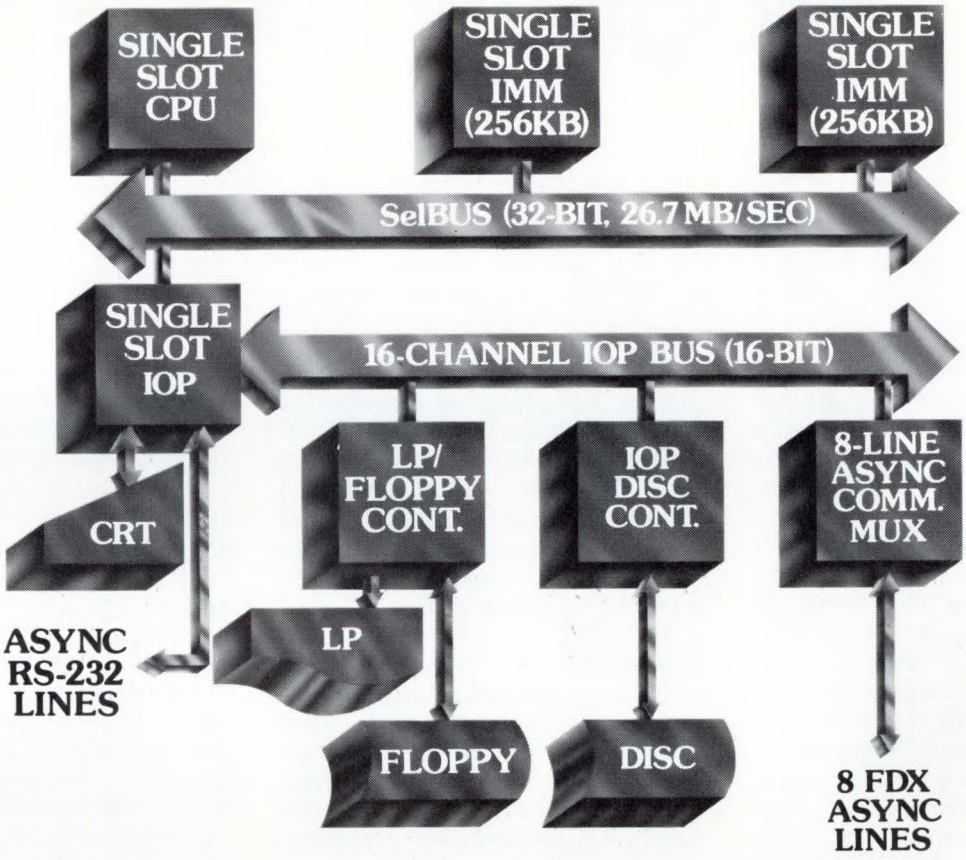

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The World of Magnetic Recording Media

Harry Shershow
Associate Editor

The recorded sounds of civilization, in whatever digital or analog fabric they are woven, are destined to remain man's most lasting monument to himself. Visual images will be silent spirits floating across a screen or frozen to paper but they will leave no trail of where they came from or where they have gone. Written words will describe man's beautiful thoughts or will catalog all the knowledge he has accumulated, but will say nothing of man himself. It is only in the records of man, whether of sounds or data, that he can hope to permanently preserve his image. Like human footsteps, the recorded works of man will remain behind him to forever creak softly on the sands of time.

The history of magnetic recording by 3M parallels the history of the industry as a whole. The 3M story is also the story of Wilvred W. Wetzel, who died in 1970 (having retired from 3M in 1963.) Dr. Wetzel contributed more to the development of this technology than did any other scientist. 3M has gone on since then to help perfect and improve the science of recording and playing back the sounds of the universe. This audio and digital technology gives the same permanence to the evanescent sensation of sound that "movie film" gives to sight.

Dr. Wetzel attended the University of Minnesota where he received a B.A. degree in 1928 and a Ph.D. in 1933. He majored in physics with a minor in mathematics. During the early thirties, Dr. Wetzel published papers on the quantum mechanical treatment of ionization phenomena. From 1933 to 1936 he taught physics at Colgate University. The 1936-1937 academic year was spent at Massachusetts Institute of Technology as a student of applied geophysics. From 1937 to 1940 Dr. Wetzel taught exploration geophysics at the University of Minnesota and at the University of Chicago. These courses covered the theory and practice of seismic, gravitational, electric and magnetic methods of mining.

In 1940 Dr. Wetzel accepted a position with the Naval Bureau of Ordnance for work in connection with the protection of ships from magnetic mines. This later evolved into studies on detecting and recording underwater sounds. Through this work Dr. Wetzel became acquainted with magnetic recording methods.

He joined 3M in 1944 as head of the physics section of the central research department. This section was assigned the task of developing magnetic materials.

Toward the close of World War II, a core of Allied scientists was sent to Germany to investigate and bring back a highly developed magnetic tape and tape recorder system for general recording purposes. 3M Company, already a large producer of a variety of pressure-sensitive tape products, immediately began an intensive development program aimed at supplying the motion picture and broadcasting industries with this new recording tool.

In 1948 Dr. Wetzel was appointed Technical director in charge of the laboratories of 3M's newly formed magnetic recording division.

His work in magnetic film manufacture, oxide development, bias theory and his pioneering achievements in the theory of magnetic sound have been most significant.

The life and contributions of Dr. Wetzel are a single chapter in the chronology of events that have marked the emergence of the magnetic-media-for-recording industry. Other bright moments out of the past follow. In 1880 William Hedic introduced a method of fixing magnetic particles to tape. In 1888 Oberlin Smith described his first successful attempts to produce magnetic recordings. In 1893 V. Poulson demonstrated a magnetic wire recorder. In 1908 Edison introduced his Amberol cylinder. In 1921 Max Kohl unveiled a magnetic recorder with built-in tube amplifier and steel disks for dictation. In 1927, Fritz Pfleumer glued iron oxide onto strips of paper. In 1933, BASF working with Pfleumer, produced magnetic tape. In 1935 BASF perfected a process for coating tape and the Berlin Radio Exhibition in that same year, featured a demonstration of a tape recorder. In 1936, Sir Thomas Beecham made the first serious musical recording on magnetic tape. In 1938, German Radio stopped using discs for recording sessions and switched to tape. In that same year, Brush Soundmirror introduced US to steel tape. In 1939 Bell Telephone demonstrated stereo recording with steel tape at the World's Fair. In 1941 Marvin Camaras got a patent for AC bias in magnetic recording. In 1944 Ralph Oace of 3M began experiments with tape coatings. In 1946 GE patented a magnetic phonograph cartridge. In 1947, Ampex introduced a tape recorder as its first post-war product. In 1949 Magnacord introduced a stereo tape recorder. In 1950, VOX offered the first commercially recorded tapes. In 1953 three

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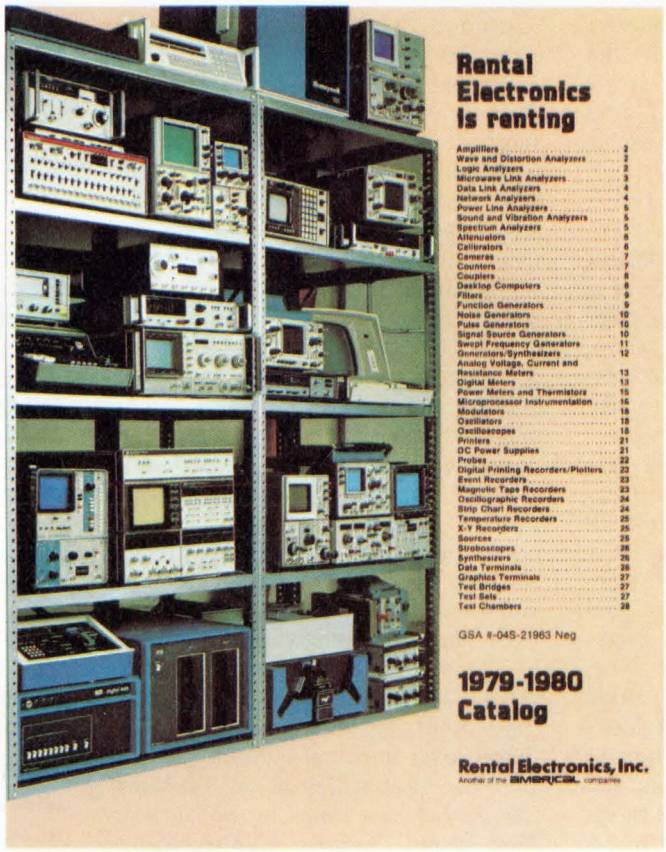

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companies (3M, Ampex and RCA) demonstrated color videotape. In 1954, Audiosphere marketed the first stereo tapes. In 1979 this author paid a visit to 3M's Data Recording Products Division at Weatherford, OK.

Oklahoma, as you look down at it from the window of a plane, is nothing like Rogers and Hammerstein's stage musical. You are awed by the power of simple landscape design lying below. Large areas of flat country run all the way to the horizon. The earth has been cut up into neat checkerboard designs of large patches alternating in color between iron-ore red and vegetative shades of green. Neatness of the countryside is its most striking feature. When you land, you are not greeted by Rogers and Hammerstein's dancing and whooping cowboys. Instead, plant manager George Olson, dressed in a natty sports outfit and wearing a colorful necktie that suggests collegiate colors, walks out to the center of a lonely, single-runway airstrip to greet us upon arrival. He is a tall, warm, smiling ambassador from the 3M company and looks athletic enough to play wide end for the Dallas Cowboys.

The 3M branch, in this isolated great Oklahoma plain, is a modern plant laid out on closely-cropped grass surroundings and with very few windows. It is air conditioned and squeezes its incoming air supply through dust cleaning filters. Inside the building everything is hospital clean. Even the floors have been painted in a clear, shiny polyurethane finish so that it looks like glass. The reason for the lack of windows and the filtering of air and the cleanliness of the area is the threat of outside contaminants trying to get in and endanger the constantly monitored clean environment. The contaminants are like viruses trying to penetrate the defenses of the human body. Dirt and contaminants are the chief enemies of magnetic coatings and a tiny dust particle, visible only under an electronic scope, when impregnated to the surface of a 14″ rigid disk, can, for the end user, wipe out some vital information or delay access times. So, 3M's constant, unending struggle, we were soon to find out, was its ceaseless battle against contamination. It is not an easy task. The human body itself, and there are about 600 permanent employees at the plant, is a factory of contamination. Each body produces five or 6 pounds of such microscopic particles daily. Those particles have to be picked out of the air before they land on disk surfaces. In this fight against contamination, 3M performs all vital operations within closed, atmosphe-controlled systems. Every completed operation is carefully tested to remove any contaminants that have landed during the process. Fifty percent of the 3M floor equipment produces the magnetic-media product; the remaining 50% of equipment has the vital function of quality testing every result. Most test instruments in the plant have been developed by 3M workers, and many of the commercial testers have been modified to do a special job in surface scrutiny and correction. Some tests are simply measurements that check conformity to prescribed parameters. Other tests are more exotic. Tests on the aluminum substrate of the 14″ disks, for example, will ensure that the finished plate will be "perfectly" flat. An oscillating sensing head, riding a microscopic distance above the "flat" surface can smash into a tiny bump and the collission could produce serious data destruction and computer shutdown. So the platters are rubbed, scrubbed, abraded and polished until test equipment indicates there is no unacceptable deviation from "flatness". The primary goal of 3M, says a spokesman, is to turn out a disk so perfectly level that no problems will ever vex the future end-user as the disk spins at around 150 mph on its permanent axis. The same hen-over-chick worry is applied by 3M to its jealously garded coating process. The liquefied ferrous oxide (plus other ingredients) are carefully flowed over mirrored aluminum disks and then polished until the operator can see his own image in the surface. This "secret" process is done behind closed doors (barred to everyone except cleared employees) and in a sealed environment. It is the most sensitive of all processes at this Weatherford plant. Company officials like to say, in their feigned cowboy twang and while wearing their happy-hour 6″-brim rolled Stetsons, "our secret isn't in the ferrous oxide formula we use. It's in the way we use it! We've spent a lot of time and money in perfecting this process and becoming No. 1 in the Data Recordings Product field. And we just don't feel like telling our competitors how to do it." Obviously, the success or failure in producing an acceptable disk for magnetic data recording is highly dependent on this particular coating process.

Once the coated disk has left the "secret room" it goes through a series of automatic cleansing baths designed to free the surface of any clinging microscopic-sized debris.

When the disk emerges from its "Roman bath" it then undergoes other procedures to assure that its critical outside and inside diameters are correct. It is also dynamically balanced so that it will not wobble as it spins at high speed. Then the final polishing and testing begins. When acceptable disks emerge from the assembly line, they are then sectioned and formatted and given a final test. They are sealed in rigid-disk cartridges and sent to the shipping platform. The 5″ miniflop-pies and other forms of magnetic media designed for computer use are treated similarly. In anticipation of the developing market for the new 8" hard disk, 3M has already "tooled up" and will be ready to meet commercial demand for that product. The 8" is already being hailed as indicative of the revolutionary changes beginning to appear in computer architecture. After the plant tour we had a chance to put some questions before 3M's supervising team. Digital Design, in the following dialogue, is interviewing Al Smith, Don Tomisak, Allen Fobes, Marv Glanzer, S.C. Kretzschmar and others.

They all have different functions at this division and their individual remarks here are listed as group responses.

DD: How long will computer technology regularly keep producing new products?

3M: People have wondered for years about that question. I think this technology will still be growing, with new products still being introduced, well beyond the 1990's.

DD: What can we expect from tomorrow's research?

3M: Industrial and university labs have already shown that we will be recording at densities 15 times greater than those in use today.

DD: Will there be any problems with such packed density techique?

3M: The implications are vast. Magnetic media will be able to store enormous emounts of information. The biggest problem will be retrieval of this information. As a result you can expect to see many new design parameters for drives and other hardware devices. We will be tailoring our own media packages to accomodate these new devices. There will be various cart-

ridges and cassettes and packs and stacks of cards and disks of unimagineable descriptions, for use on these new devices.

DD: What about thin film technology?

3M: This new techology will be used for recording very high densities – greater than 20,000 bpi. This will be primarily on rigid substrates because of physical constraints. We will see heads as the first to be effected by thin film. After that, media developments will take place. Activity in this field should start occurring in the next two years.

DD: What about optical technology?

3M: By the mid-80's optical technology will be included in many computer systems. Right now, magnetic technology is cheaper. The practical recording limits are the same, we feel, for both optical and magnetic technology. We will be able to achieve the same recording densities with magnetic techniques that will be possible with optical. Laser technology, on the other hand, could conceivably change that picture.

DD: What product does 3M find most in demand today?

3M: Computer tape has been our bread and butter product for years and is still the largest part of our business. For a while we thought computer tape would decline in favor of disk systems. It turns out that that didn't happen. Disk systems require back-up and tape is unbeatable for archival purposes. Tape is alive and doing well and we expect it to be around for a long time to come.

DD: What about diskettes? Are we seeing their slow demise?

3M: Not yet. As Mark Twain said, reports of their death are premature. Diskettes are going krazy. Pick your own number as far as growth is concerned. There are a lot of estimates being knocked around. Minicomputers are expanding at the growth rate of 30% a year and micros are expected to far exceed that. A good comparison to make is that diskettes will be bigger than tape, one day soon, measured on a dollar basis. Also, consider these facts: a roll of computer tape that is sold to a distributor for $11 required 11.1 square *yards* of magnetic coated material. A diskette, which will sell from $2.25 to $4.40, at today's prices, requires less than one square *foot* of magnetic coated material. The roll of tape sells for 2½ to 5 times more than a diskette but uses 100 times more magnetic coated material.

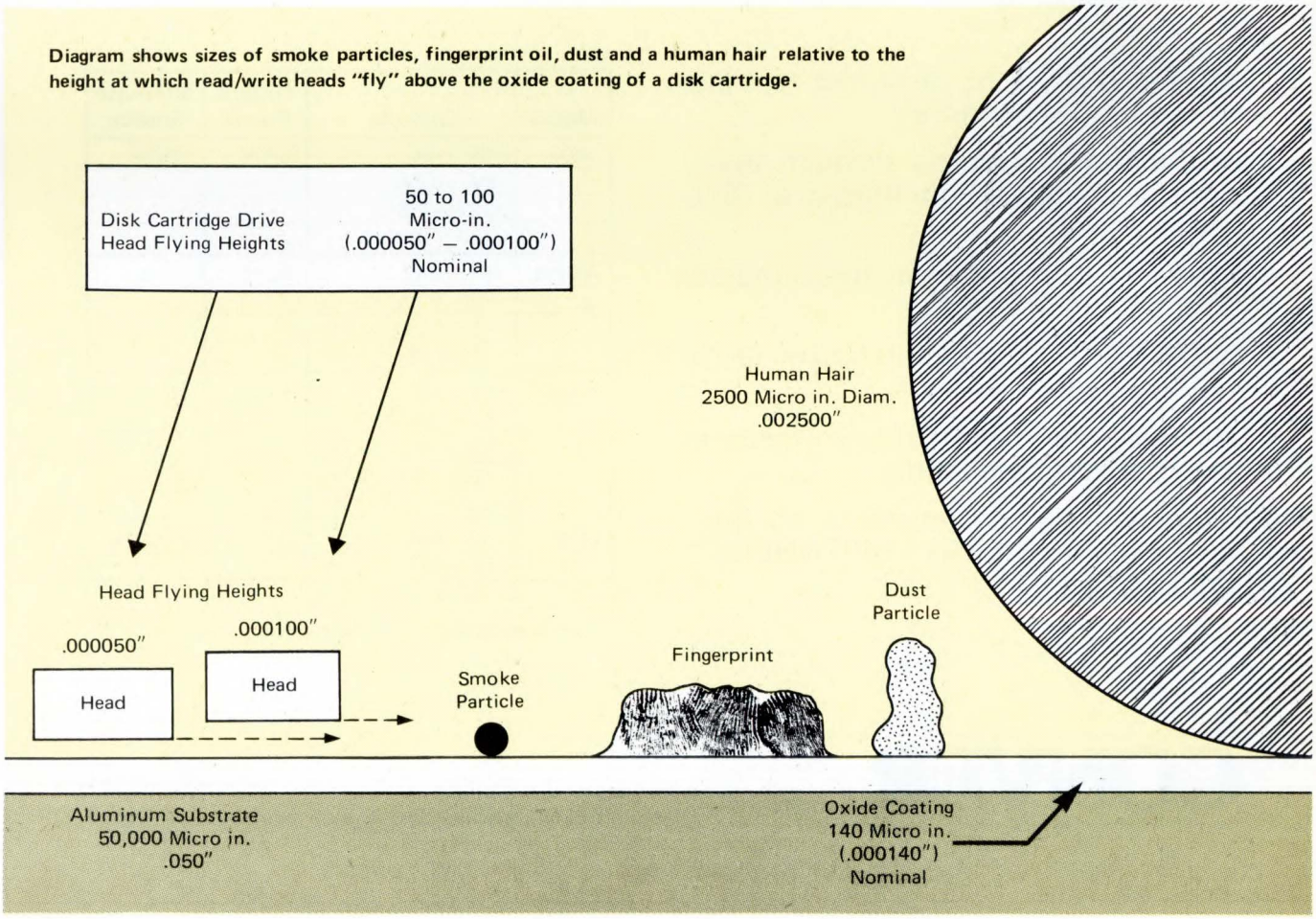
DD: What is the projected market growth for disk products over the next few years?

3M: Our own business here is very good, as you've undoubtedly noticed on the plant tour. The market growth potential as we see it is in between the mild and wild – 15% to 20% annually is probably a pretty good figure.

DD: What is happening in the marketplace and how is the 3M preparing for any changes?

3M: There is an increased shift, now, toward distributor marketing. With the advent of distributed processing and the minicomputer explosion, the market changed from one that was narrow, specialized, highly visible and easy to cover, to one that was dispersed, fragmented, difficult to find, and costly to cover. We have shifted our resources from a division that was essentially a direct industrial sales organization to one that is selling increasingly through distributors and OEM accounts. As an example, in 1974 85% of 3M's business in this

Diagram shows sizes of smoke particles, fingerprint oil, dust and a human hair relative to the height at which read/write heads "fly" above the oxide coating of a disk cartridge.



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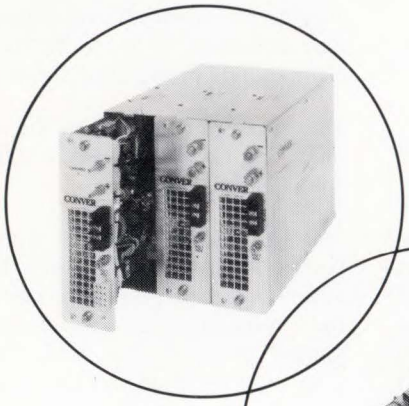

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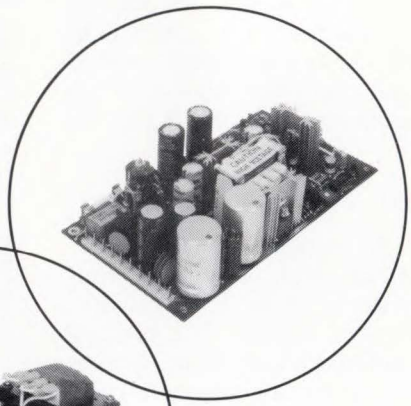

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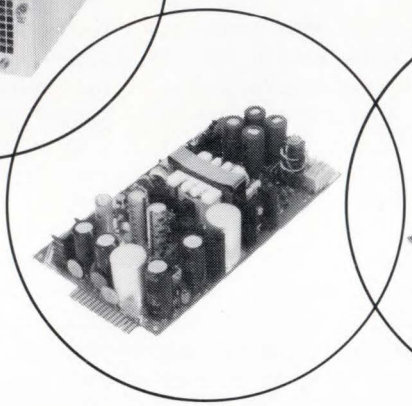

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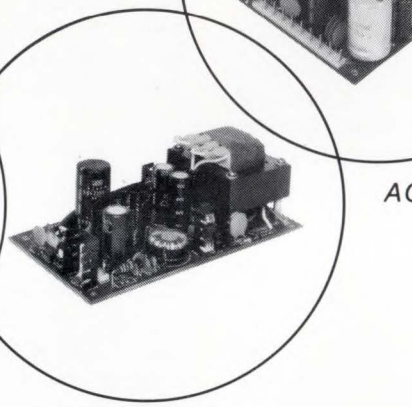

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	-12V. (15V.) - 1.0A.		
AC-65	+5V. - 6A.	65 W.	OL65
	-5V. - 0.5A.		
	+12V. (15V.) - 2.5A.		
	-12V. (15V.) - 1.5A.		
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product was on a direct basis with the remaining 15% being sold through distributors or OEM accounts. By 1983 direct sales will be around 15% and sales through distrutors will be at the 85% mark. This change is dramatic when you add our projected growth estimates on top of it.

DD: The number of quality tests that 3M does in this plant are impressive. Can you explain some of them?

3M: Measurements of all quality acceptance parameters are measured by our own production operators. We don't have special people doing the testing. The logic that 3M uses behind such a quality system is the pride that it places in each of our operators. They can see for themselves the specification requirements and also the exact workmanship that they have just completed. We feel that this has been 3M's strongest asset for achieving quality uniformity throughout our manufacturing operation. Even the majority of all test equipment is built by our own 3M people. However, some various test-measurements equipment is then modified to measure the responses that we feel are necessary. The majority of our tests are defined and characterized by our people.

DD: Can you give an example of one of your more complicated test procedures.

3M: The "TVA Test" would be such an example. The term, TVA, is derived from 1) "total indicated runout", 2) velocity; 3) acceleration. Some of the tests made at this single station of our operations is measurement of the vertical change of velocity with respect to time; the displacement perpendicular to the disk surface; local variation in disk thickness; variation of a surface above or below a reference plane; surface roughness measurement; the absolute measurement of difference between top and bottom surfaces; vertical velocity-change measurement.

DD: What are some of the contaminants that could affect disk performance?

3M: The single most common debris that a human body throws off is dead skin cells; other contaminants associated with people are saliva, hair and finger prints (which are mainly composed of body oil.) The fingerprint ultimately becomes a collecting point for other microscopic particles. The clothing worn can also be a source of debris in the form of cloth fibers and dust. To determine how large a contaminant a disk can tolerate, one must know the flying height of the recording head. This determines the size of a contaminant or a particle which may be tolerated by the head. Examples:

Product Type	Height of Flying Head	Maximum Tolerable Size of Particle
6 High Disk Pack	100 μ''	70 μ''
11 High Disk Pack	80 μ''	50 μ''
Winchester Disks	19 μ''	13 μ''
SMD 80 MB Pack	35 μ''	23 μ''

DD: What is the most critical test done at the Weatherford plant?

3M: Servo surface acceptability following servo writing. The test equipment itself is on a marble base and the chamber is air-conditioned.

DD: Describe the dozen or so cleaning baths used on the disks moving on the assembly line and applied just before the coating operation.

3M: The baths are, basically for surface preparation. The details are not discloseable. In general, though,

various chemicals are used to clean and treat the surface to assure strong adhesion of the magnetic coating.

DD: Most of the tests at Weatherford were for the 14″ rigid disk. How many tests, by comparison for the 5″ floppy?

3M: Though critical flatness tests are not as vital for the flexible disks, they do receive the same degree of product attention. Counting all stages, including visual inspection, the flexible disks must be evaluated at 63 different points in the process.

DD: How much of a physical task will it be to switch from 14″ disk production to accommodate 8″ hard-disk manufacture?

3M: Most of the 3M-designed production equipment was designed so that conversion from 14″ to 8″ production will be a relatively easy one. Basically, the structure and process are similar for both sizes.

DD: How flat are the 3M disks? Your company apparently spends a lot of time in turning out a perfectly flat product. An old law of physics says that if you put two perfectly flat surfaces against each other, they will become inseparable, due to vacuum and atomospheric pressure.

3M: Our disks typically exhibit a surface roughness of only about 1 μ″. This surface finish in combination with the overall flatness of the disk could result in disk to disk wringing if the two surfaces were ever placed in contact with each other.

DD: How long can you expect a 3M disk to last when in actual use?

3M: If the disk is not physically damaged by handling or in operation it can last indefinitely. Typical design requirements are 50,000 stop-start cycles (head load) without surface deterioration. This equates to an operator mounting a disk pack or cartridge five times a day for over 25 years.

DD: What are some of the problems encountered with OEMs and with END users?

3M: End user problems relate to improper care and handling. Customer education concentrates largely on resolving the many problems that occur on a daily basis. In the OEM area problems arise in applying state-of-the-art technology. Application of this technology to the head, disk and drive interface requires close coordination between development, manufacturing and the OEM customer.

DD: What is the top spin speed for 3M disks and how fast a reading-head movement can be designed to travel across the moving disk?

3M: Industry disk usage, as well as 3M, is typically 3600 RPM. Single disks have been experimentally spun up to 6000 RPM without apparent degradation to the disk. Factors to be considered when designing a high-speed positioning system are the aero-dynamic characteristics of the head, accelerating-decelerating forces from track to track positioning and the dynamic flatness characteristics of the media.

DD: Can you list the increase in storage capabilities of disks during the 10 years and can you predict similar such increases in the next ten years?

3M: This chart is self explanatory.

Year	BPI	×	TPI	≈	Areal Density (mbits/sq. in.)
1966	1100		100		.11
1970	2200		200		.44
1972	4040		192		.77
1974	4040		370		1.49
1976	6060		384		2.32
1977	6350		478		3.04
1978	8530		450		3.84
1979	6550		714		4.68
1980	8000		960		7.68
Future	15000		1200		18.00
Future	18000		1600		28.80
Future	25000		2000		50.00

DD: In the overall production of magnetic recording media, how many different types of each are currently being produced in the entire country by all the manufacturers?

3M: Rigid disks, 5.3 million; diskettes, 40 million; tapes, 9 million (on standard length computer reels.)

DD: If you could convert that annual production volume into one large disk, how big would it be and how much data could be recorded on it?

3M: The disk would be about 6.4 miles in diameter. Based on the content of a 30-volume set of Encyclopedia Brittanica (433 million words) and assuming an average of five characters per word, about *1/4 billion sets* of the encylcopedia could be stored on that combined magnetic medium. This means solid recording – no spaces or allowances for format or retrieval.

DD: What has happened to the costs of data storage and retrieval over the years?

3M: In 1955 the cost per megabyte in main memory was $8.5 million. By 1985 this main memory cost per megabyte will have dropped to less than $7 thousand. Auxiliary storage, for the same time period was $6.7 thousand per megabyte in 1955. That will drop to an estimated $25 or $30 by late 1980.

DD: What will the world of data processing be like in 1990?

3M: The trends toward miniaturization and areal density compaction that have occurred in the past 10 years will probably occur at the same rate during the next decade. Advances in information systems' reliable storage capabilities will continually occur, with media of all kinds possibly involved – magnetic or otherwise. The interaction between media technology and systems designers is vital; the ability to create more advanced designs will inexorably be related to advances in information storage – both media and systems. It's a moving target which will keep on moving. Everything will be growing. The Encycolpedia Brittanica contains 433 million words. If each word averages five characters, it contains two billion 165 million characters (each carried by a byte of data). Thus, it would now take 108 disks to hold the entire 30-volume set. When capacity is quadrupled in the future, it will take 27 disks. But, disks do not necessarily have massive storage capacities; their major contribution is rapid access to data. And that speed is increasing constantly.

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Sam Thompson
Data Electronics, Inc.
San Diego, CA

Tape Back-up for Winchester Fixed Disks: 1/4" vs. 1/2"

Rapid expansion characterizes the small fixed Winchester disk drive marketplace in 1980. Various market surveys indicate that 110,000 Winchester disk drives will be sold in 1980 with capacities of under 200 megabytes. Of these, 70,000 will be under 30 megabytes; and, about 20,000 of these will be the new 8-inch variety. Insiders say that the small Winchester is the "hottest thing in computer peripherals." In order for this "hot" market to mature properly, it has been necessary for an auxiliary product to develop along with the Winchester. This product is the removable-media back-up device. Since the growth of the back-up device market is as dynamic as that of the Winchesters themselves, a great deal of controversy has surrounded the selection of the proper technology for Winchester disk back-up.

During the past year the prime contenders were flexible disk drives, 1/4-inch cartridge tape drives and 1/2-inch tape drives. Further, as "streaming" technology entered the tape drive product arena, tape emerged as the obvious choice for most back-up applications. For the Winchester market settling in at under 30 megabytes, streaming 1/4-inch cartridge tape drives will be a choice.

How does capacity sort out?

Most of the Winchester disk drives that require back-up will have capacities of between 10 and 20 megabytes in the near term. Since flexible disk drives require multiple disks to record as much as 10 megabytes, they are not expected to be much of a factor; in addition, disk back-up is an archival function rather than a random access function, and why pay for random access when it is not needed?

Tape is well-suited for archival storage and has many years of field use. But, what kind of tape? The lowest capacity 1/2-inch tape drive that is touted for disk back-up use has an unformatted capacity of 46 megabytes. Only 1/4-inch digital cartridge tape drives can provide the perfect capacity match, with drives available in the 10 to 75-megabyte capacity range.

The revolution of "Streaming"

Streaming is the development that has made the back-up choice an easy one. Streaming allows a low-cost tape peripheral to be perfectly matched to the disk back-up application. Streaming is non-stop recording and/or playback. Data is transmitted between the tape back-up system and the Winchester disk in a continuous stream with no starts and stops. When all of the data has been transfered, the streaming drive stops. The technology allows for low-cost drives since the search and R/W of a single record functions are eliminated.

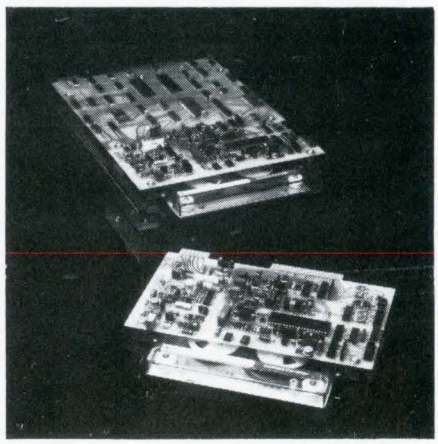

Fig 1 New streaming digital cartridge drives from Data Electronics, Inc. come with or without a built-in controller. The two drives shown here are available with either 10 or 20 megabyte capacities, at prices substantially below those of the Winchester disk drives that they back-up.

Streaming is available in both 1/2-inch and 1/4-inch tape versions. They differ in many respects. The 1/2-inch streaming drives maintain IBM compatibility. This requires interblock gaps, and cuts the usable capacity of the available drives from 46 megabytes to about 37 megabytes (formatted).

Digital cartridge 1/4-inch tape drives do not typically have this limitation. Therefore, by eliminating interblock gaps they can make more efficient use of the available tape.

What about bytes/buck?

Most small Winchester disk drives are now selling for under $2000; many are now in the $1000 range in OEM quantities. The industry desires a back-up device that costs substantially less than the device that is being backed up! Streaming tape technology now allows this to occur.

New streaming 1/4-inch digital cartridge drives are available in the $400 to $500 range in capacities of 10 and 20 megabytes, with 75-megabyte drives at under $1500. If 1/2-inch streaming technology is the choice, the price for a 37-megabyte drive is in the $2000 to $3000 range.

In both the 1/4- and 1/2-inch situation, the market is dealing with proven technology. Thousands of 1/4- and 1/2-inch tape drives have been in use for years in disk back-up applications. In both cases, the media is also low in cost.

Easy to handle?

When it comes to ease of handling and loading, cartridges win hands down. The 1/4-inch cartridges are ANSI stan-

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

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

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

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

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

THE BRAINS BEHIND THE DATA WAREHOUSE.

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

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

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

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

PACKET POWER SUPER-CHARGES YOUR SYSTEM.

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

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

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

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

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

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

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

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REMEX DIVISION

DATA WAREHOUSE

Circle 13 on Reader Inquiry Card

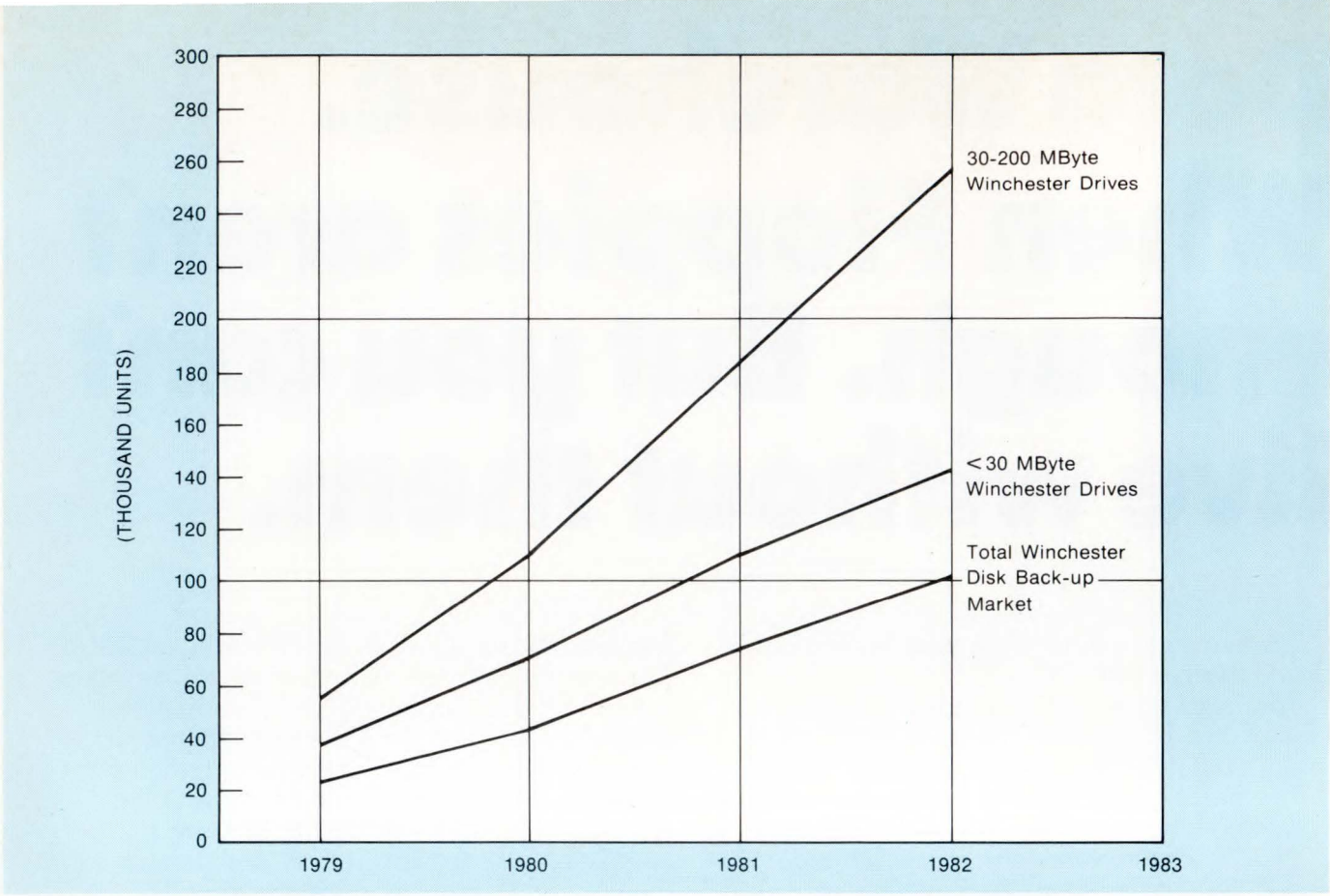


Fig 2 The market projections for Winchester disk drives, both under 30 megabytes and between 30 and 200 megabytes is impressive. The total market for disk back-up devices follow a similar curve. *(Source: Disk Trend Reports)*

dard, commonly available from multiple sources, environmentally protected media that can be easily used without any special training. Cartridges are little larger than the size of an average human hand. The tape is protected against abuse and the tape guidance system is totally contained within the cartridge. When the cartridge is inserted in the drive, a small door is automatically opened so the recording head can come into contact with the tape. When the cartridge is removed, the door closes, leaving the tape protected. Many 1/4-inch cartridges can be stored within a small area, such as a desk drawer.

Streaming 1/2-inch tape drives come in two varieties. One manufacturer offers a self-threading drive that eases handling of the tape, but doesn't offer the tape protection of a cartridge. Other 1/2-inch streaming drives require an experienced operator for tape threading and loading.

How big is just right?

Small Winchester disk drives are now being configured to fit the same size enclosure as a conventional 8-inch flexible disk drive. It is convenient if the back-up device is no larger than the Winchester drive. It is even nicer if the back-up device fits the same mounting configuration as the Winchester drive. New small streaming digital cartridge drives meet this objective. The 1/2-inch streaming tape drives are inherently larger.

. . .and the transfer rate?

Streaming tape drives work best when the transfer rate of the tape drive is closely matched to the transfer rate of the host system during backup. Winchester disk drives come in a variety of transfer rates. Cartridge 1/4-inch tape drives have recently become available with a variety of transfer rates as well, so that the host system and the back-up device can be closely matched.

Is it easy to interface?

Tape drives that look electrically like tape drives often present an unfamiliar interface to the design engineer. Great strides have been taken in the cartridge drive area to make the job of interfacing less painful. For example, one drive looks to the outside world like a FIFO semi-conductor memory. This is one of the easiest interfaces, and also one of the most familiar, for the computer system designer to work with.

Is it reliable?

Tape back-up systems are reliable. Most have comparable error rates to that of the Winchester disk that is being backed up. In the back-up application, this is equivalent to one error in more than three years of normal usage.

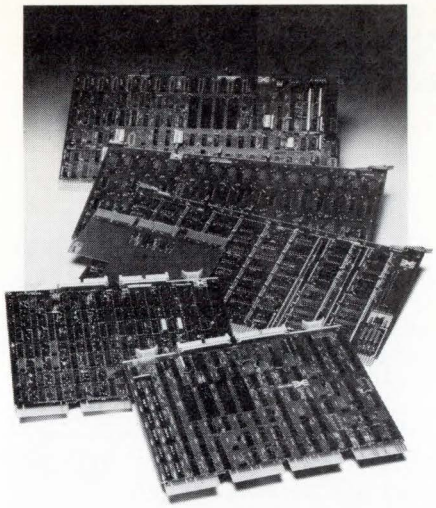
Another aspect of reliability is volatility of data on the medium. Tape back-up systems use heads that are in contact with the medium and track widths that are wider than flying head disks. Problems such as head crashes that ruin the oxide coating of the medium cannot happen with tape back-up systems. As an additional safeguard, the error correction algorithm in most tape back-up systems is good enough to detect and correct fairly gross magnetic anomalies, such as scratches or small holes in the tape.

The market has now accepted tape as the prime back-up medium for small fixed Winchester disk drives. Manufacturers are reacting by providing products that are custom tailored to the needs of the marketplace.

Rate this article: circle 2L, 2M or 2H on Reader Inquiry Card.

We're the company building a business by building the industry's preferred stock of software-transparent, microprogrammed controllers for DEC cpu's.

Now we're broadening our offerings for mag tape users



Our two new tape controllers give us the industry's broadest line of software transparent controllers for LSI-11, PDP-11 and PDP-11/70 users.

For all you mag tape users. New stock offering in DEC.

even further. Two new controllers that make it easy to climb aboard the LSI-11 Qbus and PDP-11/70 Cache bus. And a brand new discount schedule, the most aggressive in the industry.

You're probably familiar with our TC11 controller, introduced at last year's NCC. It's the proven dual-density controller that puts virtually any tape transport on the PDP-11 Unibus.

Now we put you on the LSI-11 Qbus, too, with our new TC01. It's the first and only fully-embedded dual-density controller for use with LSI-11, 11/2 and 11/23 cpu's.

It's fully compatible with DEC's TU10/TM11 tape subsystems. And it gives you the option of NRZ or PE format at all speeds up to 75 ips.

We've got a new offering for 6250 bpi tape users, too. Our TC70 controller puts you on DEC's PDP-11/70 Cache bus to meet your high density GCR storage needs. It functionally emulates the TWU45/TWU77 tape subsystems from DEC.

Fact of the matter, it makes no difference which DEC series 11 cpu you're using, or what storage device. We support 59 different drives. Including 14-inch Winchester and SMD class disks. And we're adding more all the time.

You might say we're bullish on DEC. Ask your peripheral salesman. Chances are he'll tell you we're blue chip. After all, we make his job that much easier.

And ask us about our new discount schedule. And for your copy of our Buyer's Guide. Call or write today. Emulex Corporation, 2001 East Deere Avenue, Santa Ana, CA 92705. (714) 557-7580.

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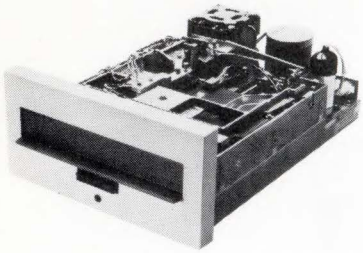
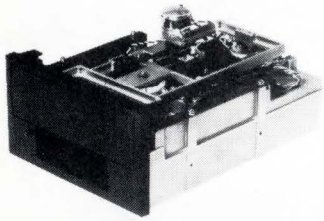
New Products

Over 100 New Products NCC80

TWO ADVANCED FLOPPY DISK DRIVES. The new Maxi-Flexi drives an 8-inch random access diskette, and the Mini-Flexi operates a 5-1/4-inch random access diskette. Both are double-density, double-sided drives that meet all industry standard inter-



face requirements and offer a wide range of cost-performance benefits and operator conveniences. Major feature of the 8-inch drive is a steel belt drive system that reduces access time to the adjacent track to 3 ms, accelerating throughput. The Maxi-Flexi has single-sided storage capacity of 3.2 Mbits per disk and double-density, double-sided capacity of 12.8 Mbits per disk. Corresponding data transfer rates are 250 Kbits/sec, and 500 Mbits/sec., respectively. The Mini-



Flexi single-sided capacity is 875 Kbits, with a double-sided capacity of 3.5 Mbits. Data transfer rates are 125 K-bits/sec. and 250 Kbits/sec., respectively. For convenient and damage-proof disk loading and unloading, both units feature a specially designed mechanism that makes it impossible to close the door unless the diskette is fully inserted. There is also a spindle offset mechanism that prevents reverse loading and an automatic eject mechanism for easy diskette removal. **C. Itoh Electronics, Inc.**, 5301 Beethoven St., Los Angeles, CA 90066. **Circle 224**

Z8000 μC BOARD. Designed for uses requiring extensive computer power, access to large memory space and high-speed serial communication capability, the Z8000-MPU is suited for stand-alone computers, complex hierarchies of processors, etc. It functions either as a stand-alone SBC or the master in a set of several peripheral boards. Stand-alone performance is possible by 32K bytes of on-board RAM with parity protection, 8-K bytes of additional ROM or PROM space, 2 flexible communication channels and real-time clock for managing multi-tasking software environments. It uses the Z80A-SIO (serial I/O) controller to incorporate 2 high-speed serial channels that provide a flexible communications subsystem w/o additional boards. Each channel is individually programmable to support synchronous or asynchronous protocols, including IBM Bisync, SDLC, HDLC and CCITT-X.25. The board supports the RS-422 or RS-423 interface standards. $2295 (unit qty.). **Zilog**, 10460 Bubb Rd., Cupertino, CA 95014. **Circle 242**

12-BIT ANALOG-INPUT MODULE connects to popular μPs w/o additional logic. MP32, a hybrid analog-input (±10V) system provides internal-interface logic for direct application with 8080A, 8048, Z-80 and SC/MP. Only minimal external logic is needed to make the MP32 compatible with 6800, 650X, F8, 8085 PDP-8, PDP-11, Nova and Eclipse. Memory mapped MP32 needs only simple programming instructions to acquire data, which greatly simplifies software development for analog input to the μC. $267 (100). **Burr-Brown**, International Airport Industrial Park, Box 11400, Tucson, AZ 85734. **Circle 246**

MATRIX IMPACT PRINTER Model 6000, a serial dot-matrix impact printer with 136-col. capacity and 150 cps speed, uses a 9 X 9 matrix format to create full lower-case descenders. It provides for underlining and operates bidirectionally, incorporating look ahead logic that decides whether to start each new line from left or right. Two interfaces are available for Model 6000 – the Centronics-compatible parallel interface and serial RS-232C interface at 1200 baud. A 240-char. buffer is std., but a larger buffer is optionally extra. Printer accommodates paper width from 2″ to 17.5″, prints multi-part forms with up to 6 parts, incorporates forms control, provides an adj. for impression control, has std. 96-ASCII character set, and incorporates an out-of-paper sensor. **North Atlantic Industries, Inc., Quantex Div.**, 60 Plant Ave., Hauppauge, NY 11787. **Circle 243**

IMAGE ANALYSIS. Images for analysis can be photographs, negative material, projected images, drawings, or X-rays. Quantitative analysis can also be made directly through a light microscope or even from a video camera mounted on an electron microscope. A microcomputer with 64K user memory and 16K video memory (including dual floppy disc drive, a video monitor, plus flexible software) comprise the system. The video monitor normally used for dialog, data and graphic dis-

play, also serves as an aid for direct measurement of video images with optional video overlay. Acquired data can be evaluated immediately or stored for later analysis. The software package consists of: a basic measurement program, a high-level statistical program, distribution and sterological programs. In addition, the user can develop his own specific programs in FORTRAN, BASIC or PASCAL with appropriate compilers. **Carl Zeiss, Inc.**, 444 Fifth Ave., New York, NY 10018. **Circle 177**

"TRS-80 INTERFACING" explains a number of interfacing techniques with the TRS-80 Breadboard, by means of schematic diagrams, software listings and 18 experiments that the reader can perform on the TRS-80. The TRS-80 accessories described enable users to acquire tools needed to design interfaces and write TRS-80 software. **Group Technology, Ltd**, Box 87, Check, VA 24072. **Circle 157**

HIGH-SPEED VAX-11/780 INTERFACE. The DR780 is a μP controlled, 32-bit parallel interface that transfers data between external devices and 11/780 memory at up to 6.67 MB/s, and is designed for very-high data throughput from array processors, sensor-based I/O and other data acq. equipment, and as an interprocessor link between two DR780-equipped VAX-11/780 systems. Typ. applications are seismic data processing, telemetry data reduction, nuclear reactor monitoring and high resolution spectrometry. $18,700. **Digital Equipment Corp.**, Maynard, MA 01754. **Circle 244**

IMAGE DATA TABLET. Said to be the first digitizing tablet capable of taking A4 or Quarto sized paper which will recognize handprint recognition input, accept drawings or sketches, recognize handprinted mathematical problems and produce automatic solutions, accept input through a Teletype-compatible touch table, accept series of calculations through a calculator touch table and accept coded entry to computer programs or security. It's shaped like a desk blotter and is 4mm thick. It takes A4 or Quarto size paper placed horiz. or vert. With a special pen, shapes and characters may be drawn, digitized and stored in an on-line or off-line computer. **Image Data Products, Ltd.**, 1-4 Portland Sq., Bristol BS28RR, England. **Circle 240**

58-MB 14″ FIXED-DISK DRIVE double capacity of prior model SA4008. Providing double the capacity of the previous model for under $3000 in OEM quantities, the 40-lb. SA4100 retains the same compact size as the SA4000 series, mounting in a 19″ RETMA rack while using only 5.25″ of panel space. Transfer rate is 7.1 MB/s; avg. access time, 65 ms; and average latency, 10.1 ms. Error rates are one/10^{10} bits for soft-read errors; one/10^{12} bits for hard read errors; and one/10^{6} bits for seek errors. **Shugart**, 435 Oakmead Pkwy., Sunnyvale, CA 94086. **Circle 239**

GPIB INTERFACE For Zeta Plotters. Users of Tektronix intelligent 4000 series terminals can access a 36″ plotter through Zeta's integral controller for efficient, high-speed plotting. Model 3653SX plotter when operating through its optional GPIB interface uses a command set which is essentially-upward compatible with the Tektronix Plot 50 command set. Status and GIN mode commands have been omitted while many new commands have been added. The additions include commands for scaling the plot, selecting one of the four pens, hardware character generation, slanting and/or shading of annotation, drawing circles and circular arcs; and drawing with user defined dot/dash patterns. 1453B, $8750; 1553, $5950, 3653SX, $19,000. **Nicolet Zeta Corp.**, 2300 Stanwell Dr., Concord, CA 94520. **Circle 241**

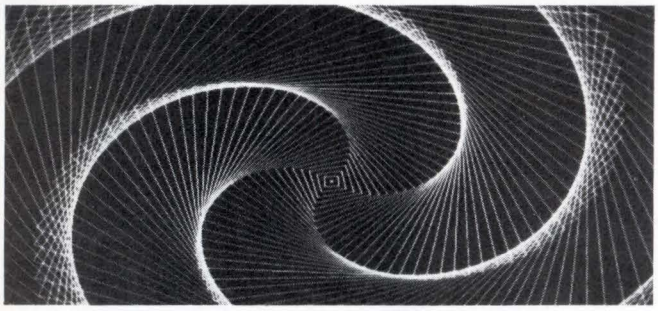
UNIBUS MULTIPLEXOR DCA System 205/11 – a μP-based statistical multiplexor for any UNIBUS-based computing system such as PDP-11, DECsystem-20 and VAX – concentrates multiple streams of data characters from the host computer onto a single, bit-serial trunk link. It offers a cost-effective way of connecting remote terminals to a UNIBUS. A System-205/11 unit on its single circuit board can support up to 128 terminals. Thus, one 205/11 board can replace up to 16 DEC DZ-11 asynchronous-terminal interface boards (each DZ/11 only supports up to 8 ports) and a host-end multiplexor. **Digital Communications Associates, Inc.**, 135 Technology Park, Norcross, GA 30092. **Circle 261**

TRIPLE DISK DRIVE. This completely integrated operational sub-system allows a larger data base than a two drive system; quick and convenient back-up at each stage; temporary write protect as needed; continued visual feedback during operation of system via indicator-control panels; maximum reliability through quality equipment and drive redundancy. Model 4400 accomplishes this through use of Innotronics Series 400 Diskette Drives, Custom Enclosure, and unique Diskette Indicator and Control Panel. **Innotronics**, Brooks Rd., Lincoln, MA 01773. **Circle 237**

KEYBOARD/DISPLAY CARD ADDED TO BUS LINE This keyboard/Display card is designed for applications in which a low-cost operator interface is required for system control, data entry, status display and operator prompting. It is also suitable for system development, testing and training applications. The 7303 card features two status displays. The alphanumeric display has eight 16-segment digit positions, each of which accepts one of 64 ASCII coded characters. An LED display tracks data in eight-bit binary form. The card's keyboard has a system reset key and 24 programmable keys. Other features include two rocker-type toggle switches. The 7303 Keyboard/Display card is available in 1-9 quantities for $295, and in quantities over 100 for $225. **Pro-Log**, 2411 Garden Rd., Monterey, CA 93940 **Circle 210**

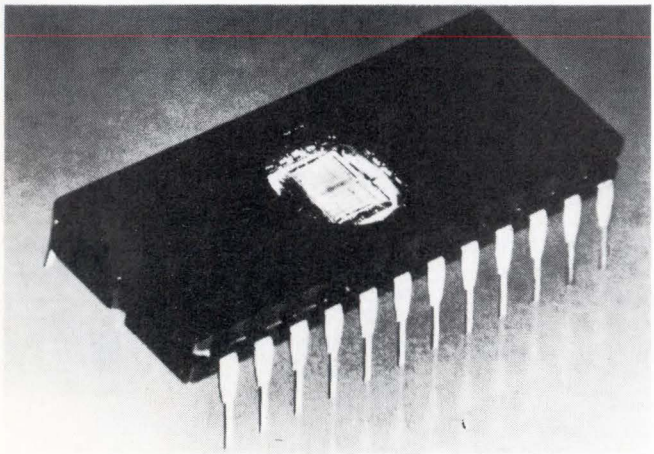
NEW BULLETIN ON 8-BIT VIDEO CONVERTERS Six descriptive pages on use of the MP8308 and MP8318 Ultra-Fast, 8-Bit, Video D/A Converters in video and graphic display applications. The free bulletin was expressly written to aid the system design engineer. It describes critical design considerations in such applications as Raster-Scan High Resolution Monochrome Video, Raster-Scan High Resolution Color Video, Graphic Display Systems, Function Generation and Time Base Correction. The information is presented in a simple yet detailed format and includes typical system block diagrams. A comprehensive glossary of terms is also included as a quick reference for the system design engineer. **Analogic Corp.**, Audubon Rd., Wakefield, MA 01880. **Circle 145**

HIGH SPEED VECTOR GENERATOR A new, fast, powerful 2-Dimensional Vector Generator is being marketed by Aydin Controls for its Model 5216 Display Computer. This option to the 5216 permits vector generation at 800 ns per pixel, plus 8 ms average set-up time. The option also per-



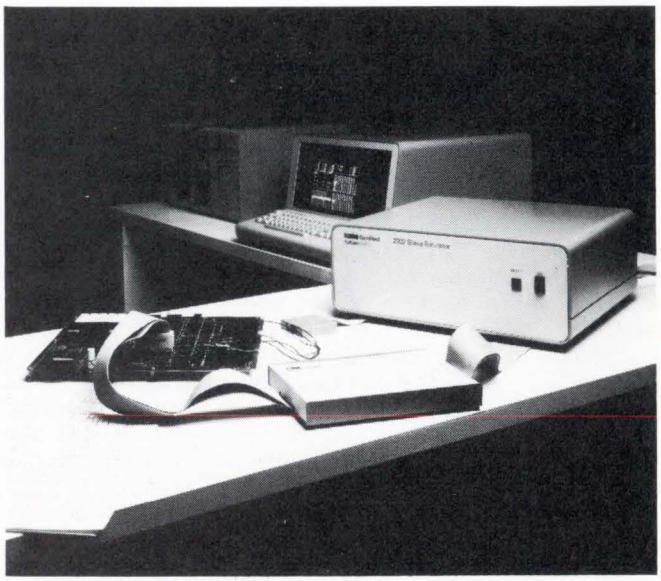
mits hardware window clipping, conversion from a World Coordinate System, 64K X 64K, to a 512 X 512 or 1024 X 1024 pixel screen format, with translation, rotation and scaling of 2-Dimensional data. List price for this option is $5K. Availability, February, 1980. **Aydin Controls**, 414 Commerce Dr., Fort Washington, PA 19034. **Circle 146**

TWO NEW EPROMS These EPROM offerings are OKI's first products to be introduced since it recently entered the memory market with its 4K CMOS static RAM. Designated MSM2758 and MSM2716, these fully decoded EPROMs are organized as 1024 words by 8 bits and 2048 words by 8 bits respectively. Pin-compatible with Intel's 2758 and 2716, they operate on a single +5 volt power



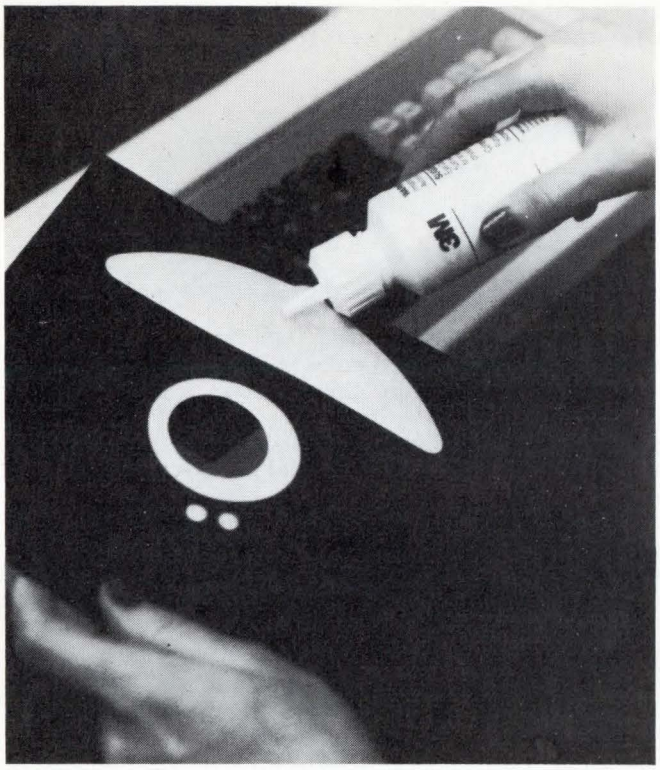
supply. Power dissipation is a low 525 milliwatts while in operation and 132 milliwatts in standby mode. Access time is 450 nanoseconds maximum. Minimum programming time is 50 seconds for the 8K version and 100 seconds for the 16K version. Multiple chips may be combined by wired-OR connection for easy memory expansion. Available in a 24-pin ceramic dual-in-line package, MSM2758 is priced at $15.60; the MSM2716 at $36.00. Delivery is six weeks, ARO. **Oki Semiconductor**, 1333 Lawrence Expressway, Santa Clara, CA 95051. **Circle 136**

GENRAD/FUTUREDATA OFFERS SUPPORT FOR 6809 Hardware support for the 6809 includes a 2302 Slave Emulator and Logic Analyzer. Emulation is at full processor speed (2 MHz). Slave logic analyzer provides three breakpoints and a trace qualifier, each 48 bits wide. Trace memory is 64 bits wide and will store 256 events. Software support for the 6809 includes a choice of three languages – macro relocatable cross assembler; PASCAL compiler; or structured BASIC compiler. Additional software: object program linker, powerful screen-based editor, interactive debugger with disassembly and symbolic debugging, and command control language. The company also offers a version of Microsoft FORTRAN-80 compatible with the firm's 2300 Series Development System. FORTRAN-80 extends the use of GenRad/Futuredata development systems to users who wish to write or use existing FORTRAN programs. They can be compiled and linked to programs written in assembly or other languages. The resulting code may be executed using development system resources or on prototype hardware using the GenRad/Futuredata 8080, 8085 and Z-80 in-circuit emulators. Also announced is a new relocatable disk operating system (RDOS) for the 2300 (stand-alone) and 2301 (network) series development systems. The new system contains enhancements to both the File Manager and Text Editor. The new File Manager provides a wild card facility, which allows



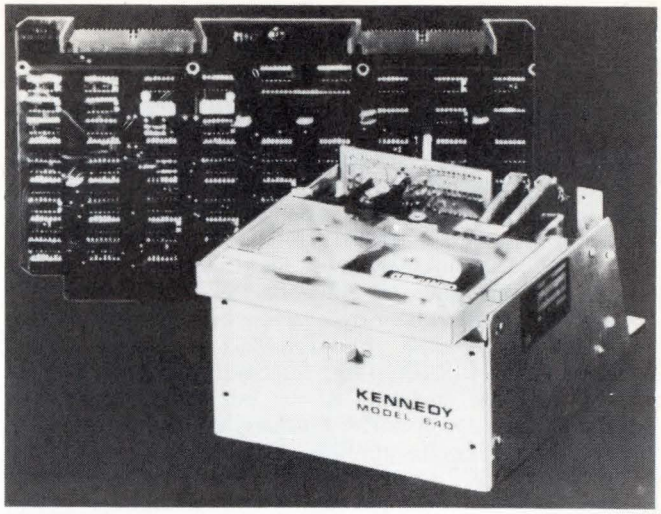
file names to be specified by name, name subset or file type for subsequent display, copy, move, delete or verify operations. Disk verify and file verify commands, which compare moved or copied information to the original, have also been added. New features in the Text Editor allow blocks of text to be moved, copied or written out as separate files. Files may also be merged. **GenRad/Futuredata**, 5730 Buckingham Pkwy., Culver City, CA 90230. **Circle 134**

CLEANING UP These kits use a unique wet-and-dry method by which a proprietary cleaning solution is applied to the porous cleaning fabric in the diskette envelope. The cleaning diskette is then run in a normal manner for 30 seconds. Two-sided systems may be cleaned with the same



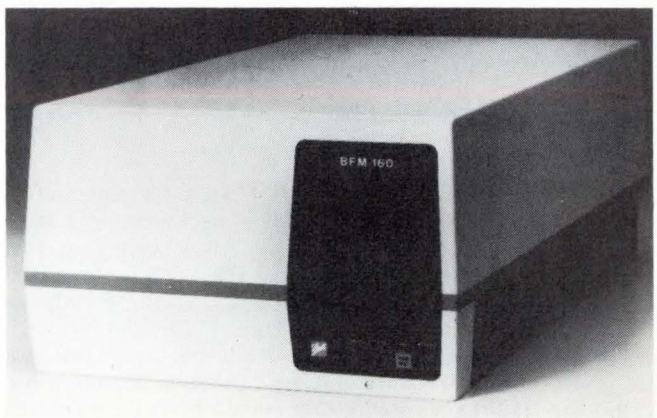
technique. Each Scotch head cleaning kit has two diskettes and a bottle of fluid, and can do 30 cleanings (15 per diskette). Available through 3M Data Recording Products distributors. Suggested list price, $30. Two diskette sizes available: Scotch 7400 8" kits, and Scotch 7440 5½" kits. **3M**, PO Box 33600, St. Paul, MN 55133. **Circle 142**

BACKUP CARTRIDGE FORMATTER REDUCES HOST OVERHEAD Microprocessor-based formatter, for use with Kennedy Company's Model 640 8-inch disk backup cartridge transport, uses an advanced data recovery system employing sophisticated Group Code Recording (GCR) techniques to reduce host computer overhead while improving data integrity. Formatter is integral to Kennedy's 6400 bpi four-track, serpentine cartridge drive with 17.3M byte unformatted capacity. With 10K byte records, formatted capacity is 15M bytes on a 450 foot DC300A cartridge. Major formatter components include an eight-bit MOS microprocessor and two-speed bipolar microsequencers. The μP handles communications with the host, provides transport control, initiates R/W sequences and monitors timing structure of commands in process. Included are special routines that sense broken tape or loss of tape from reels. High speed microsequencers provide write encoding, read synchronization and decoding for the encoded, read synchronization and decoding for the encoded GCR data. Kennedy Model 640 backup cartridge transport operates in a serpentine manner with four-track read-after-write heads and selective erase. This permits nearly continuous data writing and recovery without pausing for rewinding. Alternately, the formatter permits selective address and search for specific records on any track to reduce access time. Data transfer rate is 192K bps. R/W tape speed is 30 ips

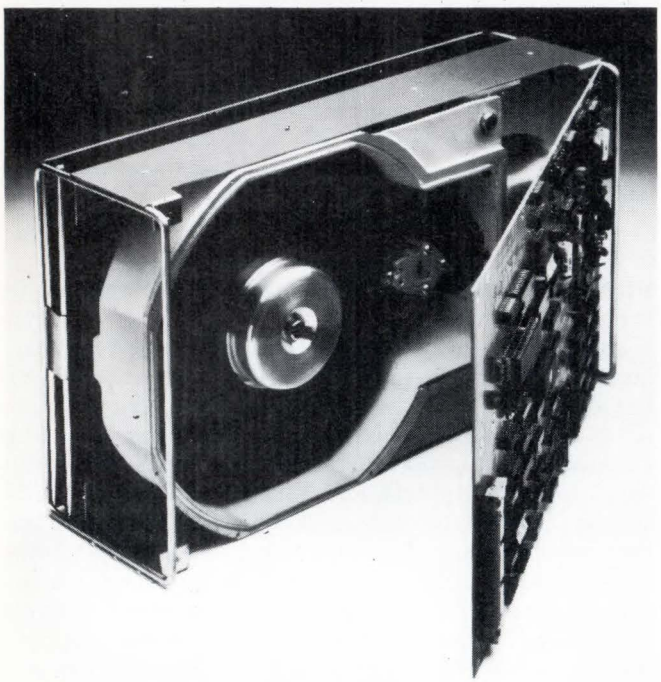


while rewind is 90 ips. Start/stop time is 25 msec at 30 ips and 75 msec at 90 ips. Drive measures 5.5" X 6.5" X 9.0". The formatter is embedded in the transport and connected with flat cable to transport and host through card-edge connectors. Formatter measures 6" X 11" X 0.5". In single unit quantities Model 640 disk backup cartridge is $1200, a Model 650 formatter is $400. OEM quantity discounts available. **Kennedy Company**, 1600 South Shamrock Ave., Monrovia, CA 91016. **Circle 140**

WINCHESTER DRIVES WITH 90-158 MBs Head/disk assembly is a sealed module of rigid deckplate, spindle, carriage/way assembly, three or four 14" disks, read/write heads and a servo head. These HDA components are protected from external contamination. Heads and disks are tested as a single assembly. Four head configurations. Two data heads R/W top disk. Up to three double-headed assemblies each R/W bottom surface of one disk and top surface of another. Servo head reads track-following information on the bottom surface of the bottom disk. All moving heads have low mass to provide fast access. a true linear motor actuator, controlled by closed loop microprocessor-based servo system, precisely positions recording heads. Track positioning information, pre-recorded on a dedicated disk surface, minimizes effect of thermal transients and disk stacking tolerances. The result is faster access and more accurate track-following during read/write operations. Two models available: BFM-90 (90 MBs) and BFM (960) (158.6 MBs.) The Centennial BFM 90 is $6,000; the BFM 160 is $7,500. OEM quantity discounts available. Delivery of production quantities, 90 days ARO. **Ball Computer Products**, 860 East Arques Avenue, Sunnyvale, CA 94086. **Circle 135**



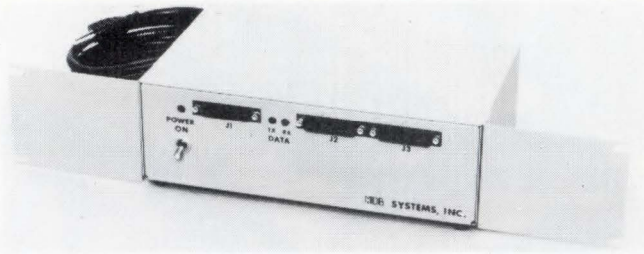
TWO NEW 8″ RIGID WINCHESTER DISK DRIVES, from Priam, designated DISKOS 2050 and DISKOS 3450, will have capacities of 20 and 34 megabytes. Based on the same design and using the same interface as the company's 14 inch disk drives, the new units employ a fully servoed voice coil positioner and a brushless DC motor. Data separation and MFM encoding/decoding circuits are onboard the drives. A single low-cost controller can now be used for PRIAM Winchester disk drives having capacities from 20 to 154 MBs. Two 8″ disks are in the DISKOS 2050; and three disks are in the DISKOS 3450. Succeeding versions of these drives will have capacities of 40 and 68 megabytes, by doubling track density. The brushless DC spindle motor is dynamically braked to minimize head/disk rubbing contact during start/stop, thereby eliminating the mechanical brake required in Winchester disk drives with AC motors. Linear voice coil head positioner permits access time of 50 ms, and t/t access of 10 ms. Average latency is 6.4 milliseconds. The



closed-loop operation of the voice coil ensures continuous on-track positioning of the R/W heads over wide thermal variations. PRIAM's linear positioner provides fast head positioning and still permits the DISKOS 2050 and 3450 to fit into a length of 14.25″, exactly the length of a standard 8″ floppy disk drive. The linear actuator is designed to support a track density of 960 TPI. A proprietary positive-pressure air flow system ensures that no contaminants will leak into the sealed head-disk chamber. In OEM quantities, DISKOS 2050 is $1800; DISKOS 3450 is $2250. Shipments of evaluation units will begin in the second quarter of 1980. Production will begin in the third quarter. **PRIAM,** 3096 Orchard Dr., San Jose 95134. **Circle 152**

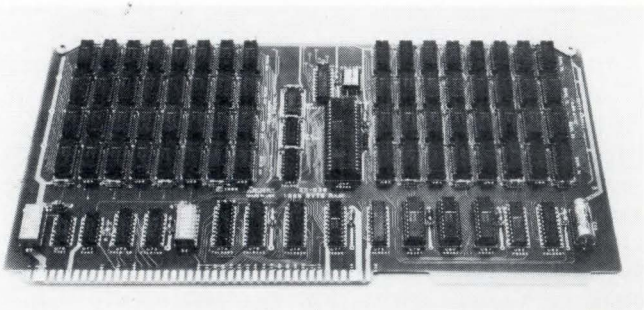
ADD-IN MEMORY. The DR-113S, 128K x 18 semiconductor ADD-IN for DEC's LSI-11/23, is packaged on a standard DEC 8-1/2″ x 10″ quad board. But more than just being a first, says the company, the DR-113S is also a best saving you not only space and money, but also greatly reducing overhead circuitry, optimizing MTBF, and minimizing power consumption. And the DR-113S is also available in 64K and 96K configurations. **Dataram Corporation,** Princeton-Hightstown Road, Cranbury, NJ 08512. **Circle 151**

LONG DISTANCE PRINTERS A Parallel Long Line Option Adapter Box allows MDB line printer controllers to operate almost any printer for full speed parallel data transmission at distances up to 3,000 feet. Long line capability is already available with MDB PDP-11, Perkin-Elmer, Data General and Hewlett-Packard line printer controllers. Long Line capability has been extended to MDB controllers for DEC PDP-8 and LSI-11, and IBM Series/1 computers to op-



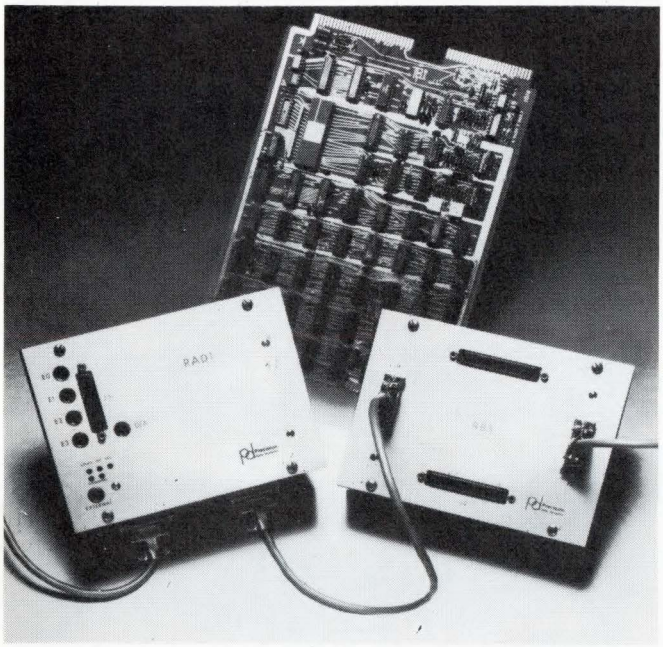
erate Centronics, Dataproducts, Data Printer, GE Terminet, Printronix and most other printers. When a printer does not have the required long line circuitry MDB can provide a second adapter box or a Long Line Paddle Board which mounts inside the printer. The MDB Long Line Adapter is $525. Paddle Board is $200. Cables for interconnection between computer-to-adapter-to-printer are optional. Delivery, 30 days ARO or sooner. One year limited warrany is offered. **MDB Systems, Inc.,** 1995 N. Batavia St., Orange, CA 92665. **Circle 147**

MULTIBUS RAM CARD. This 128K BYTE RAM Card can perform BYTE swapping. Can be used in SBC-80 Systems with 8-Bit words or SBC-86 Systems transferring either 8-Bit or 16-Bit words. Model ZX-028 is available Unpopulated or Populated in 32K steps to 128K BYTES. Address is switch selectable on 32K BYTE boundaries located in 1 M range. Access time is 450 ns maximum. Automatic & Transparent Refresh Control performed by an 8202 DRRC. Onboard data buffers handle all data written into or read from memory array. Available Unpopulated for $362 ea. in 10s or more. Stock to 2 wks. delvy. **EPROM PROGRAMMER.** MULTIBUS™ compatible ZX-908 EPROM Pro-



grammer operates within the MULTIBUS (T.M. Intel Corp.) chassis with simple software drivers. Requires only a 5 Volt power supply. Available in models to program Intel 2716, 2732, 2732A EPROMs, with the capacity to program 16K BYTES of EPROM storage in one operation. Eight Zero-Insertion-Force (Z.I.F.) sockets are provided for quick and safe PROM insertion and withdrawal. $450 ea. 2-4 wks. delivery. **UNIVERSAL DISKETTE CONTROLLER.** The ZX-204 interfaces up to four double sided, double density standard sized drives for as much as 4 million BYTES of on-line storage for SBC-80 MULTIBUS Systems. Complete diskette drive interface, data separator circuits, LSI Floppy Disk Controller chip and MULTIBUS interface. A DMA Controller relieves the Host CPU of data transfers with disk and further provides a memory block move capability. Available at $352 each for quantities over 100. Delivery 45 days. **Zendex Corporation,** 6398 Dougherty Rd., Dublin, CA 94566. **Circle 137**

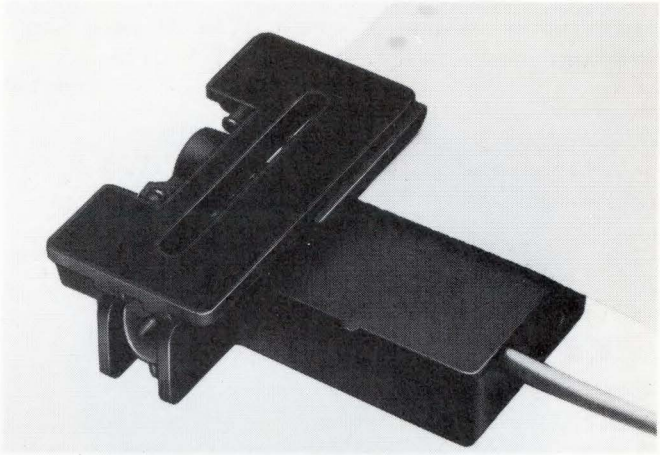
REMOTE DATA ACQUISITION SYSTEM. Specifically designed for mini/micro computers in real-time applications with communication rates to 4 MHz. Controller and software currently available for Data General MicroNova, Nova, and Eclipse computers under the DOS and RDOS operating systems. These RIM Line modules offer high economical solutions to system requirements when analog or digital inputs or outputs, pulse and control outputs, or sensor inputs are needed. Small units can be easily mounted at the signal source. A high performance results from locating the high speed circuits close to the point of use. Low system cost, says the manufacturer, is the product of simplified cabling, easily mounted modules, and reduced checkout time. Reliability is enhanced and signal quality preserved by short, simple cable runs, and digital communication using special noise rejection techniques. A control board occupying one I/O slot in the computer interfaces all modules on one line, freeing scarce slots for other purposes. Modules may be accessed up to 500 feet at a transfer rate of 4 MHz. At a distance of 1 kilometer, operation at 16 kHz is possible. Up to 16 modules of any tape may be daisy chained on a single line. Basis system



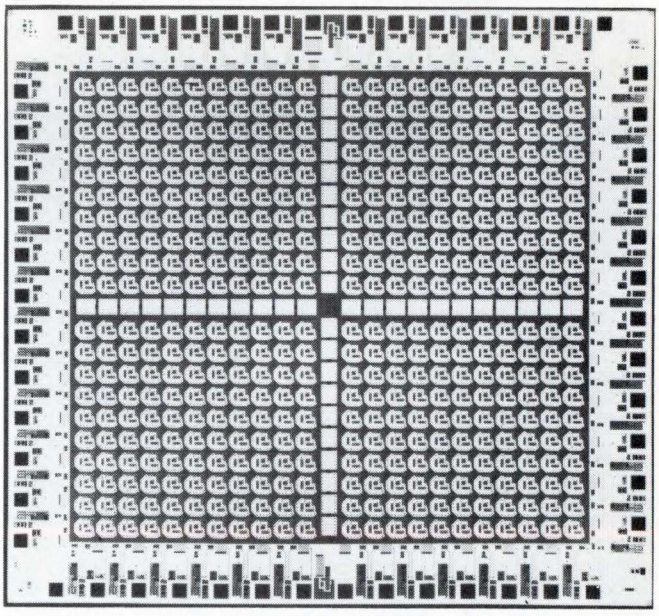
modules include A/O Converters, a 64 bit Digital I/O, plus multiplexers, line controllers, a resistance temperature converter, thermocouple converters, and several other signal handling modules. All power, control, and data signals are supplied by a single cable at distances to 250 feet making installation fast and convenient. At longer distances, a remote power box is available. All modules are tightly sealed. A complete library of FORTRAN callable routines (RIM LIB) is available to provide easy access from a FORTRAN program. Where applicable to the host computer's operating system software, full multitasking and coding of interrupt service routines in FORTRAN is supported. When multitasking is used, the application software can be easily partitioned into separate smaller program segments, greatly reducing checkout time. **Precision Data Systems**, 2030 North Forbes, Tucson, AZ 85705. **Circle 128**

COLOR CRT MONITOR This module displays 512 dots on a nominal 250 video lines. 60 Hz refresh rate. High contrast CRT. Automatic degaussing. All controls designed for front access. All active electronic components on one board. Company claims it offers best looking, brightest color picture in industry. **Industrial Data Terminals Corp.**, 1550 West Henderson Rd., Columbus, OH 43220. **Circle 150**

PAPER MOTION MONITORS. These monitors give immediate notice of a paper jam to avoid loss of data, eliminate retrieval time, and reduce risk of damage to the printer. If a paper jam occurs anywhere in the paper feed path, or if there is a paper-out condition, the processor will signal the printer controller to shut down. Monitors are designed for use with XACTRON© form-feed tractors. Model PMD (Detector) monitors change of signal to every 0.080" of linear paper travel; Model PMP (Processor) insures paper response to line advance commands. **Precision Handling Devices**, 63 S. Main St., Assonet, MA 02072. **Circle 133**



HIGH SPEED GATE ARRAYS. Two new CML high speed gate arrays, MSA and MSB, feature toggle rates of 20MHz, propagation delays of 8ns, speed-power product better than lpJoule, temperature compensated on-chip voltage regulator, compatiblity with TTL, LSTTL, and CMOS (5 and 12 volts) logic forms, and sufficient output power to drive LED displays. Propagation delays through critical gates can be reduced further to 3ns by employing multiple current sources and load resistors. CML is a logic form similar to ECL. Each CML array cell consists of two pairs of common collector NPN transistors plus a current source with two

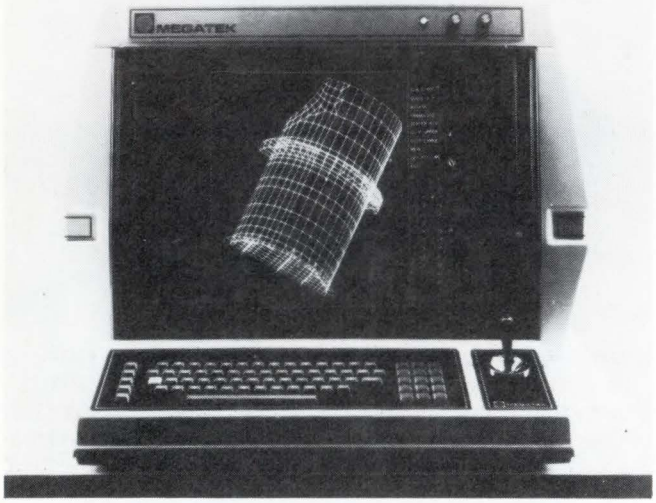


active emitters, and necessary load resistors and crossunders. Architecture permits the implementation of two 2-input NOR gates using a single array cell. A 3-input NOR gate and a 2-input NAND date also require a single cell while a D flip-flop can be integrated using only three array cells. The smaller MSA has 225 array cells, 39 peripheral cells, and 40 bonding pads. The larger MSB has 440 array cells, 48 peripheral cells, and 52 bonding pads. **Interdesign Inc.**, 1255 Reamwood Ave., Sunnyvale, CA 94086. **Circle 131**

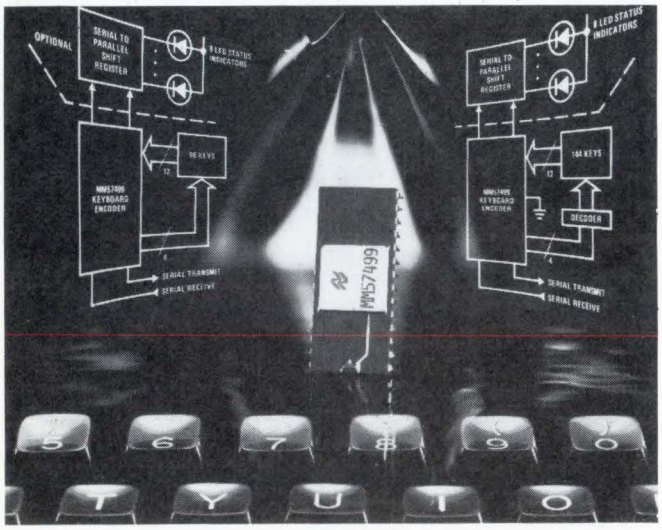
NCC 80 Over 100 New Products

PARALLEL RASTER TERMINAL. Higher speed than standard raster color terminals with enhanced resolution on a 512 X 512 screen. Using an advanced Megatek graphics processor WHIZZARD Model 7250 offers more powerful animation and dynamic capabilities than any raster device currently on the market, according to a company spokesman. The terminal is the first member of Megatek's new 7200 family. Additional members of the new series – including both vector refresh and raster models – are expected to be introduced later in 1980. **Megatek Corp.**, 3931 Sorrento Valley Blvd., San Diego, CA 92121.

Circle 130



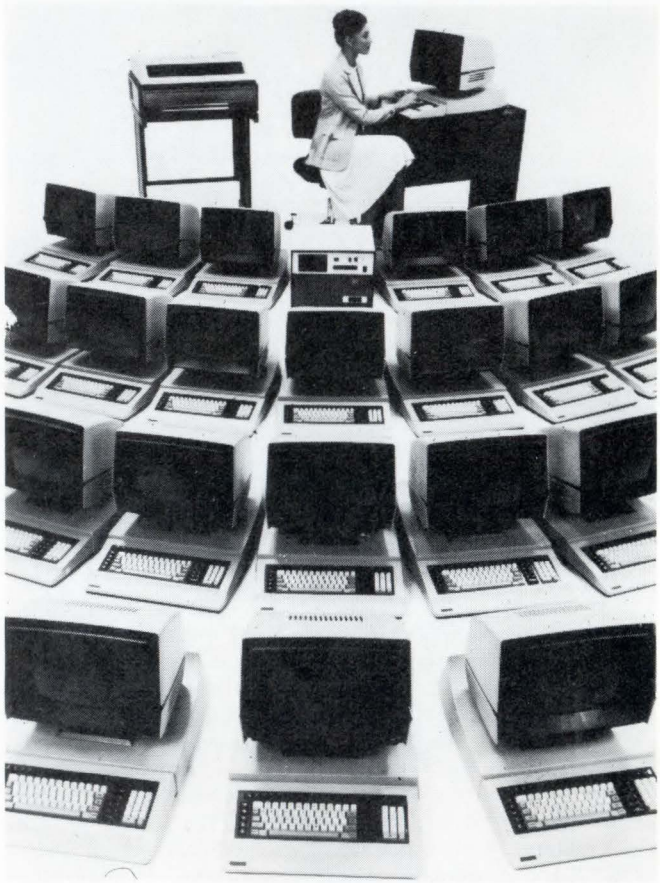
KEYBOARD ENCODER. Single 28-pin integrated circuit interfaces a detached keyboard to a CRT terminal. The usual 18 to 24 interconnections are reduced to 5 wire connections, and it is capable of handling up to 144 keys. The encoder, Model MM57499, has full upper and lower case ASCII codes, numeric pad and function encoding on chip. A two-key lockout feature prevents two or more keys being activated at the same time. All keys have access to manual repeat. Has its own oscillator and an on-



chip baud rate generator. With the addition of an external shift register, the encoder can drive up to eight status indicators, to show power on/off, system error, self test, programming mode, transmit/receive speed, etc. TTL compatible, the device operates from a single 5 volt supply. $6.15 each, in 100 quantities. Delivery is from stock. **National Semiconductor,** 2900 Semiconductor Dr., Santa Clara, CA 95051. **Circle 127**

ENCODER/READER WITH "WRITE" CAPABILITY. American Magnetics has added a new "write" capability to its MAGSTRIPTE™ card readers. The Torrance, Calif., manufacturer will introduce its new Model 44 Encoder/Reader to the industry at the National Computer Conference scheduled May 19th at the Anaheim Convention Center. The units can read warped and contaminated cards, and with low output and out-of-spec jitter. Each head is independently suspended on paralleogram springs in a gimbal mount. Low contact force produces minimum head and card wear. The Model 44 Encoder/Reader will be available in June of 1980 and will cost approximately $200 in OEM quantities. **American Magnetics Corp.**, 2424 Carson St., Torrance, CA 90501. **Circle 153**

CLUSTERED TERMINAL SYSTEM. Emulates the IBM 3270 Information Display System and incorporates the operating characteristics of both the IBM 3274 Control Unit and the IBM 3278 Model 2 Display Station. The link to the host computer supports IBM compatible data communications using either BSC or SDLC/SNA protocols. Speeds from 2000 bps to 9600 bps are supported. The



Racal Milgo 4270 system is composed of multiple, task-oriented microcomputers operating simultaneously and independently. Control functions are performed by a 16-bit microprocessor. Additional 8-bit processors are dedicated to I/O functions. Each controller can support any combination of up to 32 display stations and printers. The 4278 Display Station presents a display of 1,920 characters (24 lines by 80 columns) on a 15 inch, anti-glare screen. An additional 25th line displays a full set of status information. Monitor tilts and swivels for operator comfort. Displays may be located up to 5,000-ft. from the system controller and are connected with coaxial cable compatible with existing IBM coax. Delivery for BSC models is quoted at 60 days. A controller with 4 display stations and one 160 CPS printer sells for $27,190. **Racal-Milgo**, 8600 NW 41st St., Miami, FL 33166. **Circle 129**

DILOG CONTROLS DEC 11*

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

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

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

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

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

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

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

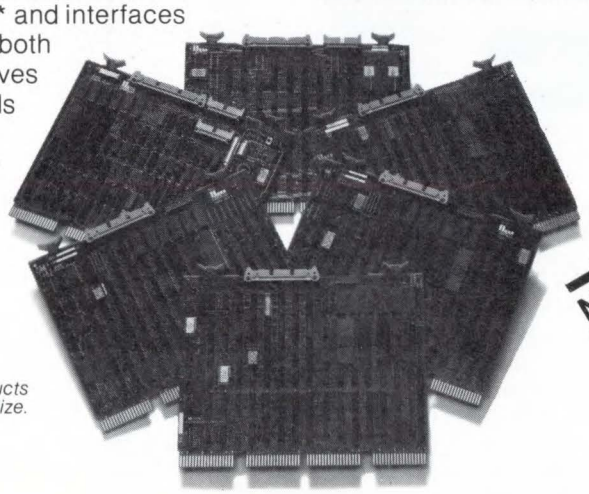
PDP-11 μP DISC CONTROLLER, Model DU100 is an RK-11*/RK05* emulator that supports all 2.5, 5, 10 and 20 MB industry standard cartridge class disc drives • expanded addressability to 40 MB.

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

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

COMPLETE SYSTEMS including drives also available.

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



All Dilog μP Products are Low Power, Quad Size.

DISTRIBUTED LOGIC CORP.
DILOG

NEW

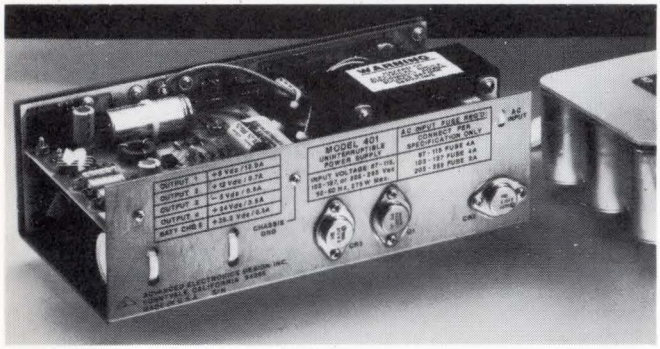
- LSI-11 Shugart SA4000 Winchester Controller
- PDP-11 Magnetic Tape Coupler
- PDP-11 SMD Controller
- 8" Winchester Controllers

*Trademark DIGITAL EQUIPMENT CORP

NCC ANAHEIM BOOTH 3110

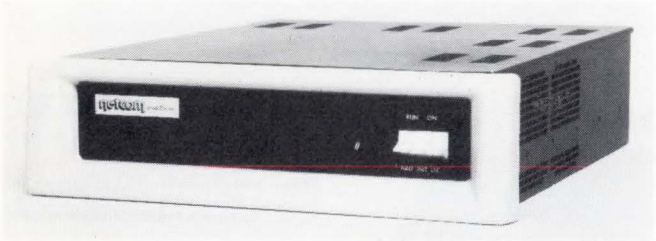
Circle 48 on Reader Inquiry Card

UNINTERRUPTIBLE POWER SUPPLY This low-cost, system-oriented power source is designed to be integrated into a minicomputer- or microcomputer-based system. Suited for designs where it is crucial to provide data integrity in the event of power failure. Providing outputs at 5 vdc, 12 vdc, −5 vdc and 24 vdc, this supply can provide full system power for minicomputer and microcomputer systems configured with either floppy or Winchester drives. Model AED 401 enables an entire system to run for five minutes following a power outage, allowing time to complete data transfer back to disk. Two logic signal lines provide handshaking between power supply and computer system. When a power outage occurs, a TTL "power fail" interrupt signal is sent (within 10 ms) from the power supply to the CPU instructing it to secure all data. Once the system has stored



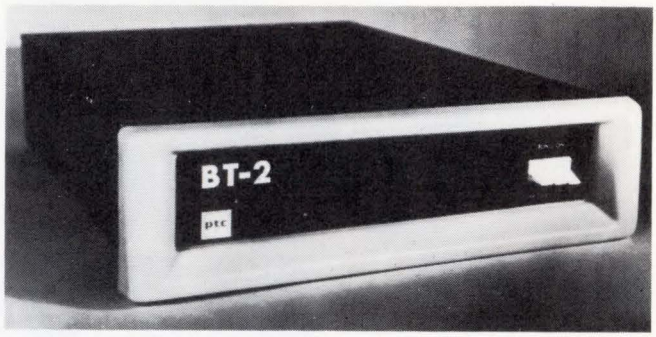
the data on disk, the CPU, via the "battery disable" line, feeds a TTL signal to the power supply causing it to shut down. When utility power returns, the "power fail" line waits 3 seconds and then signals the CPU that d-c power is available. The integral battery charging circuit restores the battery to its fully charged state. Model AED 401 can be powered from 100 vac, 110 vac or 220 vac, 50/06 Hz lines. Dimensions are 3.5″ x 11″ x 6.25″ $496 in quantities of 1 to 9. OEM pricing available. Delivery is three weeks ARO. **Advanced Electronics Design, Inc.**, 440 Potrero Ave., Sunnyvale, CA 94086 **Circle 195**

MICROCOMPUTER ENCLOSURE Enclosure incorporates an LSI-11 bus structured backplane compatible with the LSI-11 microprocessor family including the new advanced LSI-11/23 microprocessor. Contains all necessary components, such as, front panel switches, internal cooling, AC



power control and DC power supplies, which are required to support an LSI-11 based system. The HV-1123 enclosure provides the versatility to configure an LSI-11 based computer system to satisfy a wide range of applications. Has an expanded 8-quad slot backplane with easy cable access to all modules, making the unit particularly suited for communication and data acquisition applications. Options available include LSI-11 microprocessor modules, memories, serial/parallel interfaces, printer controller and communications modules. Delivery, two weeks ARO. $1,285.00 Quantity discounts available. **Netcom Products, Inc.**, 430 Toyana Dr., Sunnyvale, CA 94086. **Circle 139**

TELEPHONE-QUALITY VOICE RESPONSE. Stand-alone voice response system communicates messages, instructions, questions, answers, and alarms in natural human sentences or phrases. Eliminating the need to watch displays or signal lights the RS232C compatible system utilizes telephone quality male or female speech. Voice responses are not computer synthesized, and there is no limit on the length



of a word or phrase. The PTC BT-2 (LSI-11 based) comes standard with 8 channels of speech output and approximately 30 words. Maximum configurations is 64 input and 64 output channels, and 256 words. Options include a variety of telephone and computer interfaces. Any software that runs on an LSI-11 can optionally be run on this intelligent terminal simultaneously with the voice response functions. $7000 for the basic 8-channel unit. **Perception Technology Corp.**, 95 Cross St., Winchester, MA 01890.
Circle 179

LINE PRINTERS FOR BURROUGHS COMPUTERS. A high speed drum printer is offered as a replacement for Burroughs 250, 1100, and 1500 LPM printers. The 1250 LPM model D-2470 from Digital Associates can be used with virtually any Burroughs computer. Priced the same as the Burroughs' model 9247-3, 250 LPM printer, the D-2470

can provide five times the print speed at no added cost. In addition, the company offers both the controller and interface as required. Burroughs users can also purchase letter quality ChainTrain or economical band printers at savings of up to 50% compared to standard pricing. **Digital Associates Corp.**, 1039 E. Main St., Stamford, CT 06902.
Circle 185

MDS® 2021/2022 CARTRIDGE TAPE DRIVE -a miniperipheral with big capabilities

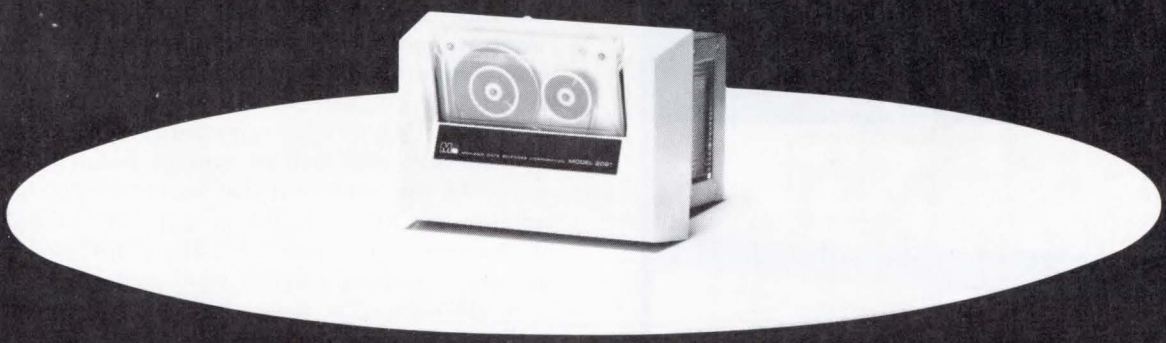
We've shed light upon a 3M-compatible* cartridge tape drive that is in use by more OEM's than any other cartridge drive. It's simple to see why.

You'll find the flexibility you need for virtually any digital data handling requirement. Features like 30 ips read/write, 90 ips search and rewind, read-after-write checking, 800/1600 bpi recording density, and phase or biphase encoding on 1, 2, or 4 tracks. Storage capacity per cartridge is up to 23 million bits. But there's more to this drive's wide acceptance than meets the eye. Features like interchangeable printed circuit boards, long-life motor, and initial low cost have made this unit particularly suitable for small system integration where cost/performance, reliability and serviceability are of utmost concern.

Applications like remote data collection, data communications, word processing, POS, and data entry are just a few ways that these drives are handling data in thousands of systems today.

To get all the facts on the MDS 2021/2022 Cartridge Tape Drive, mail the attached coupon, or call us collect today.

*3M DC300A Data Cartridge



MDS MOHAWK DATA SCIENCES

OEM Division
Palisade Street,
Herkimer, N.Y. 13350
East Coast-Contact: J. Hill (315) 866-5300
West Coast-Contact: J. Engstrom (714) 772-0803

Please send me information on the MDS 2021/22 Cartridge Tape Drive.

Name _____

Title _____

Company _____

Street _____

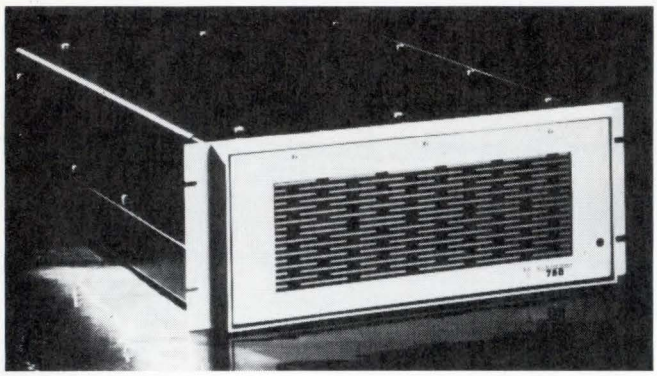
City _____ State _____ Zip _____

☐ I'm in a hurry. Have a representative call me at: (____) _____

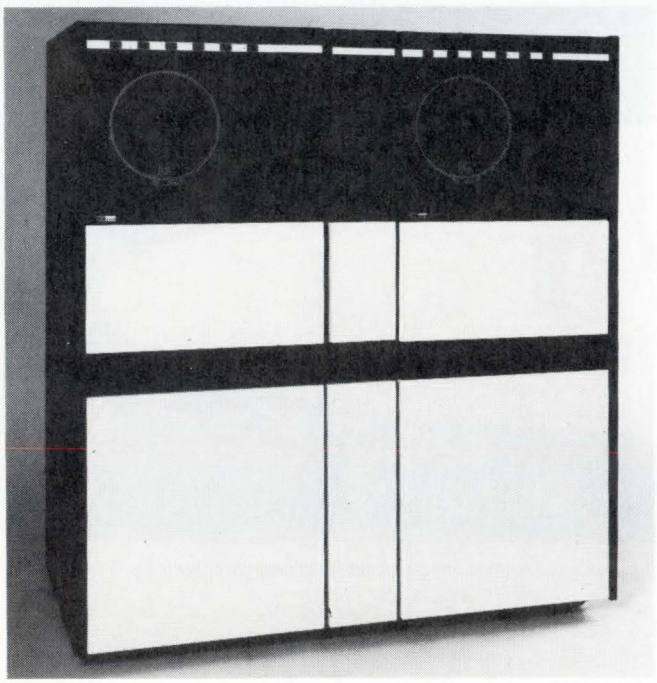
DD5/80

Circle 50 on Reader Inquiry Card

NEW DISK MEMORY. New unit features an advanced, closed, recirculating air system, which allows extended operation in non-severe environments, without periodic maintenance. Head and disk enhancements permit the unit to double its capacity to a maximum of 4.8 MBs, without adding additional tracks or components. Controllers are being offered for this DDC Model 750 to allow attachment to popular DEC and Data General systems. Orders now being accepted; production scheduled for early 1980. Evaluation units currently available. **Digital Development Corp.**, 8650 Balboa Ave., San Diego, CA 92123. **Circle 126**



TAPE SUBSYSTEM FOR INTERMEDIATE MARKET Storage Technology Corporation's (STC) first tape drive subsystem is designed specifically for the mid-size user. The STC 4500 series, comprised of eight drive models, combines the high performance advantages of big system tape drives with the price and size advantages of smaller drives. Drives are available in both 75 and 125 inch-per-second (ips) speeds, and will R/W in three densities. Basic mode of operation is 6250 and 1600 bits per inch (bpi), but an option allows a user to add 800 bpi if desired. Key feature of the 4500 series is its diagnostic capabilities. STC engineers have built in the ability to exercise the subsystem in-line through micro-diagnostics. "Wake-up" diagnostics have also been added to the subsystem to exercise the memory, micro-processor and interface when it is powered up to insure proper operation. The built-in diagnostics can also exercise the subsysem remotely. Instructions can be relayed from an STC engineer at a remote site (regional office or plant site) to a subsystem by utilizing STC's detached diagnostic device, the STC 3910. Connection is made via telephone lines. Data are then transmitted back to the remote device for analysis. **Storage Technology Corp.**, 2270 South 88th St., Louisville, CO 80027. **Circle 138**



SINGLE QUAD SIZE CONTROLLER This intelligent quad size Disk Controller interfaces DEC LSI-11, 11/2 and 11/23 computers with Shugart 14.5 MB SA4004 or 29MB SA4008 hard disk drives. Model DQ-201, μP based controller, includes all electronics for operation and is ready for plug-in to LSI-11 sub-UNIBUS and direct connection to disk drives without external support electronics. Controller includes full sector data buffer that eliminates data late errors due to DMA latency. It also has automatic media flow compensation, bad sector flagging, transparent automatic track skipping, data error checking and automatic retry on read errors. $1592 in 50 quantity. Delivery, stock to 30 days ARO. **Dilog (Distributed Logic Corp.)**, 12800-G Garden Grove Blvd., Garden Grove, CA 92643. **Circle 144**

AUTOMATIC DC MAGNETIC HYSTERESIGRAPH Fully automatic DC magnetic Hysteresigraph is capable of plotting the hysteresis curve of hard or soft magnetic materials at touch of button. System has a programmable DC power supply, a digitally controlled programmer, a field meter and an electronic integrating fluxmeter. Power supply can drive a variety of loads from toroids to Epstein frames to electromagnets. Under programmer control, the LDJ Model BH 5200 traces an entire BH loop. Horizontal motion of the recorder pen can be reversed at will to draw minor loops or recoil slopes. Speed is continuously adjustable down to a "dead stop" for careful traversing of the "knee" of the curve. Maximum drive current is fully adjustable to accommodate a variety of materials and drive windings. **LDJ Electronics, Inc.**, 1064 Naughton, Troy, MI 48084. **Circle 193**

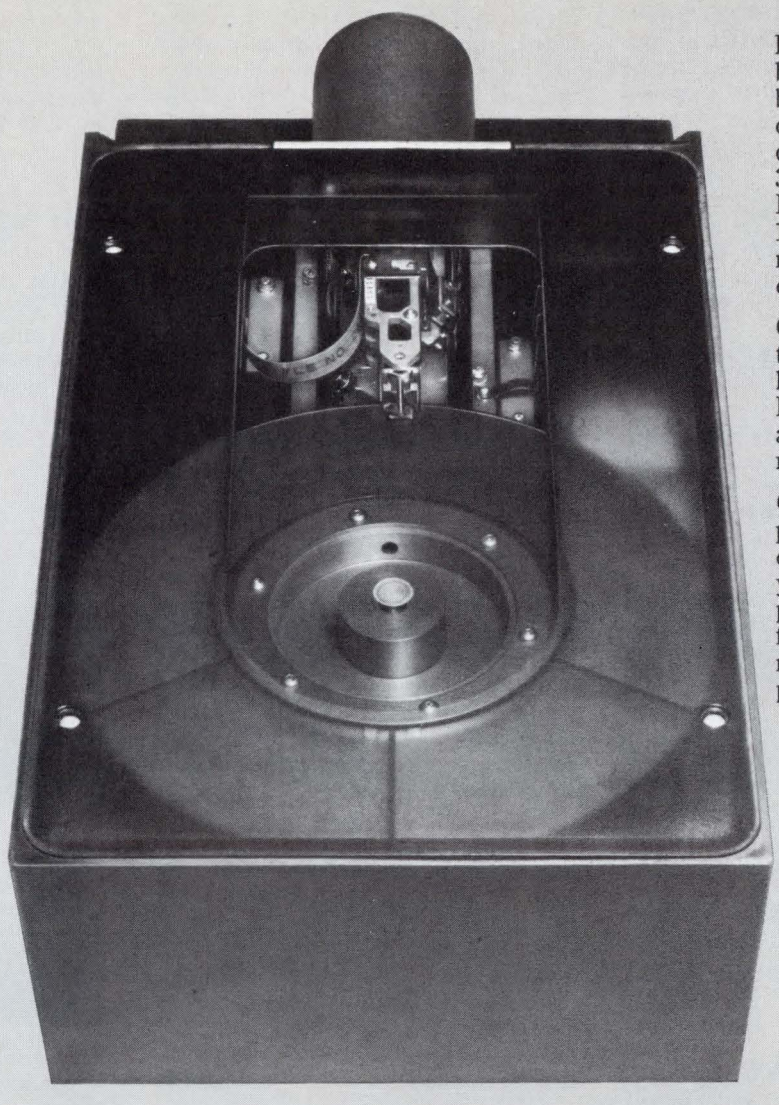
POWERFUL NEW DISK MASS STORAGE SYSTEM New, high-performance disk mass storage systems for VAX 11/780 minicomputers provides 50% increased capacity per spindle over the RH780. The 9400 system is designed especially for VAX applications requiring large, on-line, active data bases, such as in the banking, printing and graphics, service bureau, and insurance industries. This new system emulates the RH780 hardware, and DEC's RM03 software at the operating system level. The unit, from System Industries, comprises a model 9400 controller, a 300-megabyte SMD-type disk drive, a special SBI adapter to the VAX, and all connecting cables and hardware. A 9400 controller makes available a wide variety of interface options and system configurations, including dual channel drive and multiple CPUs. As many as eight drives can be interfaced to a VAX in a daisychain configuration, providing a total of 2400 megabytes of on-line storage. With the multiple CPU option, a VAX user can interface an 11/780 with up to three other CPUs, – VAX 11/780s, PDP-11/34s, or PDP-11/70s in any combination – and all machines can then share the same large database. Complete disk storage system for the VAX 11/780, including one 300-Mbyte drive, $36,500. Dual drive system with two 300-Mbyte drives is $53,900. Delivery, 45-60 days, ARO. **System Industries**, 525 Oakmead Pkwy., PO Box 9025, Sunnyvale, CA 94806. **Circle 143**

Introducing the new BASF 6170 Series 210mm Fixed Disk Drives.

High Performance. Perfect for multi-user multi-tasking applications, the BASF 6170 Series drives give you an average time-to-data of 50 milliseconds...four to seven times faster than standard 8" floppy drives.

Capacity. The BASF Model 6171 provides 8 megabytes and the Model 6172 provides 24 megabytes of fully usable unformatted capacity. Unique BASF circuitry eliminates user mapping.

Easy System Integration. BASF's exclusive SMD interface option offers cost-effective and convenient interface compatibility with industry-supported controllers. Low-cost BASF disk bus, or intelligent BASF host bus with integral controller/formatter also available.



Proven Reliability. BASF, because of its experience in both magnetic media and drives, is highly qualified to develop drives using reliable 3350 Winchester technology. BASF 6170 drives have a 10,000 hour MTBF and require no scheduled maintenance or operator intervention.

Compact Size. Far smaller than 14" drives, the quiet, lightweight floppy-sized BASF 6170 drives are suitable for desktop office environments.

Competitive Price. Get the performance, capacity, and ease of system integration you need right now...at prices you'd expect to pay for far less sophisticated technology. Write now for competitive OEM prices.

If you need high performance, capacity, easy system integration, proven reliability, in a compact size, at a competitive price, right now...

write now.

BASF Systems, OEM Peripheral Sales, Crosby Drive, Bedford, MA 01730
Please send me complete details and specifications on the new BASF 6170 Series 210mm Fixed Disk Drives.

Name _____ Title _____

Company _____

Address _____ Telephone _____

City _____ State _____ Zip _____

In a hurry? Call Dave Edwards at (617) 271-4168 DD

BASF

BASF

Circle 49 on Reader Inquiry Card

Over 100 New Products

GRAPHIC DISPLAY SOFTWARE PACKAGE. Software operates in conjunction with an intelligent color graphic CRT terminal. With this new package, the EPTAK system by Eagle Signal can define the process display adding the dimension of color, define control requirements and operate the process. The software offers advanced analog control, process and alarm displays, dynamic and historical trending and process and alarm logging. The graphic display package operates in conjunction with an Intelligent Systems Corporation (ISC) color CRT. The EPTAK controller communicates with the ISC terminal and other standard peripherals through standard EPTAK interface modules. Hard copy reports available with the GRPHPK software, when optional hardware and interface modules are added, include: dynamic trending via an analog output to a chart recorder, historical trending of process variables through a plotting printer and process status reporting via a serial printer. Control features offered by the GRPHPK software package include direct digital control, cascade control, and ratio and blend control. The new package allows the user to define control loop trim parameters. Price for the software package, color CRT terminal, printer and required EPTAK hardware is under $19,000. **Eagle Signal Industrial Systems,** 736 Federal St., Davenport, IA 52803. **Circle 184**

8″ FIXED DISK DRIVE An 8.25″ fixed media disk drive, mechanically interchangeable with an 8″ floppy disk drive, Model D8000, uses Winchester-technology and has a 20MB capacity. D8000 dimensions – 4.62″ high, 8.55″ wide and 14.25″ long – allow mechanical compatibility with a flexible disk drive. The dimensions permit mounting in most microcomputer systems without styling changes. System design impact has been further minimized by using DC voltage levels similar to those on floppy drives. **Pertec Computer Corp.,** 9600 Irondale, Chatsworth, CA 91311. **Circle 248**

PORTABLE, MULTI-USE, SINGLE-STATION TERMINAL. This "single station" equally effective for word processing, time-sharing and communications (data and/or text entry) connected to computers either local or remote via private/public networks. The TELERAM terminal is a lightweight portable with video display, typewriter-like keyboard, long-term retention memory and built-in acoustic coupler. Features of the "Portabubble": 30,000 (expandable to 120,000) characters long-term bubble memory storage, full text editing programs including automatically established directory/index; truly portable and lightweight under 15 lbs; "plug in" personality module; programs the terminal for unique user functions/applications; optional low cost and lightweight printer. **Teleram Communications Corp.,** 2 Corporate Park Dr., White Plains, NY 10604. **Circle 226**

CATALOG DATA SHEET FOR DISK SPINDLES. A new catalog data sheet gives detailed design and performance data on Rotron's new "Sextant™ Model 4700" brushless DC drive spindle for computer memory disks. The Sextant is designed specifically for direct drive Winchester disks. The Sextant is a brushless DC motor with integral electronic speed control. Brushless commutation is accomplished through optical shaft position encoding. Speed regulation is provided by a closed loop servo control system that delivers pulse width modulated current to the three-phase, four-pole permanent magnet rotor motor. For copies of the new catalog data sheet: **Rotron Inc.,** Woodstock, NY 12498. **Circle 173**

FIBER OPTIC INTERCONNECTIONS. The complete line of Amphenol Fiber Optic Interconnections is described in this 8-pg. catalog, FOC-2. It includes detailed info on the connector's design features, performance characteristics and complementary products. **Bunker Ramo Corp.,** 2122 York Rd., Oak Brook, IL 60521. **Circle 245**

MICROSTREAMER™ TAPE DRIVE. The Microstreamer, using 1/2″ mag tape, employs a streaming mode to load or unload data on-the-fly at a 100 inch per second speed. It can also use a 25 inch per second operating mode to read or record data interactively. Dual capability makes it useful as an archival storage device, as a data transfer (input/output) device, as a primary data storage device, as a disaster backup storage device or as a Winchester disk backup medium. **Cipher Data Products, Inc.,** 10225 Willow Creek Rd., San Diego, CA 92131. **Circle 230**

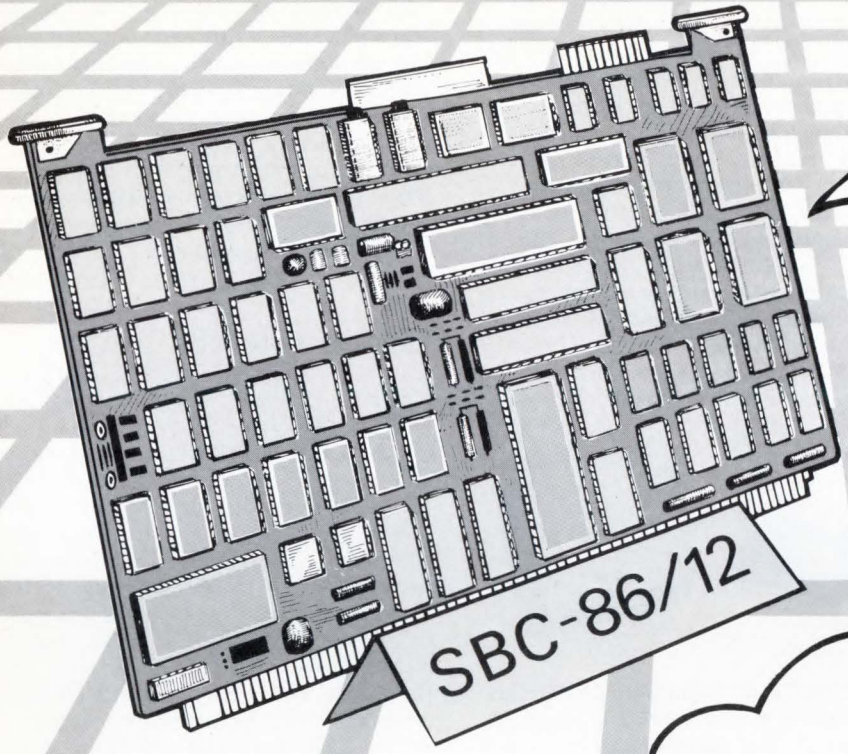
SIMPLE II DIGITIZER The Simple II is a digitizer aimed at systems with graphics applications ranging from medical analysis to interactive graphics to engineering design. The unit is 11″ × 11″ with 400 lpi resolution and 10 mil accuracy. The X-Y output is variable up to 240 coordinate pairs/sec. It replaces the Simple I, Talos' small low-priced graphics digitizer. (Simple I had specified only 200 lpi resolution, 15 mil accuracy, and 100 coordinate pairs/sec.) Price $1065. Simple II doesn't replace the 600 Series digitizers; it serves where high resolution, backlighting or rear projection aren't necessary. **Talos Systems, Inc.,** 7419 E. Helm Dr., Scottsdale, AZ 85260. **Circle 259**

DOT MATRIX IMPACT PRINTER. This 27-column dot matrix impact printer is completely packaged to be used as a stand-alone output printer. The Model 100 incorporates the C. Itoh/Epson Model 210 Printer, Interface Electronics HIF-210 Microprocessor Based Single Board Printer Controller and Modular Power Supply into a compact 6 x 6-1/2 x 11″ package.

The printer can print the 96 ASCII upper/lower case character set under software control in either black or red. Dot matrix characters (5 x 7) are printed with 27 columns per line at 2.4 lines per second. The parallel input is TTL/Centronics compatible and the serial input accepts TTY 20 MA current loop of EIA RS-232-C signals at selectable baud rates from 110 to 9600. Designed as a portable desk top printer for use with mini/microcomputer systems, units are available at $545 from: **Interface Electronics Div.,** Capitol Circuits Corporation, 24 Denby Rd., Allston, MA 02134. **Circle 209**

S-100 BUS. "The S-100 and Other Micro Buses," by Elmer Poe and James Goodwin, covers bus structures, S-100 bus, Benton Harbor bus, SBC Multibus and following buses: TRS-80, Digital Group, SS-50, EXORcisor, KIM, Apple II, PET and Ohio Scientific, as well as Benton Harbor to S-100, TRS-80 to S-100, and 6502/6800 to S-100 conversion. 144 pgs. $5.95. **Howard W. Sams & Co., Inc.,** 4300 West 62nd St. Indianapolis, IN 46268. **Circle 166**

I need a real-time, multi-tasking operating system.



Try polyFORTH!

If you are planning to use an SBC-86/12 board in your final system, you have the principal components of a development system already: a CPU, plenty of memory for most applications, and a serial port for a CRT. This simple addition of an SBC-204 disk controller provides the final ingredient for a powerful development system in which you can fully test your application **software and hardware** interactively, without needing cumbersome in-circuit emulation.

polyFORTH is a complete stand-alone operating system and programming language. The modular nature of FORTH promotes structured programming and interactive debugging, leading to reduced development time.

A specially designed utility, the Target Compiler™, allows easy generation of programs to be run from ROM in a target system.

The polyFORTH system is organized to operate out of PROM (8K bytes) with the disk as a peripheral.

Let us tell you more. Send the coupon, attend a free seminar, but first give us a call at:

213/372-8493

OK, I'm interested!
Please rush full details on polyFORTH for
_____ microprocessors
_____ minicomputers
☐ Contact us for immediate requirements
Tel: ( ) _____
☐ Send dates and locations for your polyFORTH Seminars.

Name _____

Title _____

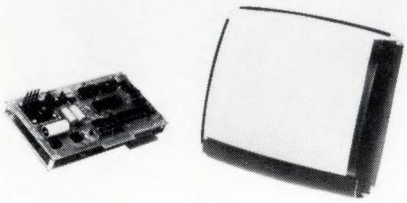
Attach coupon to company letterhead, and return to:
FORTH INC., 2309 Pacific Coast Highway,
Hermosa Beach, CA 90254. Or call (213) 372-8493.

FORTH, Inc.

Circle 66 on Reader Inquiry Card

Over 100 New Products

TOUCH SCREEN DIGITIZER. A new concept in data interaction, "Touch Screen" enables untrained personnel to use a CRT terminal to interface quickly and easily with a computer. Operated by simply touching an appropriate menu item that is displayed on the screen. Touch Screen offers a solution for interfacing personnel who have no computer and data processing experience with a data base that is stored in a computer. With no need for keyboards and light pens, the operator's attention is constantly focused on the screen. Some of the advantages of the 12-inch Touch Screen are: (1) the screen matches the curvature of most



12-inch CRT's – a minimum of parallax optimizes the operator's pointing accuracy, (2) the operator can use a finger to select data directly from the display, (3) fast and convenient data access, (4) no operator training required, (5) high stability since the detection of screen location is on a time base and not amplitude dependent, and (6) outstanding reliability. Prices for the 12-inch Touch Screen Digitizer range from $950 for a unit with parallel unfiltered data output to $1,200 for a unit with filtered RS232 data output and power supply. The special one-time evaluation unit with RS232 interface and power supply is available for $995. OEM pricing available upon request. **TSD Display Products, Inc.**, 35 Orville Dr., Bohemia, NY 11716.

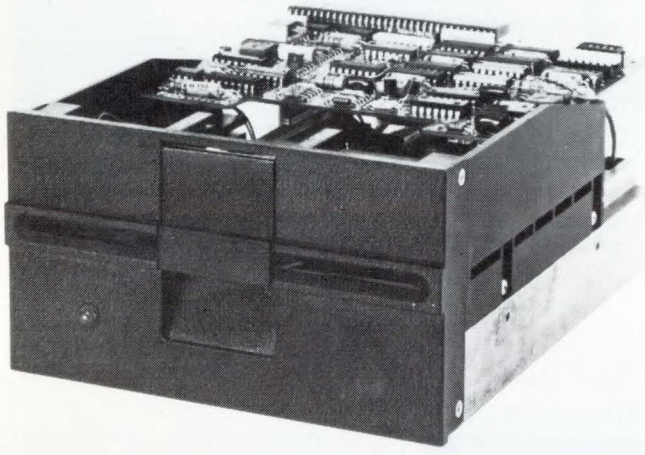
Circle 169

IEEE 488 BUS BOOK. This 238-pg. softback, "PET and the IEE 488 Bus (GPIB)", by Fisher and Jensen, begins with a thorough description of the GPIB, details GPIB lines and signals, and goes on to describe interfacing methods, discussing the most effective combinations of these devices with lab equipment. It includes: description of problems and troubleshooting techniques, character-by-character analysis of bus responses to PET BASIC statements, exhaustive lists of articles on the GPIB Bus, and of manufacturers (and their bus-compatible devices), etc. $15. **OSBORNE/McGraw-Hill**, 630 Bancroft Way, Berkeley, CA 94710.

Circle 159

EIGHT NEW FONTS. The fonts are tailored to word processing applications and specifically increase the flexibility of those users who require foreign language, proportional spacing, and APL capabilities. The eight are: Russian Pica 10, German Elite 12, Norweigian OCR-B, APL/Light Italic, Emperor P.S., German Bold P.S., Bold Italic P.S., and Focus 10. The new fonts used on the NEC Spinwriter series of impact character printers feature the unique, durable, low-mass "thimble" print element that contains up to 128 fully-formed characters. All NEC Spinwriter printers are microprocessor-controlled and are capable of bidirectional printing at speeds up to 55 cps. They are designed for installation as original equipment in data and word processing systems and are also available in system configurations compatible to those of other major print manufacturers. **NEC Information Systems, Inc.**, 5 Militia Dr., Lexington, MA 02173. **Circle 178**

FLOPPY DISK DRIVES WITH DOUBLE TRACK DENSITY These mini-floppy disk drives will R/W 96 tpi doubling the track density of any unit now available in quantity production. Prototypes in single- and double-sided versions of the new drive have already been field tested. When combined with double density and double-sided R/W features, the

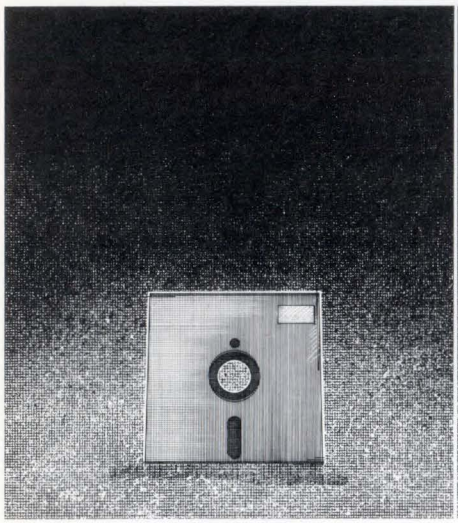


new unit will make possible storage of nearly 1 MB of data on a 5.25" floppy. The new Micro Peripherals drive will be plug-compatible with existing systems. Diskettes recorded on standard 48 tpi format can be played back on this 96-tpi device. Two choices available; Model 91 will R/W 480 KB data on a single side of a 5.25" disk; Model 92 will R/W 960 KB on both sides of the disk. Both will give track-to-track access time of 5 ms. A proprietary split-band head-position device is direct-driven by a stepper motor. Prices of single units for evaluation of OEM's $450 for the 91, $550 for the 92. OEM discounts offered. **Micro Peripherals, Inc.**, 9754 Deering Ave., Chatsworth, CA 91311. **Circle 149**

TERMINAL CONTROL UNIT. This unit allows an IBM System/360, System/370, 303X, 4300 or compatible central processing unit to communicate with a variety of local and remote data communication terminals. The 1270 Model 8 is an eight-line functional replacement for the IBM 2701 Data Adapter Unit, IBM 2702 and 2703 Transmission Controls, IBM 3704 and 3705 Communications Controllers (including the IBM 4331 Communications Adapter, in emulation mode). The unit is compatible with IBM 270X software support and it attaches directly to an IBM System/360, System/370, 303X, 4300 or compatible byte multiplexer channel. Automatic polling, synchronous transparency, automatic speed detection and protocol selection (for asynchronous lines), TTY II (ASC II), IBM Type I (2741) and IBM BSC (both EBCDIC and ASC II) support are all standard on this new unit. Options, at additional cost, include an alternate channel switch, automatic dialing, code conversion and IBM Type III (2260) support and built-in asynchronous modems. Delivery of the unit is scheduled for July 1980. Purchase prices, for various models, range from $14,500 to $18,550. Lease rates are available. **Memorex Corp.**, San Tomas at Central Expressway, Santa Clara, CA 95052. **Circle 222**

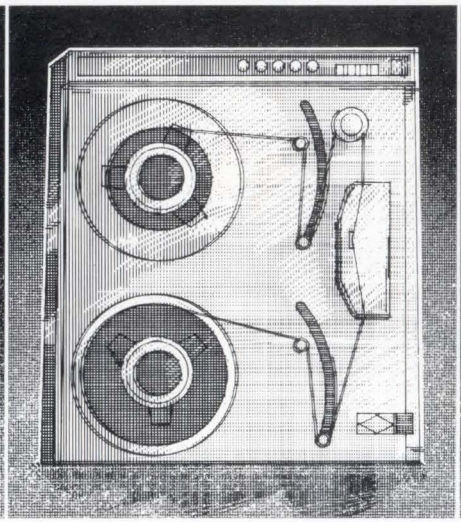
NEW PORTABLE GRAPHICS S/R TERMINAL. This wide carriage portable S/R (send/receive) terminal features full width 136-column (14-7/8") printout on either paper or transparent film. Also operates with 80 column (8-3/4") printout. In the graphics mode, the quiet thermal printer produces time plots, bar charts, histograms, pie charts, etc. Graphics printed directly on transparent film can be shown immediately on an overhead projector screen without additional processing. The Execuport 4000G can draw lines in any direction and print with a resolution of 1920 points per square inch (40x48) or more than 4x the resolution of ordinary 5x7 dot matrix printers. The unit is completely portable. Any location with regular telephone service and electric power can be used to create an on-line connection with a remote computer. Connection to the computer is made by simply inserting the handset of an ordinary telephone into the Execuport 4000G's built-in acoustic coupler. A single control allows the Execuport 4000G to be switched from operation in the graphics mode to standard alphanumeric operations. The single unit price of $3795 (quantity discounts available), includes a full year warranty covering all parts and service. Operating leases and financial leases are available with monthly rates as low as $134 for 3 years. **Computer Transceiver Systems, Inc.**, East 66 Midland Ave., Paramus, NJ 07652. **Circle 216**

THERE ARE A LOT OF ALTERNATIVES TO THE DISK BACK-UP PROBLEM.



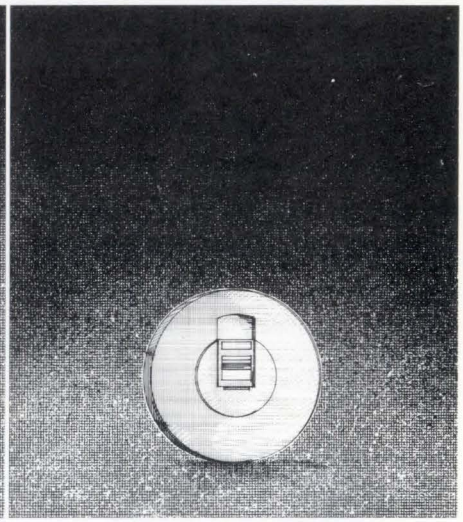
FLOPPY DISKS

Storage capacity: limited.
Handling problems.
Low cost.



REEL-TO-REEL TAPE DRIVES

Low performance: 36 megabyte capacity.
High performance: 90-100 megabyte capacity.
Large, bulky, high cost drives.
Cost: very expensive, up to 20 times that of floppy disks.



DISK CARTRIDGES

Storage capacity: 5-10 megabytes.
Back-up data remains on a disk.
Large drive mechanisms.
Cost: up to $5000.00.

HERE'S THE SOLUTION.

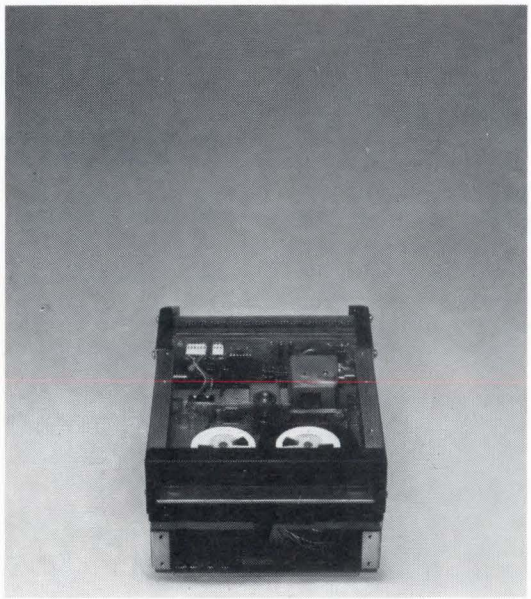
3M HCD-75 DATA CARTRIDGE DRIVE

Storage capacity: 75 megabytes formatted (144 Mbytes unformatted).

Drive dimensions: 4.62" x 7" x 8.625".

Preformatted tape, allows unlimited record replacement.

Built-in error detection/ correction capabilities.



Fully-buffered I/O channel, permits asynchronous data transfers.

Serpentine recording, eliminates wasted rewind times.

List price, including Controller, $2,150.00.

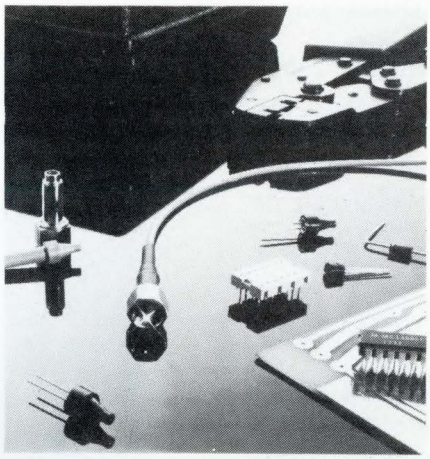
To learn more, check the listing at the right and contact the Data Products Representative nearest you. Or write: Data Products/ 3M, Building 223-5E/3M Center, Dept. 125, St. Paul, MN 55101.

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

3M

NCC 80 Over 100 New Products

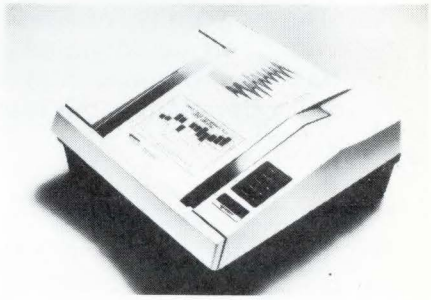
FIBER OPTIC KIT. Major components for two TTL-compatible, 20 Megabaud fiber optic transceivers with a bit error rate of 1×10^9 are supplied in this duplex data link kit. The pc board layout enables transceivers to be used as transmit/receive stations in a full duplex fiber optic data link or as repeaters in an optical data line. Kit includes printed



circuit boards, IC devices, emitters, detectors, emi/rfi shields, ferrite chokes, fiber optic connector components, with associated tooling, a length of terminated fiber optic cable, and complete instructions and specifications of all major components. **AMP Inc.** of Harrisburg, PA 17105. **Circle 182**

NEW INTERFACE FOR DIGITAL CARTRIDGE RECORDER. A microprocessor based controller interfaces the TDC-3000 to other IEEE 488 devices. Transparent to Hewlett/Packard, Tektronix, Systrom/Donner, Fluke and all other manufacturers of IEEE 488 controllers this GPIB-3000 unit will operate as a "LISTEN ONLY", "TALK ONLY", or under software control in dual mode. Instrument users may take advantage of the dual (2048 bytes) buffer front-end to record data at 6 bytes/sec. without use of a costly bus controller. The internal 8085 microprocessor controller interprets ASCII command characters to establish format recording, play-back, error messages, and provides editing capabilities. GPIB-3000 is a Digital Cartridge Sub-System providing data storage that complies with ANSI/ECMA/ISO standards. Built to operate in environmental and vibration/shock extremes, the device is applicable for mini-computers input/output peripheral storage, software distribution, local data collection and text editing. Data is recorded serially at 1600 bits/inch in a four track format providing for 34.5 megabits of unformatted data storage on a DC 300 XL cartridge. The unit is $4080 with additional slave units (up to four) at $1780 each. Delivery is stock to 30 days. F.O.B. San Diego. **Innovative Data Technology**, (Formerly Tanberg Data), 4060 Morena Blvd., San Diego, CA 92117. **Circle 223**

NEW PRINTER/PLOTTER This mid-priced printer, ($3402 in 100's) prints 1000 132-column lines per minute, three times faster than comparably-priced impact printers. It is also a high speed, high resolution plotter, plotting an 11 x 8-1/2-inch plot with 200 dot-per-inch resolution in seven seconds. With optional controller, it can produce a hard copy from CRT or video source in twenty seconds or less. The V-80-711 provides 200 dots-per-inch with 16 by 16 dot matrix characters. A new etched and plated head forms new, precisely formed square dots for finer line and character quality. The new writing electrodes offer better writing quality and lower wear. Servo-controlled paper drive assures maximum vertical dot deviation of 2 mils (0.05mm). Horizontal deviation is within 1-1/2 mils (0.04mm). Improvements in electronic design include use of microprocessor control, new LSI technology, and low power Schottky TTL logic. A differential paper sensor determines top of page for fan-fold, end of roll and out of paper. The V-80 prints in eight languages. Changing to another language involves the replacement of a single ROM language configurator. To meet international electrical standards, the V-80 has been designed to meet both UL and VDE standards. Re-positioning one electrical plug adapts the printer/plotter to different voltage requirements. A circuit breaker in the AC line combines reset



with the on/off switch.The Versatec V-80 can print and plot directly from most popular computers, then, upon request, make copies from up to eight display terminals or digital video sources. Hard copy from display is accomplished through the addition of a hard copy controller. OEM evaluation units of Model V-80-711 are priced at $5400 in single unit quantities. OEM one-hundred unit price is $3402. OEM evaluation units are available now; production quantities available, September, 1980. **Versatec**, Xerox Company, 2805 Bowers Ave., Santa Clara, CA 95051. **Circle 219**

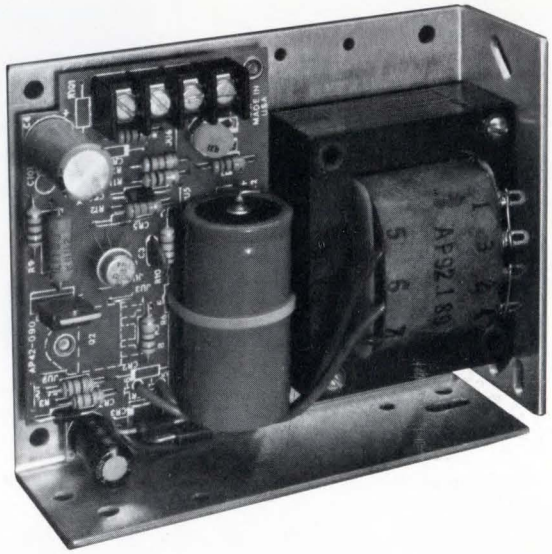
PRICE BREAKTHROUGH!

ADTECH POWER

ON OPEN FRAME LINEARS

SINGLE OUTPUT – IC REGULATED

Industry Standard Thin Profile
OEM Economy DC Power Supply @ $19.90*
5 Year Warranty



- Universal 103-130V/206-260VAC 47-63Hz Input
- Full Power Rated to 50°C
- Electrostatically Shielded Transformers for Lower Noise Experience
- Remote Sensing
- Reverse Polarity Protection
- Enclosed Insulated Shaft Potentiometer
- Metal Cased Hermetically Sealed IC Regulator
- U.L. Recognized Glass Epoxy Circuit Boards
- Over 25,000 Hour MTBF
- Series or Parallel Operation
- Meets U.L. & C.S.A. Requirements

Thinner profile with interchangeability offered in four models will meet the requirements of most needs within a wide variety of applications. IC Regulation, simplified circuitry and top quality components assure long-term reliability.

Designed for low cost high volume production; permits Adtech to offer the lowest priced high quality, precision regulated power supplies equal to any major power supply manufacturer.

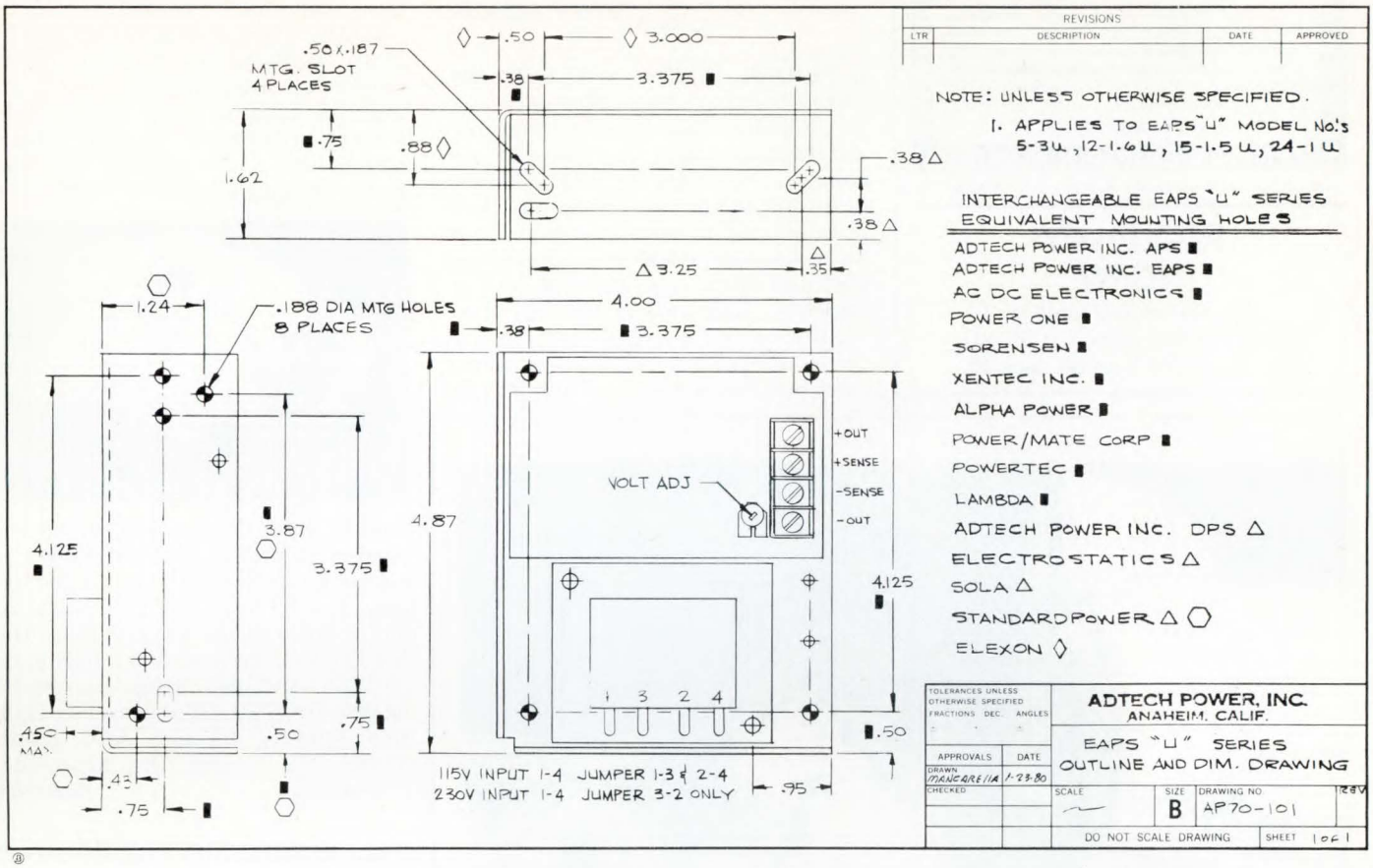
The new units, offered in the industry standard thin profile HB Case with three plane mounting, combination barrier strip output for screw terminals and optional solder tabs or fast-on tab connection, are directly and fully interchangeable with all competitive units, but offer many more features.

MODEL NUMBER	RATING		REGULATION		RIPPLE (PK/PK)	ALL MODEL PRICING BY QUANTITY			
	VDC	AMPS	LINE	LOAD		1-49	50-99	*100-249	250-499
EAPS 5-3U	5	3.0	±0.05%	±0.10%	5mV	$23.25	$21.00	$19.90	$19.50
EAPS 12-1.6U	12	1.6	±0.05%	±0.10%	5mV				
EAPS 15-1.5U	15	1.5	±0.05%	±0.10%	5mV				
EAPS 24-1U	24	1.0	±0.05%	±0.10%	5mV				

1) Production orders must be for 50 or more pieces with a firm delivery schedule.
2) Minimum shipment is 25 pieces, bulk packed to one address.
3) A one to 49 piece "Prototype" order will be accepted one time only per customer.
4) Optional overvoltage protection is available on factory orders over 50 pieces at a price of $1.50/unit regardless of quantity. Add suffix "OV" to model number.
5) Optional solder/fast-on tabs are available on factory orders over 50 pieces at a cost of $1.00 per unit in any quantity. Add suffix "ST" to model number.

New Toll Free Number – Call today: 800/854-8288

ADTECH POWER, INC., 1621 S. SINCLAIR ST., ANAHEIM,CA 92806. (714) 634-9211 ● TELEX 68-1498



EAPS "U" SERIES SPECIFICATIONS

Input: 103-130V/206-260VAC 47-63Hz.

Line Regulation: ±0.05% for ±10% line change.

Load Regulation: ±0.1% for ±50% load change.

Ripple: Less than 5mV peak to peak.

Transient Response: Less than 50 micro-seconds.

Short Circuit and Overload Protection: Automatic recovery foldback current limiting.

Reverse Polarity Protection: Standard.

Remote Sensing: Standard with open sense lead protection.

Output Adjustment: ±5% minimum.

Outputs: Screw type barrier strip output connection with optional solder or fast-on tabs.

Operating Temperature Range: 0°C to +50°C at full power rating derate linearly to 40% at +70°C or -20°C.

Stability: ±0.1% for 24 hours after warm up.

Temperature Coefficient: ±0.01% typical ±0.03% maximum.

Vibration: Per MIL-STD-810B Method 514, procedure 1, curve AB (to 50Hz).

Shock: Per MIL-STD-810B Method 516 procedure.

Overvoltage Protection: Optional.

Size: 4.0" W x 4.87" H x 1.62" D x +0.45 transformer projection.

Weight: 2 lbs.

Call our engineering sales office in your area for application engineering assistance.

Arizona, Phoenix
Phone: (602) 894-2335

Arkansas, El Dorado
Phone: (501) 862-2051

California, Anaheim
Phone: (714) 634-9211

California, Long Beach
Phone: (213) 426-7375

California, Los Gatos
Phone: (408) 354-6496

California, San Diego
Phone: (714) 560-1009

Connecticut, Meriden
Phone: (203) 237-9232

Florida, Clearwater
Phone: (813) 536-8536

Florida, Fort Lauderdale
Phone: (305) 752-7520

Georgia, Atlanta
Phone: (404) 233-6679

Illinois, Chicago
Phone: (312) 437-2700

Indiana, Indianapolis
Phone: (317) 844-2800

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Washington, Spokane
Phone: (206) 455-3460

Wisconsin, Milwaukee
Phone: (414) 527-1500

Mexico, Mexico City
Phone: 575-58-95 or 575-62-97

Israel, Tel Aviv
Phone: (03) 615469 or 622429

In Europe: Adtech International, Subsidiary of Adtech Power, 46 BD, Roger Salengro, 78200, Mantes La Ville, France Phone: 4775301

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REQUALIFY NOW!

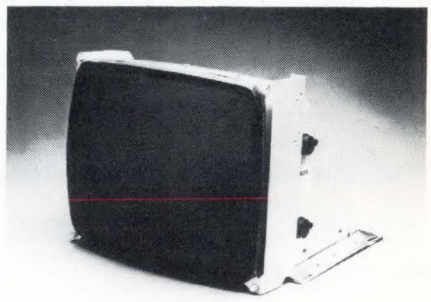
If your address label is printed in red, you must fill out and return the form on page 15.

NCC 80 Over 100 New Products

A MODEM INSIDE A STANDARD TELEPHONE. The ModemPhone, which is supplied with an 8-foot cable and Telco matching plug, plus a 25 pin connector to accept the RS232C interface from the terminal, is the first modem designed to mount inside a rotary or touch-tone telephone, eliminating the need for a separate modem and associated interconnect circuitry. For $250 (less for quantity orders) users can now have a telephone which provides both voice and 0 to 300 bps full duplex data communications. For $80 more, automatic originate/answer is provided. The unit uses a standard ITT rotary or touchtone telephone with all modem circuitry mounted inside the case on a small (17.5 square inch) printed circuit board. An additional 6 square inch board provides an Automatic Originate/Answer option. A

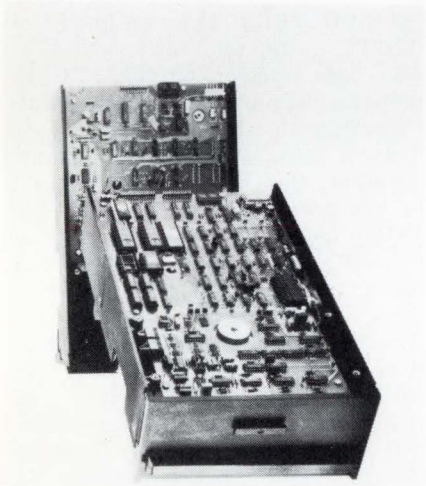
three-position slide switch behind the handset determines voice, originate or answer mode of operation. All models have Local Copy, and TTY Interface (active 20ma current loop) options. The VA103 ModemPhone has a unit price of $250. Automatic Originate/Answer models are $330. OEM discounts available. Delivery, 60 days ARO. **Racal-Vadic**, 222 Caspian Dr., Sunnyvale, CA 94086. **Circle 220**

HIGH RESOLUTION CRT MONITOR FOR OEMs. The raster scan monitor displays more than 1920 characters in either white or green phosphor. It provides 400 active raster lines with high horizontal scan rate of 25 KHz, refresh rate of 50-60 Hz, vertical step scan, and dual intensity. The 15-inch diagonal CRT screen is non-reflective, using etched, bonded faceplate to eliminate glare. An 110° deflective angle permits compact enclosures. The electronic components in this monitor are in one easy-to-repair board. This reduces the number of interconnections, and less chance of malfunction. The



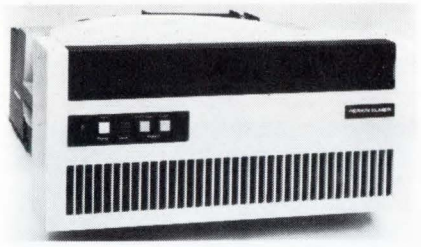
interface is a standard display monitor interface, including: horizontal and vertical sync, step scan, intensify video, brightness/contrast, and power $260 in large OEM quantities. Delivery 60 days ARO. The terminal package with monitor, cabinet, and power supply is priced at $550 in large OEM quantities. **Telex Computer Products**, 6422 East 41st St., Tulsa, OK, 74135. **Circle 205**

DISKETTE DRIVE WITH BUILT-IN INTELLIGENT CONTROLLER. This diskette drive subsystem allows systems designers to house a complete high performance dual-head subsystem in the space usually required for a standard "dumb" drive. In addition, unlike other double density systems, this unit offers a simplified interface organized around an eight-bit bidirectional data bus for efficient systems integration. The RFS 4800 drive incorporates: (1) a unique head referencing design; (2) FRP base material to achieve temperature expansion coefficients commensurate with the diskette; (3) an R-C circuit on the loading solenoid to control head delivery, and (4) an improved band positioning technique. The IBM 6800 microprocessor-based on-board controller makes it possible to read and write data on both sides of an eight-inch 2D or equivalent diskette in eight double density and five single density formats. Six of the formats are



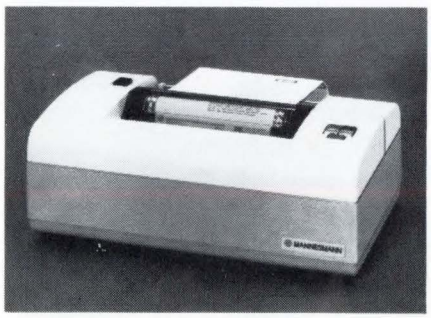
standard IBM single and double density schemes of 26, 15 and 8 sectors per track. Three other double density formats simplify software generation by formatting track "00" in a like manner on both sides of the diskette. The system also has a unique 128 byte 46 sector format in double density encoding for the user who wants to employ double density but has a substantial investment in single density operating system software. The RFS 4800 master drive is $830 in OEM quantities. Slave Drives are $489 in OEM quantities. **Remex**, Div. of Ex-Cell-O, PO Box C-19533, 1733 Alton St., Irvine, CA 92713. **Circle 221**

NEW SERIES OF CARTRIDGE DISK DRIVES. Completely redesigned with state-of-the-art technology, these new cartridge disk drives satisfy OEM's systems requirements for backup store and audit trails, and for working and archival storage in small business systems. Aimed at the OEM marketplace, Perkin-Elmer's new Vanguard I is available in 5, 10, or 20M versions and is totally compatible with existing cartridge disk drives and interfaces. A 24-inch depth allows the new unit to fit into small business and computer systems. Vanguard I can be disassembled to its basic subassemblies in less than seven minutes, and reassembled quickly with minimum of tools, making maintenance a matter of minutes rather than hours. A new air moving system designed for maximum cleanliness and



minimum temperature rise in the media chamber, enhances reliability. The AC-driven blower ensures a positive pressure when power is applied. The direct drive motor tightly regulates disk speed thereby increasing data recovery margins. **Perkin-Elmer**, Memory Products Div., 7301 Orangewood Ave., Garden Grove, CA 92641. **Circle 235**

OCR AND BAR CODE PRINTER New low cost 80 column, 200 cps matrix serial printer features microprocessor controlled logic seeking bi-directional printing for increased throughput. The M80 MC printer can be equipped with a choice of print heads to produce a wide range of character styles that include OCR A and OCR B, bar code, upper/lower case with descenders plus others. Also, the character pitch of the printer can be changed to achieve character spacing of 10, 12, 14 or 16.5 cpi. With 16.5 cpi spacing, 132 columns of data can be printed on 80 column paper. The new unit can be fitted with one of three matrix heads – 7 x 7, 7 x 9, or 9 x 9.

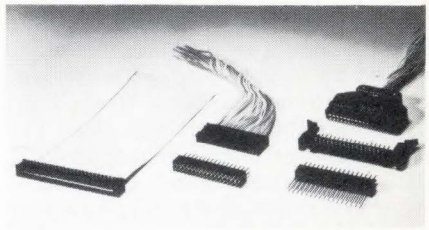


The print head automatically adjusts itself to accommodate varying forms thicknesses. Adjustable, sprocket drive tractors handle forms from 3-7/8" to 9"wide. $2,445. Quantity discounts available. Delivery, 60 days ARO. **Tally Corp.**, 8301 S. 180th St. Kent, WA. 98031. **Circle 214**

NCC 80 Over 100 New Products

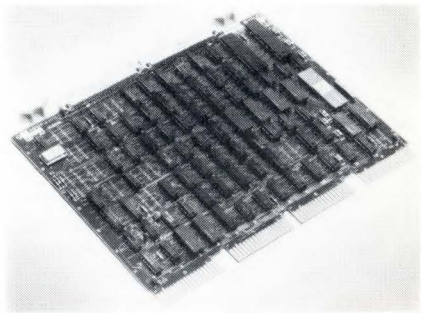
μC PROGRAMMING. "Guide to Good Programming Practice," a 182-pg. hardcover by Meek and Heath, provides in one comprehensive text the basics of strategy and design generally not taught in courses. It includes program writing and development, documentation, testing and debugging, improving run-time performance and handling project problems. $27.95. **John Wiley & Sons, Inc.**, 1 Wiley Dr., Somerset, NJ 08873.
Circle 165

SOLDERED FLAT CABLE CONNECTORS. This series of Flat Cable Connectors is designed to connect flat cable to PC boards permanently by dip soldering. No wire stripping is required. The new system allows termination of 0.05 in. center-spaced flat cables of 10 to 60 conductors. A U-shaped contact design preserves gas tight, positive connection for continuous long-term reliability. Contacts are solder plated over nickel to ensure purity of the solder bath. Other features: dual in-line terminals, low profile 0.209 in. above PC board, compatible with 3M's PCB connector, tab Ansely and other connector suppliers; manufactured with solvent-resistant PBT. The FCN-730 connector is part of the FCN 700 series connectors that have been developed by Fujitsu for mass termination of flat cables with AWG #28 stranded or

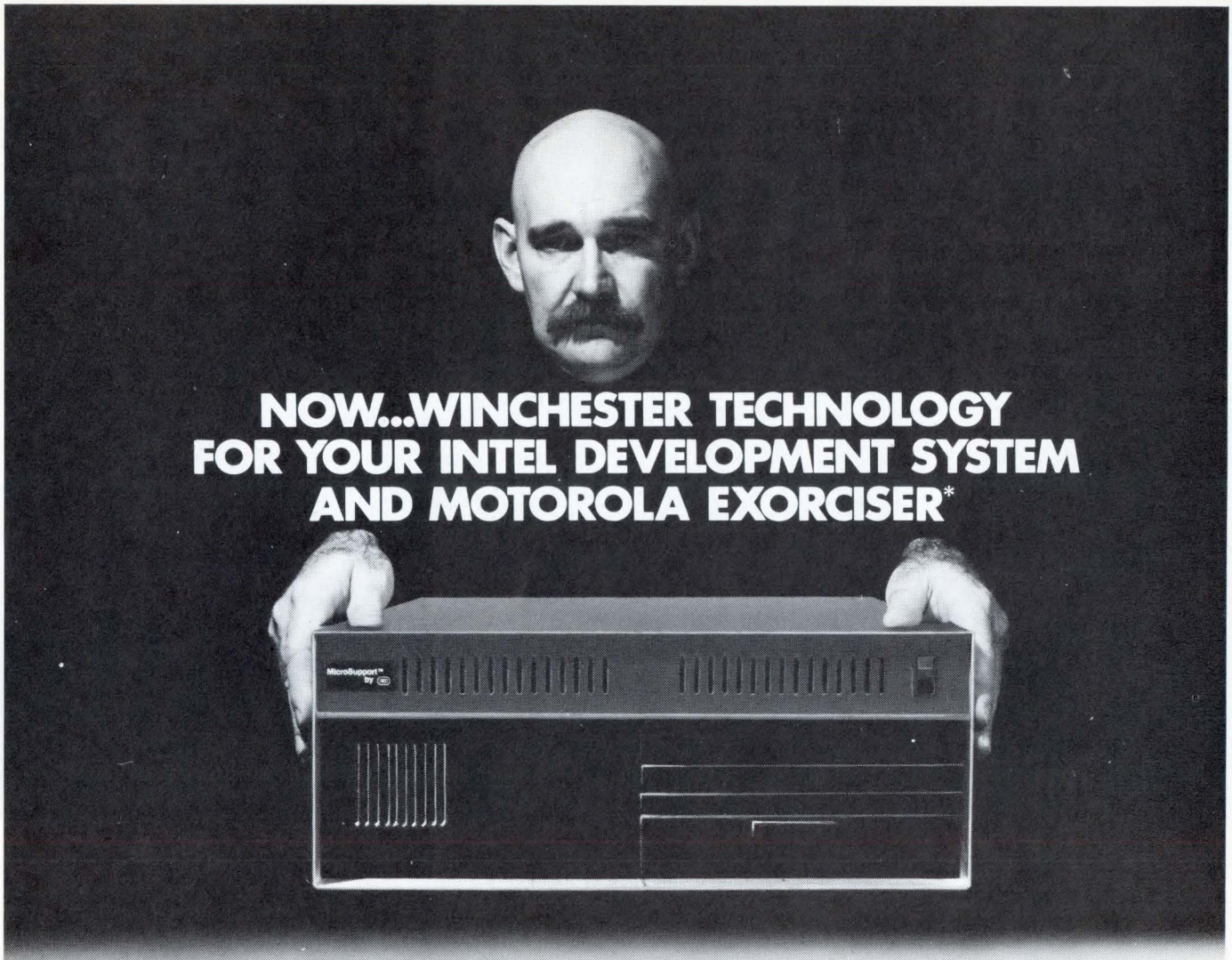


AWG #30 solid wire. They are available in a variety of types permitting neat, simplified assembly and interwiring of PC boards. **Fujitsu America, Inc.**, Component Sales Division, 910 Sherwood DR-23, Lake Bluff, IL 60044.
Circle 233

SINGLE QUAD SIZE MAGNETIC TAPE COUPLER, This new quad size LSI-11* compatible intelligent Magnetic Tape Coupler, includes TM-11* emulation circuitry and exclusive built-in circuitry that handles tape product advances such as "Streamer" mode operation. Designated Model DQ130, the self contained single quad size module requires only 3.5 amps from the CPU for operation. The unit couples up to two formatted tape drives, with three slave units each, for a total of eight drives from one LSI-11 Qbus slot. The coupler interfaces with 800 BPI NRZI, 1,600 BPI PE or dual NRZI/PE formatted tape transports, with speed ranges from 12.5 ips to 125 ips. Data transfers are via the DMA facility of the LSI-11 at rates



to 200,000 characters per second (1,600 BPI and 125 ips). Features include built-in DMA channel buffer of data and status transfers between units, generation of formatter, start, stop, rewind, IRG gap, EOF gap, etc. signals. An automatic self test and card edge LED indicator display test results. The module also includes card edge indicators for data transfer and command status. $1,695 – single quantity. Delivery, stock to 30 days, A.R.O. **Distributed Logic Corp.**, 12800-G Garden Grove Blvd., Garden Grove, CA 92643.
Circle 211



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Today's more sophisticated microprocessor programs need more data storage capacity than you can get with your Intel development system or Motorola Exorciser.

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Over 100 New Products

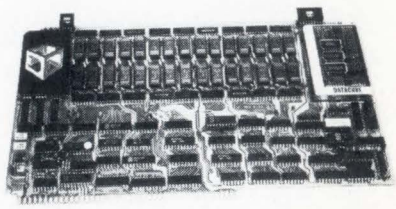
MICROCIRCUIT REFERENCE. "Handbook of Microcircuit Design and Application" enables engineers to find quick solutions to a wide variety of microcircuitry problems. Written by David F. Stout and edited by Milton Kaufman, it is organized so that each unit can be used independently. The handbook covers a specific functional group of devices in each chapter. 499 pgs. $32.50. **McGraw-Hill Book Co.**, 1221 Ave. of the Americas, New York, NY 10020. **Circle 156.**

DUAL OUTPUT DC POWER SUPPLY This model outputs ±18V to ±24V at 2.4A, continuously variable. Targeted for use in systems requiring dual regulated DC voltages, the unit will power combinations of most semiconductor devices and electromechanical devices. Standard features include 115/230VAC ±10% AC input capabilities, ±0.05% line and load regulation, and full protection against short circuit and overload. Maximum output ripple is 5mv PK-PK. Units meet shock and vibration requirements of MIL-STD 810C, and carry two year warranty. Each unit undergoes double factory testing and is burned-in for two hours before shipping. $79.95 (1-9 pieces). Delivery from stock. **Power-One, Inc.**, Power One Dr., Camarill, CA 93010. **Circle 194**

μC HANDBOOK. "An Introduction to Microcomputers: Vols. 2 and 3 describe different μPs/μCs in such a manner as to make them easily comparable to one another. Architecture, timing, instruction set and usage are detailed for each. Vol. 3 offers extensive descriptions of micro support devices which can be used with more than one micro. Categories include Memory Devices, Parallel and Serial I/O Devices, Single-Function Devices, System Busses, Analog Interfaces, Telecommunication Devices and Peripheral Controllers. Vol. 2, $30; Vol. 3, $20. **Osborne/McGraw-Hill**, 630 Bancroft Way, Berkeley, CA 94710. **Circle 167**

FREE OK CATALOG. Many new additions to the O.K. line of wire-wrapping tools, machines and associated products are included in the latest edition of Catalog 80-36N. An illustrated section on the technology of wire-wrapping makes this catalog invaluable to the design, packaging or manufacturing engineer as well as to purchasing and production personnel. This new 60 page catalog has been expanded to include our complete line of Industrial and Hobby products. Products described are available from stock. Free. **OK Machine and Tool Corp.**, 3455 Conner St., Bronx, NY 10475. **Circle 231**

VIDEO DIGITIZER GRAPHICS BOARD. This MULTIBUS compatible single board grpahics system simultaneously digitizes and stores real time data from a TV camera or other source, enters it into an onboard 320 x 240 x 6 bit memory, and displays it on a TV



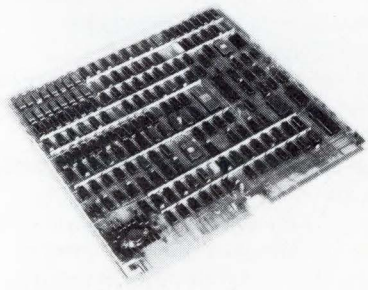
monitor. Output video is either a 6 bit gray scale (VG-120A) or a 64 "pseudo-color" display (VG-120B). Average access time is 800 ns. The Datacube VG-120 provides indirect addressing with an auto increment mode, allowing up to 1.2 Ms data transfer rate. Applications include graphic generation, image processing, scan conversion, and (with a MODEM) transmission of TV images over voice grade telephone lines. The Datacube VG-120 is $2495. OEM quantity discounts offered. Literature available. **Datacube, Inc.** 670 Main St., Reading, MA 01867. **Circle 203**

DC TO DC CONVERTERS These wide input range high performance DC to DC power converters are designed to be telecommunications compatible. The converters provide +5 VDC, +12 VDC, and +15 VDC to power analog circuits with up to 22 watts of power. The input range of 36 VDC to 60 VDC makes converters ideal choices for telecommunications systems having 48

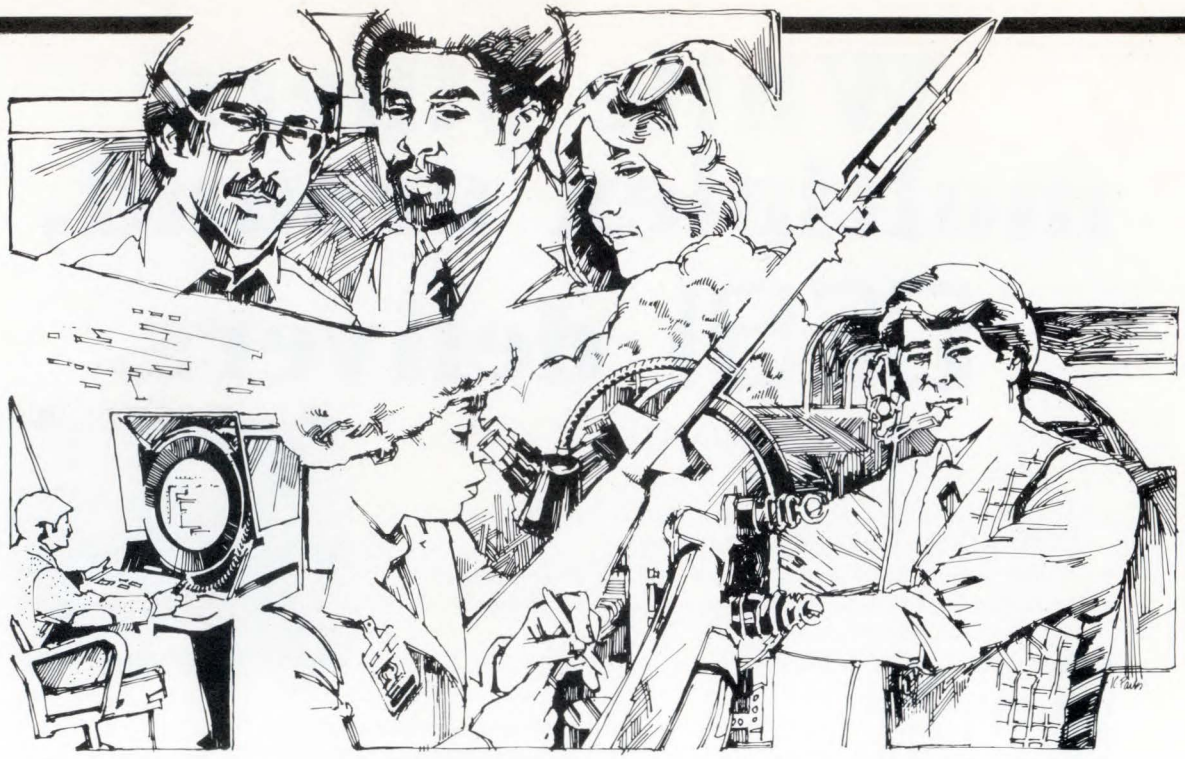
volt auxiliary battery power. Output noise and ripple is low. A high attenuation filter reduces kickback spikes and reflected ripple caused by inverter switching, thus protecting other loads across the same DC bus. High input/output isolation permits complete separation of output circuits from DC bus. Each converter is packaged in a shielded case virtually eliminating radiated EMI/RFI. The DCW Series converters are available in 4 models; 5 VDC @ 3 amps ($98), 5 VDC @ 4 amps ($126), 15 VDC @ 1.5 amps ($99) and 12 VDC @ 1.7 amps ($99). Delivery is stock to 6 weeks. **Intronics,** 57 Chapel St., Newton, MA 02158 **Circle 212**

PASCAL. "Pascal With Style" provides short rules for writing more accurate, error-free programs. It includes many samples of Pascal programs and contains a special chapter that shows your customers how to use the top-down approach with Pascal. $6.95. **Hayden Book Company, Inc.,** 50 Essex St., Rochelle Park, NJ 07662. **Circle 158**

LOW COST VIDEO DISPLAY CONTROLLER. This video display controller has graphics and alphanumeric display capabilities for use in Data General's Nova and Eclipse series computer systems. The new microprocessor based product is intended primarily for the OEM and System Builder markets. The Lexiscope 4000 can emulate standard alphanumeric (A/N) display terminals as well as provide moderately high resolution graphic displays for systems currently using only alphanumeric displays. The new Display Controller is contained on a single 15 inch board which plugs directly into one slot in a Nova or Eclipse mainframe. It is used in conjunction with economical raster scan video monitors and a serial keyboard which permits flexible packaging in OEM systems. Separate graphics and A/N cursors and display memory allow independent programming, display and erase of the graphic and A/N screens. The graphic display resolution is 560 (horizontal) by 500 (vertical) thereby allowing effective use in a wide range



of applications. The A/N capabilities include 2 pages of 25 X 80 character lines with individual character attributes of blink, dim, underscore and reverse video. The 96 ASCII upper-lower case character set is provided as well as 32 special pseudo graphic symbols: $2,00.00 in OEM quantities of 50 units per year. **Lexicon, Inc.,** 60 Turner St., Waltham, MA 02154. **Circle 202**



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General Dynamics is the nation's largest defense contractor. The Pomona Division is the Free World's leading producer and developer of tactical missiles and advanced weapons systems including Standard Missile-1, Standard Missile-2, Stinger, DIVAD, RAM, Viper, Sparrow AIM 7-F, Phalanx, Assault Breaker and more. These programs provide a continuing challenge for creative engineers in a growing company that is meeting America's defense needs for tactical systems.

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Engineering Writers
Hydraulic Design
Reliability
Power Supply
Electronic Packaging
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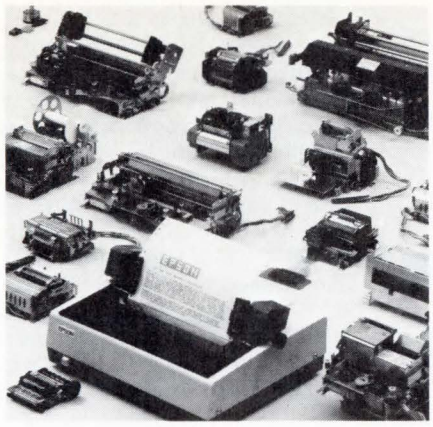
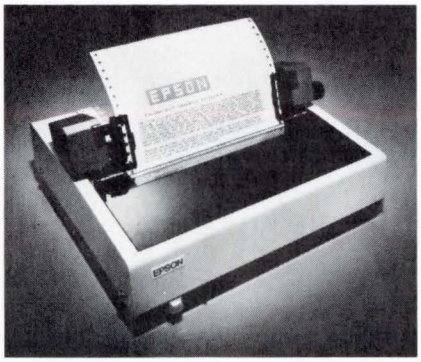


Epson.

Nobody—but *nobody* else can say this: of all the print mechanisms in use throughout the world today, more than half were manufactured by just one company. This company. Epson.

It's simply because we build a better printer.

Take, for example, our TX-80. Of the first 3,000 sold in Europe, the failure rate was about 1%. Now that's phenomenal reliability. But it's not the only remarkable thing about this rugged little printer. The TX-80 prints a full 96 ASCII at 125 CPS in 80 columns of easy-on-the-eyes 5x7 dot matrix. Or 64 graphic characters in a 6x7 matrix. It's controlled by an internal microprocessor, is available with a friction or tractor-type paper feed, and comes packaged in a sturdy all-metal cabinet. And you can get it with an RS-232 current loop, custom Apple and TRS-80 interfaces, or an IEEE 488 that makes our TX-80 the perfect little printer for just about any instrumentation package.



Before you think about someone else's printer, consider this bit of logic: because Epson has more printers in use than anybody, we must make a pretty good printer. And because we make more, we probably have the size, configuration and interface you need. Right now. And because we sell more, we must be able to sell each one for a little less.

That's what we call impact.

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EPSON AMERICA, INC.

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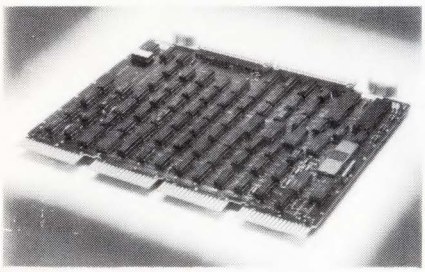
Circle 62 on Reader Inquiry Card

NCC 80 Over 100 New Products

NEW QUAD SIZE MAGNETIC TAPE COUPLER. New quad size intelligent Magnetic Tape Coupler, requires a single PDP-11 SPC (Small Peripheral Controller) slot to interface up to eight dual density (NRZI/PE) formatted magnetic tape drives (including streamer drives). Designated Dilog's Model



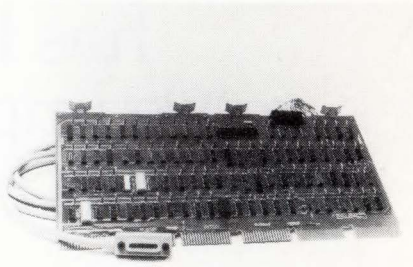
DU-130, the μP based coupler is completely contained on one quad printed circuit module including on-board LED indicators that provide visual display of coupler status. In operation the DU-130 couples two formatted tape drives with three slave units each for a total of eight . . . all from a single PDP-11 SPC slot. New low price: $1695 in single quantities. Delivery: Stock to 30 days ARO. **DILOG**, 12800-G Garden Grove Blvd., Garden Grove, CA 92643.

Circle 172

SWITCHING POWER SUPPLY MODULE The design of this unit incorporates the use of monolithic switching regulator and Schottky rectifiers. Use of a push-pull pulse width modulated technique which operates at 20 KHz minimum results in silent operation. Precision metal film resistors provide low tempco and stable output voltage. A ferrite pot core transformer is used for low-loss operation with low RFI. Other important features of Model USM-5/3 include a wide input line voltage range of 90 to 130 VAC at 47 to 450 Hz. Output ripple is 50 mV peak to peak maximum. Output voltage is 5V ± 1% at 3A with overvoltage protection and **Datel Intersil**, 11 Cabot Blvd., Mansfield, MA 02048.

Circle 196

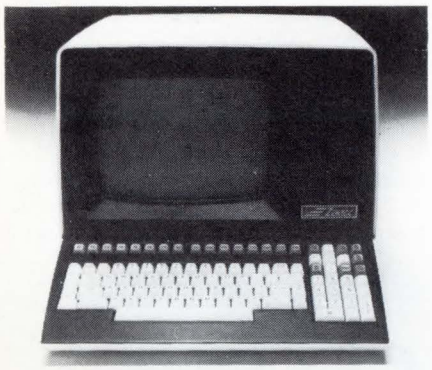
INTERFACING PDP-11 TO IEEE STD, BUS. This General Purpose Interface Bus (GPIB) provides transfer rates of up to 500 K/s for tri-state operation and up to 250 K/s open collector. The GPIB 11-2 option for tri-state or open collector operation is switch selectable! This new unit from National Instruments allows implementing 14 PDP-11 controlled measurement systems. The GPIB handshake speed is software programmable and plugs into any hex wide SPC slot. The interface provides hardware for decoding various GPIB commands for implementing Talker, Listener and Controller functions. Software support includes drivers, utilities and an interactive control program. The driver program may be assembled as a subroutine package for stand-alone use or as a handler. The utility program performs most common sequences of bus functions. The interactive control pro-



gram allows the user to perform GPIB functions interactively and at a low level to facilitate debugging and instrument checkout. A four meter cable with a GPIB connector on the outboard end allows the user to connect as many as 14 instruments on a single interface. The high-speed interface is available from stock. $1995, including software, cable and documentation. **National Instruments**, 9800 Shoal Creek Blvd, Austin, TX 78758.

Circle 176

NEW INTELLIGENT TERMINAL. This unit is a compact, powerful microcomputer system aimed toward sophisticated data and word processing applications. Incorporating the latest integrated circuit technology, the ZMS-40 is fully programmable and offers many intelligent terminal features. Word processing programs can be downloaded and programs can be executed in firmware, relieving the CPU of valuable processing time. Housed in a convenient self-contained desk top enclosure, the ZMS-40 features an Intel 8085A microprocessor



chip with up to 16K bytes of RAM, a 12″ diagonal non-glare video display, keyboard, an asynchronous telecommunications port and an optional RS-232C printer interface. The ZMX-40's high resolution video display offers 24 lines of 80 characters each and a 25th operator error/status information line. Standard keyboard traits include a 96 ASCII character set in both upper and lower cases, a 14 key numeric keypad, 12 special-purpose function keys and 16 programmable function keys that operate in both shifted and non-shifted modes. **Zentec Corp.**, 2400 Walsh Ave., Santa Clara, CA 95050.
Circle 187

DOT MATRIX PRINTER. The MP, while designed specifically for use with Vector Graphic μC systems, can be adapted to other systems as an OEM product. It features ultra-quiet operation due to extra case soundproofing designed into the case. The 5 X 7-dot matrix printhead is software driven and prints an almost endless array of graphic characters at 150 cps. Base price under $1000. **Vector Graphic, Inc.**, 31364 Via Colinas, Westlake Village, CA 91361. **Circle 238**

NARROW-BAND FM, IF IC MPS5071 FM IF IC replaces Motorola's MC 3357, has a higher gain and better stability. Applications? Voice communication scanning receivers, wireless extension phones, land mobile radios, weather radios, pocket pagers and ham radios, Operates from supplies as low as 4V, with typ. 3 mA current. The 10.7-MHz mixer input sensitivity is 5 μV; the detector produces 350 μV of audio from a narrow 3-KHz signal. **Micro Power Systems.**, 3100 Alfred St., Santa Clara, CA 95050. **Circle 260**

XEROX HAS A CRT TERMINAL. This full-page keyboard display terminal can function as a stand-alone CRT or system workstation for users of Xerox's national data communications network. The 1330 has a standard keyboard, a ten-key numeric pad and uses standard ASCII protocol. The terminal, while specially designed for customers of the company's computer services, is available to all users. The new 1330 terminal, available now, leases for $97 per month, including maintenance. Purchase price is $1,500. Optional maintenance on purchased terminals is $25 per month. **Xerox Computer Services**, a Xerox company, offers business and financial services through a time-shared computer network to manufacturers, distributors and municipalities in more than 150 metropolitan areas across the country. This division has its headquarters at 5310 Beethoven St. in Los Angeles. **Xerox Corp.**, 701 South Aviation Blvd., El Segundo, CA 90245.
Circle 229

NCC 80 Over 100 New Products

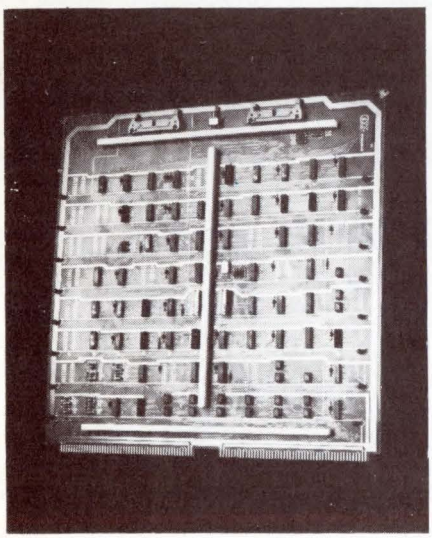
MINIATURE PANEL-MOUNT THERMAL PRINTER A second-generation miniature 20-column alphanumeric panel-mount thermal printer weighing 4.25 pounds. Uses only 2 input data wires to simplify user interfacing. An internal microprocessor and serial port reduces circuit complexity so that all electronics are contained inside the miniature printer housing; no extra electronics are required. The APP-20A2 prints up to 96 ASCII alphanumeric data characters which are supplied through the 2-wire data input connected to the user's remote data source. Applications include microcomputer data systems, factory data acquisition units and industrial data loggers with a full alphanumeric printer including upper and lower case letters, numbers and punctuation. The new

unit accepts full upper and lower case 96-character ASCII set and prints up to 1.2 lps (24 cps) at high baud rates. The basic print and advance period is 720 ms per line with the remainder consumed by data character input buffer loading, which is insignificant at high baud rates. The featherweight 105 cubic inch, panel-mount unit uses 2.31 inch wide thermal paper and prints about 8400 lines (168,000 characters max.) on a 150-foot roll using .11″ high (2,8 mm) 5 x 7 dot matrix characters. Single quantity price is $880. OEM discounts available. Delivery 2 to 8 weeks ARO. **Datel Intersil**, 11 Cabot Rd., Mansfield, MA 02048. **Circle 213**

μP SYSTEMS DEVELOPMENT. "Managing The Development of Microprocessor-Based Systems," by Eddie Bleasdale and Dr. John Walker, is a 188-pg, 11.75″ X 8.25″ softcover book designed for managers who must introduce μP technology into their firms. If you're involved in project management engineering, this manual provides you with the ins and outs of μP technology. **Bleasdale Computer Systems Ltd.**, 7 Church Path Merton Park, London SW19 01-540 8611, England. **Circle 154**

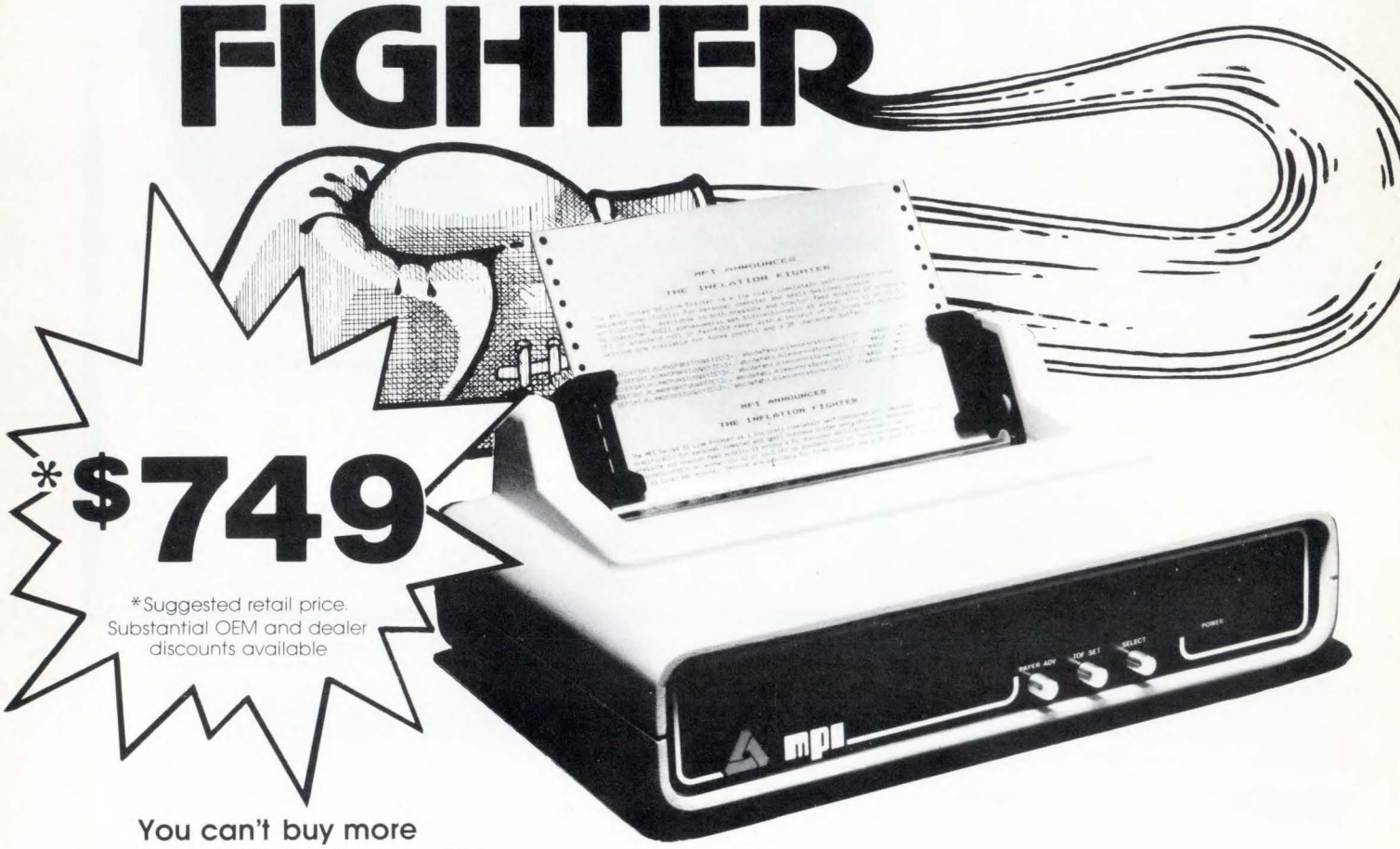
UPGRADING CRT TERMINAL. Four new options from TEC improve CRT's capability. They include one and two pages of memory, a hard copy adapter, a light pen option, and an auxiliary diagnostic test unit. The hard copy adapter is offered either buffered or non-buffered. In the buffered mode, printer can be driven by the computer and at the same time, operator can enter data on screen, totally independent of printer operation. The light pen option can facilitate operator entry in applications where keyboard entry could cause operator error. The auxiliary diagnostic test unit performs comprehensive failure diagnostics on Model 570 without use of any additional test equipment. This automatic fault finding device steps the operator through test procedures by printing instruction on the terminal CRT and will indicate any major electronic component failure and any unacceptable variation in power supply voltages. **TEC, Inc.**, 2727 North Fairview Ave., Tucson, AZ, 85705. **Circle 232**

LINE PRINTER CONTROLLER. Designed for simplicity of installation, operation and maintenance, this controller operates with Data General Nova or Eclipse Computers and with Dataproducts or Centronics printers or any computers and printers emulating these systems. The DLP-1200 module can be plugged into any I/O slot position in the computers and is ready to operate without hardware or software modification. Completely compatible



with the host computer, the device is transparent to the operating system. SELF-TEST is also featured in the DLP-1200. When activated, SELF-TEST, isolated from the computer, sends a 96 character ASCII set to the printer for 132 columns to test operate the line printer, cable and controller. **Datasystems Corp.**, 8716 Production Ave., San Diego, CA 92121. **Circle 207**

THE INFLATION FIGHTER



***$749**

*Suggested retail price.
Substantial OEM and dealer discounts available

You can't buy more capability for less . . . But you can buy less for more.

MPI presents the perfect answer to your inflation-riddled printer budget. THE MODEL 88T DOT MATRIX PRINTER. The first in a series of new full-capability low-cost printers designed specifically for the general use computer market. The Model 88T is a fully featured printer with a dual tractor/pressure-roll paper feed system and a serial or parallel interface. The tractor paper feed system provides the precision required to handle multi copy fanfold forms, ranging in width from 1 inch to 9.5 inches. For those applications where paper costs are important, the pressure-roll feed can be used with 8.5 inch roll paper. A long-life ribbon cartridge gives crisp, clean print without messy ribbon changing. The microprocessor controlled interface has 80, 96 or 132 column formating capability while printing upper and lower case characters bi-directionally at 100 characters per second.

With all of these features, **plus** quality construction, continuous duty print head and attractive styling, the Model 88T would easily sell at the competition's "under $1000" (999.99) tag. But we are offering it for only $749; this should make you happy and several hundred dollars richer.

Write for complete specifications and pricing information.

mpi **MICRO PERIPHERALS, INC.** 2099 WEST 2200 SOUTH / SALT LAKE CITY, UTAH 84119 / (801) 973-6053

Circle 69 on Reader Inquiry Card

NCC 80 Over 100 New Products

DISK SYSTEMS BOOST AVAILABLE STORAGE TO 1M PER DISK DRIVE. These two double-sided double-density systems boost available storage to 1M per drive. Both systems have been created by offering two existing CRDS products with optional Shugart SA850 double-sided/double-density drives. The MF-411, completely self-contained, includes an LSI-11 processor, memory, power supply and two floppy disk drives. The FD-411 is an RX02 equivalent dual floppy disk drive add-on system. Both systems feature the CRDS-designed and developed interface controller card which contains all controller, interface, and formatter electronics.

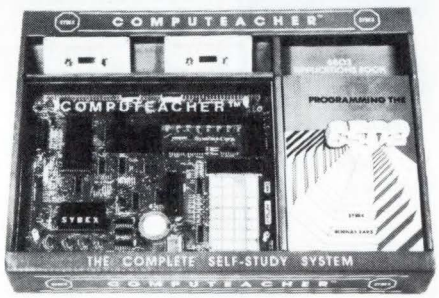
In addition, it provides software/media compatibility with the RX02 DEC floppy-disk system, while a 2901 microprocessor controller allows total RX02 emulation plus additional intelligent functions. A bootstrap loader allows for automatic loading of system diskette on power-up or when Init/Boot switch is activated. Single quantity price of MF-411 double-sided dual floppy system with LSI-11/2, 32K words, Controller, Bootstrap loader, power supply, rack mountable enclosure and front panel console with switches is $6980.00. The FD-411 double sided dual floppy add-on system is $4250. Delivery, 30 to 45 days ARO. **Charles River Data Systems, Inc.**, 4 Tech Circle, Natick, MA 01760.

Circle 228

MESSAGE STATION FOR PRIVATE LINE NETWORKS Message Station will provide users with fast, flexible data transmission, and important storage and back-up capabilities. The Comm-Stor 8A1/8B1 Message Station is an expansion of the capabilities of both the Sykes Comm-Stor III Communicating Forms Entry Station, and the Sykes Comm-Stor II Communications Storage Unit, which is marketed by AT&T and the Bell System operating companies. Addition of this option will make these low cost, floppy-disk based units compatible with existing 8A1/8B1 networks and equipment. Significantly, the new option supports the standard 8A1/8B1 Selection Calling Arrangement specification. Comm-Stor II provides terminal users with many functions on a local basis that otherwise would require connection with a computer. Data can be entered, edited, sorted, merged and printed locally. When data is sent or received it can be sent in batches at high speeds to or from a Comm-Stor II. In fact, Comm-Stor II automatically answers and send or receives data at night, when telephone line charges are low. Typical applications of Comm-Stor II include order entry, administrative messages, remote data collection, bank fund transfer and remote batch for time-sharing networks. Comm-Stor II works with nearly all low cost RS-232 terminals and printers. List price of new 8A1/8B1 option is $500. **Sykes Datatronics Inc.**, 375 Orchard St., Rochester, NY 14606

Circle 198

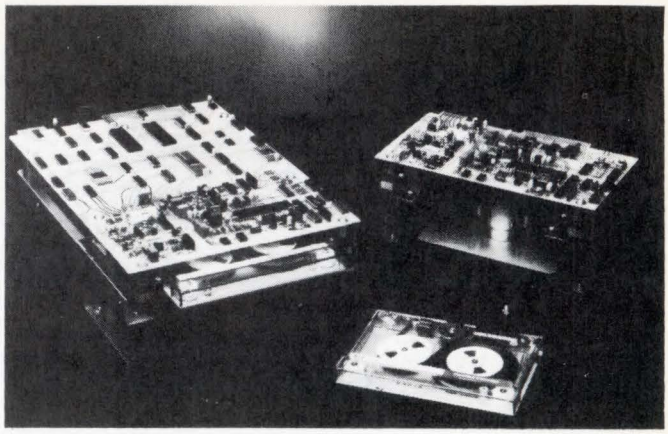
μC BOOKS. (1) "Programming The Z80," by Rodney Zaks, offers a comprehensive description of the Z80 instruction set and thorough account of its internal operations. Included is an extensive chapter on data structures where the reader will find lists, tables, binary trees, even hashing and other algorithms. (2) **Computeacher** is a self-study training system designed to teach personal home computing with a microcomputer at a low cost in a minimal amount of time. A self-contained educational instrument, the package has a microcomputer board, program cassette, two educational books and required manuals. An instructional audio cassette is also included to prep the user for connecting and using the board.



Price: $299. 464-pg. (3) **"Microprocessor Interfacing Techniques"** by Austin Lesea and Rodney Zaks is the 3rd ed. of this classic text. This book introduces basic interfacing concepts, and then presents in detail implementation techniques for both hardware and software. It covers the essential peripherals, from keyboard to floppy disk, as well as standard buses (S100 to IEEE 488) and introduces basic troubleshooting techniques. Softcover, $13.95; hardcover, $22.50. All from **Sybex**, 2344 Sixth St., Berkeley, CA 94710.

Circle 155.

NCC 80 Over 100 New Products



LOW-COST STREAMING DIGITAL TAPE DRIVES. These streaming digital cartridge tape drives are custom-tailored for OEM Winchester-disk backup application. These drives fit industry-standard slot for 8-inch flexible disk drives, and use standard 1/4-inch ANSI/ECMA Data Cartridges. **Data Electronics, Inc.**, 10150 Sorrento Valley Rd., San Diego, CA 92121. **Circle 189**

DUAL-CHANNEL WAVEFORM DIGITIZER. Unit captures, digitizes and stores single-shot or repetitive signals for subsequent computer processing. The unit is two digitizers in one cabinet. Each channel analyzes a single shot waveform well below one μs. Sampling intervals are determined by a crystal-controlled clock and can range from five ns to one second. The sample intervals, as well as all other functions can be selected independently for each channel. Signals in this 7612D unit are converted to eight-bit words by a newly-designed analog to digital converter before they're stored in memory. High speed conversion is achieved with unprecedented accuracy at high input signal frequencies. Memory capacity (2048 words) in the 7612D can be partitioned. Record length can be set at 2048 words per channel to capture complex signals. Or, it can be set at two records of 1024 words, four records of 256 words to capture fast, successive signals, such as those found in breakdown phenomena or in complex digital circuits. Instrument is priced at $14,000 U.S. **Tektronix, Inc.**, PO Box 1700, Beaverton, OR 97077. **Circle 199**

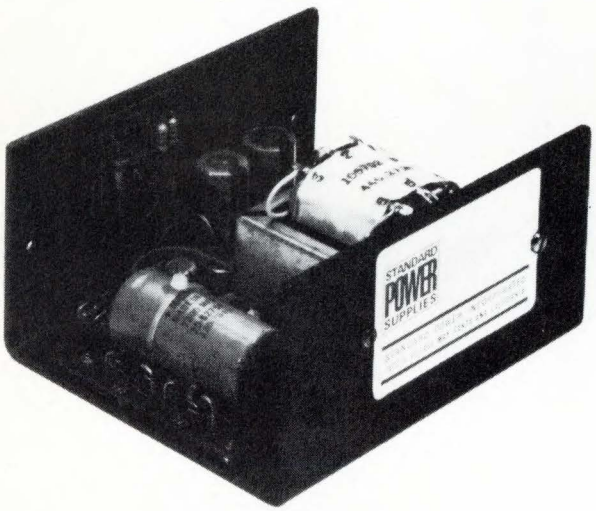
FLOPPY DISK DRIVES WITH DOUBLE TRACK DENSITY. Minifloppy disk drives read/write 96 tpi, doubling the track density of any unit now available in quantity production. When combined with double data density and double-sided R/W features, the new unit will make possible storage of nearly 1 M of data on a 5.25″ floppy disk. The new disk drive will be plug-compatible with existing systems. Diskettes already recorded on the standard 48 tpi format can be played back on this 96-tpi device. Model 91 will R/W approximately 480 K of data on a single side of a 5.25″ disk. Model 92 will R/W about 960 K on both sides of the disk. Track-to-track access time is 5 ms (five times faster than competitive models, says the company). The head assembly for the double-sided 92 incorporates a fixed bottom head with a gimbaled top head. In conjunction with a precision chassis design, this assembly provides more than 3 million in-contact passes of the media over a single track. Models 91 and 92 accommodate FM, MFM, of M^2FM encoding. Single unit prices are $450 of the 91 and $550 for the 92. Oem discounts available. **Micro Peripherals, Inc.**, 9754 Deering Ave., Chatsworth, CA 91311. **Circle 206**

SNAP-IN KNOBS FOR CODED P.C. BOARD SWITCH. Knobs are .25", .50", .75" in length and can be snapped in after switch assembly is mounted into P.C. board, Extended knobs are color coded and available in black, beige, red, yellow, green, blue and white. Designed to be mounted directly to a P.C. board by wave or hand soldering, Strip-Pak is available in 10 and 16 position binary and decimal codes. Snap together feature allows individual modules to be assembled into one integral unit. Wiping/cleaning contacts are plated with 30 millionths inch of gold. Guaranteed life of 500,000 detent operations at 25°C for resistant load of .100 amp at 28 VDC. Strip-Pak can be activated by thumbwheel, screwdriver, or optional snap-in knob. **Stanford Applied Engineering**, 340 Martin Ave., Santa Clara, CA 95050.

Circle 225

NEW PRINTER/PLOTTER FOR NCR 8200. A low-cost printer/plotter system for use with the NCR 8200 minicomputer series. The new impact dot matrix printer/plotter, Trilog's T-800, costs 50% less and provides considerably more capabilities than the NCR Band Printer. The Software-selectable T-8200 makes possible such business applications as graphs, bar code symbols, and labels; the wand-readable OCR-A font is also available for printing on labels. For line printer operation, the T-8200 provides the full ASCII 96 upper-and-lower-case character set at 300 lines per minute. An option is the choice of 10, 13 or 16 characters per inch at either 6 or 8 lines per inch which are selected under software control or via an external manual switch. Priced at $7630 including pedestal, paper basket, static eliminator, forms length switch and common trunk interface. **TRILOG, Inc.**, 17391 Murphy Ave., Irvine, CA 92714.

Circle 170



TRIPLE OUTPUT DC POWER SUPPLY New unit is suitable for computer, microprocessor, instrumentation and general industrial electronic applications. Specific applications include power for memories, floppy disks, operational amplifiers, microprocessor circuitry, logic, transistorized circuitry and similar electronic product applications. The SPS 40T provides a triple output of ±5Vdc at 2.5 Amps and two each ±12Vdc at 0.75 Amps. With its regulated dual 12Vdc output and the 5Vdc for powering basic computer logic, this regulated DC power supply is ideal for powering OP-Amps. In addition, regulation of ± 0.1 line or load, low ripple of 5mV and fast response time of 500 microseconds enable this open-frame power supply to handle many small computer and related peripheral needs. Single unit price, $85.00. **Standard Power, Inc.**, 1400 S. Village Way, Santa Ana, CA 92706

Circle 191

Advertisers' Index

Sales Offices

NEW ENGLAND and UPSTATE NEW YORK: John A. Garland **(617) 934-6464** Box 314 SHS, Duxbury, MA 02332
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924 Westwood Blvd., Suite 610, Los Angeles, CA 90024

JAPAN: K. Yanagihara **(03) 350-0272** International Business Corp., 10-10 Shinjuku 3-chome, Shinjuku-ku, Tokyo 160 Cable Address: Yanacour Tokyo

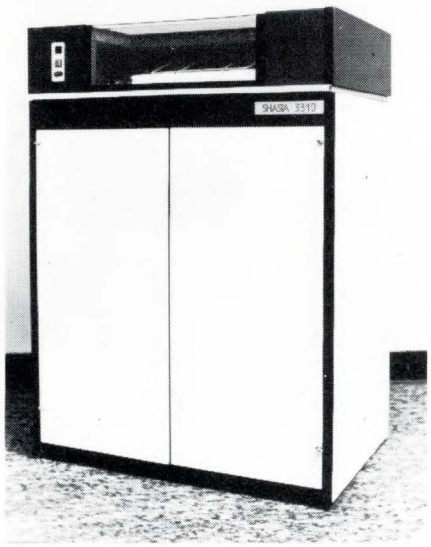
Over 100 New Products

THREE NEW PRINTER MODELS AT NCC. Okidata unveils three new matrix printers at the NCC show. Two "under $750" additions to the Microline Series feature rugged, continuous duty, short line seeking capabilities. The third is a new Slimline Series graphics unit. The new Slimline SLG provides a choice of two dot densities for alphanumeric printing in addition to its 100 X 100 graphics capability. The unit will print routine reports at 400 LPM with a low density pattern and then switch to a high density pattern to print correspondence at 120 LPM. The two new low cost printers, designated Microline II and III, contain two motors and will operate continuously with no duty cycle limitations. Microline II is an 80 column unit that operates at 80 cps. The Microline III offers higher speeds and accommodates larger forms. It operates at 120 cps. **Okidata Corp.**, 111 Gaither Dr., Mt. Laurel, NJ 08054. **Circle 267**

ADD-ON MEMORY FOR SBC. This system is field-expandable to a full megabyte of storage that is directly addressable by the iSBC 86/12A single-board computer. It is available in capacity configurations of 128K, 256K, 512K, 768K and 1,024K. The new system has two components: a Multibus interface board and a Series 90 random-access dynamic memory system. The interface board plugs directly into the Multibus backplane and connects the Series 90 to the bus through a ten-foot cable. The system is designed to operate from 0° C to 55° C. Has a 90-day warranty. Available 30-60 days ARO. A typical 512K configuration is $16,690. **Intel Corp.**, 3065 Bowers Ave., Santa Clara, CA 95051. **Circle 266**

EVALUATION KITS SPEED SYSTEM DESIGN To aid designers in evaluating versatility of the REMDACS system, Intersil is offering three low-cost kits which can be assembled in a few minutes. Kit EV-1 contains two remote voltage stations, the receiver/transmitter card, and the RS232 card. Kit EV-2 has two remote temperature stations and the receiver/transmitter-RS232 card sets. Kit EV-3 contains one remote temperature and one remote voltage card, in addition to the receiver/transmitter and RS232 cards. Kits are available in 110V/60Hz or 220V/50Hz configurations. Associated hardware includes a 24V transformer, an RS232 cable with connectors, twisted-pair wire and card connectors. A 130-page technical manual is provided. Kits are $995.00 each. Prices for additional remote station or receiver/transmitter cards are available from factory. In the REMDACS system concept, transmission of digital data over a twisted pair eliminates requirements for expensive shielded cable which is usually associated with conventional data acquisition systems. In such systems, wiring and conduit alone can account for 30 to 50% of total system cost. Extensive use of LSI and microcomputer chips in the REMDACS system tends to simplify system design, cut hardware costs, and reduce host computer software overhead. **Intersil Inc.**, 10710 North Tantan Ave., Cupertino, CA 95014. **Circle 263**

NEW 300 LPM PRINTER. Producing full-formed characters and multiple-copy lines this printer operates at 300 lines per minute with a standard ASCII 64-character print belt. The printer is suitable for heavy-duty appli-



cations where high performance is needed. The Shasta 3319 is plug-compatible with the Diablo 3200 small business computer, as well as having a Centronics interface. Available through Shasta's direct branch offices and extensive dealer network. Delivery, 90 days ARO. $12,950. **Shasta General Systems,** 895 Stanton Rd., Burlingame, CA, 94010. **Circle 204**

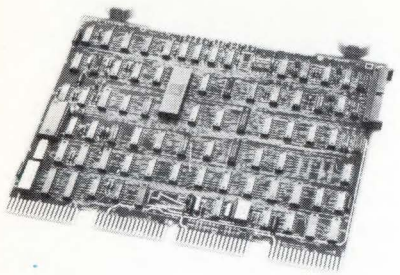
INDUSTRIAL X-Y DIGITIZER TABLET. A four page brochure describing a line of low cost industrial X-Y digitizers. This high performance digitizer tablet has electronics built into the base of the tablet, is only 1.7 inches high, has no adjustments, requires no preventive maintenance and features an exlusive 2-year warranty on the tablet. Digi-Pad with an accuracy of ±0.005", a resolution of 0.001" and a free-movement cursor, has applications in computer aided design, entry of menu data, analysis of medical, statistical, image and strip chart data. This two color brochure describes features, applications, specifications, ordering information and options. **GTCO Corp.**, 1055 First St., Rockville, MD 20850. **Circle 265**

DISK CONTROLLER WITH ERROR CORRECTION. This single-board, high-density disk drive controller is plug-compatible with TI-990 minicomputers. The MSC-1990, with operational features, like error correction code (ECC) provides control for up to three high-density storage module disk drives. The new unit utilizes a NP that is compatible with existing TI operating systems. It buffers the data in two 256-word buffers to allow nominal data transfer rates with the disk drives while at the same time accommodating data transfer requirements of the host TI-990. The device implements automatic head and cylinder switching, and supports partial-sector and multisector data transfers. With the hardware error correction code (ECC) single-burst data errors of up to eleven bits per sector are detected and corrected within the MSC-1990 full-sector buffer before data transfer to the host is initiated. **Microcomputer Systems Corp.**, 432 Lakeside Dr., Sunnyvale, CA 94086. **Circle 262**

PRINTWHEEL FAMILY There is a new family of seven English-language proportional space printwheels, for use with any Qume daisywheel printer or data terminal equipped for proportional spacing. The seven typefaces of the family include. modern, arcadia, thesis, title, boldface, boldface italic and essay italic. The wheels have 96-char. sets with complete punctuation and numerals, and all of them are readily interchangeable. Pricing is similar to that of Qume's other printwheels. **Qume Corp.**, Box 50039, San Jose, CA 95150. **Circle 256**

VIDEO INTERFACE A video display interface for the PDP-11, VIURAM VRU-11, provides direct hook-up between any Unibus-type computer and a CRT monitor. VRU-11 permits direct random access to all character positions on the CRT. When operating software deposits an ASCII character code in on-board memory, that character is immediately displayed. Other features of the VRU-11: direct character access; programmable line, column format; programmable alphanumerics; graphics capability; light-pen or touch-screen; serial port; compact performance; and some application software. **Computer Technology**, 3014 Lakeshore Ave., Oakland, CA 94610. **Circle 257**

NEW MDB SYNCHRONOUS COMMUNICATIONS INTERFACES. Two new MDB DUP-11 synchronous, single line communications interfaces are functionally equivalent and software compatible with the DEC DUP-11. They provide parallel-to-serial and serial-to-parallel data conversion, EIA level conversion, modem control for full and half-duplex operation, protocol management and bus interface. With data rates to 500K bps, the MDB inter-



faces will accommodate BI-SYNC and DDCMP in byte-control (BCP) and SDLC, ADCCP and HDLC bit-oriented protocol (BOP). Programmable character lengths of one to eight bits for BOP and five to eight bits for BCP further tailor the boards to a wide variety of applications. Q-bus model: $950 in single unit quantity; Unibus model: $1,200 in single unit quantity. Delivery: 30 days ARO. **MDB Systems, Inc.**, 1995 North Batavia St., Orange, CA 92665. **Circle 161.**

ACOUSTIC COUPLER/MODEM A Bell-compatible 103/113 unit, the TC3001 modem combines portability of an acoustic coupler and reliability of a modern modem. TC3001 optimizes transfer of low-speed data over normal voice grade phone lines using an ordinary phone handset. Specs include: 300-baud asynchronous data rate; originate only; acoustic and DAA/private line interfaces; half/full duplex; simultaneous EIA RS-232 and 20 mA interfaces; and power and carrier indicators. **Tek-Com, Inc.**, 1147 Sonora Ct., Sunnyvale, CA 94086. **Circle 258**

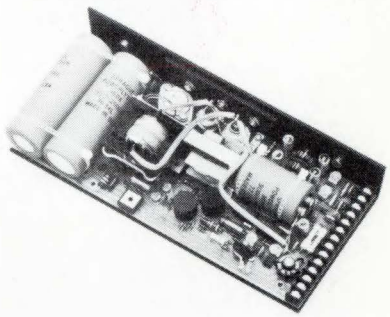
PDP-11 & VAX-11/780 TAPE STORAGE. Enables DEC users to record in 6250 (GCR), 1600 (PE) and 800 (NRZI), bpi formats and to store more than 150M on a single 2400 reel. Maximum data transfer rate of 780K is nearly four times faster than conventional 1600 bpi. System consists of an Aviv controller, Telex 75-125 ips drive and formatter plus all cables. Aviv's controller radially connects up to 8 drives. Controller takes a single slot in the host computer and includes a 4K FIFO buffer. IBM proven, on-the-fly, two track error correction provides maximum data integrity. Tapes recorded on this system are fully interchangeable with those recorded on other IBM compatible systems and software is transparent to DEC operating systems. $30,200. OEM discounts available. Delivery, 120 days. **Aviv Corp.**, 6 Cummings Pk., Woburn, MA 01801. **Circle 264**

POWERFUL, SMALL CARTRIDGE TAPE RECORDER. This cartridge tape (1/2″) recorder from Genisco is in 9-track parallel standard format. The new unit totally emulates large reel-to-reel recorders and has a 31-1/4 ips speed (large machines operate at 125 ips.) In addition, Model ECR-40 promises to have the industry's fastest tape shuttling speed: 360 ips. Its rapid start/stop action is 2 ms, same as in larger units. Uses 28 VDC and draws 100 W power maximum (compared to 1000 W by large machines.) The Genisco tape recorder has a capacity of 6400 bpi per track with a total cartridge capacity of 42 M. The small unit (5″ X 8″ X 19″) weighs only 40 lbs. The unit's front door opens to permit insertion of the unbreakable-cased cartridge (7″ X 5-1/2″ X 1/2″) in an edgewise, vertical position. ECR-40's interface is standard industry compatible. Formal introduction of the new unit is expected next month. Pre-production models will be available in Dec. Full production will begin by March of 1981. For more detailed information on this new, powerful, military-acceptable recorder, write to Systems Division, **Genisco Technology**, 18435 Susana Rd., Comptom, CA 90221. **Circle 236**

NEW HIGH PERFORMANCE COLOR GRAPHICS COMPUTER. This new system has four times the resolution, eight times the color selection and 25 times the vector writing speeds, available in the other models in Ramtek's 6000 series. The 6214 Colorgraphic Computer offers resolution of 640 X 480 picture elements. Four refresh

memory planes under the control of a software loadable video lookup table will support up to 16 displayable colors from a palette of 64, eight colors plus an alphanumeric overlay or eight colors plus a blink function. A high speed vector generator, available as an option, enables vectors to be written at the rate of .8 μs per pixel, 25 times the speed of the 6114. The 6214 can operate at either 30 Hz or 60 Hz refresh frequency. Another feature of the 6214 is its high speed video erase capability which permits rapid picture sequences to be run. This feature allows the refresh memory to be set and erased to a specific color in a single frame time. Standard 6214 computer is $19,250. Delivery in July. A rack-mounted version is $10,250. Additional interfaces available. **Ramtek Corp.**, 2211 Lawson Lane, Santa Clara, CA 95050. **Circle 164**

FOUR OUTPUT OPEN FRAME SWITCHER. This 20-kHz switching power supply produces four output voltages with a total power capability of 111 watts. New open frame design offers reliability and performance of a modular type supply at approximately half the price. Model 912 delivers 5 volts at 15 amps, ±12 volts at ±1.5 amps, and −5 volts at .5 amps . Line regulation is ±0.1% on all outputs.



Load regulation is better than ±0.5% on all outputs. The unit will accept 100/115/220/240 VAC inputs selectable on the barrier strip. All outputs have short circuit and current limiting protection. Self-recovering overvoltage protection and remote sensing are standard on the +5 volt output. $225.00. Delivery is stock to thirty days. Significant OEM discounts are available. **RO Associates, Inc.**, 246 Caspian Drive, Sunnyvale, CA 94086. **Circle 190**

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Designers' Notebook

Pulse-Width Modulated Inputs To MCS-48

In many control applications it is necessary to measure the period of one or more input pulse trains — a situation that arises because utilizing frequency modulated input signals allows measurement of a systems operation without addition of ADCs to the μP. An additional benefit is that the transducer cost is often reduced. As an example, consider an automotive control system which is intended to control the spark advance as a function of engine speed and temperature. Rather than add a dc tach, ignition pulse frequency can be used to derive engine speed. A temperature sensitive resistor and relaxation oscillator will convert temperature into an FM signal that can be input to μP.

If only one FM input is required, a fairly straight forward algorithm can be devised to measure the input signal's period. If more than one signal is present, however, the situation gets more complicated due to timing interactions between signals. A combined hardware/software approach to solving this problem starts with the hardware design. The basic concept is to let the timer within the MCS-48 run continuously and then generate an interrupt whenever one FM signal changes state. When the interrupt occurs, software can save the timer's current value in a table which the main program can reach to determine input variable value.

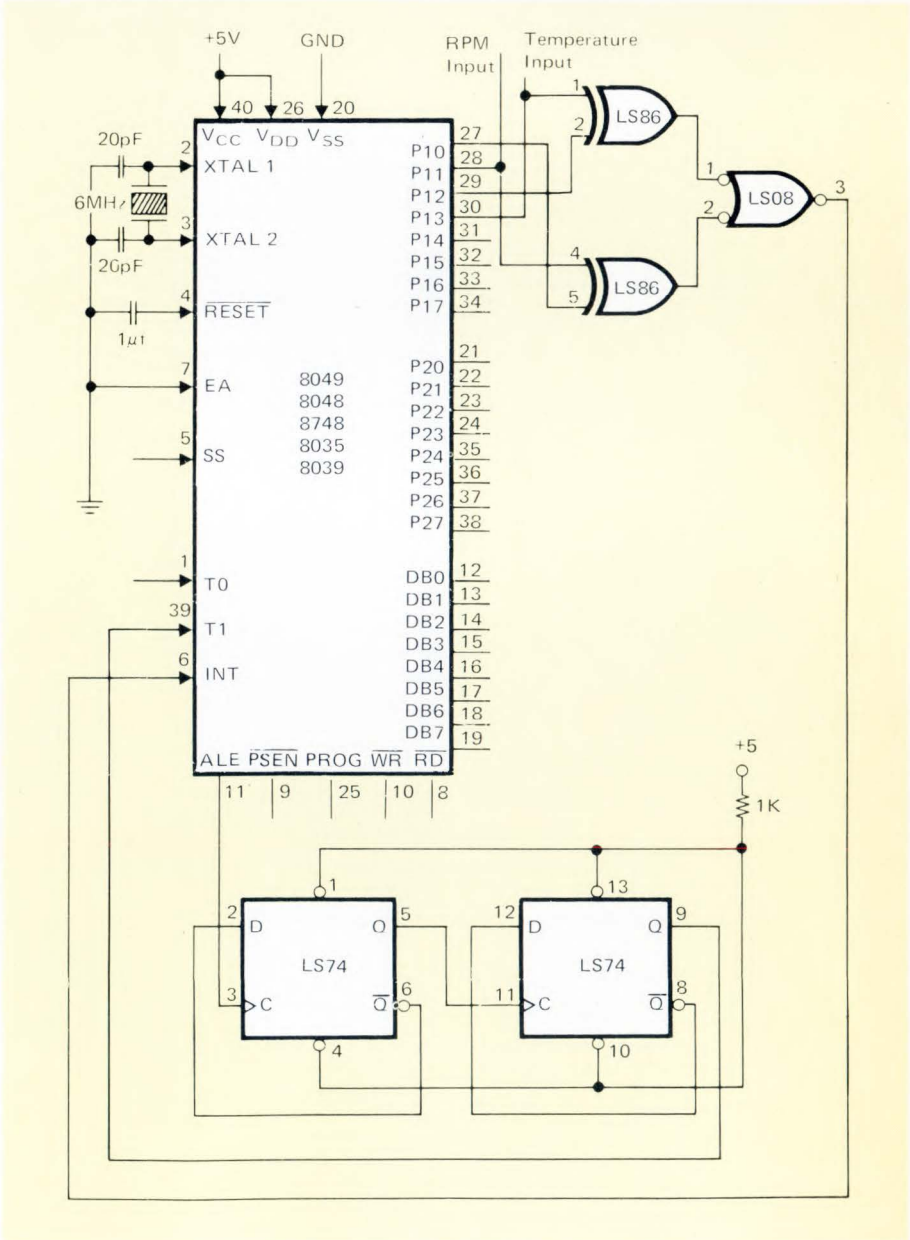
An interrupt can be generated on each transition of the input signals by the hardware shown. Here's how it operates. Assume that both input signals are at a zero and that P10 and P12 have both been set to one by the software. Under these conditions, the MCS-48 interrupt input will be inactive. As soon as one input changes state, however, an interrupt will be generated which the software can acknowledge (that is, turn off) by an appropriate change to either or both of P10 and P12. Turning off the interrupt will again put the system in a state which will detect the next change to either of the input signals.

The program listing represents an interrupt service routine (ISR) which monitors the two input signals and builds a table of timer values for each cycle of the two inputs. In order to maximize the resolution obtained, the MCS-48 timer is being run in the event count mode and the time values are each 16 bits. This gives a maximum resolution of 10 μsec with a 6 MHz crystal.

The program, which uses 141 bytes of ROM, maintains a table for each of the two input signals. The size of these tables was chosen to be eight entries for this particular application. Each entry consists of a 16-bit value which represents the time at which the input signal made a positive going transition. Variables LPOINT and RPOINT point to the next location to be loaded in the table. Since they could be loaded at any time the main routine should use the two previous entries in the table to calculate the instantaneous value of the variable.

Lionel Smith, Intel Corp., Santa Clara, CA.

Rate this design: circle 12L, 12M or 12H on Reader Inquiry Card



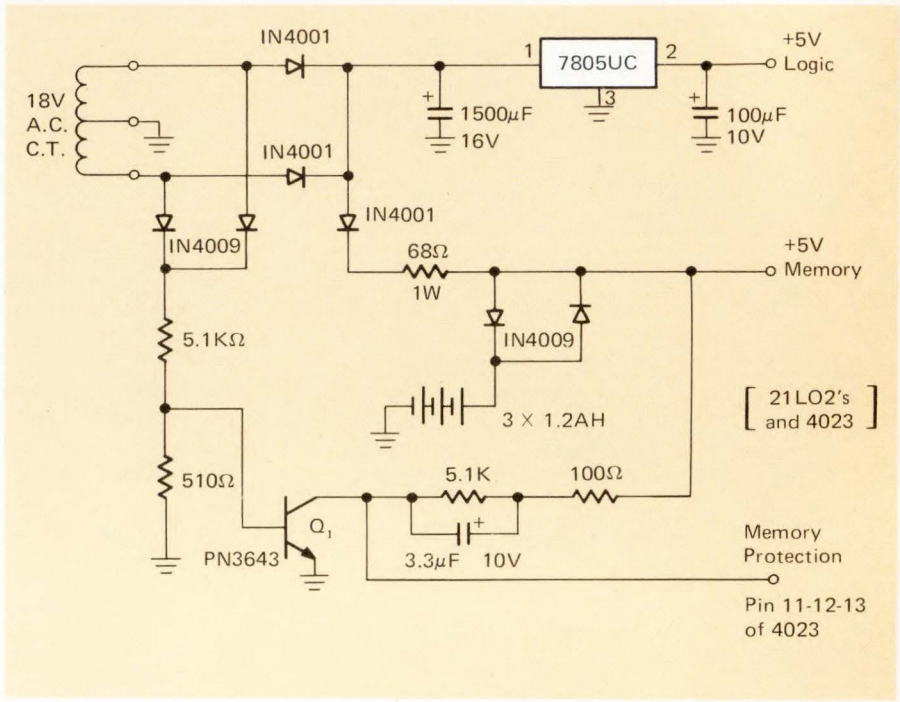
```
LOC  OBJ        SEQ     SOURCE STATEMENT
                   1
                   2 ;*****************************************************
                   3 ;*                                                   *
                   4 ;*                                                   *
                   5 ;*     INTERRUPT SERVICE ROUTINE                     *
                   6 ;*       THIS SEGMENT UTILIZES THE TIMER INTERRUPT AND THE   *
                   7 ;*       EXTERNAL INTERRUPT TO MAINTAIN A TABLE DESCRIBING   *
                   8 ;*       THE HISTORY OF THE TWO FREQUENCY MODULATED INPUTS   *
                   9 ;*       THE TABLE CONTAINS EIGHT ENTRIES FOR EACH INPUT     *
                  10 ;*       EACH ENTRY IS A DOUBLE BYTE VALUE WHICH INDICATES   *
                  11 ;*       WHAT THE VALUE OF THE TIMER WAS WHEN A POSITIVE EDGE *
                  12 ;*       WAS DETECTED                                *
                  13 ;*                                                   *
                  14 ;*     LIONEL SMITH, INTEL SINGLE CHIP APPLICATIONS  *
                  15 ;*                                                   *
                  16 ;*****************************************************


                  17
                  18 ;      REGISTER ASSIGNMENTS-BANK1
                  19 ;      ************************
                  20
0000              21 LPOINT  EQU    P0      ; POINTER FOR TEMP INPUT TABLE
0001              22 RPOINT  EQU    P1      ; POINTER FOR RPM INPUT TABLE
0002              23 LOTIME  EQU    R2      ; USED TO SAVE THE TIMER VALUE
0003              24 HITIME  EQU    R3      ; UPPER EIGHT BITS OF THE TIMER
0004              25 ATEMP   EQU    P4      ; USED TO SAVE A DURING ISR
                  26 ;

                  27 ;      PROGRAM CONSTANTS
                  28 ;      *****************
                  29 ;
0004              30 LC      EQU    04H     ; USED TO MODIFY TEMP CONTROL BIT
0001              31 RC      EQU    01H     ; USED TO MODIFY RPM CONTROL BIT
                  32 $       EJECT
0000              33         ORG    00H
                  34 INIT                   ; RESET VECTORS HERE
0000 0485         35         JMP    MAIN
                  36
0003              37         ORG    03H
                  38 EXINT                  ; EXTERNAL INTERRUPT VECTOR
0003 D5           39         SEL    RB1     ; ENTER INTERRUPT CONTEXT
0004 AC           40         MOV    ATEMP,A
0005 0413         41         JMP    INTLP   ; GO TO INTERRUPT LOOP
                  42
                  43 TMINT                  ; TIMER INTERRUPT VECTOR
0007 160A         44         JTF    UPDATE  ; IF TIMER FLAG IS SET UPDATE HITIME
0009 93           45         RETR           ; IF NOT THEN RETURN
000A D5           46 UPDATE  SEL    RB1
000B 1B           47         INC    HITIME
000C 860F         48         JNI    ENTER   ; IF EXTERNAL INTERRUPT IS ACTIVE ENTER ITS SR
000E 93           49         RETR           ; IF NOT THEN EXIT
000F AC           50 ENTER   MOV    ATEMP,A
0010 42           51         MOV    A,T     ; SAVE A AND GET TIMER CONTENTS
0011 0418         52         JMP    CASE    ; NOW GO DO THE PROPER CASE
                  53
0013 161B         54 INTLP   JTF    TCHNGE  ; TIMER IS OFF BY 256
0015 42           55         MOV    A,T
0016 161B         56         JTF    TCHNGE
0018 AA           57 CASE    MOV    LOTIME,A
0019 09           58         IN     A,P1
001A B3           59         JMPP   @A      ; DO CASE ON P1 STATE
001B 42           60 TCHNGE  MOV    A,T
001C 1B           61         INC    HITIME
001D AA           62         MOV    LOTIME,A
001E 09           63         IN     A,P1
001F B2           64         JMPP   @A
                  65
                  66
                  67
                  68 $       EJECT
                  69

                  70 ;      CASE TABLE
                  71 ;      **********
                  72
0020              73         ORG    20H     TABLE MUST START AT XX0H
0020 38           74 VEC0    DB     CASE0
0021 36           75 VEC1    DB     CASE1
0022 36           76 VEC2    DB     CASE2
0023 3C           77 VEC3    DB     CASE3
0024 51           78 VEC4    DB     CASE4
0025 57           79 VEC5    DB     CASE5
0026 57           80 VEC6    DB     CASE6
0027 3E           81 VEC7    DB     CASE7
0028 51           82 VEC8    DB     CASE8
0029 57           83 VEC9    DB     CASE9
002A 57           84 VECA    DB     CASEA
002B 3E           85 VECB    DB     CASEB
002C 5B           86 VECC    DB     CASEC
002D 5D           87 VECD    DB     CASED
002E 5D           88 VECE    DB     CASEE
002F 70           89 VECF    DB     CASEF
                  90
                  91 CASE0                  ; SET TEMP AND RPM CONTROL BITS
0030 8905         92         ORL    P1,#LC+RC
0032 FC           93         MOV    A,ATEMP
0033 8613         94         JNI    INTLP
0035 93           95         RETR
                  96
                  97 CASE1                  ; SET TEMP CONTROL BIT
                  98 CASE2
0036 8904         99         ORL    P1,#LC
0038 FC          100         MOV    A,ATEMP
0039 8613        101         JNI    INTLP
003B 93          102         RETR
                 103
                 104 CASE3                  ; SET TEMP CONTROL, CLEAR RPM CONTROL, TIME RPM
003C 8904        105         ORL    P1,#LC
                 106 CASE7
                 107 CASEB
003E 99FE        108         ANL    P1,#NOT RC
                 109                       ; PLACE LOTIME AND HITIME IN THE RPM  TABLE
0040 FA          110         MOV    A,LOTIME
0041 A1          111         MOV    @RPOINT,A
0042 19          112         INC    RPOINT
0043 FB          113         MOV    A,HITIME
0044 A1          114         MOV    @RPOINT,A
0045 19          115         INC    RPOINT
0046 F9          116         MOV    A,RPOINT
0047 D24D        117         JB6    WRAPR
0049 FC          118 RBACK   MOV    A,ATEMP
004A 8613        119         JNI    INTLP
004C 93          120         RETR
004D B930        121 WRAPR   MOV    RPOINT,#30H
004F 0449        122         JMP    RBACK
                 123
                 124 CASE4                  SET RPM CONTROL
                 125 CASE8
0051 8901        126         ORL    P1,#RC
0053 FC          127         MOV    A,ATEMP
0054 8613        128         JNI    INTLP
0056 93          129         RETR
                 130
                 131 CASE5                  INVALID-
                 132 CASE6
                 133 CASE9
                 134 CASEA
0057 FC          135         MOV    A,ATEMP
0058 8613        136         JNI    INTLP
005A 93          137         RETR
                 138
                 139
                 140 CASEC                  ; CLEAR TEMP CONTROL,SET RPM CONTROL TIME TEMP
005B 8901        141         ORL    P1,#RC
                 142 CASED
                 143 CASEE
005D 99FB        144         ANL    P1,#NOT LC
                 145                       ; PLACE LOTIME AND HITIME IN THE TEMP  TABLE
005F FA          146         MOV    A,LOTIME
0060 A0          147         MOV    @LPOINT,A
0061 18          148         INC    LPOINT
0062 FB          149         MOV    A,HITIME
0063 A0          150         MOV    @LPOINT,A
0064 18          151         INC    LPOINT
0065 F8          152         MOV    A,LPOINT
0066 926C        153         JB4    WRAPL
0068 FC          154 LBACK   MOV    A,ATEMP
0069 8613        155         JNI    INTLP
0068 93          156         RETR
006C B820        157 WRAPL   MOV    LPOINT,#20H
006E 0468        158         JMP    LBACK
                 159
                 160 CASEF                  ; CLEAR TEMP AND RPM CONTROL BITS, TIME TEMP AND RPM
0070 99FA        161         ANL    P1,#NOT(LC+RC)
                 162                       ; PLACE LOTIME AND HITIME IN TEMP AND RPM
                 163                       ;  TABLES
0072 FA          164         MOV    A,LOTIME
0073 A0          165         MOV    @LPOINT,A
0074 A1          166         MOV    @RPOINT,A
0075 18          167         INC    LPOINT
0076 19          168         INC    RPOINT
0077 FB          169         MOV    A,HITIME
0078 A0          170         MOV    @LPOINT,A
0079 A1          171         MOV    @RPOINT,A
007A 19          172         INC    RPOINT
007B 18          173         INC    LPOINT
007C F9          174         MOV    A,RPOINT
007D D286        175         JB6    RRWRAP
007F F8          176 RRBAK   MOV    A,LPOINT
0080 926C        177         JB4    WRAPL
0082 FC          178         MOV    A,ATEMP
0083 8613        179         JNI    INTLP
0085 93          180         RETR
                 181
0086 B930        182 RRWRAP  MOV    RPOINT,#30H
0088 047F        183         JMP    RRBAK
                 184
                 185 MAIN                   START OF MAIN PROGRAM
                 186
                 187         END

USER SYMBOLS
ATEMP  0004   CASE   0018   CASE0  0030   CASE1  0036   CASE2  0036   CASE3  003C   CASE4  0051   CASE5  0057
CASE6  0057   CASE7 003E   CASE8 0051   CASE9  0057   CASEA  0057   CASEB  003E   CASEC  005B   CASED  005D
CASEE  005D   CASEF 0070   ENTER 000F   EXINT  0003   HITIME 0003   INIT   0000   INTLP  0013   LBACK  0068
LC     0004   LOTIME 0002  LPOINT 0000  MAIN   0085   RBACK  0049   RC     0001   RPOINT 0001   RRBAK  007F
RRWRAP 0086   TCHNGE 001B  TMINT 0007   UPDATE 000A   VEC0   0020   VEC1   0021   VEC2   0022   VEC3   0023
VEC4   0024   VEC5  0025   VEC6  0026   VEC7   0027   VEC8   0028   VEC9   0029   VECA   002A   VECB   002B
VECC   002C   VECD  002D   VECE  002E   VECF   002F   WRAPL  006C   WRAPR  004D

ASSEMBLY COMPLETE,  NO ERRORS
```

Power Supply/Battery Backup For Memory

It is desirable to protect memories from power failures or accidental loss of line power. A suggested battery back-up supply for memory power is shown in this power supply diagram. It consists of 3 cadmium nickel sub-C batteries, capacity 1.2AH, providing backup power to the MOS RAM's for 24 hours in case of power loss. A transistor Q_1 sensing the loss of AC power assures that the memories will be deselected before loss of DC power to the controller. In this particular application, the Fairdial Set CES200 or CES201 a single supply voltage of +5V ±5% is required to power the devices and the display.

Engineering staff, Fairchild Camera and Instrument Corp., 464 Ellis St., Mountain View, CA.

Rate this design: circle 13L, 13M or 13H on Reader Inquiry Card



Four-Stage VC Sequential Timer

Looking for a four-stage sequential timer with voltage-control capability for industrial control applications? This circuit design fills the bill, and provided satisfactory results in our 8085-based system.

We selected an XR-558 (Exar) quad timer. The 558 quad timer IC contains four separate timer sections, each of which can produce independent time delays ranging from microseconds to several minutes, depending on the external RC network settings. Since all four timer sections are housed in the same package on the same chip, (1) their matching and temperature tracking characteristics exceed those of single timer circuits and (2) space and component savings cut costs in our timing and sequencing applications, especially in view that they require a large array of timing circuits.

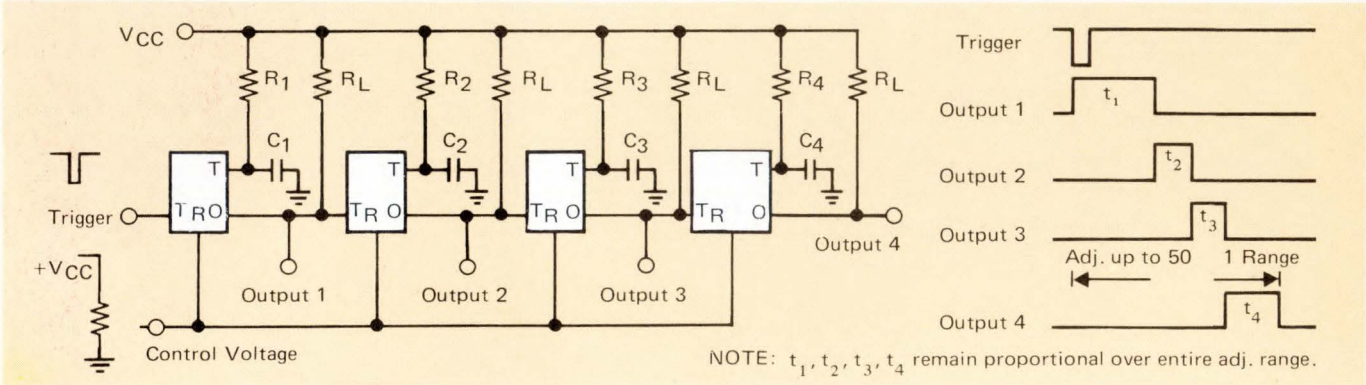
Note that, when triggered, the circuit produces four sequential time delays, where the duration of each output is independently controlled by its own RC time constant. Yet, all four outputs can be modulated over a 50:1 range, and remain proportional over this entire range. Since each timer section is edge-triggered, the sections can be cascaded by direct coupling of respective outputs and trigger inputs.

Each of the four timer sections has separate output, timing and trigger controls; all four sections, however, share a reset control. Since the 558 is an "edge-triggered" device, each timer section can be cascaded (connected in tandem) to other sections without using coupling capacitors.

The 558 is designed with open-collector outputs, each of which can sink up to 100 mA of load current.

Don L. Sanders, MicroTechnology, Inc., New York, NY.

Rate this design: circle 14L, 14M or 14H on Reader Inquiry Card



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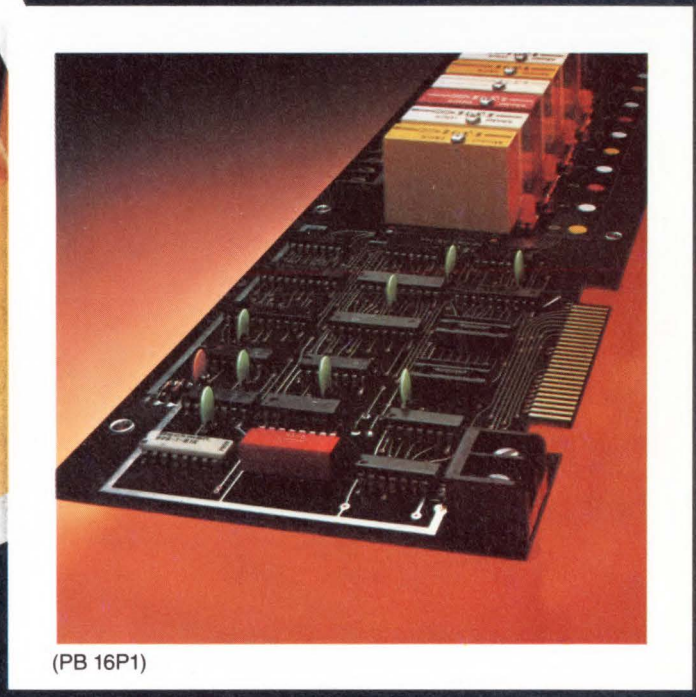
(PB 16S1)



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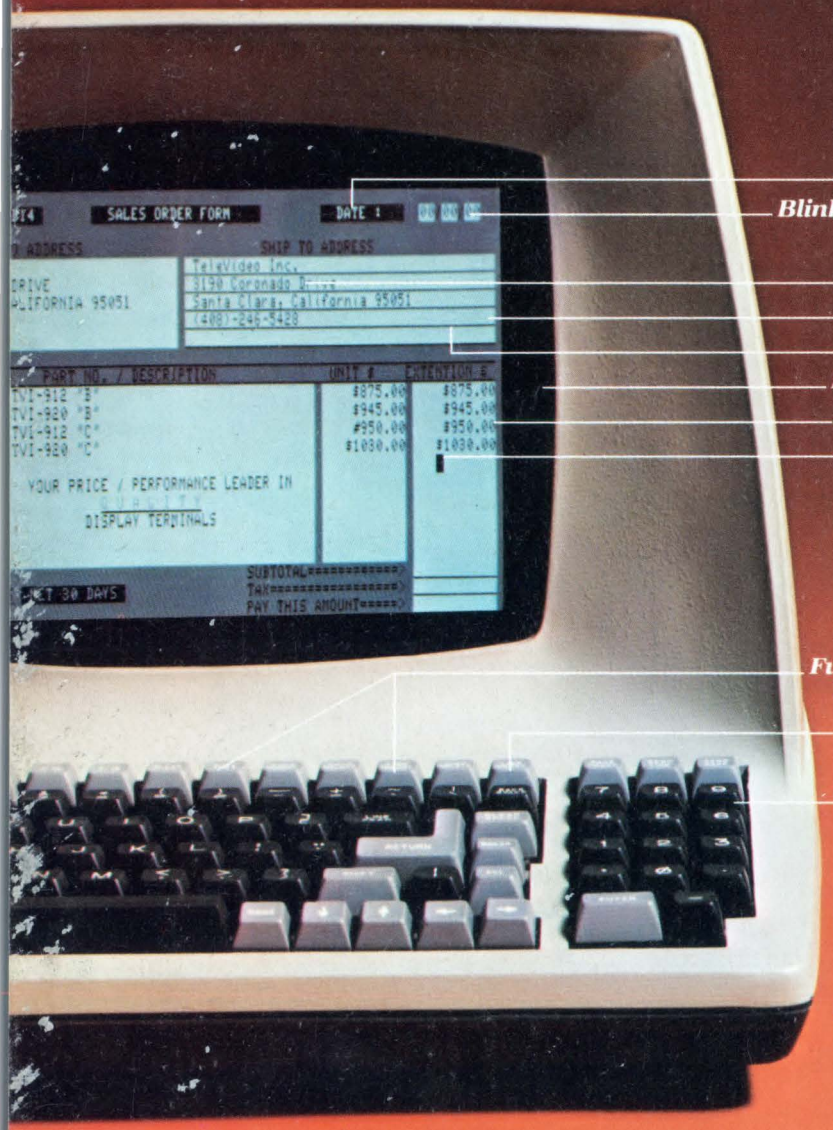

Reverse video
Blinking/blank fields
Upper/lower case char.
Protected fields
Underlining
Non-glare screen
12 x 10 char. res.
Blinking cursor

- *9 Baud rates (75-9600 Baud)*
- *Self test*
- *Auxiliary port*

Function/edit keys
Typewriter/TTY keyboards
Numeric pad

Model 920C shown.

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