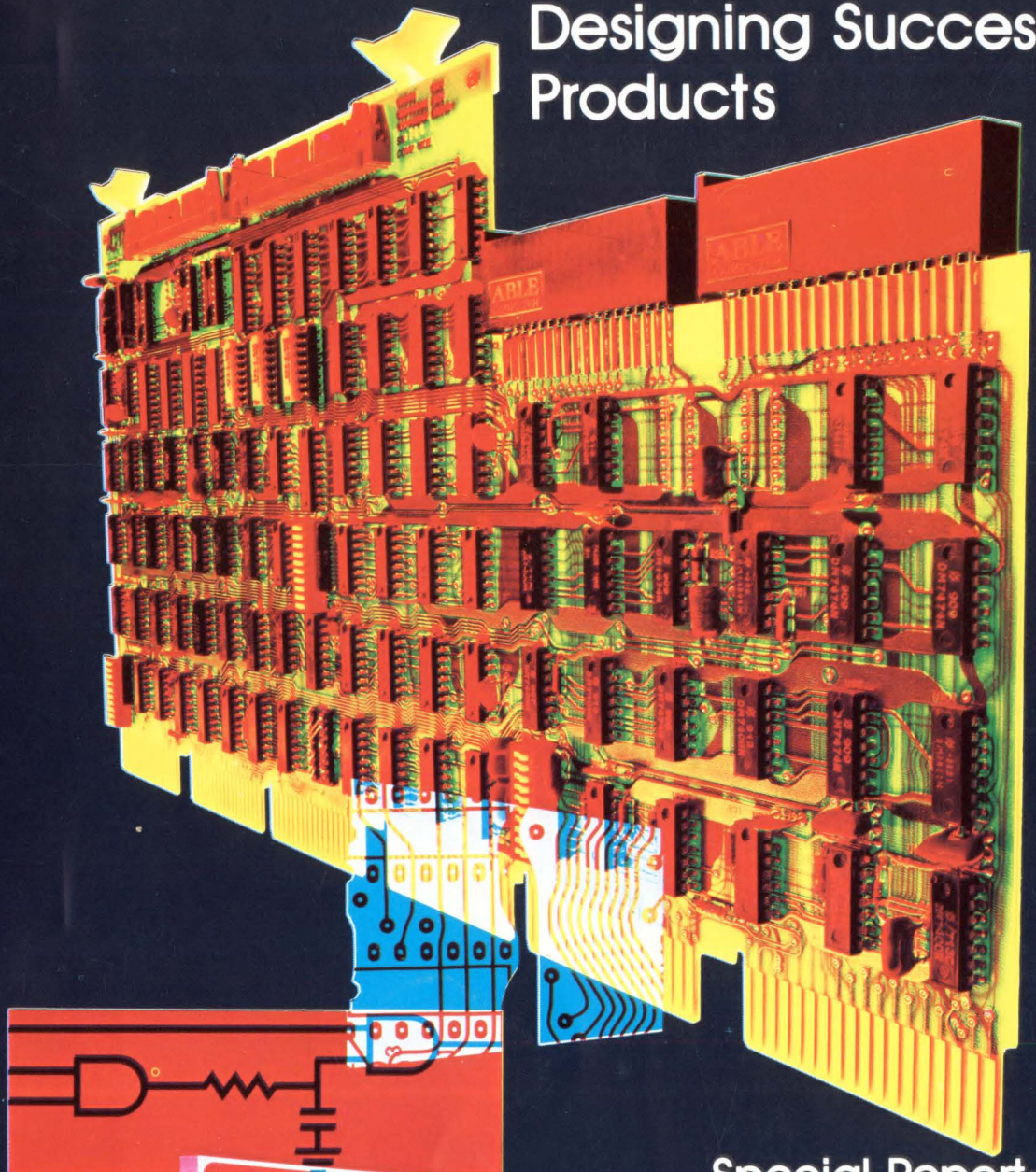
VOLUME 9, NO. 8 AUGUST 1979

Digital Design

The Magazine of Systems Electronics

REQUALIFY NOW!
If your label is printed in red,
SEE PAGE 55

Designing Successful Products



Special Report:
8-Inch Hard Disk Drives

Superminicomputers

Prototyping Tools

Introducing the Data Warehouse.

Winchester disk plus floppy copy.

Big for its size.

Calling it a "warehouse" may sound like an exaggeration.

But in spite of its mini/micro size, there's room inside for 20 megabytes of fixed Winchester-disk storage with reliability sealed in.

And there's room for one or two of Remex' flexible disk drives, as well. So you can quickly transfer up to 2.5 megabytes at a time from temporary storage to permanent.

High level protocol.

Like any warehouse, it has a front office — our highly intelligent, embedded formatter. This state-of-the-art, 6800-based unit features Channel Command Control, making the Data Warehouse one of the first mini/micro disk memory systems to incorporate a high-level protocol.

40% faster throughput.

Channel Command Control gives you direct memory access, reducing communications with the computer to the extent that throughput is increased 40 percent. It also permits transfer of up to 64,000 words by a single command. And there's a built-in 2K word buffer to provide a constant transfer rate under varying CPU conditions.

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Data contained on the fixed disk can be copied onto the floppy(s) off-line, without slowing CPU activity at all.

We've packed a lot of unique capabilities, along with a power supply, into a single package that provides big, reliable mass memory performance for minis and micros at an unheard-of price.

Calling it a "warehouse" may be an understatement.

Call us today for full details.
Ex-Cell-O Corporation, Remex Division,
1733 E. Alton St., P.O. Box C19533,
Irvine, CA 92713. Phone: 714/957-0039.
TWX: 910/595-1715.

Ex-Cell-O Corporation

REMEX DIVISION

Paper isn't the only thing we look good on.

Circle 10 on Reader Inquiry Card

MiniComputer Technology

The solid name in disk controllers introduces two smart new single boards. For DEC and Data General.

Above,
the SMC11 (DEC)

Below,
the SMC 12 (DG)

They're ready for delivery now. Intelligent storage module disk controllers with multi-drive capability, multiple sector transfer, and hardware error correction. They come complete with cables and manuals. For $3580, quantity one.

These controllers are substantial achievements. But then we've been making single board disk controllers for DEC, Data General, and Interdata systems for over four years. And more than three thousand trouble-free units are out there working now.

Mail us the coupon and we'll send you the full story. Give us an order and within thirty days we'll have as many of these disk controllers as you want on your loading dock or on your desk. That's not just a promise. It's a solid guarantee.

MiniComputer Technology

2470 Embarcadero Way, Palo Alto, California 94303, (415) 856-7400

Name _____

Title _____

Computer Type _____

Drive Type _____

Company _____

Address _____

City _____ State ____ Zip _____

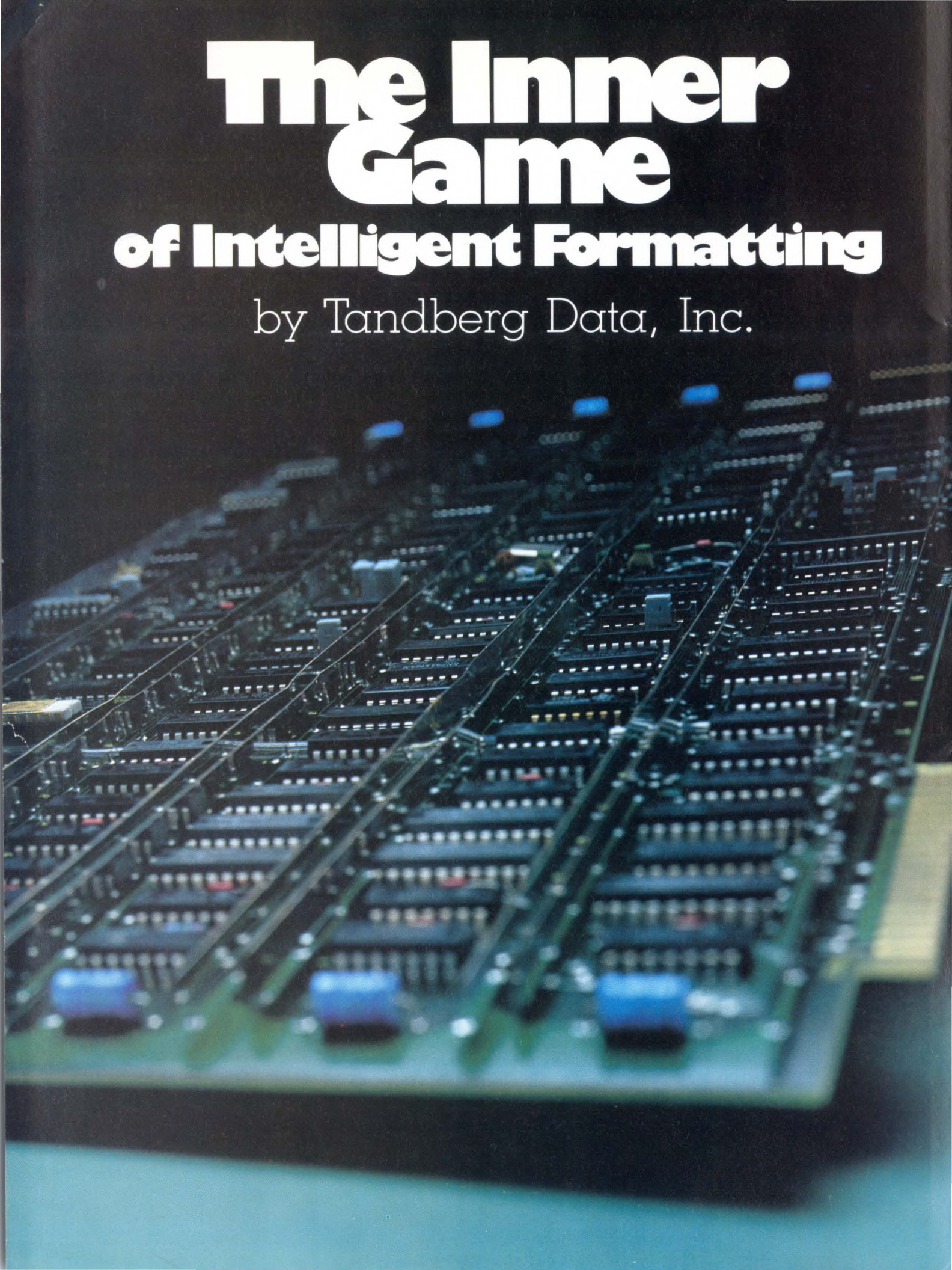
Telephone ( ) _____

Circle 2 on Reader Inquiry Card.

Interdata people,
ask about the SMC903.

The Inner Game of Intelligent Formatting

by Tandberg Data, Inc.



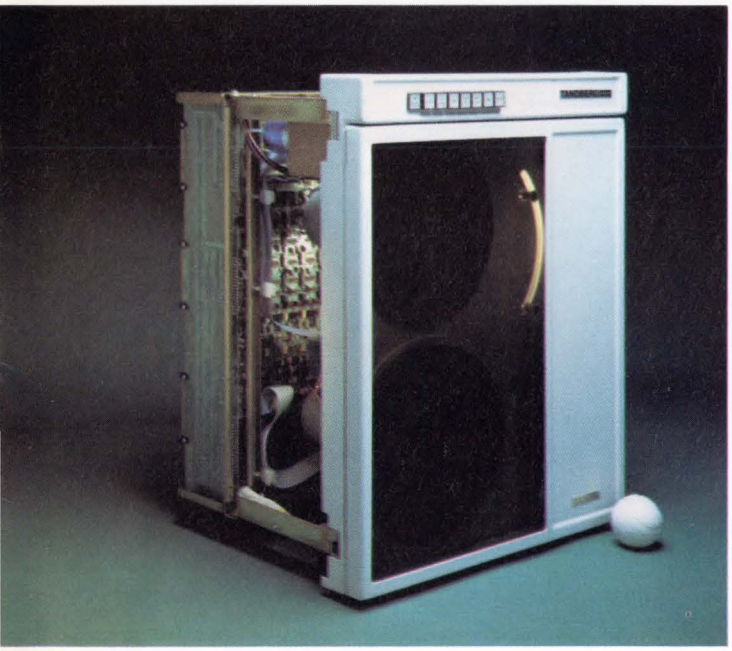
Get it together . . . and everything comes easier.

Put tape transport intelligence on the inside, and watch your game improve. It's possible with Tandberg Data's TDF 4050 (microprocessor-based) Formatter — now installed *internally* in the industry-proven, dual-format TDI 1050 Synchronous Tape Transport.

No more need for an external formatter to control the reading and writing of data. The interfacing task is naturally a whole lot simpler. And real savings follow with only one system to ship, handle, and mount, rather than two. Cost of ownership is resultantly the lowest currently obtainable.

The internal TDF 4050 Formatter reads and writes ANSI, IBM, and ECMA compatible tapes. It is designed to work with 9-track 1600 bpi PE and 800 bpi NRZI tape drives and 7-track 200/556/800 bpi NRZI tape drives.

Contained on one 19″ x 10″ PC board, the new Tandberg dual formatter can control from one to



four tape transports — either the same or half speed or a mix of different formats with dual stack heads.

The TDF 4050 can handle six different tape drive speeds. It can read and write PE and NRZI at the specified speed or one-half that speed when drives of different speeds are connected.

The TDF 4050 executes all standard commands, as well as other customer-specified commands.

Tandberg's TDI 1050 dual-format Synchronous Tape Transport utilizes 10½-inch reels. With the TDF 4050 Formatter, users may easily daisy-chain up to four transports simultaneously,

WHAT CAN THE INNER GAME OF FORMATTING DO FOR MY GAME?

1. Simplify interfacing.
2. Reduce integration time.
3. Eliminate redesign.
4. Facilitate daisy-chaining.
5. Cut shipping and handling costs.
6. Cut rack space and costs.

thus saving rack space and cost by freeing slots formerly occupied by an external formatter.

The TDF 4050 and the TDI 1050 are microprocessor-based systems. Using the test program designed into the TDI 1050 firmware and the optionally available test ROM set for the TDF 4050, the magnetic tape system can have initial set-up and be trouble-shot in the field without external test boxes, without tying up expensive computer time and without special tools.

Impeccable quality in engineering and fabrication has long been the hallmark of the Tandberg name worldwide. But Tandberg's globe-girdling facilities also mean immediate delivery and service responsiveness wherever needed, 24 hours a day, seven days a week, 365 days of the year.

OKAY. BUT DO I GET THE WHOLE RANGE OF COMMANDS?

Here's the whole slew — and let us know if you require any others.

- Read Forward
- Read Reverse
- Write Forward (Normal)
- Read Reverse Edit
- Write Forward Edit
- Write File Mark
- Erase Forward (Fixed Length)
- Erase Forward (Variable Length)
- Space Forward
- Space Reverse
- File Search Forward
- File Search Reverse
- File Search Forward (Ignore Data)
- File Search Reverse (Ignore Data)
- Load-On-Line
- Rewind
- Off-Line

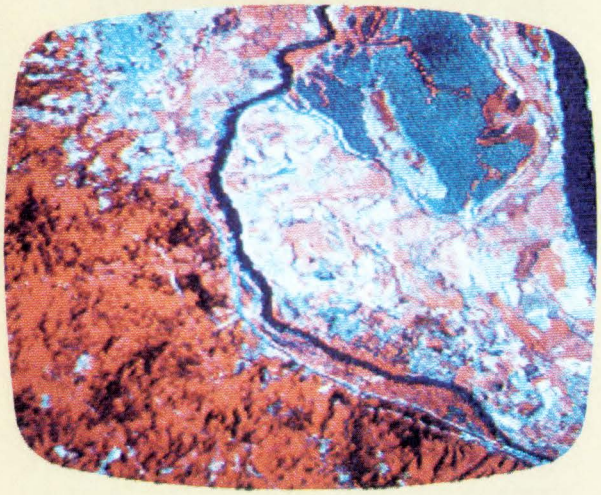
Now with Tandberg's new TDF 4050 *internal* Formatter you'll get your inner game together. And start finding the competition is a whole lot easier to handle.

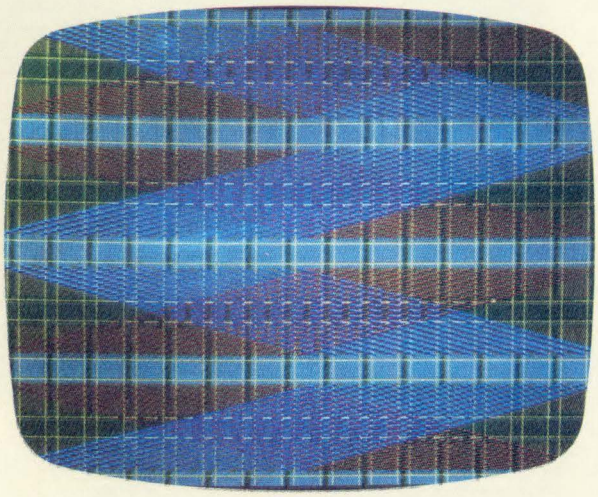
TANDBERG DATA INC.
4060 Morena Blvd.
San Diego, CA 92117
(714) 270-3990

TANDBERG

Circle 3 on Reader Inquiry Card

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
- Image arithmetic operations
- Zoom and pan
- Up to four 8-bit image memories
- 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 256 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.

GRINNELL SYSTEMS

2159 Bering Drive, San Jose, California 95131 (408) 263-9920

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VOLUME 9, NO. 8 AUGUST 1979

Digital Design

The Magazine of Systems Electronics

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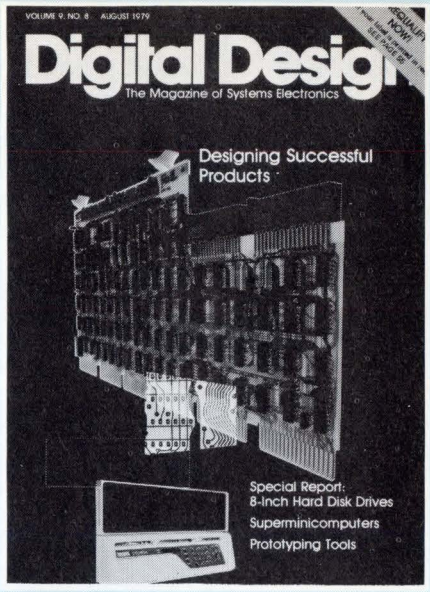
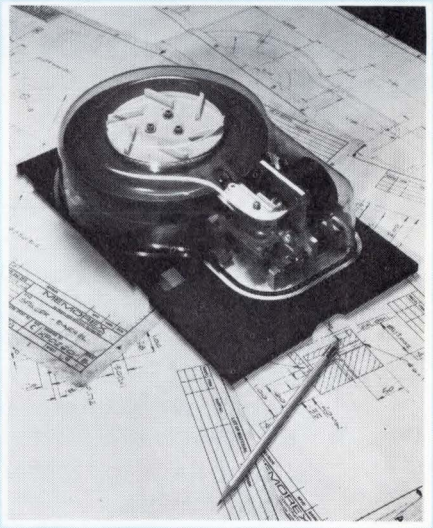
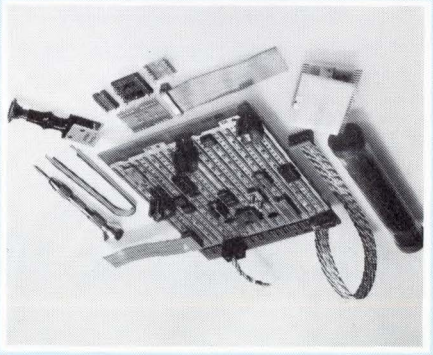


ON OUR COVER

Cover photo symbolizes in montage form the creation of a computer enhancement, starting with the target computer. *(Able Computer Technology)*





DIGITAL DESIGN
Publication Number: USPS 407-010

Published monthly by Benwill Publishing Corp., a Morgan-Grampian Company, 1050 Commonwealth Ave., Boston, MA 02215. Application to mail at controlled circulation rates is pending at Long Prairie, MN 56347.

Digital Design
The Magazine of Systems Electronics

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DIGITAL DESIGN
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Subscription rates: Domestic subscriptions for non-qualified subscribers, groups, libraries or companies, $25/yr. International subscriptions, $35/yr.

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VBPA CIRCULATION: 54,369 (JULY, 1979)

Published monthly by Benwill Publishing Corporation, a Morgan-Grampian Company, Harold G. Buchbinder, Chief Executive Officer; George Palken, President; Domenic A. Mucchetti, Treasurer; Executive, Editorial and Subscription Offices, 1050 Commonwealth Ave., Boston, MA 02215. Telephone: (617) 232-5470.

OUR PDP-11* MAGTAPE CONTROLLER IS GOOD AS GOLD

every two hours of every working day somebody puts a TC-130 on a PDP-11 computer

Here are just a few of the reasons why more people put TC-130's on their PDP-11 systems than any other magtape controller:

- Software compatible – embedded design
- Mixed density – 1600 bpi PE and 800, 556, 200 bpi NRZ
- Intermix 9 track and 7 track, up to 8 drives
- Fits all PDP-11 Series Computers
- Dual speed – switch selectable, 12.5 to 125 ips

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Circle 9 on Reader Inquiry Card

Letters

Film Ribbon Printers

Dear Editor:
Your article on matrix printers excluded a few important reasons why impact printers with film ribbon or T3 type ribbons will still find a market: OCR and particularly OCRB as well as the need to use the printer as a substitute for the quality typewriter for prestige purposes. There is nothing like turning off potential business with printed output that has a lot to be desired—particularly if the ribbon needs changing or the only type of paper you can use is continuous. Luckily band printers and daisy wheel printers fill some of this gap, but not perfectly.

Anthony D. Hodge
Principal Consultant
Engineering Research Div.
Systems Consultancy
Box 45
Wakefield, WF1 2UZ, England

Misleading Discussion

Dear Editor:
Eugene Zuch's article, "Principles of Data Acquisition and Conversion" ends with the usual misleading discussion of sampling theory. First, the characteristics of the input band-limiting filter may have profound effects on the aliasing error; no mention is made of this. Second, at the point of data reconstruction, even assuming zero error in all prior operations, the error attributable to perfect sampling is profoundly influenced by the reconstruction filter, an item not mentioned by Mr. Zuch at all. As a practical matter, tens of samples per cycle may be required to achieve 1% accuracy even with multipole reconstruction filters.

It appears that the field of A/D conversion is another where hardware capabilities are far outstripping the "software" capabilities being brought to bear on the subject.

Frank T. Innes
Sr. Staff Engineer
Litton Industries
Monroe Div.
American Rd.
Morris Plains, NJ

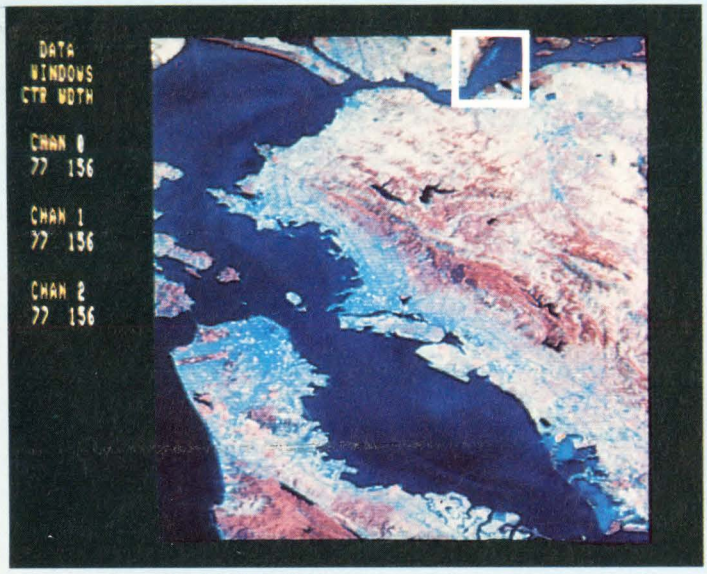
μP Cuts Energy Use

Dear Editor:
We at Andover Controls were extremely pleased to see the article, "Programmable Microprocessor Based System Provides Total Energy Management", in your April issue. This excellent staff report resulted from the joint effort of George A. Adaniya of Andover Controls, Andover, MA; William A. Taylor of TE Corp., Boston; and Ronald Reder of TE Corp., Boston, MA. When the article was written, Sunkeeper Corp. was the original name of the company, but is now Andover Controls Corp.

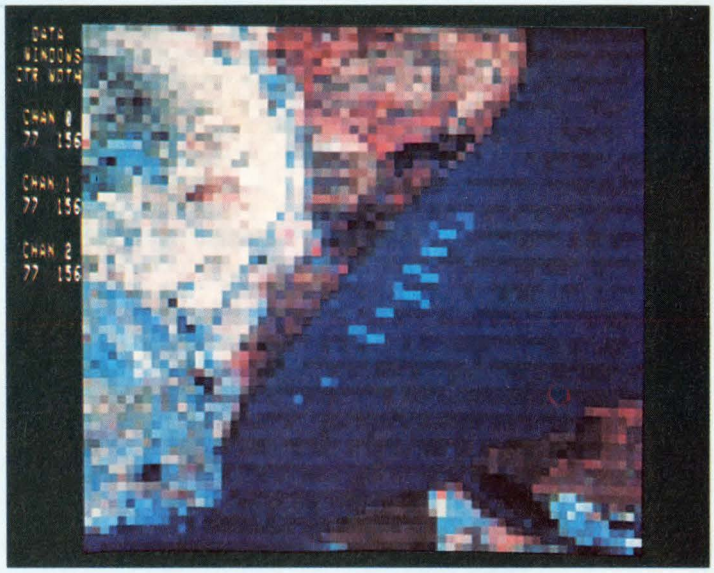
Carol J. MacLaren
Sales Administrator
Andover Controls Corp.
Box 37
Shawsheen Village Station
Andover, MA 01810

Do you agree with us? Disagree? Have an opinion on issues we've raised? Address letters to Letters, DIGITAL DESIGN, 1050 Commonwealth Ave., Boston, MA 02215.

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.
- Performs pixel replica zoom of 2:1, 4:1 or 8:1 in real time.
- 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

Circle 6 on Reader Inquiry Card

Publisher's Letter

Yuri Spiro, *Publisher*

Continued Growth Ahead For Electronics

This year has been a better year for electronics than anticipated only eight months ago. Maybe it's too early to tell for sure, but it seems that the electronics industry will benefit from the economy and energy situation.

Benefits are likely for at least two reasons. First, increased demand for electronics – particularly microcomputer-based equipment and systems – is growing so rapidly that it could conceivably offset any downturn. Second, microprocessor-based systems have become inflation fighters, energy savers and cost cutters, and consequently will benefit.

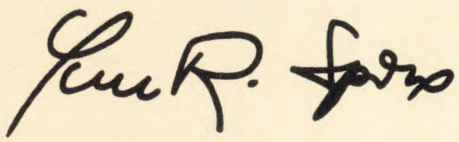
This explosive growth in micro-based systems and associated electronics will create a "coat-tail effect" demand for discrete devices, interfaces, peripherals, CRT display terminals, printers and related products.

Troubles exist. They emanate from the electronic's industry's inability to meet customer demand. Shortages continue, and as a result, manufacturers may be forced to pay many times more than cost to get deliveries in time, or settle for last-minute substitutions (and re-design their systems to accomodate it) – or bite the dust. Or, they can wait for deliveries. But all too often, manufacturers' customers won't wait; they switch to a competitor. Another trouble: there is a serious lack of qualified designers skilled in the latest technology.

Other effects are taking place. Skyrocketing costs, short supply and delivery of semiconductor fabrication equipment have impacted semi makers; many are cautious about expanding production capacity too rapidly, wondering if a downturn could hurt them as in the past. All this has contributed to price gouging, multiple ordering and long leadtimes. Partly because of long leadtimes, more manufacturers release preliminary spec sheets that designers are forced to design around while they await delivery. All too often, after designing around the listed parameters, the engineers discover that the final delivered device doesn't meet the specs originally listed! The great complexity of these devices and their accelerating half-life obsoletes them shortly after entering production. This complexity and shorter half life forces semi makers to offer designers preliminary spec sheets.

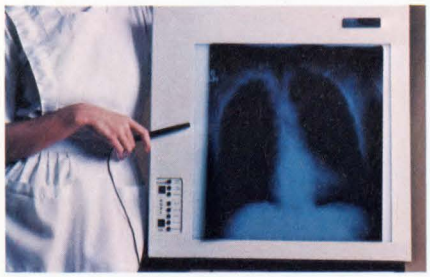
Will semiconductor manufacturers, who are achieving ever-greater chip densities, be the cause of lower demand for electronic equipment? Since equipment is becoming more efficient and is reducing capital expenditures, when (or if) any real economic downturn comes, capital expenditures would essentially stop. Since the market for electronics and equipment was sensitive in past recessions, some doomsayers predict that the market will also react negatively again. They also predict that there is a limit to the memory capacity and processing power needed for many applications and products; and, with ever-increasing densities, designers will use fewer chip devices with greater densities. With wafer processing providing better uniformity and increased yields, and with more functions being shoehorned onto a chip, design and manufacturing will assume less significance; firms using electronics in their systems will de-emphasize circuit design and manufacturing orientations and depend more on a software, marketing, system design and integration orientation.

Digital Design is positioned in the center of this growth market: its editorial coverage reaches the rapidly-growing numbers of specifiers and purchasers of products used in system design. Although many industry experts already forecast an economic downturn coupled to oil shortages, it's not likely these events can cause any serious long-term downturn in the computer/electronics industries. Since electronics- and computer-based products improve efficiency, cut energy usage, and penetrate so many new product areas so rapidly, it's quite likely that electronics will continue its expansion into new applications and worldwide industries, generating greater profits and increased sales.



Tālos...the best buy in Digitizers.

Extensive Selection.

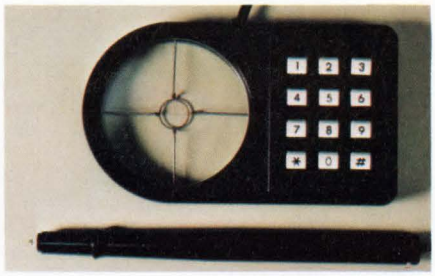


We know that digitizers are used for many projects (from tracking icebergs to mapping to radiology to CAD/CAM). That's precisely why we've developed the most extensive line of digitizers available. Active surface areas range from 11″ x 11″ to 44″ x 60″ and are offered with capabilities for Backlighting & Rear Projection in addition to our rugged solid surface.

We've Got Smarts...

Our "SMART" option is actually a microprocessor in a digitizer. Some of the functions selectable from the movable menu include distance, area, and volume calculations, coordinate translation, independent X, Y, scaling, and origin relocation as off-line functions, saving valuable computer time.

Quality Construction.



Our pens and cursors are built with sturdy aluminum for durability. The digitizing surface is solid and not susceptable to magnetic fields, temperature, humidity, noise, or age.

For more information, write to the dependability people at

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(602) 948-6540

Dependable Performance.

We design, build and inspect each Talos digitizer to the highest quality standards in the industry. Before any digitizer meets our approval it has been run under operating conditions for at least 96 hours while over 50 control functions are tested. Our highly trained staff checks and re-checks resolution and accuracy. 1000 lines per inch is standard at Talos – and remember the higher the resolution the greater the potential for accuracy.

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Progress in Technology • Quality in Products

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TOO HOT, TOO COLD, JUST RIGHT!

What type of switch offers the best overall keyboard cost structure? Ask the industry.

Capacitive designs offer switch cost structures equal to contact types, but with the reliability of a solid state switch. Furthermore, the economies of a non-soldered design more than offset the cost of simple 2-chip "drive and sense" circuitry.

Key Tronic offers you a 5 year record of reliability. With over 500 different designs and 500,000 keyboards in the field, we have the design expertise and manufacturing controls to make your keyboard selection 'just right'.

key tronic
INTERNATIONAL KEYBOARDS

Circle 25 on Reader Inquiry Card

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Technology Trends

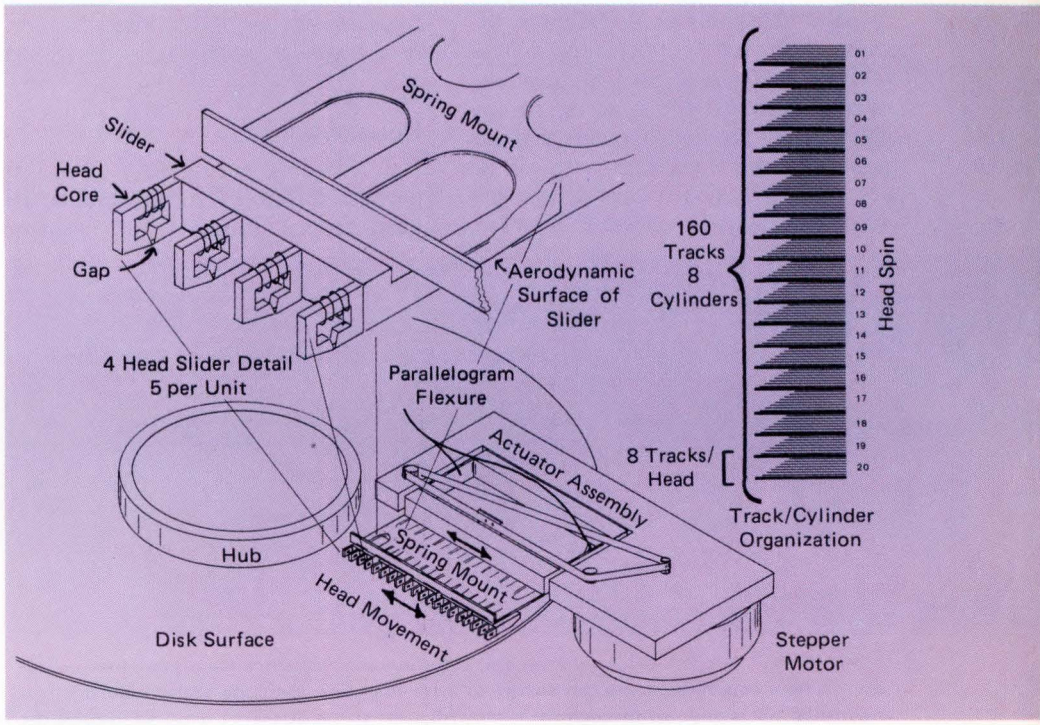
8-Inch Hard Disk Drive Betters Conventional Designs

Traditional disc drive product development over the past 25 years has concentrated on either high-performance (head-per-track) or cost/capacity effectiveness (moving head) designs. The industry has long considered the two objectives to be mutually exclusive, and the OEM system designer has been arbitrarily limited to a choice between two antagonistic extremes.

On the one hand, he could optimize for access time by employing the more expensive head-per-track drive; at the other extreme, the system designer could optimize for a cost/capacity parameter by employing one of the many lower performance moving head drives. For absolute cost reduction, flexible diskette drives offer a third alternative, but further carry with them the burden of extremely long access times. There have been no alternatives available between these extremes.

The only recent attempts by the industry to seek a marriage of the two competing techniques have been made in the area of adding head-per-track options to the Winchester-type mass storage devices – an expensive option, exceeding the reasonable cost constraints imposed on all but larger systems.

To solve this, New World Computer designed the MIKRO-DISC 211, a low-cost hybrid disc drive for high-speed mass memory performance. The MIKRO-DISC 211 balances fast access attributes of a head-per-track drive with the lower cost of a moving head design.



Recording heads are held against the disc surface by spring mounts. To keep from burnishing the magnetic coating on the disk, aerodynamic surfaces, called sliders, force the recording heads to lift away from the disc surface, against the spring force. Actuation is effected by stepper motor-driven band.

Head-track definition

Key to an economical system is to design it within limitations of existing, proven technology. Major components are readily available, meeting all quality assurance requirements, in sufficient quantity and at low-cost. Manufacturing tolerances are such that the product is easily and efficiently assembled. And, the product meets the critical test of economically efficient producibility.

The design of a fast-access disc memory system that remains within the mechanical state of the art, requires that a multiple head assembly be employed. In fact, early product definitions dictated that 20 recording heads were required to provide the performance characteristics desired of the MIKRO-DISC 211. However, the use of multiple heads can defeat the cost objectives of the product unless mechanical specifications can be relaxed sufficiently to allow high-volume, economical manufacture.

To meet the multiple head requirement, New World Computer Company designed a proprietary low-cost head that writes and reads data onto 0.008-in. wide tracks. This reasonably relaxed specification assures high volume manufacture and low rejection rates. This, coupled with the in-house value-added assembly of heads, reduces substantially the cost of the system's pacing item.

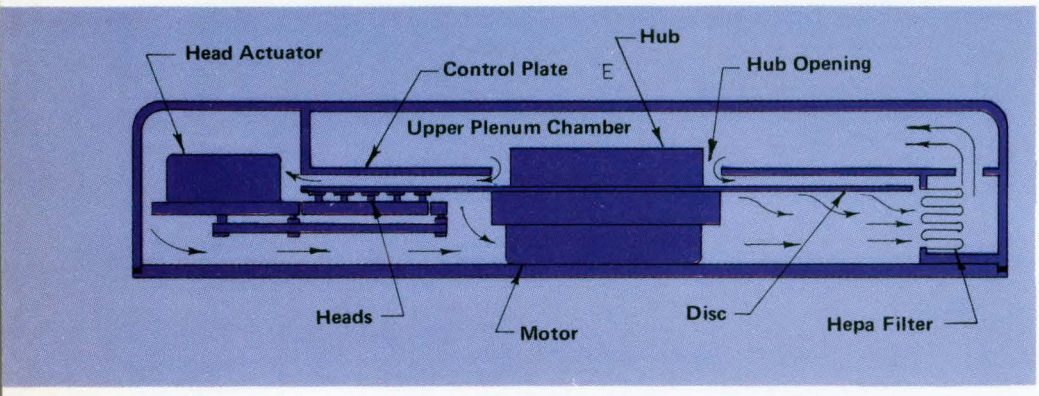
Twenty such heads may be economically mounted over one surface of an 8-in. diameter Winchester-type hard disc, along its radius, at 0.080-in. increments. Despite the reasonably relaxed track density, each head writes and reads a track of 13 Kbytes, thus preserving the overall capacity objectives of the system.

To further reduce the cost of manufacture, the electronics are shared among the several heads. The write driver and read amplifier circuits are switched between the twenty heads at TTL speed. Since these twenty tracks are each capable of storing 13 Kbytes of data, unformatted, the data under the twenty heads is a quarter of a Megabyte and are accessible at head-per-track performance.

The set of tracks defined by the twenty heads is called a "cylinder", analagous to the tracks defined by heads on the various disc surfaces in a single actuator position of a conventional multi-platter moving head disc. By moving the entire 20-head assembly in 0.010-in. steps, seven additional cylinders are interlaced between the

tracks of the first cylinder.

Each head therefore services eight tracks for a total recording capability of 8 X 20 = 160 tracks. Since each cylinder is capable of storing a quarter of a Megabyte of data, the total unformatted capacity of the disc surface is eight times this or 2.1 Mbytes. Because the actuator must move only a total of 0.070-in. to cover all positions of the eight cylinders, access to any cylinder of the data requires a maximum of seven steps. Each step can be accomplished in five msec., so that worst-case cylinder access is 35 msec.



In this HEPA filter-disk rotation arrangement for pumping air, since the disc spinning under laminar flow conditions takes less energy to drive than one operating under tubulant flow conditions, air is pumped through the filter with a net saving of energy required to drive the disc.

Conventional disc drive terminology does not adequately lend itself to a precisely accurate specification of MIKRO-DISC 211 performance, owing to its hybrid nature. Average access time to a quarter of a Megabyte, one cylinder, is 8.825 msec. which is the drive's latency. Absolute worst case access time to the entire contents of the drive can be calculated as the total track move time from track zero to track seven, or 35 msec. (at 5 msec. track-to-track) plus one rotational delay time of 17.65 msec., or a total worst-case access time of 52.65 msec. This is faster than most other drive averages.

To obtain the average access time, several conventions can be used. The conventional specification, as adopted by most of the manufacturers, would be to divide the total track move time (35 msec) by three, producing an average access time of 11.66 msec. Still another valid calculation would be to simply halve the worst-case access time of 52.65 msec., producing a 26.325 msec. average access time. We have adopted a convention that considers actuator position over a central track, such as either track 3 or track 4 as a "home" track, then access to the entire contents of the drive is a maximum of 4 track moves in one direction and three track moves in the other direction, for an average of two track moves and 8.825 msec. latency, or an average access time of 18.825 msec.

Head/actuator

The recording heads are held against the disc surface by spring mounts. To keep from burnishing the magnetic coating on the disk, aerodynamic surfaces, called sliders, force the recording heads to lift away from the disc surface, against the spring force. The altitude at which the heads "fly" is microscopic, about 20 X 10^{-6} in. Four heads are mounted on each aerodynamic slider, and five sliders are attached to the spring mount to make up the 20-track head assembly. By grouping the heads in this manner, the sliders allow a slight articulation in the head assembly every four tracks to follow slight irregularities in the disc surface.

The head mount spring is attached to a parallelogram flexure which allows the actuator to move the assembly in a translatory manner from one cylinder position to another, but does not allow the head mount to rotate. This action maintains accurate track positioning.

Actuation is effected by stepper motor-driven band. Since only seven steps (eight positions) are required, this can be accomplished open loop without the need for a track-following servo or other electro-mechanical complications, and still maintain precise positional accuracy well within the existing state of the art. It also frees up an additional surface for data in future models.

Air filtration

Winchester disc technology requires the provision of a sealed environment with a filtered air supply. In the MIKRO-DISC 211 system, this is accomplished by recirculating the internal air through a HEPA (High Efficiency Particulate Attention) filter. The pumping of the air through the filter is accomplished by the disc rotation. A control plate separates an upper plenum chamber from the rest of the disc housing. One surface of this plate is located about 1/32-in. from the surface of the disc. At this distance, turbulant air flow due to the disc rotation is converted to laminar flow, and the disc acts as a centrifugal pump. An opening at the hub allows air to be pumped from the upper plenum chamber into the disc housing, evacuating the plenum. Air returning to the plenum must pass through the filter, thus continually cleaning the air as the disc operates.

Cost comparisons

Today's head per track disc drives exhibit typical access times of 8 msec. at a "most friendly OEM price" of about $0.0021/byte. The recently announced 8-in. Winchester-type moving head drives are exhibiting typical access times in the range of 80 to 130 msec. at an indicated "most friendly OEM price" of about $0.00015/byte. The New World MIKRO-DISC 211, exhibiting an average access time of 18.8 msec. and priced at $900 (1,000 units) compares favorably at $0.000428/byte, slightly higher than the moving head drives, but well below the head-per-track drives.

If a comparison based upon cost per byte/msec is conducted, the equation looks like: C = (Selling Price X Access Time)/Capacity. This equation provides the following values: head-per-track drives, $0.0000168 per byte/msec; 8-in. Winchester drives, $0.000015 per byte/msec; MIKRO-DISC 211 Drive, $0.0000077 per byte/msec.

New World Computer Co., Inc., 3176 Pullman St., Suite 119, Costa Mesa, CA 92626. (714) 556-9320.

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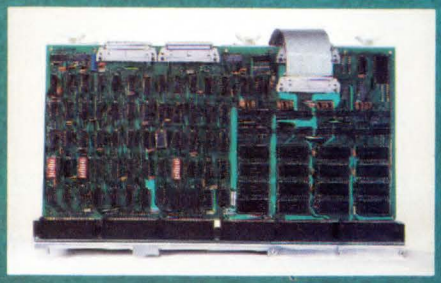

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CRT Graphics Enters New Fields

New markets for computer graphics will differ greatly from those of previous computer products. The data processing departments are neither purchasing the systems nor operating them. All of the decision makers and purchasers of computer graphics equipment have roles which are distinct and separate from the users' data processing departments. The dp department handles a company's general purpose business computing functions, but, at present, does not get involved in CRT graphics purchasing. Operators of graphic terminals are highly trained in their specialties (such as engineering, drafting or factory operation), but not in computer programming or computer sciences.

The market for CRT graphics terminals and turnkey systems will grow from $275 million in 1978 to $1.1 billion in 1983, with only 17% of computer graphics terminal operators trained as computer professionals.

Operators influence selection

The operator is an important influence on the purchase of computer graphics equipment; although he or she does not usually initiate the equipment purchase requisition, he or she participates in the selection process. The person who operates a CRT graphics terminal is not a low-level employee; 36% have college degrees, and all have technical training and special skills. However, computer sophisticates are in the minority. Not only do user companies not look for computer skill among their operators, but some – especially in CAD-CAM – actually want to avoid computer-skilled operators.

The operator inputs to a CRT interactive graphics system through the keyboard, which is integrated into the terminal, and/or through manual input devices such as the joystick, data tablet, trackball, or light pen, which are usually separate. The operator receives his feedback from the CRT screen. In some systems this will be the only output; in others, hard copy is produced. Plotters, photostatic copiers, magnetic tape or photographic film may provide additional output.

When CRT graphics equipment is purchased directly by the end user, the real decision makers are project engineers or specialists in computer graphics technology, in more than two-thirds of the cases; while the rest, the mechanical designer, engineer or other operator who uses the equipment makes the decision. Higher level approvals are often mere formalities. The end user's management does not usually concern itself with the selection of computer graphics in a CAD/CAM system, because their company's interest is focused on producing automobiles, aircraft – not on drawings. Approval is generally obtained relatively easily because CAD/CAM has been proven very cost effective in the past.

Users are varied

Among the important CAD/CAM users of interactive computer graphics are designers of complicated mechanical parts in aircraft companies such as Lockheed, Boeing, Grumman, and McDonnell-Douglas and in automobile companies such as General Motors, Chrysler, and Ford; designers of integrated circuit Patterns at Fairchild, Texas Instruments , National Semiconductor, Motorola and Intel; architectural and construction firms; and those who build pipeline systems.

CAD/CAM users generally like to buy turnkey systems, in which a complete graphics system includes a computer, associated peripherals, and operating software; 85% of the turnkey market is CAD/CAM, and this percentage is not expaected to chage through 1983.

Process control manufacturers who use CRT computer graphics include chemical processors like Dupont, Dow and Monsanto; electric power companies such as Commonwealth Edison; petroleum refiners such as Exxon, and pulp and paper companies like Scott and Boise Cascade. Those preparing reports are also likely users.

Management info systems

The use of graphics in management information systems is new. Because management is not presold on this graphics application, a champion is often needed who will fight to initiate purchase of the first system – most likely an executive or planner within the user company who has knowledge of computers (but rarely a computer company specialist). Although use of graphics in management reporting is still a small market compated with otehr graphics applications, CRT graphics for management will be a part of the central dp system and could routinely accompany sales and profit figures.

Want more information? Obtain "CRT Graphics Terminals and Systems Markets" from Venture Development Corp., One Washington St.,Wellesley, MA 02181. (617) 237-5080.

Gray Scale Printer "Zooms In" On Targets

The CEC Div. of Bell & Howell is expanding its data display product line with the introduction of the new CEC 912 Gray Scale Printer. A completely digital recording device, it prints images and/or alphanumeric information on electrosensitive paper with a resolution of 200 x 200 dots/in. The printer is capable of 16 true gray scales, and is a completely dry process (no heating or toning). Operation may be interrupted at any time. This rugged instrument is suited for mobile application in military and industrial sonar, and mapping of weather, sea floors and off-shore drilling sites.

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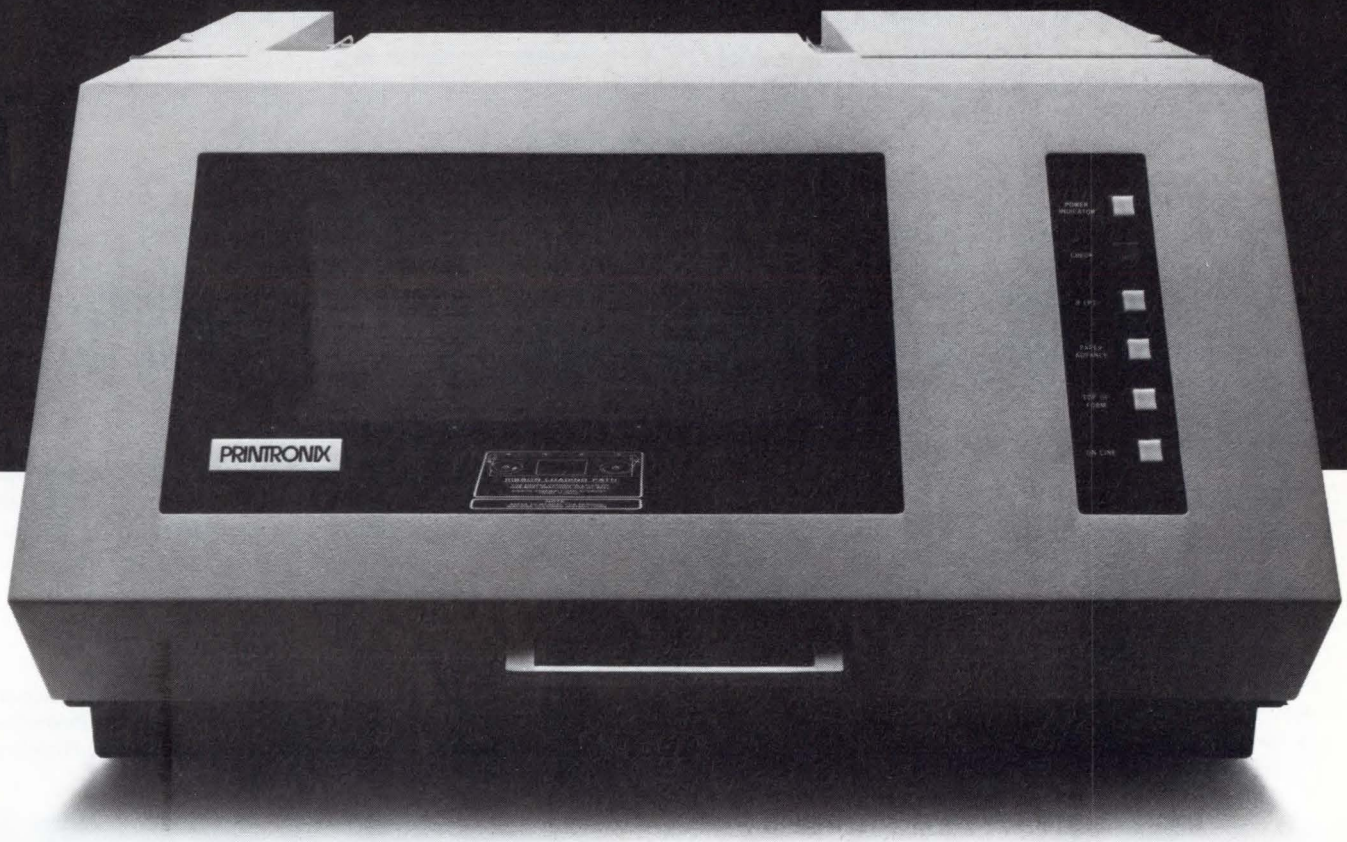

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System Designer's Guide to 8-Inch Hard Disk Drives

Paul Snigier, *Editor*

The 16-bit microcomputers are demanding more capacity. The double-side diskettes are having problems, price increases and more delays. Meanwhile, an upcoming generation of new computer systems is demanding concurrent handling of multiple users and tasks. The result? A gap for on-line mass storage lying between the traditional 14-in. hard disks and the flexible disk – one which is very well suited to the 8-in. hard disk (microdisk) drive.

Why use 8-in. hard disk drives?

Until the 8-in. hard disk, system designers of small business and multi-terminal systems would string up to four floppies together (or move up to a full-size fixed disk) and pass on the higher costs to buyers. With a maximum of 1.6 megabytes from floppies replaced by 20-30 megabytes of 8-in. hard disk storage – not to mention faster access time, elimination of media wear, and a 40% reduction in price over larger rigid disk drives – the reasons for such sudden interest in the new 8-in. hard disks become obvious.

Able to fill on-line mass storage needs for micros, minis and even small mainframes, the 8-in. hard disk drive lends itself to use as a cache memory or swapping disk in database systems, as quick-access and high-throughput mass storage for on-line applications, or even as the primary file store device in small or dedicated systems, including high-end personal computers! Such personal computers, small, scientific computers, word processing machines and other new applications need data bases from a few hundred thousand bytes up to several megabytes. By adding an 8-in. hard disk drive (probably a low-end type – more about that later), system designers can add several megabytes of fast access capacity on-line to present floppy capacity, and reduce average access time and retain file copies and secure back-up files. And, by increasing the number of users accessing the system and its data base, designers and system integrators can get a jump on their competitors and also retrofit existing systems.

Three categories emerge

IBM first began shipping computer systems that contained these small hard disk drives last February, although International Memories Inc. (IMI) was an even earlier entrant (May 1978). With 8-inch hard disks the highlight of NCC '79 (models and specs listed in adjoining table), it already appears that three distinct categories of microdisks will evolve: (1) slow access and low-capacity disks selling for a few hundred dollars under equivalent 14-in. hard disk drives, (2) on the other end of the 8-in. hard disk drive spectrum, high-capacity/high-performance microdisks, and (3) a mid-range grouping of microdisks.

High-performance microdisks

As a typical example of the high-performance microdisks, IBM's Model 62PC possesses 29 Mbytes on three platters all the way up to 64.5 Mbytes for six platters at its maximum. If desired, it can also add 131 kbytes of fixed-head storage. It transfers data at a 1.03 Mbytes/sec. rate.

Offered as part of IBM's 8100, Systems 38 and Series/1

The Memorex Corp. 8-inch rigid disc drive has a storage capacity of 11.7 Mbytes and provides small system users with the flexibility and cost advantages of compact design, and the enhanced reliability and performance of Winchester technology.

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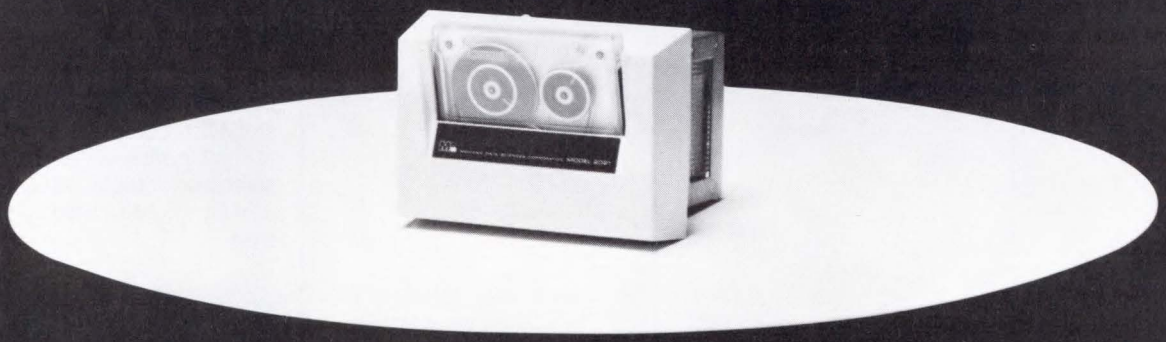
Applications like remote data collection, data communications, word processing, POS, and data entry are just a few ways that these drives are handling data in thousands of systems today.

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



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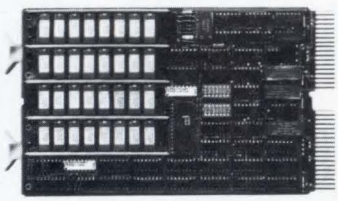
LSI-11

For high density LSI-11 memory expansion the dual height MSC 4601 gives you 32K to 64K bytes, with on-board distributed refresh, in a single option slot. Provision for battery backup. Addressable in 2K byte increments. Only $935 for the 64K byte version.



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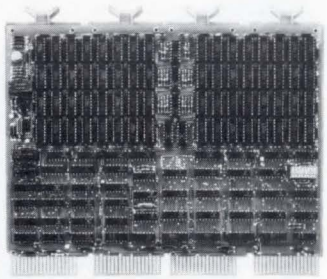
The MSC 4501 gives you up to 32K bytes in 8K increments in a single quad slot. Distributed or burst refresh modes are on-board switch selectable. $450 for 32K bytes is our best price ever.

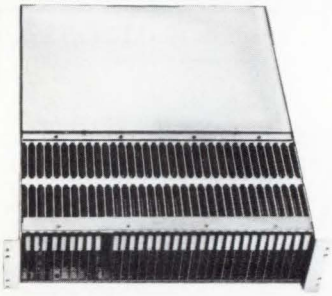


MSC 4501

IS THE BEST TIME TO BUY OUR LSI-11, PDP®-11 & PDP-8 MEMORIES. HERE'S WHY:

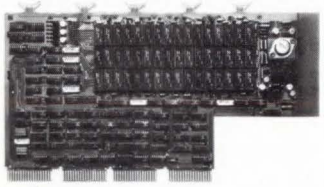
PDP-11

For expanding PDP-11/04 to 55 memory, the MSC 3302, with built in power supply, provides 32K to 248K bytes, with or without parity. Can operate with two CPU's, either singly or simultaneously. $7,370 for 248K bytes with parity.



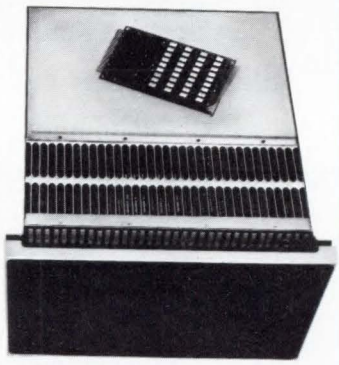
MSC 3302

The MSC 3303 fits 24K bytes into any, single DD-11 small peripheral slot. Works with PDP-11/04 to 55. A special version provides clearance for use with PDP-11/15's and 20's. Lower power and low price of $995.



MSC 3303

Our "intelligent memory" for PDP-11/70's has up to 4MB in 64KB increments, with ECC. Nonvolatile with battery backup. Built in microcomputer monitors and locates single bit and parity errors. At $35,210 for 2MB it's cost per byte is less than $0.018.



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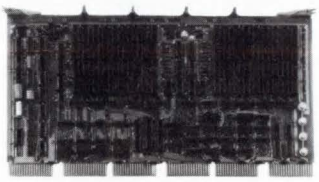
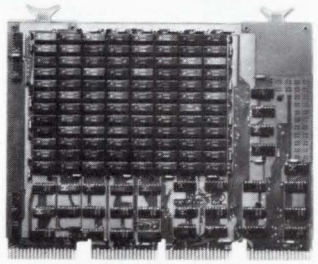
PDP-11/04/34 users can have 32K to 128K bytes, with or without parity, in a single, modified SPC slot. Provision for battery backup. On-board DIP switch assigns address start position on bus. $1,945 for 128K bytes with parity.



MSC 3603

PDP-8/A, E, F, or M

Get 8K words in a single OMNIBUS® slot for only $553. And our special price of $2,146 for four MSC 3102's gives many PDP-8 users full memory capacity.



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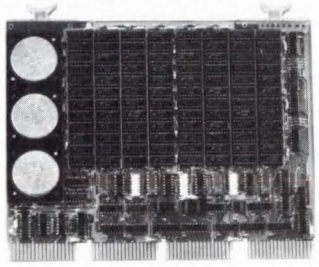
If you need a nonvolatile, low power memory, the MSC 3201 gives you 8K words with on-board batteries for $761. Our four board price is just $2,972. Has 30 day data retention and requires only 3.3 watts per board.



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systems, Model 62PC also comes in a stand-alone package (Model 3310). How much does it cost? And how does it compare with its traditional 14-in. relatives? IBM's Series/1 using its 13.9 Mbyte 14-in. drive is pegged at $6895; its 58 Mbyte 8-in. hard disk drive (with 131kbytes of fixed-head storage), $11,420 – or 1.66 times as costly, but offering 4.17 times greater storage capacity.

In terms of throughput (transfer rate), only Priam equals IBM's drive, tying it at 1030 kbytes/sec, although in terms of capacity, 20 Mbytes, Priam's entry falls short of IBM's 29 to 64.5 Mbytes.

On the low end . . .

Directly on the opposite end of the 8-in. hard disk spectrum lie several new entries. Kennedy's Model 7000 stores 4 and 12 Mbytes of unformatted data on one or two platters. Although its Winchester microdisk drive transfers data at 687 kbytes/sec, when compared to the 62PC/3310's transfer rate of 1.03 Mbytes/sec, it's 33.3% slower. The 7000's weight – 14 to 25 lbs., which varies with the number of disks – and its small size (5.25 x 8.5 x 16.5"), when combined with its low quantity price (previously reported to be approximately $1000 in quantity) will make it lower in cost than many others.

At the bottom of this spectrum is a new Pseudo-Winchester (unsealed and non-removeable media) contestant announced recently by New World Computer Co. – MICRO DISC Model 211.

MIKRO-DISC 211 is a low-cost, quick-access disk drive based upon a "Modified Winchester" technology. The micro-sized (210 in^3) drive features a proprietary low-mass multiple head assembly that provides ultra fast access to data. MIKRO-DISC 211 is a departure from conventional "mini-disks": its data access characteristics suit it for systems requiring high speed cache and mass store capability.

Specs? MIKRO-DISC 211 features include: 18.825 msec. avg. access time, 2.1 megabyte capacity, 6.052 Mbit/sec transfer rate, 9.5 x 11 x 2.0 inch size, 8.825 msec. t_a to 0.250 Mbyte, and 20 R/W heads. It consumes less than 50 W.

The low-mass, multiple-head assembly permits high recoding densities achieved by a 20 micro-inch flying altitude and simplified actuator mechanism that facilitates 5 msec track-to-track positioning time. Simplicity of head and actuator assembly make it economically feasible to provide 20 R/W heads/surface, and enables 8.825 msec avg. access time to a quarter of a megabyte.

The lubricated oxide disk's inside diameter is 2.5 in.; recording area is 1.6 in. wide, and the 211 provides 160 tracks, each 8-mils wide recorded on 10-mil centers. This assures high data reliability and is well within the current state of the producible art. Inside track diameter of 4.25-in.

8-Inch Winchester Disk Drive Buying Guide

FIRM	BASF	IMI	KENNEDY	MEMOREX	MICROPOLIS
Model No.	6171, 6172	7710, 7720	7000	101	1201,1202, 1203
Capacity (Mbytes)	8, 24	11, 20	4, 12	11.7	9, 27, 45
Average Access Time (millisec)	50	50	50	70	34
Throughput: Transfer Rate Kbytes/s)	800	648	687	593	705(MFM) 929(GCR)
Demensions (inches)	4.6x9x18	5.5x8.5x 19.25	5.25x8.5x 16.5	4.38x8.55x 14	4.62x8.55x 14.25
Media Size (mm)	210	200	210	200	200
Bits/Inch	6542	5868(11MB) 6000(20MB)	5280	6100	8750
Tracks/In.	500	300	300	195	478
Price (Single)	$3100(8MB) $3900(24MB)	$2990(11MB)	$2100(4MB) $2300(12MB)	1900	$3500(9MB) $3750(27MB) $4000(45MB)
Price (Quantity)	$2100(8MB)	under $2000(11MB)	n/a	$1560	1000(9MB) 1350(27MB)
Quantity Delivery Date	12/79	already ship 11MB 2/80(20MB)	2/80	4/80	2/80

provides for an unformatted capacity of 13,351 bytes/track (106,814 bits).

Soft error rates are less than 1 in 10^{10} bits, and hard error rates less than 1 in 10^{12} bits. Positioning errors are less than 1 in 10^6 accesses. MTBF for the MIKRO-DISC 211 is over 5,000 hrs.; and MTTR is under 30 min., a 10^4-to-1 ratio.

Dissipating less than 50 W, the 211 uses 100 VAC at 150mA (max) and DC voltages of +24VDC at 1.0A (max) and -5VDC at 75mA (max).

Mid spectrum growing

Between the IBM, NEC and Micropolis high capacity drives and Kennedy, Shugart and New World Computer low capacity drives lies the mid-range microdisks.

Most other entries at NCC '79 and other rumored 8-in. hard disk drives, fall or will fall into the mid-range of capacity. For example, Pertec's Model D8000's capacity is 20 Mbytes/sec; its transfer rate, 870 Kbytes/sec.

D8000 dimensions – 4.62 H x 8.55 W x 14.25 in. – allow both mechanical compatibility with a flexible disk drive and ease of mounting in most microcomputer systems without styling changes. System design impact is minimized by using the same DC voltage levels as those on floppy drives.

D8000 interface uses bi-directional command/status bus and byte-oriented data transfer to simplify communications between drive and computer. A single 50-pin connector also makes the interface simpler and easier to use in microsystems and minicomputers. A radial or daisy chain connection is available for maximum versatility. D8000 uses two aluminum alloy disks with three data surfaces and one prewritten servo surface. Lubricant-coated oxide disks allow the head to actually rest on the media. An environmental seal eliminates danger of contaminants.

Although International Memories Inc. encountered some fiscal difficulties shortly after it introduced its Model 7710 last year, this disk drive falls into the mid-spectrum in terms of capacity – 11 or 20 Mbytes.

Buyers of 8-in. hard disks are already lined up. For example, Cromemco of Mt. View, CA, a manufacturer of microcomputers and peripherals, will use IMI's 7710 drives in Cromemco's Z-2H Computer Systems, which will sell for under $10,000. SORD U.S.A. will use the 7710 drives to upgrade their microcomputer-based intelligent terminals and their small stand-alone business system by replacing floppy disks with the rigid disk drive.

Model 101 from Memorex Corp. is the first in a planned family of 8-in. rigid disk drives with more than seven times the capacity of the largest flexible disk drive, yet occupying the same small space. The 101 drive features 11.7-megabytes of fixed storage capacity on two disks. It provides

NEC	NEW WORLD	PERTEC	PRIAM	SHUGART	SLI
	211		D8000		Sli Mini Fox
47.5	2.1	20	20	5	51.2
30	18.825	50	50		38
1198	756.5	870	1030		705
4.62x8.55x14.57	9.5x11x2.0	4.62x8.55x 14.25	4.62x8.55x 14.25		8.75x5x 14.75
	200	210	200		200,210
	8000	6688	6370		8750
	100	476	480		478
	$3000	$3000	$3000		2500 (less electronics)
From $2950	under $1000	$1800	$1500	under $1000	400
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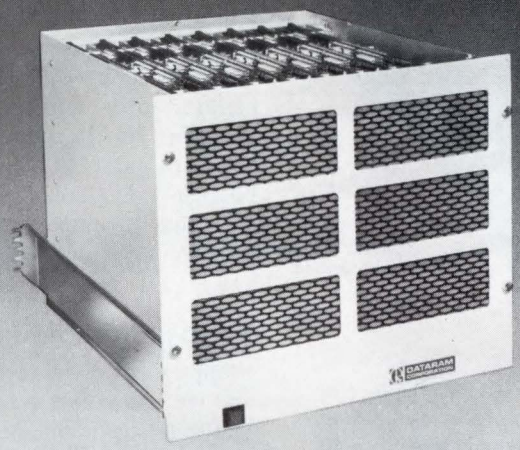

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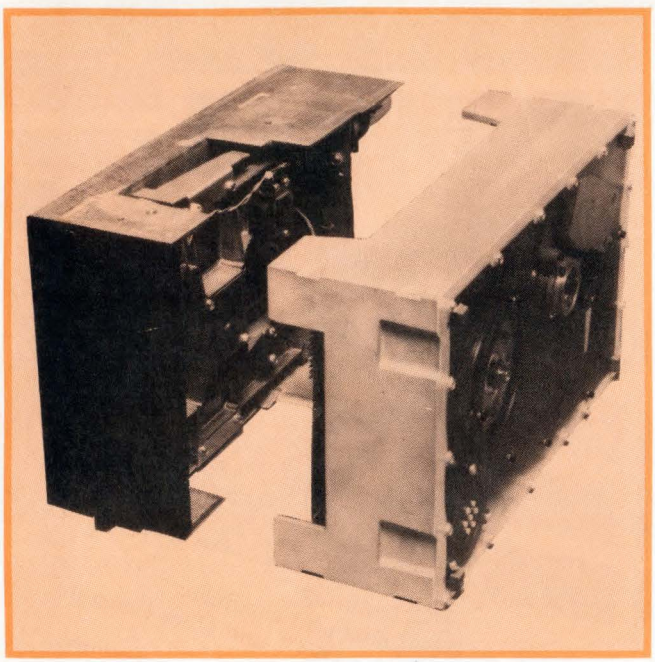


Rigid vs. floppy – The device at left is a typical 8-inch floppy disk drive with 143,000 bytes of storage. The Micropolis Microdisk at right is about the same overall dimensions, but can store up to 45 million bytes (unformatted).

many of the same high performance and enhanced reliability advantages found in the company's recently announced 635-megabyte end-user drive, but in a greatly condensed format.

Memorex claims several exclusive features, such as the direct drive spindle motor. By incorporating the motor with the hub, the 101 eliminates belts, brackets, and side-loaded bearing wear, enhancing system reliability and lowering costs by reducing parts count.

Memorex lists capacity as: drive – 11.7 MB; per surface – 2.9 MB; per track – 12,000 Bytes. As for data retrieval times, track-to-track access time is 20 msec; avg. latency, time, 70 msec; max. access time, 120 msec; avg. latency, 10.1 msec. Required voltage is +24 VDC ± 10% @ 7A; + 5 VDC ± 5% @ 2.5A; - 5 VDC ± 5% @ 250 mA. VDC ± 5% @ 2.5; - 5 VDC ± 5% @ 250 mA.

Micropolis' 1201, 1202, 1203 offer 25,000 MTBFs and optional capacities of 9, 27 and 45 megabytes, respectively, in a unit profile that measures 8.55 W x 4.625 H x 14.25 D in. (excluding optional bezel), permitting full interchangeability, including matching screw mounting holes, with a typical 8 in. floppy.

Variations in capacity are determined by the number of non-removable 200 mm platters, up to a maximum of three. A three-platter version provides five recording surfaces, each with 8.975 megabytes of unformatted storage. Access time averages 34 msec, twice that of the new low-end 14-in. drives.

The optional intelligent controller board ($500, OEM qty.) allows selection of a number of standard hard-sectored formats, ability to handle four drives, direct or buffered data transfers, automatic verification and re-tries, multi-sector trasnfers, error correction and a versatile command structure.

Filling a spectrum gap

System designer's desire for 8-in. hard disk drives stem from several market and design pressures, with floppy disks and traditional hard disks leaving a gap between them that has been unfilled; and with the demands of 16-bit micros and new small business markets growing stronger, this gap in the spectrum must be filled.

From the top end, 14-in. hard disks such as Shugart's SA4008 can offer 29 Mbytes at $1800 or so in quantity. Although it loses on a size comparison, it more than makes up on a cost/bit basis.

A Shugart Associates' spokesman who refused to say too much about their 8-in. hard disk drive (it will be a 5-in. Mbyte unit selling for under $1000, in quantity), did reveal that, "When our 8-in. hard disk drive enters the marketplace, it will create a sensation." Target date for market entry remains guarded. Earlier, Executive Vice President Jim Bochnowski had stated that the chances for Shugart's entry into the 8-in. hard disk market were good, but had hinted that since dozens of companies were also preparing to enter it, that this (anticipated competition) made it less interesting, but that Shugart was nevertheless looking into bringing out an 8-in. hard disk.

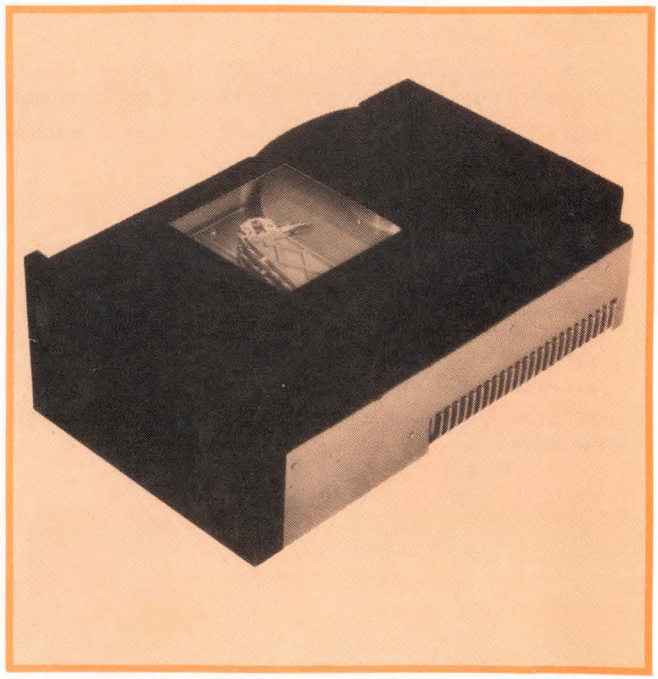
Floppys strike upward . . .

Floppy disk drive technology has by no means matured; and we can expect great improvements in design and manufacturing for double-headed and related technologies. For a system designer who's looking for a cost-effective alternative to floppies – and who doesn't mind the greater difficulty removing the 8-in. disks from their drives (unlike floppies) – then 8-in. hard drive is a choice to consider.

If backup mass storage is a consideration, floppies can be used, although a 27 Mbyte microdisk with only 1.6 Mbytes of flexible disk storage isn't exactly desirable. If high-density cartridges are integrated into your system, this could alleviate the backup problem. System designers see the backup problem occuring in two situations: (1) exchanging bulk-stored data between systems and (2) data dumps of microdisk contents onto a lower-cost medium (such as reel-to-reel tape or cartridges) at given intervals.

As for media size, most units listed in our chart show that

PCC's Model D8000 uses Winchester-technology and has a capacity of 20 Mbytes. The D8000 disk drive fits into a flexible disk "envelope" to solve mass storage needs.



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- Model 610 DEC PDP-11® Cartridge Disk Controller
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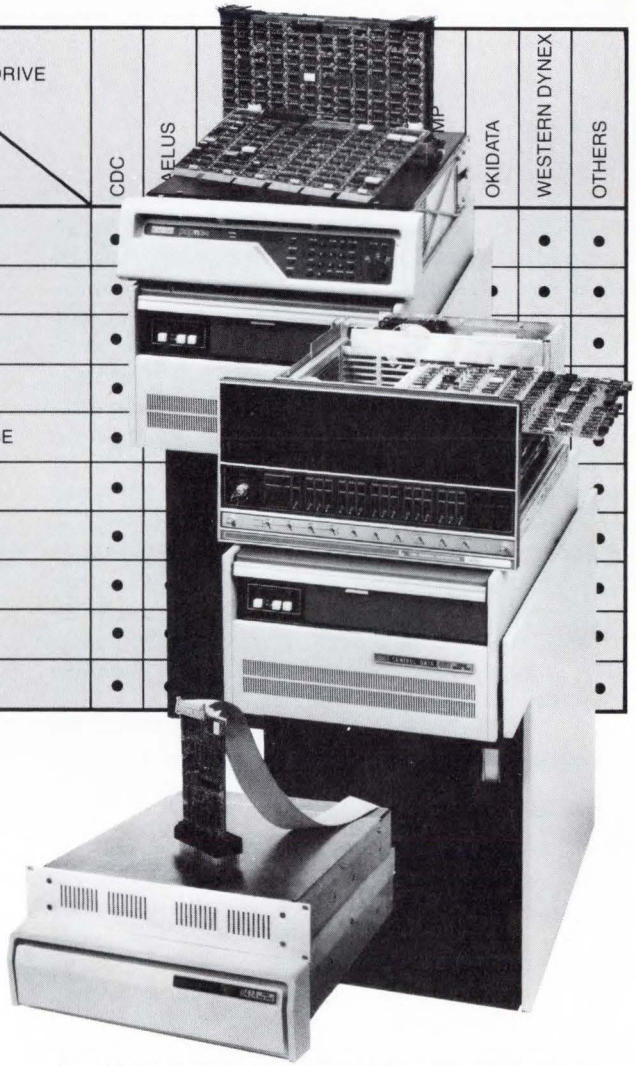
- Model 211 DEC PDP-11 Storage Module Disk Controller
- Model 850 Data General Nova/ Eclipse Storage Module Disk Controller

CPU \ DRIVE	CDC	ELUS	MP	OKIDATA	WESTERN DYNEX	OTHERS
DEC LSI-11	•				•	•
DEC PDP-11	•				•	•
DEC VAX	•					•
D.G. NOVA	•					
D.G. ECLIPSE	•					
INTERDATA	•					
SEL	•					
INTEL	•					
MOTOROLA	•					
OTHERS	•					•



Systems designers know that the latest microprocessor technology goes into Xylogics controllers, insuring superior performance. Users of Hewlett-Packard, Varian, Interdata, Honeywell and many other mini/microprocessors may also find Xylogics technology applicable to their systems needs.

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Shugart Assoc.
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Circle 135

SLI Industries, Inc.
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Woodland Hills, CA 91367
213-884-7300
Circle 136

Note: Only International Memories is shipping OEM quantities at this time.

size is either 200 or 210 mm (0.0874 or 0.08268"). The larger 210 mm offers greater stability due to its greater angular momentum at greater speeds. As a result, the R/W head can fly closer to the disk surface, permitting a greater bit density. Although this advantage (2-3% or so) is alleged to be small, BASF claims this argument for the 200 mm disks. BASF, which had been providing 210 mm evaluation disks to users, discontinued its 210 mm microdisk, which is not listed on our chart.

Double-sided diskette drives have encountered unforseen production difficulties; and, according to W. Ferrel Sanders, Vice President of Marketing at Shugart, "The increase in manufacturing difficulty involved in double-sided drives versus single-sided was underestimated. Shugart's first assessment was that a double-sided drive could be manufactured at a cost about 25% over that of a single-sided drive. That estimate proved unattainable."

In fact, the difficulty of manufacturing heads for double-sided floppy disk drives was a major factor in the announced price increase of the SA850 – from $485 to $580 in 500 quantities.

Sanders then added, "Shugart's manufacturing and engineering groups have been engaged in extensive testing and evaluation of all technologies, and it is their judgement that there is no double-sided head technology today that can be mass produced cost effectively."

Sanders noted that, while one or two companies may claim manufacturing levels that appear satisfactory for mass production, the yield for *all* companies is unacceptable. "The improvement in yield, achieved through our planned enhancements in manufactureability of double-sided heads,will create the breakthrough to cost-effective high-volume production." Sanders said this was expected in early 1980.

Can the SA850/851 diskette storage drives and others like it hinder the low-end 8-in. hard disk drives? Yes, these enhanced double-headed versions of the standard SA800/801 drives provide up to four times the on-line storage capacity, faster access time, and lower heat dissipation, along with improved reliability and maintainability over the standard 800 versions. The SA850/851 drives read and write, in single- or double-density, on standard diskettes and on both sides of two-sided diskettes.

If manufacturers can quickly solve their double-sided floppy disk problems, they could erode the lower spectrum of the 8" hard disk market.

Three methods can raise floppy capacity to hinder growth of 8-in. hard disk drives: double-bit density (changing the way of encoding bits on the floppy disk to permit more information encoded on it), (2) double-track density (placing disk recording tracks closer) and, most likely, (3) double-sided diskettes. Double-bit density is nothing new and double-track density is sensitive to climate, expanding unevenly and requiring a compensating servo mechanism. Of course, access time improvements won't improve data access time unless latency times (set at 360 RPM for 8-in. floppies) are lowered. So double-sided diskettes are the most logical way to significantly increase capacity, despite manufacturing troubles.

Bubble trouble ahead?

Magnetic bubble memories won't impact the low end of floppies or 8- in. microdisks until the mid-1980s. Although anticipated to approach floppy cost/bit on-line storage by then, floppies' offline storage advantages will remain unequaled – perhaps a hundred times lower in cost. But we can expect to see system designers combine floppies or microdisks with bubble memories to utilize the bubble's fast access time in something like a cache store, reading a couple of tracks at a time, thus increasing microcomputer system speeds.

One thing is now certain: 1979, the year which has already seen the 1 megabit bubble and first real use of 16-bit micros, is also the year that saw the 8- in. hard disk drive enter the market. System designers preparing products for the 1980s are advised to evaluate the new 8- in. hard disk drives for their needs.

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IQ 120

The SOROC IQ 120 is the result of an industry-wide demand for a capable remote video display terminal which provides a multiple of features at a low affordable price. The IQ 120 terminal is a simple self-contained, operator / computer unit.

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Data Acquisition/ Microprocessor Interface Performance Analysis – Part 1

N. Jagannathan
Univ. of California, Irvine

When it comes to speed, data rate and other factors, minis still beat micros. Then why do so many engineers choose microcomputers for so many signal processing functions? Let's see why and show how to circumvent certain performance limitations plaguing μP interfaces in typical signal processing environments. We'll also look at the trade off between cost, speed and data rate.

Converter selection tradeoffs

Electrical signals can be processed by analog or digital. Analog circuits provide many degrees of freedom, offer noise immunity, speed and accuracy that vary with signal level and component tolerances, and provide functional simplicity, speed and low cost. Digital circuits also offer advantages – high noise immunity, simplicity of use, high speed and no drift. Which should you choose? You must consider cost, speed and accuracy tradeoffs to determine the type of processing to select for your specific application.

Except for pre-amplification, all processing functions can be performed digitally after analog-to-digital conversion. The low cost of digital ICs and increasing chip complexity make digital processing easier and cost effective compared to many analog functions. Typical examples include μPs, with arithmetic logic and ROMs.

How you'll approach interface design depends on the input signals and type of processor. Input signals are defined by their signal level, source/load impedance, signal/noise frequency spectrum and environmental specifications (temperature, humidity, shock, vibration and so on). Operations performed on input signals vary from simple delay for digital signals to real time spectral analysis; and typical operations involve filtering, measurement of correlation between two signals or implementing an FFT. Interface output signals – whether analog, digital or even a number are identified by their accuracy and data rate.

What problems will you run into when designing an interface? There are three types: • data acquisition and distribution, • converters and • processor (**Fig 1**) – and we're going to look at the limitations of each, plus trade offs between cost, speed and accuracy. For our particular application, although we'll use the 8080A and Z-80, and not the Z8000, 8086, or 68000, you can easily apply these principles to any other μP.

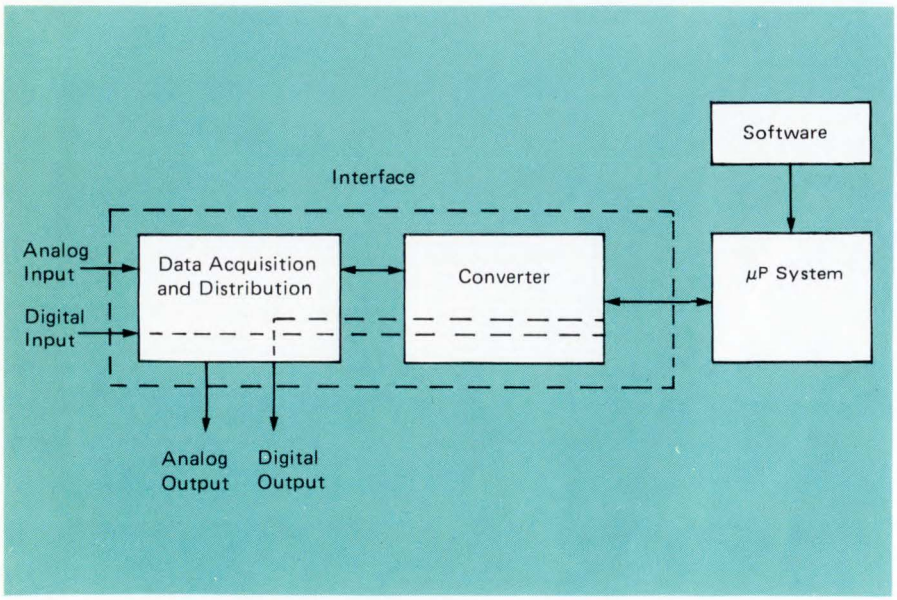
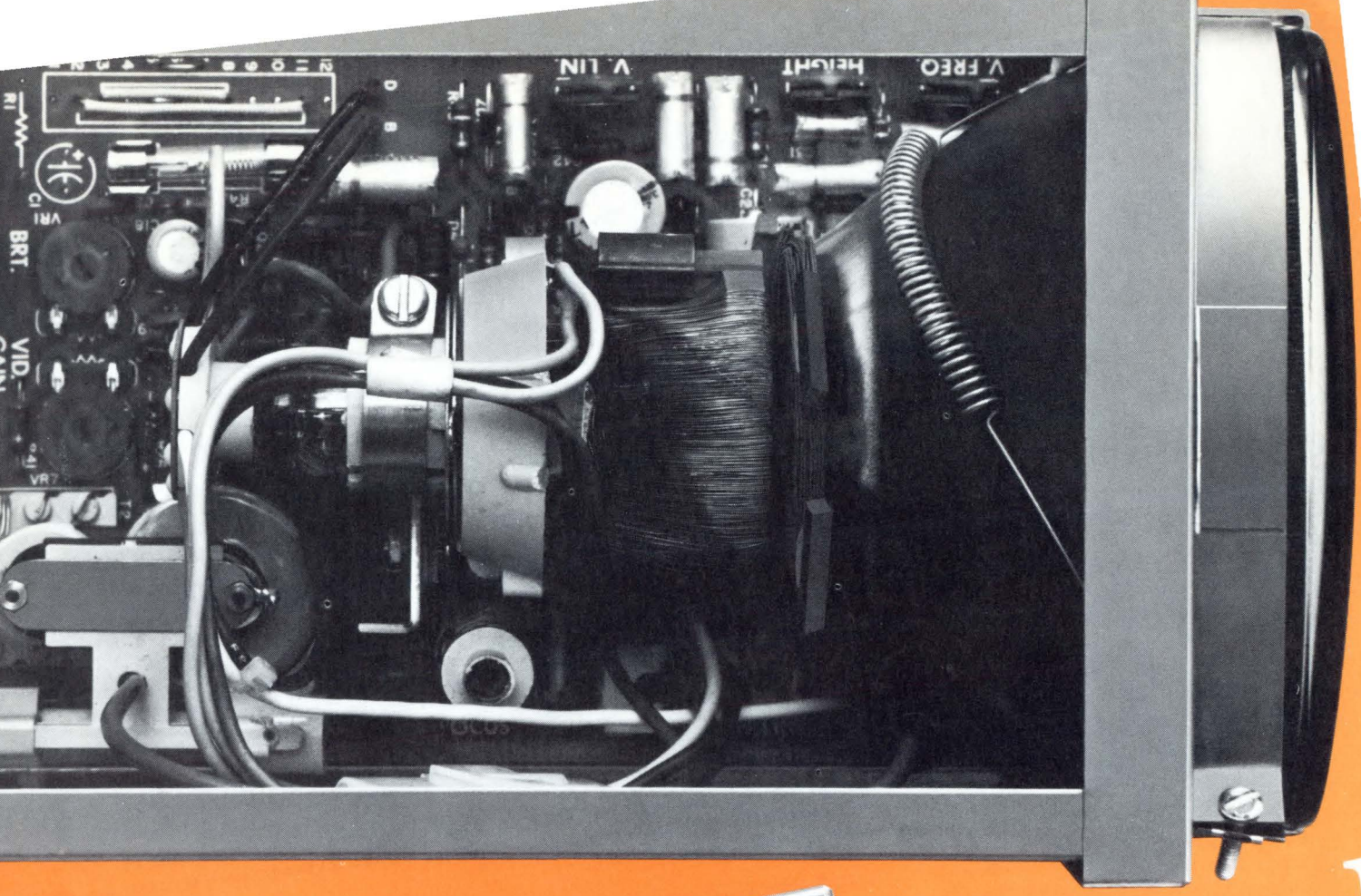


Fig 1 In the basic system, N input signals are processed, yielding M output signals.

The interface block: an overview

Input signals on the interface's input channels, whether analog or digital, are either precision signals (from favorable environments such as in medical instrumentation and laboratory data) or are ordinary signals from noisy environments – both analyzed by their noise properties, accuracy, signal level and frequency response. Data source impedance is important; it significantly influences measurement accuracy when the interface is used.

Depending on user preference, interface output signals are analog or digital. If analog, the output signals are characterized by their accuracy and drive capability (since these processed signals are sometimes used for recording purposes); if digital, they are specified by their logic levels, data format and data rate. Signals between interface and processor are digital, generally positive logic TTL-compatible and speci-



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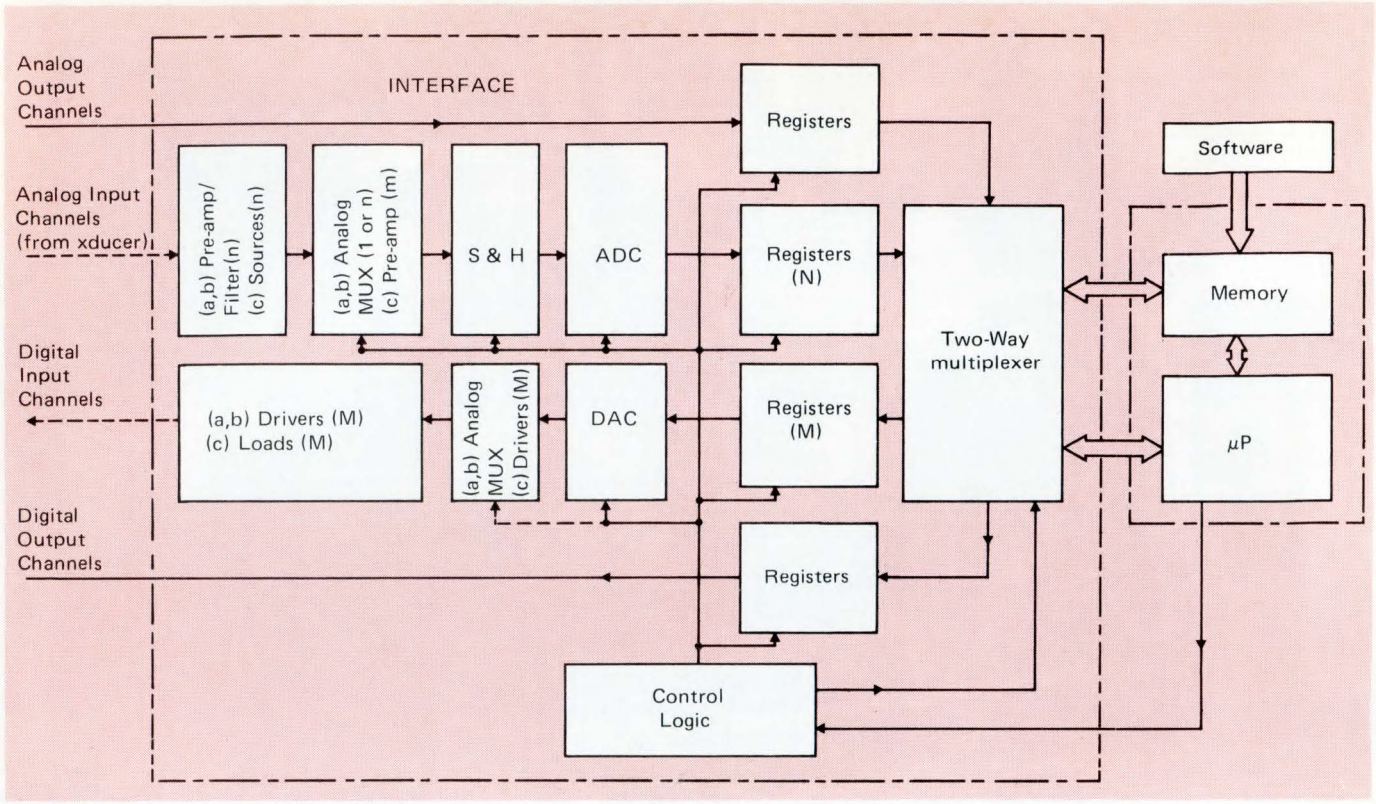

Fig 2 This block diagram represents three converters: (a) As an interface with one ADC and one S&H, the dotted line signals included and there is one analog MUX. (b) As an interface with one ADC and N S&Ss, there is only one change — N analog MUXes. (c) But for parallel conversion, the dotted signal lines do not exist and the four leftmost block functions are different.

fied by their logic levels and format and you'll be interfacing logic levels of various logic families with the data format deciding the code accepted by the processor. While it's true that most processors accept a wide variety of codes under software control, most interfaces are normally designed for a particular code.

Interface arrangements

How many different ways can you configure an interface? Various arrangements are possible to suit a particular application, and **Fig 2** shows three. Input signal voltages are filtered and amplified by n pre-amplifiers and these voltages are applied to the inputs of the A/D converter one at a time for conversion. The converted digital signals are stored in n temporary registers before being sent to the μP through a two-way MUX. An ADC takes a finite amount of time for conversion and its input must be held constant by sample-and-hold (S&H) during conversion which reduces conversion time for converting fast-changing input signals. Since more than one channel of input will be converted, you must use an analog multiplexer when designing an interface.

A D/A converter converts the digital output signals back to analog form. Registers preceding the DAC (**Fig 2**) store digital code to be converted. Next, an analog multiplexer (analog MUX) and M drivers distribute the analog output to more than one load. Digital I/O signals are connected to the μP through the two-way MUX and registers in each and every digital channel. Typical digital sources or loads include video terminals, keyboards, line printers and paper tape readers.

The three approaches, advantages and disadvantages in terms of cost, speed and accuracy mean a trade off, which must be reached before selecting a particular arrangement. Multiplexing n S&H outputs provides better speed and data rate, but at greater cost and logic complexity. In parallel conversion, the analog input channels are replaced by n sources and pre-amps feeding n S&Hs. Instead of M drivers providing analog output channels, they drive M loads in parallel conversion. So, what are the advantages? High speed, high accuracy and high data rate.

In addition, with parallel conversion you may use modest accuracy, medium-speed and lower-cost converters. With parallel conversion, each signal is converted at its source using n ADCs, and the digital signals are then transmitted to the two-way MUX through cables. Even though the setup has high noise immunity, the cost of running cables from different sources and loads with a converter at each and every source and load is considerable. Of the three basic arrangements mentioned above, we will discuss the interface with one ADC and one S&H.

Fig 2 shows input analog signals from n different sources amplified and filtered in n pre-amp/filters. They have pre-determined gain and bandwidth characteristics that are directly related to signal level, S/N ratio and input signal spectral density. The amplified signals are then multiplexed using a N:1 analog MUX to the input of a S&H that acquires a particular channel under control from the μP through the control logic. After acquisition and upon receiving the convert command from the control logic, the S&H goes to the hold mode and the ADC initiates the conversion. The converted signal, stored in the registers at the ADC output, are accessed by the μP under software control. Digital output from the μP is stored in the input registers of the DAC and, upon command, converted to analog form. They are then distributed through the analog multiplexer and drivers to the various loads.

Software can influence interface operation considerably through control logic. The pre-amplifiers' gain can be made programmable if input signal range varies with time and the ADC's full resolution is required. A scale fac-

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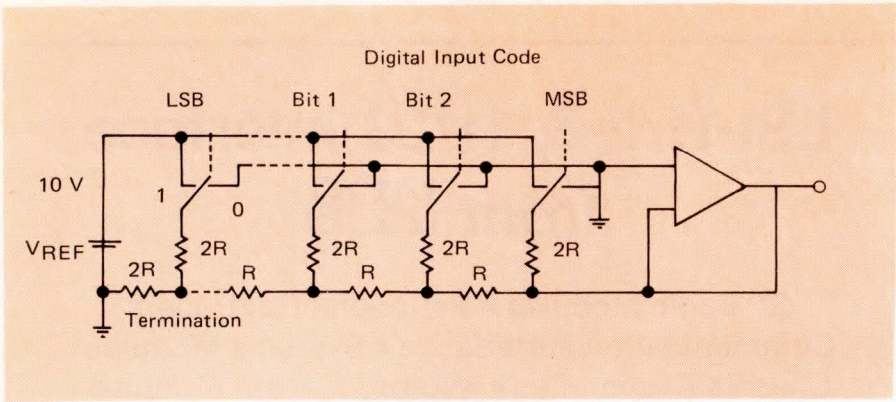

Fig 3 General circuit showing D/A converter using R-2R ladder network. The LSB switch is closest to the reference source; the MSB, farthest away.

tor must then be applied to the signals while decoding and before processing them, with level shifting and introducing arbitrary offsets (if needed) done at this stage.

What we've done so far is to get a general picture of the interface. Now that we've seen the interface, let's take a closer look at the functions of the individual components we've described and examine their limitations.

Pre-amplifier/filter

The pre-amp/filter scales transducer input signals and raises the signal-to-noise ratio (SNR). What separates a good pre-amp/FL from a poor one? Specific requirements depend on each analog signal's magnitude and spectrum. The pre-amp must amplify the analog input signal to the ADC's full-scale range to provide the highest resolution. A filter removes noise and unwanted signal harmonics. Higher input signal frequency components are eliminated at this level based on the ADC's sampling rate. Common mode signals are avoided by using isolation amplifiers before the signals are actually sampled. Select amplifier gain, bandwidth and slewing characteristics for optimum performance. If the input signal level varies between two widely distinct levels (wide dynamic range), range compression is needed before conversion; logarithmic amplifiers are used for this purpose at the input stage. Level shifting and removing offsets (fixed dc signal present in the analog channel) are also made at this stage of the interface.

Analog multiplexers

It is at times necessary in a μP-based system to accept and distribute data to many analog channels by an analog multiplexer, and all analog I/O channels are connected to the ADC/DAC through this subsystem. A particular channel is accessed by the interface in a pre-determined fashion depending on the input signals and type of processing. Sequential (selecting the channels in the increasing or decreasing numerical order) or random addressing are commonly used modes. Switching rate and the frequency with which one particular channel is sampled depend on the number of channel and MUX settling time after switching from one channel to the other. A suitable addressing scheme is selected under software control depending on signal amplitude, its dynamic range and its dv/dt characteristics. An input channel's dv/dt characteristics specify how fast the input signal level changes and how often it occurs so that sampling time and sampling rate can be synchronized for the best accuracy.

Analog multiplexers have problems – cross talk between channels and leakage current effects limit interface accuracy. Cross talk is frequency dependent; leakage current depends on MUX ON resistance (10 to 300 Ω). For optimum performance, good channel isolation is a must.

D/A converters

But it's not so easy in a μP-based system to implement a signal processing function by analog methods. Since many signals are analog, it is necessary to convert the signals after processing back to analog form with a DAC, which converts the digital code to analog form within a specified accuracy and accepts a particular code for conversion. How? With input registers, and under software control, a DAC converts different input codes.

What must you look for in selecting a DAC in an interface? The four criteria include 1) resolution, accuracy, linearity and monotonicity characteristics, 2) speed requirements and type of output (voltage or current), 3) logic levels and type of digital code available for conversion and 4) operating temperature range. Exactly what to look for depends on your type of application. Should you chose modular or monolithic converters? Your choice depends on all the above criteria. Select the number of DAC bits according to the 1 LSB (least significant bit) resolution and accuracy needed. Linearity errors are important in DAC design; they influence the converter's accuracy and monotonic behavior. **Fig 3** shows the basic DAC schematic.

How does a DAC work?

The two most commonly used D/A conversion techniques are binary-weighted resistor and R-2R ladder networks. With weighted resistor networks, n switches (one for each bit applied to the input) are each in series with one resistor. The MSB single-pole, double-throw switch, S_{n-1}, switches 2^{n-1} R in or out so that current flows through it or not. The LSB switch, S_0, switches

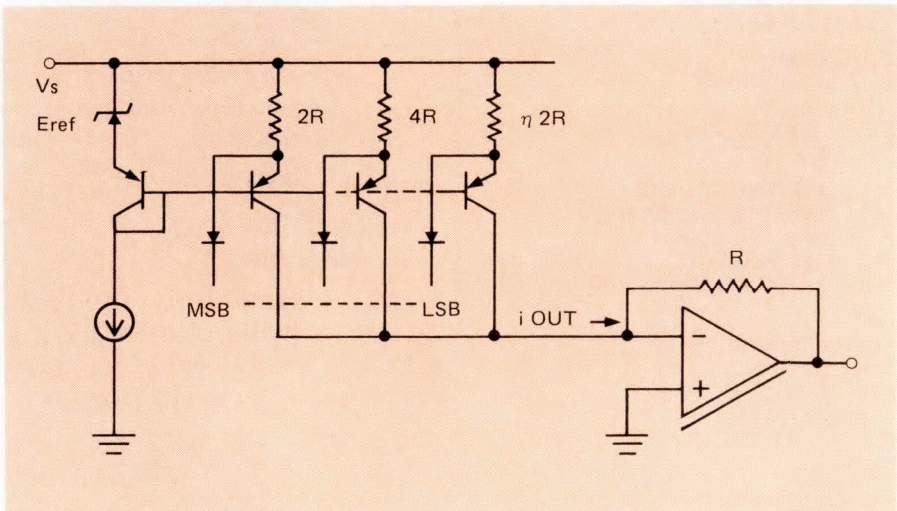

Fig 4 Basic schematic of a current-switching DAC shows how bit-switching transistors and network provide the combined current output, depending upon bit levels.

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$2^{n-1}R$ in or out. For each lower bit, contribution to total current is less by a factor of two, so that resistor accuracy and stability need not be so exacting on lower order bits. By switching bits, source voltage is either applied across that bit resistor or not; and a summing element sums the currents. The MSB switch and its R resistor are farthest from the summing element; the LSB and its $2^{n-1}R$, closest.

For a 12-bit DAC, resistor range is 4096:1, or 40 MΩ for LSB if MSB equals 10 kΩ. Unfortunately, fabricating this wide range in thin- or thick-film, or IC form, is impractical; discrete resistors suffer from size and cost, inventory woes and lose tracking advantages.

To eliminate the weighted resistor network disadvantages, the R-2R ladder network (**Fig 3**) circumvents the resistor range problem by using an extra resistor/bit. Because the R-2R ladder network is linear, each bit switch and its 2R resistor is independent of the other sources, in being summed by the op amp to yield a resultant voltage. The MSB switch is closest to the op amp; the LSB, the farthest. If E_{REF} is reference voltage, the modes contribute

$$-E_{REF}2^{-n}\sum_{i=0}^{n-1} a_i 2^i$$

where a_i equals zero or one if the ith switch is 0 or E_{ref}. Since the R-2R DAC doesn't use a wide range of resistances, it's easy for DAC manufacturers to use it in monolithic ICs. Other advantages for R-2R ladder structures exist – better temperature tracking and accuracy. DAC speed depends on its comparators and output amplifier; their gain characteristics and slewing response together with the converted signal's settling time define a clear upper range in DAC speed. DACs come in two types – current DACs and the faster voltage output DACs. Can we further increase the speed of a DAC? Yes, by using high-speed comparators and monolithic quad current switches (**Fig 4**). However if current output is used to develop a voltage in a later stage, this could cause common mode problems. So, you must reach a tradeoff *before* selecting the DAC's output. Gain errors and drive requirements depend on the output amplifier and must be adjusted.

Component tolerances and reference stability affect conversion accuracy and lead to zero and offset scale errors. Static and dynamic errors contribute significantly to the converter's accuracy. Voltage drops in ground loops cause a DAC's static errors.

Proper layout is a must

What makes a proper layout? Analog and digital lines are shielded; unshielded analog and digital lines are not run in parallel; and if at any time they have to cross, it is done at right angles to each other. Separate ground returns for analog, digital and power are tied together only at one point to avoid circulating currents in ground leads and digital transients affecting analog circuits.

DAC dynamic errors result from contact resistance of connectors, improper layout, inductances and capacitances associated with lines leading to parasitic oscillations. To avoid power pickup problems, bypass power supplies at each and every terminal. Use deglichers to hold DAC output at a constant level during switching, depending on the digital code used for conversion. Linear filtering of gliches is impractical because they're non-uniform and random. Since input registers are provided for, updating a DAC is not a requirement (unless demanded by the system application).

Obstacles remain . . .

So far, we've seen that despite certain shortcomings of microcomputers (with comparison to minicomputers), many system designers choose microcomputers for many signal processing applications. Despite the growing use of newly-introduced 16-bit micros, or 16-bit micros about to be introduced, such as the 8086, Z8000 or 68000, certain limitations still remain as obstacles hampering microprocessor interfaces within most signal processing environments.

In the design of interfaces, designers encounter three problem categories – in data acquisition and in distribution, in converters and in the processor. We examined several different ways to configure an interface, each suited to its own particular application, and then made an overview of DACs, preamplifier/filters and analog multiplexers.

In Part 2 of this two-part series, we will briefly cover ADCs, S&H devices, interface registers and two-way multiplexers before examining the effect of buses upon data handling. Other topics will include input multiplexers, tri-state drivers, synchronization and I/O selection and block data transfer.

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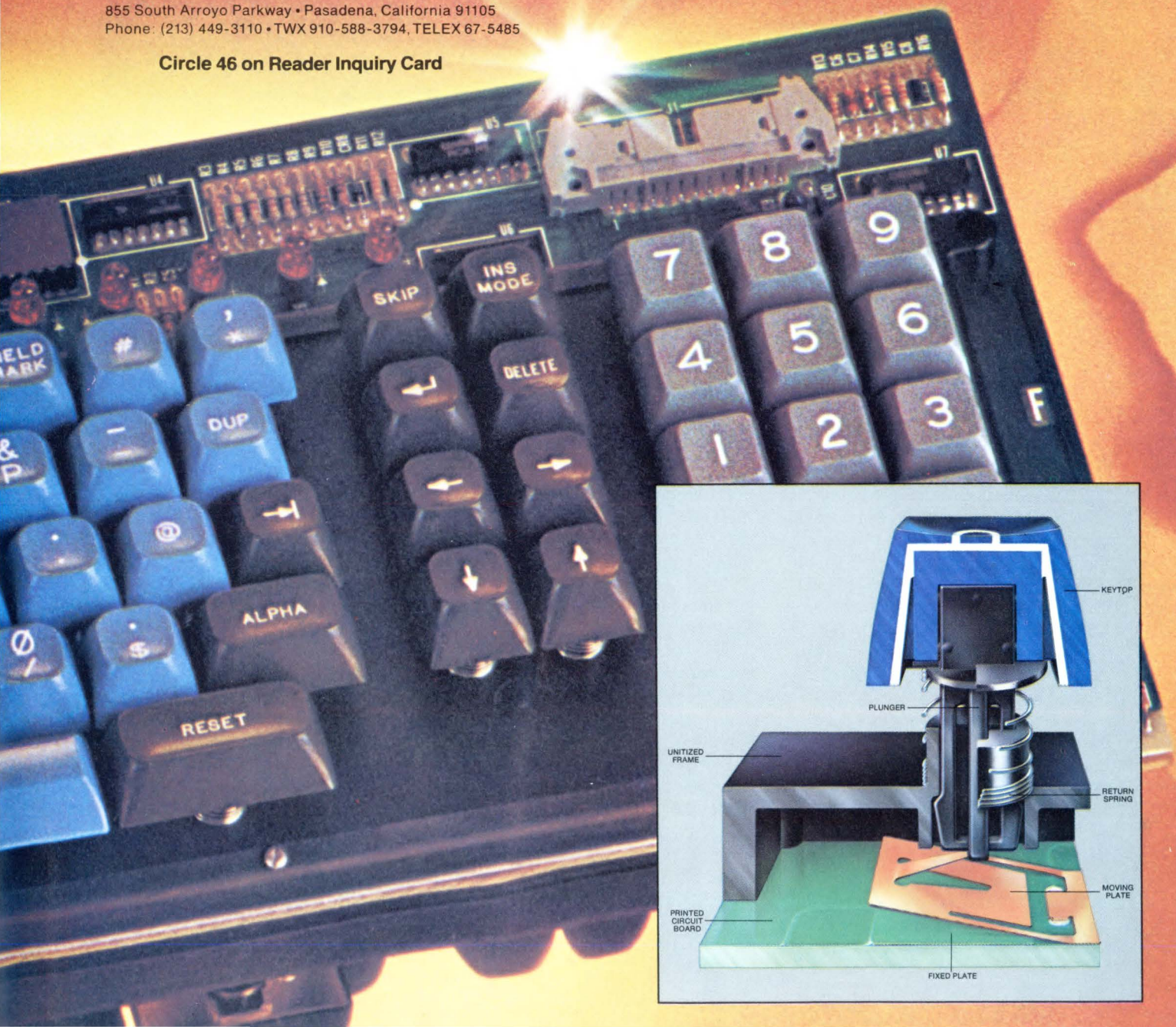
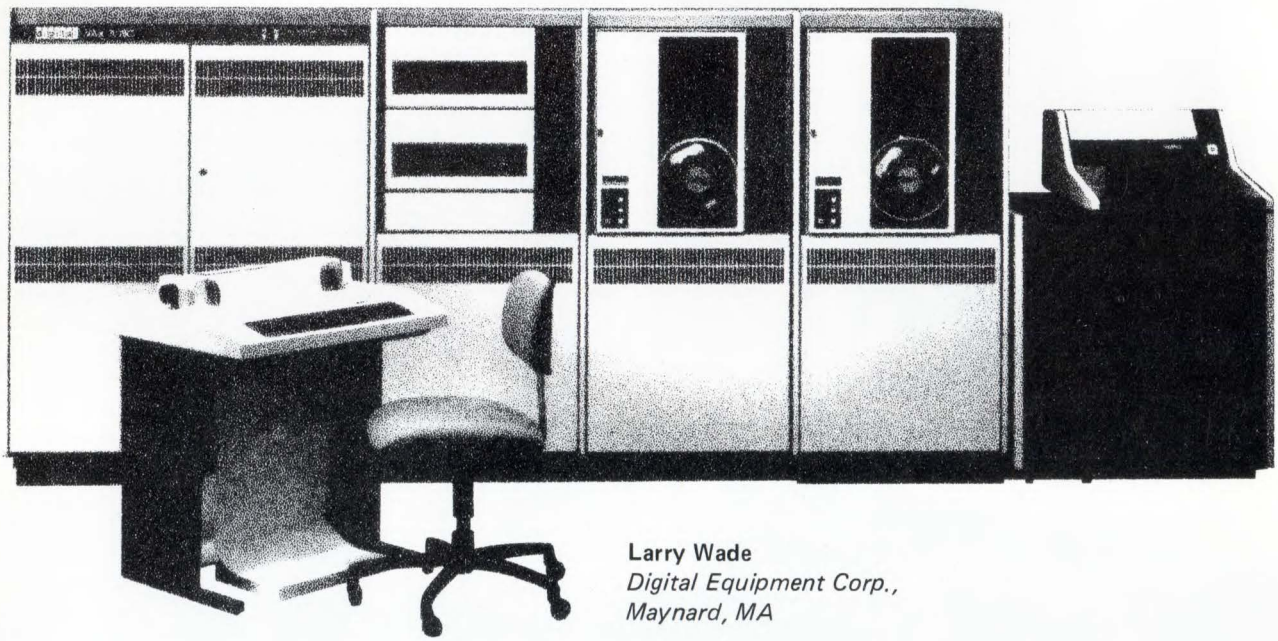


Superminis: Evolution or Quantum Jump?

Part Two



Larry Wade
Digital Equipment Corp., Maynard, MA

In the first half of this series we saw how a new computer, with proper organization, can be related to a family, yet not be a direct lineal descendant. For the PDP-11 family, the need for such a superminicomputer led to a computer with a 32-bit wordlength.

32-bit superminis

The VAX-11/780 was the result. The 32-bit machine was developed by Digital in a manner that took advantage of its longer wordlength yet kept a strong "family" relationship to the 16-bit PDP-11 line. Organizationally, it appears to be different, but close examination of its architecture shows a strong level of "eleven-ness," including use of one or more UNIBUSSES (block diagram on page 42).

The central element of the VAX-11/780 is the "synchronous backplane interconnect" or "SBI." This is an internal synchronous path operating on clocked 200 nanosecond cycles. All transactions in the system are synchronized and occur at defined points in time. The SBI, which is the primary control and data transfer path in the VAX-11/780 system, has a physical address space of 1 gigabyte (i.e., 30 bits of address).

The VAX-11/780's CPU can operate in two modes – "native mode" (wherein it executes VAX-11 instructions) and "compatiblity mode" (basically the PDP-11 instruction set). Both instruction sets are implemented in microcode and logic of the processor; neither is an emulation or simulation.

From a software investment viewpoint on the part of both the manufacturer and user, having the compatibility mode feature enables a user to "get on the air" quickly if necessary. Thus, the software developed on PDP-11s can "migrate upwards" out of the 16-bit family for many applications.

The VAX-11 native instruction set is an extension of the PDP-11 instruction set: VAX-11 instructions provide 32-bit addressing, 32-bit SBI-based I/O operations and 32-bit arithmetic. Without delving too deeply into the programming of VAX-11 in the native mode, the following generalization exists: VAX-11 instructions are far more versatile and flexible than those of the PDP-11 instruction set, but the VAX-11 instructions are clearly an outgrowth of the PDP-11. Therefore, if you're used to programming at the assembly level in PDP-11 language, you can adapt quickly to programming in VAX-11 instructions.

Built into the processor are an integral floating-point capability and a main cache memory. This cache has an 8 Kbyte capacity and up-dates itself on any SBI I/O transfers. Thus no operating system overhead is required to synchronize the cache with I/O operations.

The VAX-11/780 has been designed as a virtual-memory machine. While the central processor can address 512 megabytes reserved for I/O register addresses), it has a virtual addressing capability of four gigabytes. Both UNIBUS and high-speed (32-bit) bus adaptors permit medium-speed and high-performance peripherals to be connected to (addressed by) the SBI. Both the UNIBUS and high-speed bus are of the same types as found on the PDP-11/70.

Such an arrangement has an obvious design advantage at the system level: peripherals that operate with the PDP-11/70 can also work with the VAX-11/780 merely by being attached to the appropriate bus.

While VAX-11/780's compatibility

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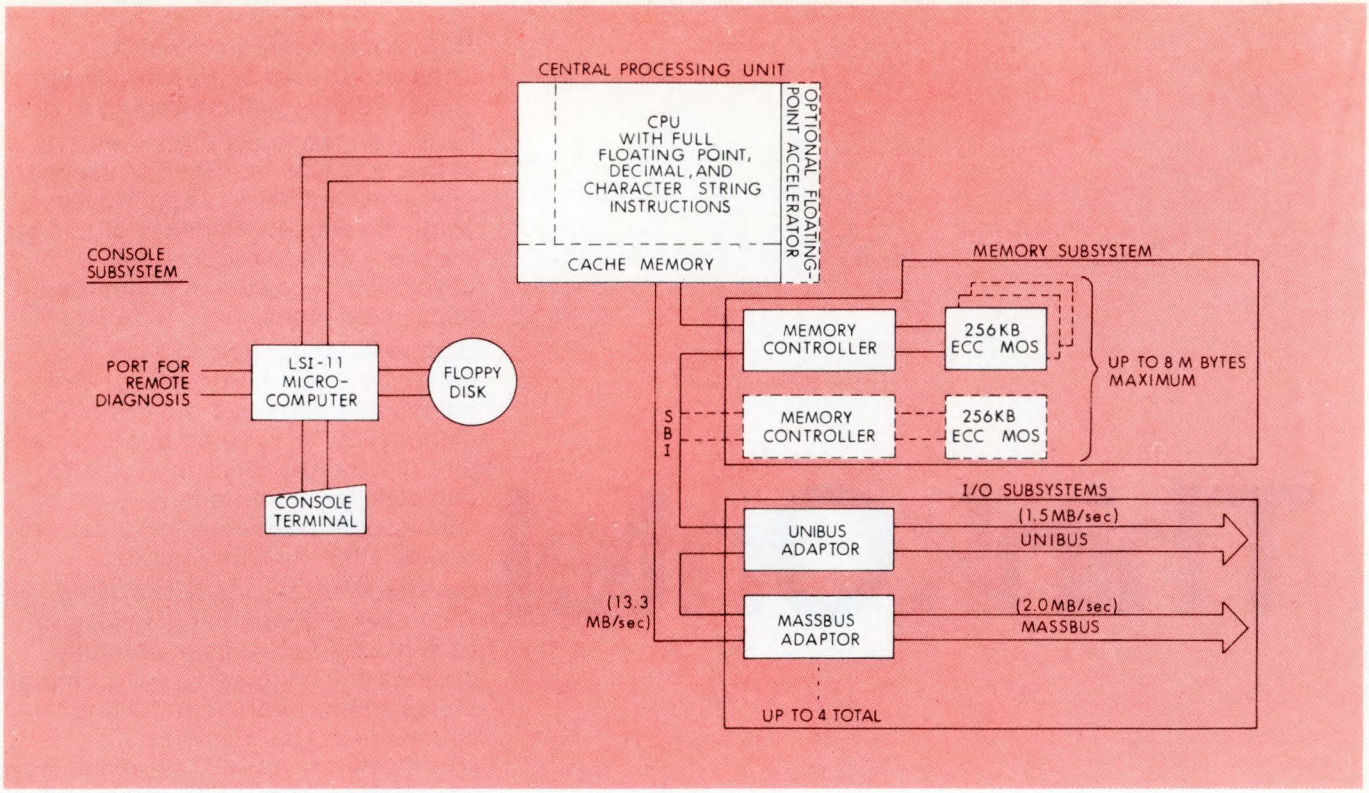


VAX-11 architecture shows SBC or synchronous backplane interconnect, an internal synchronous path using a 200 ns clock cycle. VAX-11's instruction set is an extension of the PDP-11's set.

mode permits execution of programs developed for the PDP-11 line, it also has a significant number of high-level-language compilers available for native-mode operations. It has an ANSI-compatible FORTRAN-IV, PASCAL, BLISS-32 and COBOL. (BLISS is a programming language generally used to develop systems software, such as compilers or operating systems.) In addition to the assembler, VAX-11/780 also has a multi-key ISAM file access capability, and a number of utilities including SORT. Thus, programs written in high-level languages operate in native mode format for optimum execution.

Software evolution

At this point, it is appropriate to mention the evolution of the software at the operating system level. Initially, the PDP-11 was introduced without an operating system, with development at the assembly level being carried out via paper tape systems. In time, powerful operating systems were developed. In particular, the developers of the RSX-15 operating system (which worked on another Digital computer system) developed the RSX-11D operating system for the PDP-11 family, an operating system has been developed as a real-time, multi-user system. RSX-11D was originally designed to run on the medium- to high-end PDP-11 computers (PDP-11/40, -11/45, and -11/70).

A more compact version of the RSX-11 family, RSX-11M, was developed to cover the full spectrum of the PDP-11 family, from the PDP-11/04 through the PDP-11/70 (it has even recently been downward extended to the non-UNIBUS LSI-11/23 microcomputer and its "boxed" version, the PDP-11/23). In the VAX-11, the compatibility mode employs an "applications migration executive" (AME) that permits RXS-11M tasks to run with little or no modification. RSX-11M programs can be developed on a VAX-11, and can be down-line-loaded from the VAX-11 to a PDP-11 system.

The native-mode operating system for VAX-11, VAX/VMS, takes advantage of the 32-bit architecture of the VAX, but bears the same "family resemblance" to RSX-11 as the VAX-11 hardware resembles the PDP-11 hardware. Like the RSX-11 systems, VAX/VMS has been designed as a multi-purpose operating system with a strong real-time orientation.

Just as was the case with hardware evolution, the degree of software compatibility inherent in the PDP-11 line led to software design evolution, with an evolutionary transformation to the 32-bit operating system. In many respects, software evolution is as significant as hardware evolution.

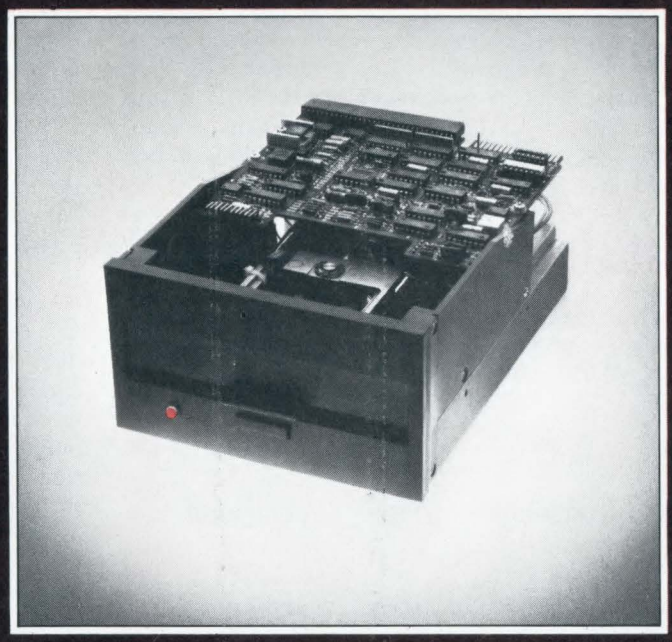
While we could go on for hundreds of pages on the PDP-11/70 or VAX-11/780, there are important, specific features that we should look at. For example, both the PDP-11/70 and VAX-11/780 offer remote diagnosis to minimize downtime. For a PDP-11/70, a user can have the standard front panel replaced by a μP-controlled unit called an electronic console to permit him to connect the PDP-11/70 with a remote computer via a standard, voice-grade phone line.

The remote computer, operated by our service department, receives the results of diagnostic commands initiated by the electronic console's processor. From the information received, the remote computer makes an initial evaluation of a malfunction; this is forwarded to specialists at the appropriate field service office for action.

Similarly, VAX-11/780 has a rather more elaborate console subsystem that permits system evaluation. The VAX-11 has a complete floppy-disk-based 11/03 μC subsystem that performs extensive diagnostics. A communications-line port in the console subsystem also permits connection to a remote diagnostic host computer.

Both remote diagnostic capabilities represent methods of increasing the uptime of high-performance minis. In neither case does the capability interfere with or change fundamental programming; maintaining program-upward-compatibility should always be a prime consideration in such a design.

In the VAX-11/780, an optional feature is the floating-point accelera-



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tor. While VAX-11/780 has an integral floating-point capability, an additional unit that operates in parallel with the central processor is available as an option. This floating-point accelerator is transparent to the programs being run, but significantly decreases execution times for arithmetic operation. Again, adding the floating-point accelerator doesn't alter the fundamental program; it just helps execute it more rapidly.

By tracing the basic PDP-11 16-bit architecture evolution to the large-memory, high-performance PDP-11/70 and VAX-11/780 32-bit architecure, we can see that the fundamental concepts have been maintained throughout the family. While the VAX-11 architecture is both more complex and more extensive, the "family" is there. This is a significant point, because many perspectives of the high-performance, longer-wordlength minicomputers are treated as if the devices were created in a vacuum. While this may be true of some minis, it is not true of all. This can be of extreme importance to either an end user or OEM.

	Small PDP-11 11/03, 11/04	Mid-Range PDP-11 11/34, 11/60	Large PDP-11 11/70	VAX-11 11/780
Remote Diagnosis	NO	NO	YES	YES
Relative CPU Performance	LOW	MEDIUM	HIGH	VERY HIGH
Relative I/O Capacity	LOW	LOW	HIGH	VERY HIGH

Table shows Relative Comparison of PDP-11, VAX-11 Lines.

New directions

It is important to point out that though there is a "family relationship" between the design of the PDP-11 and VAX-11 systems, the VAX-11 architecture is a new direction in computer design. The architectural innovations in the VAX-11 optimize the performance of the 32-bit real-time computer; that it has evolved from another, successful computer design does not mean that it has been restricted by that design. Rather, the evolutionary process permits more systematic and effective hardware and software development.

When a manufacturer introduces a new computer of any size and word-length that has not evolved from previous designs, the software investment and availability is usually minimal. With the possible exception of someone developing an OEM system requiring a thoroughly unconventional programming approach, the user of such a new and unique system must operate at a great disadvantage in comparison with someone who has a full library of software development aids and application programs available. Further, with "related" systems such as the PDP-11 and VAX-11 lines, adapting to the new instruction set at the assembly level becomes quite easy.

Developing computers as part of a relatively continuous spectrum of products can pay other dividends from the standpoint of design. As noted earlier, the low end of the PDP-11 line extends to the microcomputer level. There is a commonality of programming possible from the upper range of the microcomputer line – the LSI-11/23 – through the PDP-11 line to VAX-11. This makes integrating microcomputers, minicomputers, and high-performance minicomputers into unique networks much easier than would be the case with "unrelated" minicomputers.

A bad word?

Industry observers refer to high-performance minicomputers, often with extended wordlengths, as "superminicomputers" or "superminis." But this classification, based too often on word-length or data path bandwidth, could mislead users. Through examining PDP-11 and VAX-11 lines, we saw that there is no sharp dividing line between the mini and supermini. In fact, features such as memory management (which some people associate with "superminis") can be found on some microcomputers! Are you going to use the word "supermini"? If so, use extreme care in defining it.

Small mainframes vs. minis

In terms of minicomputers, we have seen the evolution of a basic design extend the performance spectrum of a computer family. A comparison of the small, medium, and high-performance minicomputer illustrates the relative positions of these machines, and is shown in the table.

For a full 32-bit wordlength high-performance minicomputer, a question arises: how do we differentiate between it and a small mainframe? There is no pat answer to this question – nor is it necessary that there be one. While it is possible to compare architectures, instruction sets, and the like between different 32-bit-word-length computers, what is perhaps more important is the way that a computer is used in a particular application rather than how it is organized. In the minicomputer field there is quite a difference between the PDP-8 and PDP-11 architectures – yet both are minicomputers. Their "similarity" lies in the general types of application for which they are used.

Similarly, one big difference between a 32-bit mini and 32-bit mainframe lies in their use. Although any generality is subject to exceptions, as the industry traditionally views the mainframe, it is primarily a batch-processing and remote-job-entry device. The preponderant types of applications for minicomputers tend to be interactive ones. This is reflected as much in software as in hardware design. Thus, with appropriate configuration and software design, a 32-bit mini can assume the role traditionally associated with a small mainframe, and vice versa.

Quantum jump? No.

The advent of the high-performance 16- and 32-bit minicomputers should not be seen as a quantum jump in computer development, but an orderly evolution in computer design and applications. And further progress in both medium- and long-wordlength minicomputers will be optimized through evolutionary development of existing designs that take full advantage of existing software and hardware.

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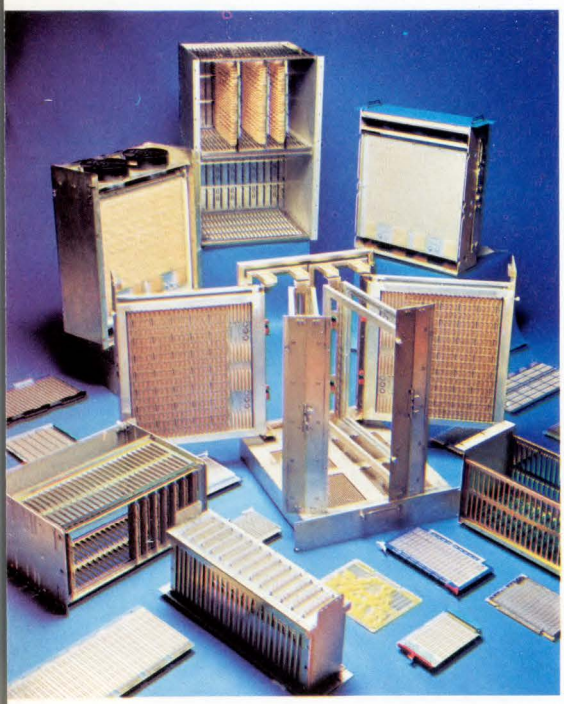
New Generation of Prototyping Tools Aids System Designers

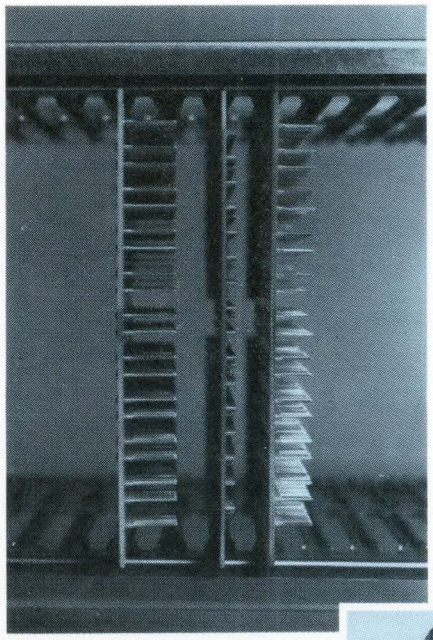
Russell Petit, Product Manager
Interconnection Products Div.,
Augat Inc.

What occurs between the schematic and final production is the subject of this article.

Utilizing both sides of the breadboard, with components on one side and wiring on the other side and wire wrapping is nothing new, but it has brought with it new concepts and methods for achieving efficient use of circuit board space. Today, boards are available that contain voltage and ground planes which can eliminate the need for individual power connections to each device.

Designers and manufacturers of interconnection products offer wire-wrapped panels because of their easy maintenance and flexibility. A variety of boards, for broad applications that run the gamut from microcomputers to minicomputers to large mainframes, are available that are compatible with Data General and DEC minicomputers as well as others. Also available to the engineer are boards designed specifically for ECL, Schottky and microprocessors.



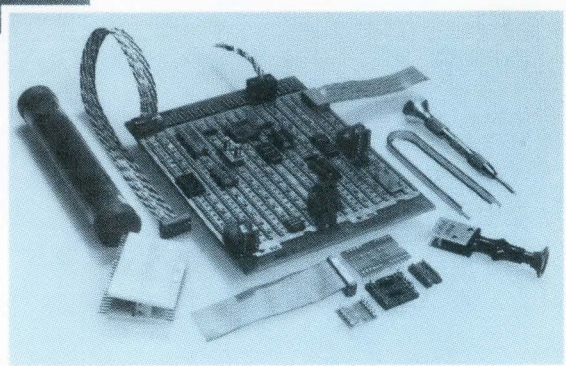


Wire-wrapped packaging techniques are excellent for production and prototyping. If a higher packaging density is required, the "Switchweld board" allows 0.500-in. centers between boards, offering a lower profile than the wire-wrapped board. Wiring changes are easy: since all wiring is done on the same level, simply clip the old wire from the stitch weld pin and reweld to the same pin, with no degredation to the weld.

CAD cuts prototyping

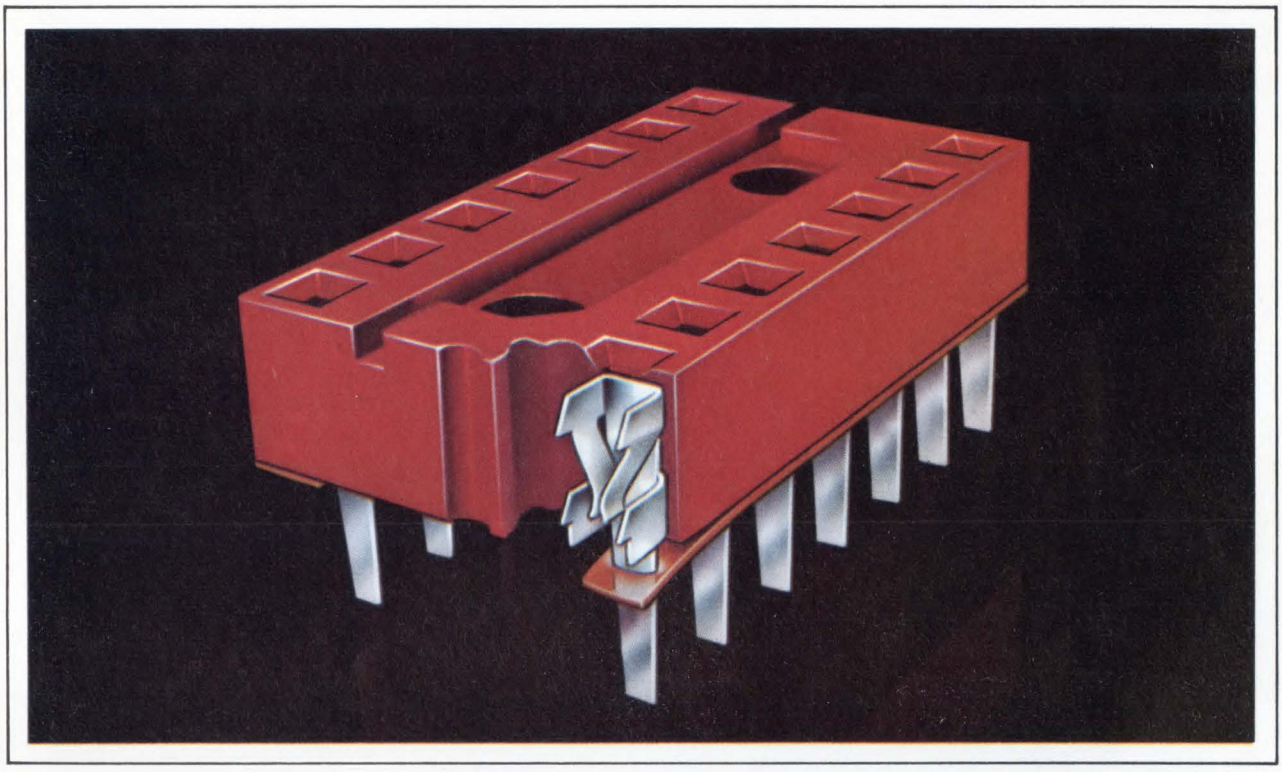
In fact, using today's wire wrapping boards and CAD software virtually eliminates the breadboard stage of circuit design. CAD was developed partially from the need to eliminate prototyping problems created from human error. With the software available today, the engineer can avoid many of the problems inherent in prototyping. He can use the computer that industry created, to verify the product he is creating. By eliminating common errors made in transposing from a schematic to a wiring list, the engineer or technician can concern himself with logic design rather than troubleshooting wiring errors.

Datatex Corp. (our subsidiary), to take one example, is a leading supplier of CAD services. One of its more ad-



Manufacturers now provide many prototyping tools for the design engineer and technician. These Augat tools include test clips, 30 Ga wire, programming plugs, adaptors for discrete components and TO-5 packages, pluggable LED sockets, programming matrix boards and insertion and extraction tools.

There are solid engineering reasons why you should have Cambion on board.



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vanced services is the Datatex Data-Logic™ system – a comprehensive logic design aid program that analyzes electronic logic design and flags many errors, spare circuits and loading conditions. The design is checked by computer, allowing necessary modifications before wiring takes place. Such CAD systems can save the design engineer many weeks of painstaking development effort.

In addition to the time and money saved, this system provides excellent computer-generated documentation that can be shipped with each system.

Tools of the trade

Criteria for selecting prototyping tools should be: saving time, space and money, and flexibility in prototyping, in production and in field repair.

Combining the wire wrapped concept and CAD provides these economies, flexibilities and faster turn-around. The repetitious tasks of breadboarding, debugging, prototyping and re-debugging are eliminated and, with proper application, the cost of logic design can be cut by well over half. The engineer now uses CAD to verify logic, builds a functioning prototype, and then puts it into production.

There is no need to convert to a different packaging technique for production, because the same wire wrapped packaging technique can be used for both prototype and production.

However, if during the course of prototyping, higher packaging density is required, the engineer can adapt any of the wire wrapped boards into a stitch weld style board that will allow 0.500-in. centers between boards. He can maintain the same wiring program used on the wire wrapped board. He can then add additional logic on other boards and mix both wire wrapped boards and stitch weld boards in the same card file.

We provide circuit designers and technicians various prototyping tools such as LSI adaptors to adapt 20-, 22-, 24-, 40-pin devices on 0.300- and 0.400-in. centers, boards for 16-pin devices, and universal boards with rows of pins on 0.300-in. centers. Other prototyping tools available include adaptors for discrete components and TO-5 packages, programming plugs and matrix boards, pluggable LED sockets, test clips and logic test probes. Also available are tools to decommit pins soldered to V_{CC} and GND, solder clips to solder in selected pins to V_{CC} and GND, wire kits of 30 Ga wire, and insertion and extraction tools.

In addition to the software and wiring service provided by various CAD service firms, manufacturers of hardware and interconnects offer a complete line of card cages, drawers, page systems designed specially for any of the standard off-the-shelf boards, and custom-made hardware for custom-made boards. Also available are standard and custom designed backplanes.

If the development and design efforts are becoming simplified, it is a natural evolution: it takes technology to make technology, and future advances can only be effected by using the tools and developments of today. Much time, energy, effort and dollars can be saved by efficiently utilizing state-of-the-art products available today.

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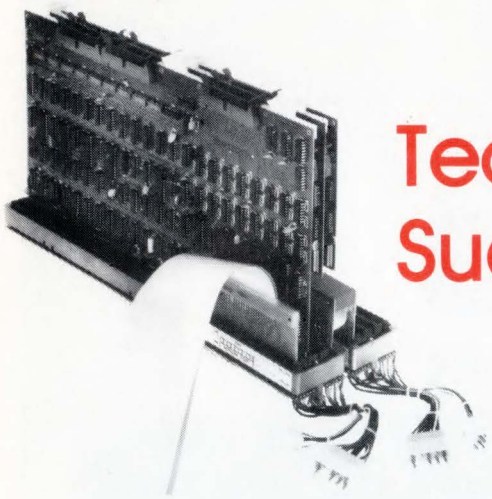


Techniques For Designing Successful Products

Ken O'Mohundro and Les Wellington,
Able Computer Technology, Inc.

Did a product of yours ever fail to perform as expected in the market? Such failures happen frequently in the fast-paced electronics field. We have reduced our market failures virtually to zero by following one doctrine: a product can be successful only if it makes the customer happy. This principle implies that the product must satisfy an actual – not imagined – customer need. The item must also be available when the customer requires it at a price he can afford. And it must provide him with dependable service over an extended period of time.

To create a product that meets these criteria, we developed a design process and a firm belief that each step in the process is critical and can potentially cause product failure if neglected. You cannot omit any of the steps and you go through them as thoroughly as possible. Does the process sound plodding and slow?

Actually, our new product development time is quite short. We do not push engineers to work faster to meet unreasonable deadlines. Instead, we ask our engineers to take care in each step of the design process and do each task right the first time around. In the long run, this methodical care saves the costly time needed to correct the errors that haste inevitably causes; with it, we can skip certain traditional procedures, such as wirewrap prototyping. The design process works, because in less than 36 months, we introduced 18 products, all of which are selling competitively and profitably on a worldwide basis.

Our product development procedure is divisible into the following four phases:
(1) **architecture**: basically consists of generating a solution for a need or gap in the market, (2) **project cost analysis**: since we like to ensure a profit from our products, we analyze a product's cost effectiveness before we begin design work, (3) **design**: we don't

	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
	OP CODE				*	B OPERAND				*	R OPERAND					
0	A PLUS B				WRITE "B"	CPU INTERNAL FILES				WRITE "R"	TR, IMMED<512/LC*					
1	B MINUS A										TR, INDEX<512/CC*					
2	A MINUS B										TR, IMMED>512/LC*					
3	A + B										TR, INDEX>512/JSR*					
4	A • B										SCRATCH IMMED.					
5	A • B										SCRATCH INDEXED					
6	A ⊕ B										A R					
7	A ⊕ B										D R					
8	R PLUS A															
9	A MINUS R															
A	R MINUS A															
B	R + A										OPTION DEFINED					
C	R • A															
D	R • A															
E	R ⊕ A															
F	R ⊕ A															

Fig 1 Instruction fromat used for the Able Uniface microword.

design the product by just creating a schematic; the procedure includes several well-defined steps, and (4) **product support**: keeping a customer happy after he has purchased a product means providing adequate user documentation and speedy repair service.

Architecture

In the first step you take in determining product architecture, you identify a need in the marketplace. This task is typically referred to an applications engineering group within the marketing department. Traditionally, the applications group consists of technically-oriented individuals who will fill the gap between marketing and engineering functions. These people must remain current with the state-of-the-art to be able to meet with customers and advise them on applications and systems. After the applications group identifies a need in the market, it relays this information to the design group. The design group then assumes the task of creating a solution to a problem that it has received second hand. This group often gets too few inputs and can draw only upon its usually narrow experience to find a solution.

To broaden the experience of its design engineers, we insist that they participate in the applications engineering world by interfacing with customers. As a result, Able has a group of product engineers with the experience and knowledge needed to create high-quality designs. They are also more sensitive to customer needs and design products that are genuinely helpful to users.

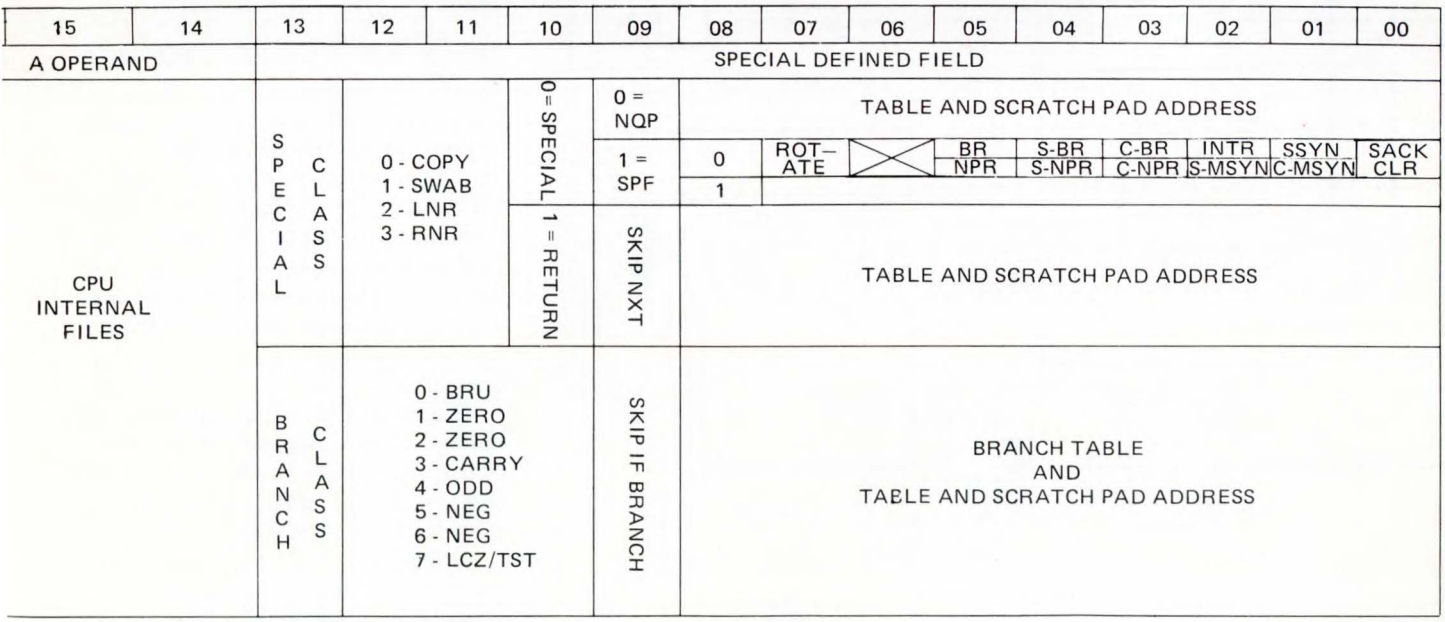
Placing engineers in the dual applications/design role also allows you to aim for general product solutions that meet the needs of many customers. Each customer's requirements are specific to his application. By talking to several customers with similar problems, an engineer can sometimes find a solution that is applicable to many different problems. Instead of satisfying a demand from one customer for 10 or 20 pieces which often will not justify the nonrecurring engineering costs, such a general solution for several customers can increase the volume sufficiently to amortize these costs. In the final analysis, the customer is offered a product that would not otherwise be available to him because of his limited volume.

A general solution that typifies the broad scope approach is the Uniface (TM of Able Computer Tech.). Company engineers noticed that the more difficult part of a PDP-11 interface design also involved the common thread between all interfaces – the DMA and interrupt facilities – and the ability to emulate existing DEC hardware to maintain software compatibility. This recognition led to the decision to put the Unibus (DEC TM) interface functions on one microprogrammable interface board. Each PDP-11 interface must additionally provide I/O functions to give it its "personality" or uniqueness for a particular application. But this I/O portion of the design is relatively simple, once the more complex Uniface is complete. This general solution allows us to supply the market with solutions to many applications easily and quickly. For instance, Uniface plus a personality card or cards can perform as a multichannel DMA communications controller (such as the DV/16), a customer-specified product or other proprietary Unibus compatible devices.

Once you choose a general solution, you should specify it in writing. The specification should include a block diagram and an indication of the performance features that the new product is expected to provide.

Then you should measure new product specifications against the capabilities and limitations of the host computer. The chosen solution must not overburden the bus or demand a faster response that the computer can provide. If incompatibilities are found, improve the product architecture to correct them. For example, you might make it more intelligent or less restrictive.

Once you have measured the solution against the computer and adjusted it as needed, the next step of the architecutre involves considering product requirements from software and hardware points of view. Many companies derive the architecture from the hardware or software department and the other department must live with the structure that this imposes upon them. To reach an optimum solution, hardware and software specialists must work together. One instance when this joint effort paid off occurred in the design of the microword for Uniface. Although hardware requirements dic-



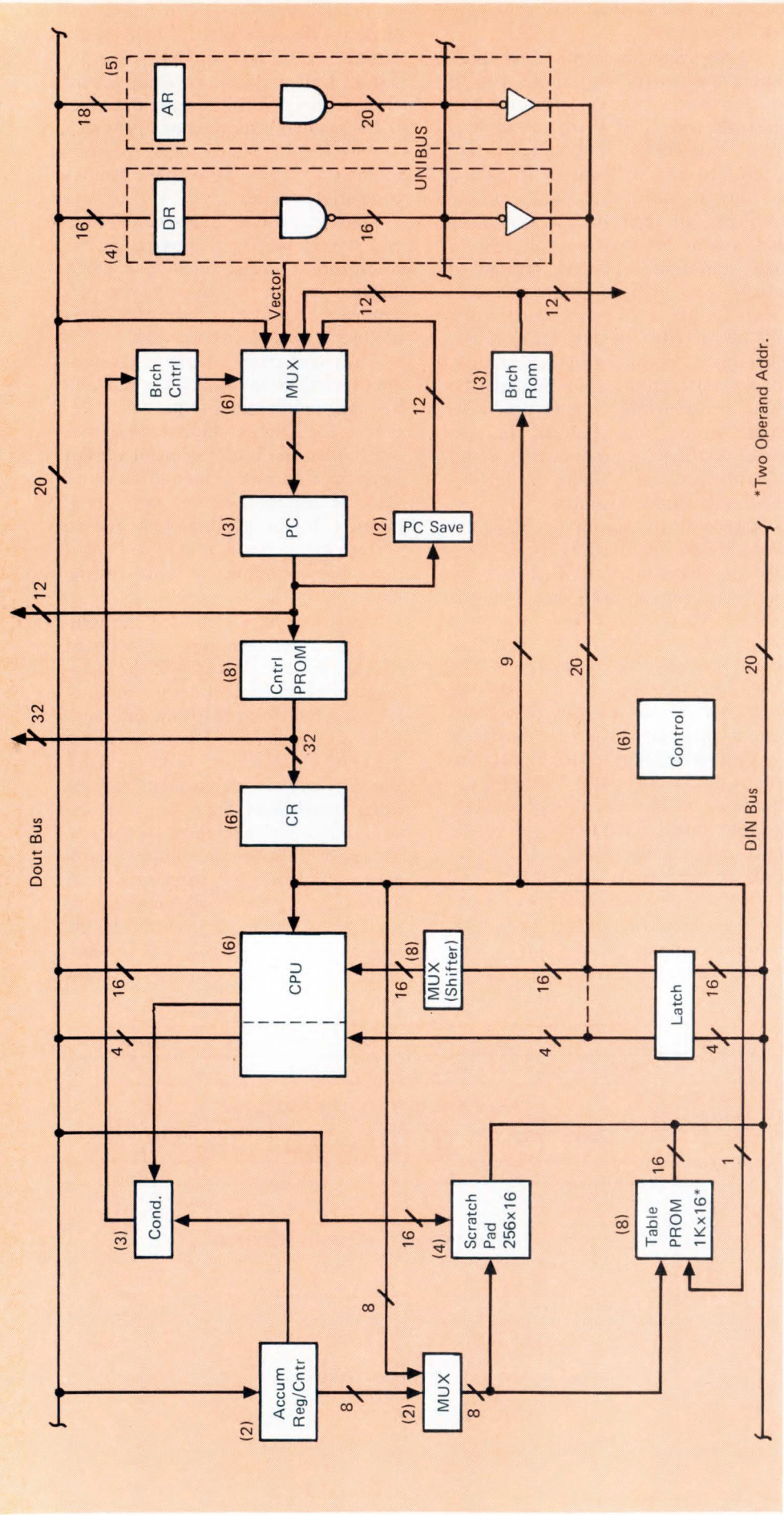


Fig 2 CPU block diagram for the Able Uniface.

tated a rather long microword, this word was overly complex to decode and understand from a software point of view. The specialists reached this joint solution (**Fig 1**): the addition of a ROM addressed by the 32-bit microword. This additional storage increased the effective programming complexity. Collaboration produced a product not only agreeable to hardware and software personnel, but made it more attractive to the customer.

Project cost analysis

At this point, the architecture is complete and the product fully defined and ready for the design phase. But before you start the design, it is here that you should scrutinize the project for its cost effectiveness. You must determine whether it will earn an adequate return on investment. Sometimes, the amortization of engineering costs is so high or the target price of the product is so low, that continuing the project becomes unfeasible.

Factors to be considered include product life. Will the product remain viable in the marketplace for one year or five years? Will the target price be reasonable for the product's life or will discounting be required? To support a product, a company must maintain a minimum of a 50% gross margin on a product. If the product requires special field support, then it needs an even larger gross margin.

If the cost analysis indicates that the product is not cost effective, then you must scrap the project and absorb the time spent on architecture as a loss. On the other hand, if the analysis projects a profit, design work can begin.

Design: Use a standard approach

After the design engineer has completed the configuration of the architecture, he usually has formed a mental image of the product. His task at this point is to implement the design. Design implementation occurs numerous ways and no way is better than any other. However, you should adopt a structure design procedure. We design our products in the following sequence:

Diagrams. The first step involves detailing a block diagram of the functional units of the product and a flow diagram of the relationship between the functional units (**Fig 2**).

Schematic. This step implements the logic or analog functions of the product in a schematic. You should represent each functional unit on a

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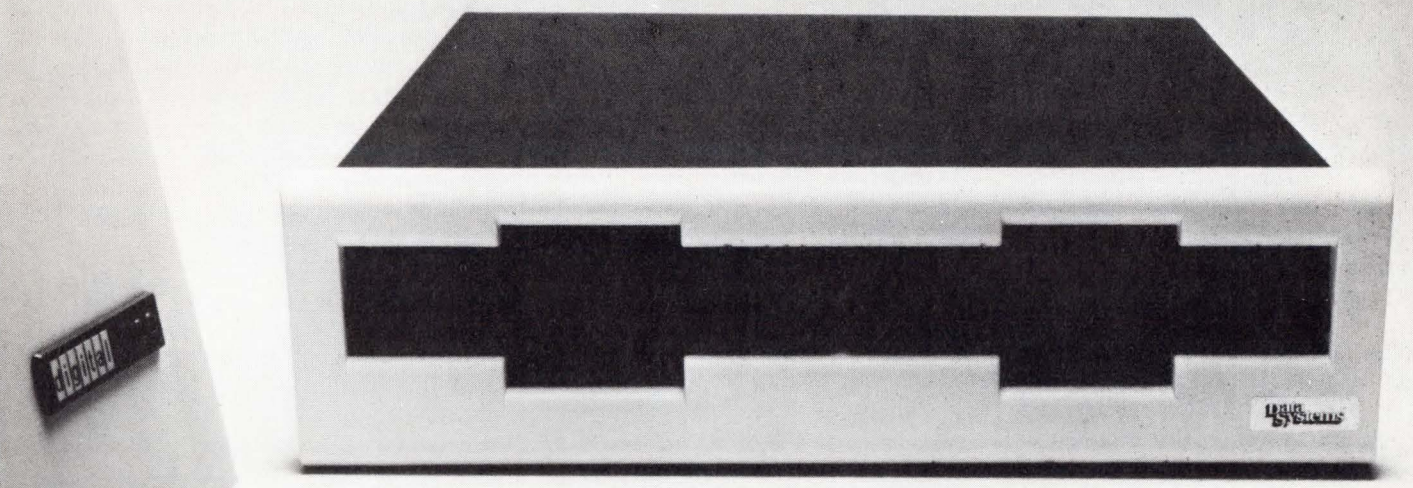

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Timing analysis or waveform charts. From the schematic, build timing diagrams. Use them to verify the design against the block and flow diagrams and what you want as the end result.

Worst case analysis. (We feel that worse case analysis is an extremely important part of the design phase and is often omitted by many companies.) Suppose that an engineer executes a design, debugs it in the laboratory, verifies that it runs and releases it as the final design, only to find out that it does not run well in production. During the design of a product, you should always do a worst case analysis on paper. For example, if a product works on paper, it stands a good chance of working well in production. However, a typical Uniface cycle time was 155 ns, low enough to appear to make the 200 ns we had specified ample. Our worst case analysis produced a possible 210-ns cycle, which was outside of our specification. So we modified the design to employ a different CPU and Schottky RAMs. Our new worst case turned out to be 193 ns, which is well within specification. This change eliminates later timing problems that are more difficult or even impossible to get rid of.

Product test considerations. LSI and MSI devices make contemporary printed circuit boards very complex. This condition sometimes makes it difficult to reach enough conductor lines to diagnose the board. Make every attempt to avoid this problem, by formulating designs with an eye toward product testability. If an engineer cannot test his product, production will not be able to test it either. During the design stage, build the necessary adapter board, cables and other paraphernalia that will be used in production testing. In this way, the engineer can debug his prototype by using the same tester that will later be used in production. From this procedure, he can often find ways of improving the test equipment and can sometimes improve the product so that the tester works better.

Wirewrapping. Able does not use wirewrapping in its prototypes. It generates the artwork for its circuit boards. In most cases, Able reduced the design cycle by a matter of months and readied its product for the market sooner. But more importantly, the company feels that the design should be sound the first time around. Its engineers spend sufficient time with each design before the artwork stage to be confident that the product will work. Knowing that he has the wirewrap stage to debug any glitches in the design tempts an engineer to be less careful than he should be.

The company also noted that the wirewrapped board does not always succeed in its intended function of pin-pointing problems before getting to the final form of circuit board etched from artwork. A product that works with wire-wrapped interconnections may still have noise problems at the final artwork level. Although going straight to artwork may create the need to add extra wires to the initial circuit board design, you can detect noise problems early enough to correct them before your deadline date.

Mechanical considerations. The design of mechanical layout is also important. For example, place switches and indicator lights on PC boards where they are easy to use and see. Appearance is important; an attractive piece of equipment receives better care from users than unattractive ones.

Artwork. At the artwork level, aim for a good analog approach in design. Time spent with analog equations can reduce noise problems. Similarly, when designing the artwork for the logic functions, make sure that they do not fall apart in a noisy environment. Put special emphasis and stress on the use of good ground and power connections and avoid placing critical lines near noise-sensitive lines. To insure a good sound design at the artwork stage, the engineer must work closely with the artwork designer, to prevent the creation of a noisy environment.

All this endeavor should result in a workable product – one that not only works in the lab, but after large scale production begins. For an effective endeavor, the design/application engineer must interface with many people: with the customer to determine a need, with software people to create a better system solution, and with manufacturing to determine that the product is producible. No longer can you lock engineers away like mad scientists in a room to do their design work; they must be active in all phases of the design process. Your engineers should continue to participate in product refinement after they release the product for marketing.

Product support

The engineer's work does not end after his product goes into production. He must be willing to spend time locked arm-in-arm with Marketing and to listen for customer response to the product. Look upon any response from a customer as a potential problem for the engineering group. No matter how much you have tested, how much you have evaluated a new product, its design does not become "solid", until it has operated in customer applications. As a product goes into the field, engineers should wait for any customer call that might pinpoint unique performance demands from the new product; they must be ready to go into the field to inspect the problem on-site to incorporate appropriate engineering changes into production as quickly as possible.

Make user documentation a prime concern. A well documented product is less likely to be misused and stands a better chance of providing reliable operation. Comprehensive and easy to understand installation and preventative maintenance sections in the user manual reduce the number of problems that customers will encounter and thus save support time for the seller.

In conclusion

Make directing new product development and support toward customer requirements a major goal. For a product to be successful, it must supply customers with what they want. For a company to be successful, it must help customers when problems arise. A structured design and implementation process should allow you to build readily marketable products. You must perform each step in the process well; if you omit even one step or do it poorly, your customers suffer and your product will not be successful.

ABOUT THE AUTHORS

Ken O'Mohundro, founder and president of Able Computer, worked in computers for California Data Processors and Microdata.

Les Wellington, vice president and director of engineering at Able Computer, also worked for California Data Processors and Microdata.

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23. Computers, Micro
24. Data Acquisition Modules
25. CRT Terminals & Displays
26. Digital Circuit Components
27. Disc or Drum Storage Units
28. Floppy Disc Storage Units
29. Memory Chips
30. Add-on Memories, Core & Semi
31. Modems
32. Software Development Aids for Microcomputers
34. Plotters
35. Power Supplies, Switching
36. Printers
37. Microprocessors
38. Punched Tape Equipment
39. Readouts & Displays
40. Magnetic Recording Media
41. Programmable Controllers
42. Tape Drives, Cassette or Cartridge
43. Tape Drives, Reel-to-Reel
44. Terminals, Intelligent/Data Entry

PACKAGING

45. Cabinets, Enclosures
46. Connectors
47. Cooling, Fans & Blowers
49. Backplanes

TEST & MEASUREMENT INSTR.

55. Component Function Testers
56. Logic Analyzers
57. I/C Function Testers
58. Instruments, Recording
59. Oscilloscopes
60. Sub-Assembly Function Testers

Product Highlight

1024 Pixels x 1024 Lines Raster Displays Permit 4000 User-Selectable Colors

Higher clarity and more concise color delineation than ever before possible with computer generated raster-scan displays is achieved with the 1,048,576-pixel resolution (1024 pixels/line x 1024 lines) full-color Model GCT-3500. A Monitor Control Module Board, that can handle up to 8 memory planes and display 256 different colors from a selection of 4096 values, is used; other monitor control systems are optionally available that accomodate up to 12 memory planes and display up to 4096 colors from an over 16-million color-shade selection.

The GCT-3500 comes with a choice of 19-in. or 25-in. specially built high-resolution color CRT monitors. In addition, all the other advanced features of Genisco's raster-scan computer display line are included. For example, the proprietary User-Programmable Graphics Processor (PGP) provides 150 nsec internal cycle time graphics high-speed data manipulation (600 nsec mx. instruction time), and has a 55 mnemonic instruction set. The new system also offers DMA data transfer from a host computer, selective erase, and flicker-free operation.

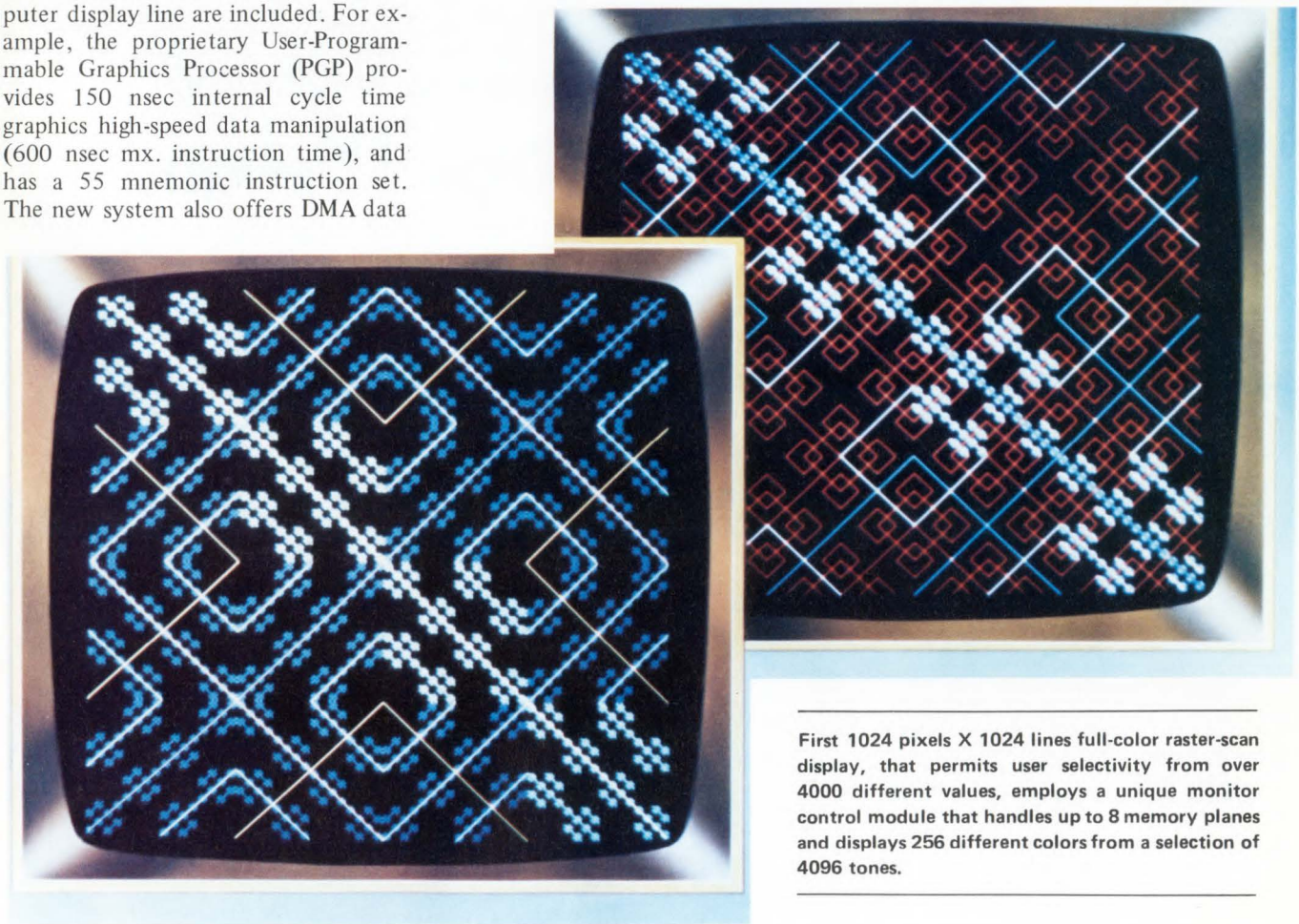
The GCT-3500 can operate up to 4 monitors from a single system. A Character/Vector Generator module permits high-speed display of dynamic information. A large selection of standard interfaces is also available for most popular minicomputers. All this, and complete Basic Graphics instructions and maintenance diagnostics software completes the package that sells for under $25,000 (in production-run quantities).

A full line of RS-232 compatible interactive peripherals, consisting of a keyboard with 16 Function Switches, Joystick, Trackball and Data Tablet is optionally available. A unique Scroll/Zoom plug-in module board, that allows pixel-by-pixel scrolling, or up to eight-times picture enlargement, is also optionally offered.

Genisco can also provide what it claims is the most comprehensive raster-graphics software ever developed, the FORTRAN Callable Subroutine Package, called GRAFPAC II, that simplifies contro! and display generation programming by allowing transfer of instuction sets in complete program blocks.

Want details? Write to John M. Fletcher at **Genisco Computers,** 17805 Sky Park Circle Dr., Irvine, CA 92714.

Circle 276



First 1024 pixels X 1024 lines full-color raster-scan display, that permits user selectivity from over 4000 different values, employs a unique monitor control module that handles up to 8 memory planes and displays 256 different colors from a selection of 4096 tones.

C. Itoh's Model 8300 printer looks superb.

It works even better.

C. Itoh offers you the perfect OEM printer for general purpose computers, communication terminals, data loggers and micro computers: the Model 8300. This quiet and low-cost unit features a straightforward, reliable design and a continuous-duty 7-wire head with a life expectancy of 100 million characters. Designed with a 7-bit parallel interface, the 80-column, dot matrix Model 8300 prints bi-directionally at 125 CPS. Its sprocket paper feed mechanism accepts multi-ply pin-feed paper in any width from 4.5″ to 9.5″; paper can be loaded from the bottom or rear; and print line position is readily adjustable. The Model 8300 works even better than it looks. Would you expect anything less from C. Itoh? Write today for detailed specifications.

C. Itoh Electronics, Inc.

C. Itoh means excellence in printers.

5301 Beethoven Street, Los Angeles, CA 90066
Call: (213) 390-7778 • Telex: WU 65-2451
East Coast
280 Park Avenue, New York, NY 10017
Call: (212) 682-0420 • Telex: WU 12-5059

C. Itoh Electronics is part of the 119-year-old C. Itoh & Co., Ltd., world-wide trading organization.

Circle 296 on Reader Inquiry Card

Lots of people talk.

The talk is thick and fast. Yet the truth is simple. IMI and only IMI can deliver proven production unit 8″ Winchester disk drives. We began volume delivery the first of the year, and we'll deliver 5,000 drives by year-end.

Another fact. Despite all the hoopla at this year's NCC, only IMI showed an 8″ Winchester disk drive in actual operation. A drive that uses well-proven technology and conservative design to ensure maximum reliability in environments outside the computer room.

Only IMI delivers 8" Winchester disk drives today!

Why wait? Join the OEM's getting off-the-shelf delivery of production quantities. Evaluate an IMI production unit (not a prototype) and hasten the day you'll be using 8″ Winchester technology in your system.

IMI INTERNATIONAL MEMORIES, INCORPORATED

10381 Brandley Drive, Cupertino, CA 95014
(408) 446-9779

Circle 48 on Reader Inquiry Card

western peripherals

GENERAL PRODUCT DESCRIPTION

MAGNETIC TAPE AND DISC CONTROL SYSTEMS

Western Peripherals controllers for ½" magnetic tape, ¼" data cartridge tape, fixed and removable cartridge discs, and storage module discs for mini- and microcomputers offer the most advanced features by utilizing the latest in solid state microcircuit technology. These embedded controllers are designed to mount totally within the host computer. This insures uniform electrical and physical environmental conditions while saving the cost of non-essential cabinetry.

INDIVIDUAL CONTROLLERS OR COMPLETE SYSTEMS

Western Peripherals' controllers are sold separately, or as complete systems integrated and tested with a selected drive (or drives), and installed in the customer's computer. Both individual controllers and complete systems are covered by Western Peripherals' one-year factory warranty.

STORAGE MODULE DISC CONTROLLER

NEW

DC-233 FOR DIGITAL EQUIPMENT CORPORATION PDP-11 COMPUTERS

The DC-233 is designed to accommodate up to eight of the large capacity non-removable and removable media multiplatter disc drives in the range of 50 to 300 megabytes.

When used with the CDC 9762 80 megabyte drive, the DC-233 emulates and is media-compatible with the DEC RM03 with a formatted capacity of 67 megabytes per drive. When used with the Memorex 677 series 100/200 megabyte drives, the DC-233 emulates the DEC RPO5/RPO6 systems with 88 or 176 megabytes per drive.

The DC-233 is an embedded controller based upon a microprocessor employing bit slice technology. Like the DEC RMO3 disc system, the DC-233 consists of a high speed controller and from one to eight drive adapters. However, unlike the RMO3 system, both the controller and adapters are housed together within the CPU or expansion chassis. Since each drive has its own adapter, and cabling, it is a true radial configuration, thus effectively isolating one drive from another. Each drive adapter has within it a microprocessor whose function is to control the commands and status associated with its drive. The controller portion with its own microprocessor handles all communications to the CPU and implements the data transfers as well as the error correction coding and decoding.

This controller/adapter arrangement means that the DC-233 stays software-compatible no matter how many drives are being used since each drive and adapter can communicate status and command information with the CPU while any other drive is transferring data.

The data transfer section is throttled automatically, dependent upon the NPR demand of other devices and the data rate of the drive. Dual drive porting is totally supported for all drives having that capability. Dual unibus porting is also an available option.

FEATURES

- Software compatible to all DEC operating systems having RMO3 or RPO5/RPO6 support.
- Media compatible.
- Completely imbedded.
- Radial cabling configuration.
- Microprocessor based.
- ECC fully implemented.
- All local as well as remote registers fully implemented.
- Automatic NPR throttling.

Circle 109 on Reader Inquiry Card

Control Data Corp. 9762 Storage Module

Memorex 677 Disk Storage Drive

UNIVERSAL MAGNETIC TAPE CONTROLLERS

TC-120 FOR DATA GENERAL AND D.G. EMULATING COMPUTERS

The TC-120 Magnetic Tape Controller combines both PE and NRZ formats on one board to fit all NOVA, Eclipse, and other Data General emulating computers. It provides the ability to mix 7-track and 9-track NRZ, PE, or dual-density tape units in any combination up to eight drives at any two speeds in the range of 12.5 to 125 ips.

On 7-track, its 4-6-6 pack allows the user to dump core memory onto tape; and a 33-word data buffer, instead of the usual 2-word buffer, gives greater flexibility in assigning DMA priorities in the computer.

Read-and-write on the fly, another special feature, allows automatic non-stop operation when doing consecutive read-write operations, and it saves switching time when switching between multiple tape units. This is accomplished automatically without special software or software restrictions.

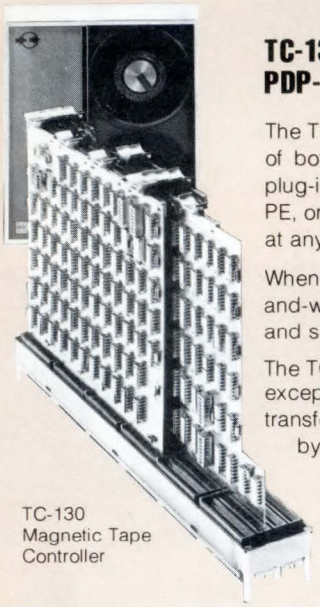
Data General Compatible

The TC-120 is software compatible with all Data General NOVA and Eclipse series computers and other Data General emulating computers. Virtually any tape drive having an industry standard interface can be used with the TC-120.

FEATURES

- Dual speed capability.
- IRIS and RDOS compatible.
- IBM 360 compatible format in both PE and NRZ.
- Read after write parity check.
- 33-word data buffer.
- Two or three byte 7-track packing (software controlled).
- On-the-fly operation for consecutive reads or writes.
- Allows user to edit previously recorded records.
- Comprehensive diagnostic programs provided.
- Tape drive connections are via a push-on connector to the CPU backplane.
- Single board embedded.

Circle 110 on Reader Inquiry Card



TC-130
Magnetic Tape
Controller

TC-130 FOR DIGITAL EQUIPMENT CORPORATION PDP-11 COMPUTERS

The TC-130 Magnetic Tape Controller offers users the convenience of both Phase Encode and NRZ formats consolidated onto four plug-in PC boards. It also has the ability to mix 7- and 9-track NRZ, PE, or dual-density tape units in any combination up to eight drives at any two speeds in the range of 12.5 to 125 ips.

When doing consecutive read-write operations, the TC-130's read-and-write on the fly capability permits automatic non-stop operation, and saves time when switching between multiple tape units.

The TC-130's logic does all data transfers in the word (16 bit) mode except for odd bytes at the beginning or end of a block. These are transferred in the byte (8 bit) mode, thus reducing data transfers by almost 50% compared to other systems. The TC-130 also has a 33-word data buffer instead of the usual two-byte buffer. This allows greater flexibility in assigning priorities within the computer.

DEC PDP-11 (TM11) Compatible

The TC-130 is software and hardware compatible with all PDP-11 series computers. Virtually all tape drives having an industry standard interface can be used with the TC-130. These include drives from Ampex, Cipher, Kennedy, Pertec, Qantex, STC, Tandberg, Telex and Wangco.

FEATURES

- Word transfer of data used where byte transfer is not necessary.
- DEC or IBM byte packing under software control.
- IBM 360 compatible format in both NRZ and PE.
- 33-word data buffer.
- Handles up to eight tape drives.
- Allows user to edit previously recorded data.
- Dual speed capability.
- Comprehensive diagnostics.
- Software compatible (TM 11).
- Embedded — The TC-130 resides within the host CPU.
- Fits all PDP-11 series computers.
- Permits automatic read-and-write on the fly for consecutive read-write operations.

Circle 111 on Reader Inquiry Card

TC-140 FOR INTERDATA SERIES COMPUTERS

The TC-140 Magnetic Tape Controller combines both PE and NRZ formats on one board to fit Interdata computers. It provides the ability to mix 7-track and 9-track NRZ, PE, or dual-density tape units in any combination up to four drives at any two speeds in the range of 12.5 to 125 ips.

Its device code is switch-settable on the controller, allowing multiple controllers in one CPU each with up to four drives.

The TC-140's enhanced command set and extended status register (which remain "invisible" under standard operating systems) allow a higher level of control for special applications.

The TC-140 is software compatible to all Interdata operating systems having magnetic tape support and runs through either the multiplexer bus or SELCH.

FEATURES

- Interdata software compatible.
- Single-board, embedded, provides both PE and NRZ formats.
- Allows mixing 7-track or 9-track, PE, NRZ, or dual-density tape units in any combination.
- Provides 4 × 4 or 6-bit pack on 7-track for dumping core memory onto tape.
- 66-byte data buffer increases flexibility in assigning priorities when programming data transfer.
- IBM 360 compatible 7/9 channel format.
- Operates via SELCH or multiplexer bus.
- Comprehensive diagnostic program.
- Enhanced command and extended status set.

Circle 112 on Reader Inquiry Card

TC-150 FOR DIGITAL EQUIPMENT CORPORATION LSI-11 COMPUTERS

The TC-150 Magnetic Tape Controller offers users the convenience of both Phase Encode and NRZ formats consolidated onto four plug-in PC boards. It also has the ability to mix 7- and 9-track NRZ, PE, or dual-density tape units in any combination up to eight drives at any two speeds in the range of 12.5 to 125 ips.

When doing consecutive read-write operations, the TC-150 read-and-write on the fly capability permits automatic non-stop operation, and saves time when switching between multiple tape units.

The TC-150 logic does all data transfers in the word (16 bit) mode except for odd bytes at the beginning or end of a block. These are transferred in the byte (8 bit) mode, thus reducing data transfers by almost 50% compared to other systems. The TC-150 also has a 33-word data buffer instead of the usual two-byte buffer. This allows greater flexibility in assigning priorities within the computer.

DEC LSI-11 compatible

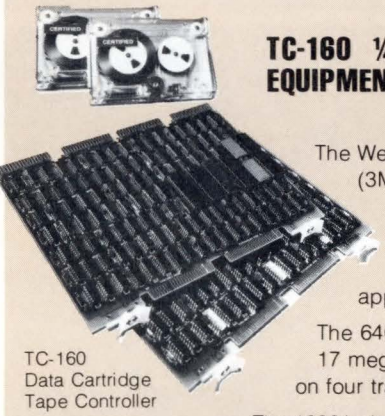
The TC-150 is software and hardware compatible with all LSI-11 Series computers. Virtually all tape drives having an industry standard interface can be used with the TC-150.

FEATURES

- Word transfer of data used where byte transfer is not necessary.
- DEC or IBM byte packing under software control.
- IBM 360 compatible format, in both NRZ and PE.
- 33-word data buffer.
- Handles up to eight tape drives.
- Allows user to edit previously recorded data.
- 7-track 4 × 4 or 2 × 6 packing.
- Dual speed capability.
- Q bus buffer provided to isolate the TC-150 and its associated cabling from the bus.
- Embedded.
- Software compatible (TM 11).

Circle 113 on Reader Inquiry Card

DATA CARTRIDGE TAPE CONTROLLERS



TC-160
Data Cartridge
Tape Controller

TC-160 ¼" DATA CARTRIDGE TAPE CONTROLLER FOR DIGITAL EQUIPMENT CORPORATION LSI-11 COMPUTERS

The Western Peripherals TC-160 Controller for ¼" Data Cartridge (3M type) drives offers users the convenience of handling ease and compact size inherent in this style of drive.

Built-in Tri-mode formatting of the TC-160 allows the user to select the drive type and format best suited to his application.

The 6400 bpi MFM formatting offers unformatted capacities up to 17 megabyte on a single DC-450 (450') cartridge. Data is written on four tracks in serial mode.

The 1600 bpi phase encode four-track parallel format allows the full tape to be written or read in a single pass with up to 4 megabytes of data on a single cartridge.

The 1600 bpi phase encode four-track serial also has a total storage capacity of 4 megabytes. Sixteen-word write and read data buffers are used in the TC-160 instead of the usual two-bytes, giving greater flexibility in assigning priorities on the computer.

The TC-160 is hardware compatible with all LSI-11 series computers. The two controller boards plug directly into the computer Q bus. The TC-160 is software compatible to all operating systems or utilities having DEC TM 11/TU 10 support.

NEW

FEATURES

- Emulates DEC TM 11/TU 10 ½" magnetic tape system.
- Embedded — two quad controller cards plug into any two adjacent DEC Q bus slots with no special wiring required.
- Controls up to eight drives.
- Any of three formats: 6400 bpi serial MFM, 1600 bpi PE serial, or 1600 bpi PE parallel.
- 16-byte data buffer eases DEC Q bus priority positioning.

Circle 114 on Reader Inquiry Card

TC-170 ¼" DATA CARTRIDGE TAPE CONTROLLER FOR DATA GENERAL NOVA COMPUTERS AND EMULATORS

The Western Peripherals TC-170 Controller for ¼" Data Cartridge (3M type) drives offers users the convenience of handling ease and compact size inherent in this style of drive.

Built-in tri-mode formatting of the TC-170 allows the user to select the drive type and format best suited to his application.

The 6400 bpi MFM formatting offers unformatted capacities up to 17 megabyte on a single DC-450 (450') cartridge. Data is written on four tracks in serial mode.

The 1600 bpi phase encode four-track parallel format allows the full tape to be written or read in a single pass with up to 4 megabyte of data on a single DC-450 cartridge.

The 1600 bpi phase encode four-track serial also has a total storage capacity of 4 megabyte. Write and read data buffers are used in the TC-170, giving greater flexibility in assigning priorities on the computer.

The TC-170 is hardware and software compatible with all Data General NOVA and Eclipse Series, as well as other Data General emulating computers. The embedded controller plugs into a single slot in the host computer and connects with the tape drive through the backplane of the computer, using push-on connectors.

NEW

FEATURES

- Emulates D.G. 6020/4196 ½" Magnetic Tape System.
- Embedded — single board controller plugs into any slot.
- Controls up to eight drives.
- Any of three formats: 6400 bpi serial MFM, 1600 bpi PE serial, or 1600 bpi PE parallel.
- 16-byte data buffer eases priority positioning.

Circle 115 on Reader Inquiry Card

UNIVERSAL DISC CONTROLLERS

DC-220 FOR DATA GENERAL NOVA COMPUTERS

The DC-220A Series Disc Controllers operate with all Data General NOVA and Eclipse computers as well as other Data General-emulators. DC-220's are available in three configurations compatible with the Data General 4057, 4234, and 4047 systems. All versions are mounted on single PC boards to occupy a single card slot inside the computer.

DC-220A-25 Multi-surface Drive Controller Emulates the Data General 4057 System

☐ RDOS compatible ☐ Maximum capacity 100 megabytes using four 25-megabyte drives such as the Calcomp 114; or two 50-megabyte drives such as the CDC 9746 or Calcomp 214; or one 100-megabyte drive such as the Calcomp 215.

DC-220A-10 Cartridge Drive Controller Emulates the Data General 4234 System

☐ RDOS compatible ☐ Data General media compatible using 5440-type drives ☐ Also available with 2315-type drives ☐ Maximum capacity 40 megabytes using four 10-megabyte drives or two 20-megabyte drives.

DC-220A-2.5 Cartridge Drive Controller Emulates the Data General 4047 System

☐ RDOS compatible ☐ Data General media compatible using 2315-type drives ☐ Also available with 5440-type drives ☐ Maximum capacity 10 megabytes using four 2.5-megabyte drives, two 5-megabyte drives, or one 10-megabyte drive.

FEATURES

- Lets computer see multi-disc platters as though from separate drives.
- Stores track associated with every computer-selected drive even if there is in reality only one drive mechanism.
- Performs automatic seek as part of read-write operation.
- Compatible with Data General RDOS software.
- Complete data error checking.
- Choice of formats with or without address verification.
- Simplified system installation, maintenance, and service.
- Electrical connection to the drive via push-on connections to the CPU backplane.
- Switch selectable implied seek on read.
- Single board embedded.

Circle 116 on Reader Inquiry Card

DC-230 FOR DIGITAL EQUIPMENT CORPORATION PDP-11 COMPUTERS

The DC-230 Disc Controller is designed to accommodate both dual-platter and single-platter drives with 203 or 406 tracks per surface.

Because the controller stores the track information associated with present selected drive, the seek operation need not be issued separately. The operator simply issues a new disc address for the drive stipulating the desired track. The seek operation then occurs automatically when the operator activates the read-write command with a "go" pulse.

Cartridge Drive Control

☐ Capable of controlling eight 2.5-megabyte drives, four 5-megabyte drives, two 10-megabyte drives, or one 20-megabyte drive. The standard DC-230 interfaces with almost any desired cartridge drive while retaining total software compatibility to the DEC RK11/RKO5 system.

The data on the 2315 cartridge (at 100 TP) is also media compatible with DEC.

The DC-230 is software compatible with the PDP-11. The two controller boards plug into two slots in the computer or expansion chassis and connect with the disc drive from connectors coming off the top of one of the boards.

FEATURES

- Lets computer see multi-disc platter drives as though from separate drives.
- Performs automatic seek as part of read-write operation.
- Complete data error checking.
- Fits all PDP-11 computers.
- Simplified system installation, maintenance, and service.
- Up to 20 megabytes total storage.
- PDP-11 software compatible.
- 16-bit word data buffer.
- RK11 software compatible.
- Two board embedded.

Circle 117 on Reader Inquiry Card

GENERAL INFORMATION

DIAGNOSTIC PROGRAM

Comprehensive diagnostic programs are supplied with all control systems for testing the Western Peripherals Magnetic Tape or Disc Controller, and insuring compatibility with the standard operating system under dynamic operating conditions.

ORDERING INFORMATION

All sales are FOB Anaheim, California. Payment terms are Net 30 days subject to credit approval. Specifications listed are subject to change without notice.

SERVICE

Western Peripherals' combination of nationwide contract service and worldwide Distributor service network assures you of support at almost any point on the globe. Customer training is available at the Western Peripherals plant for both controllers and drives. It is provided at a nominal cost for material and supplies or can be quoted at the customer's site.

CUSTOMER SERVICE CENTERS

793 Elkridge Landing Rd.
Linthicum, MD 21090
(301) 796-2236

188 Civic Circle, Suite 114
Lewisville, Texas 75067
(214) 436-5577

1100 Claudina Place
Anaheim, California 92805
(714) 991-8700

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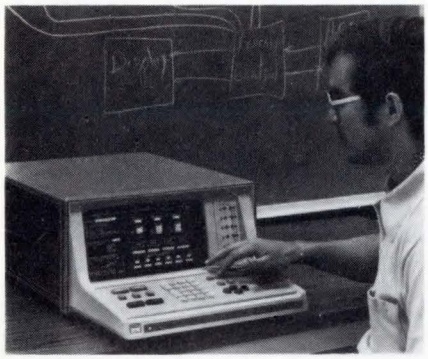
New Products

LOGIC STATE ANALYZER

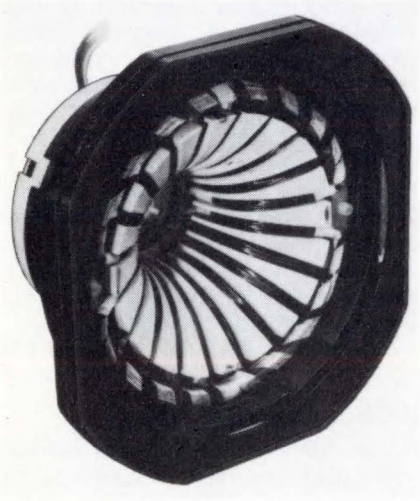
Model 1610B keyboard-controlled logic state analyzer, based on the previous 1610A, adds multiphased, qualified clocks for quicker, easier analysis of multiplexed buses. This clocking capability introduces three data capture modes, 32 bits, 16/16 bits, and 16/8/8 bits. The 1610B also displays contents



of the analyzer memory when all trigger conditions are not satisfied or a system clock fails. For hard copy records of tests, and format and trace specs, the 1610B includes an output compatible with HP's 9866A and 9866B thermal printers. $12,500. **Hewlett-Packard Co.**, 1507 Page Mill Rd., Palo Alto, CA 94304. **Circle 202**

STATOR YOKE

A 29 mm Ferrite Core Stator Yoke for 110° CRT systems requiring high density, clearly readable uc and lc characters anywhere on the screen. With either raster/dot scans or stroke written



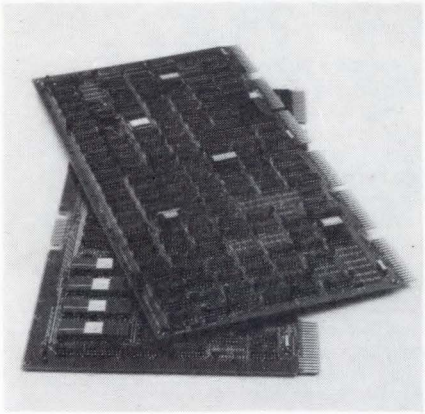
systems, the yoke produces clean, clear char. with absence of edge smear. Over 6,000 char. can be displayed on popular 15″ (diag.) screens. **Syntronic Instruments, Inc.**, 100 Industrial Rd., Addison, IL 60101. **Circle 213**

4K STATIC RAM

An 18-pin DIP, 4096-bit static RAM clip, part #EA2114L, offers five access time options (150-450 nsec). Uses? Memory applications requiring real time I/O access, large storage, easy interface and high performance. Use this 1k x 4N-channel MOS RAM in micros, video terminals, communication devices, computer peripherals, instrument systems, word processors, and POS products. $7.65 (100). **Electronic Arrays**, 550 E. Middlefield Rd., Mountain View, CA 94043. **Circle 217**

DISK CONTROLLER FOR PDP-11

A Ball disk controller, #3211, interfaces any PDP-11 and up to four SMD or SMD-compatible drives in any mix of data capacities from 806K bytes to 1.2 Mbytes/sec. The host-resident controller mounts in a quad system backplace. Direct access to memory for all R/W block transfer is accomplished through the Non-Processor Request



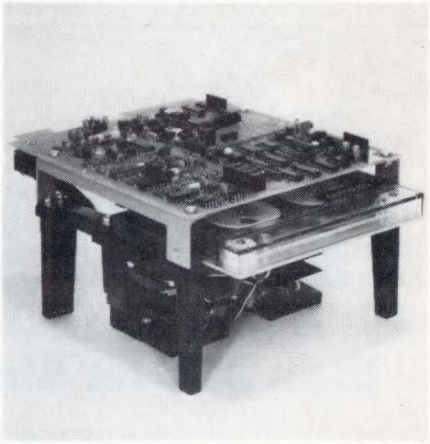
(NPR) DEC Unibus facility. Requiring only one Unibus load, the controller can be strapped to any arbitrary priority level (BR5 standard), interrupt vector address (254 standard) and device register address (776700 standard). $6,100. **Ball Computer Products**, 860 East Arques Ave., Sunnyvale, CA 94080. **Circle 215**

DOT MATRIX PRINTER

Advantages claimed for the Epsom 80-col. Model 3110 Dot Matrix Printer Mechanism – now available in the ready-to-go TX-80 Dot Matrix Printer – include tractor feed, a 100,000,000 char. dot head, and 150 cps printing using 96 ASCII characters. It comes with a connector compatible with either a Centronics plug or EIA std. 25-pin connector. **Epson America, Inc.**, 23844 Hawthorne Blvd., Torrance CA 90505. **Circle 228**

34-MBYTE MICROTAPE

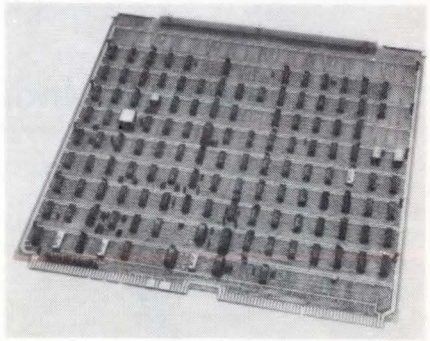
This 34-MByte digital cartridge tape drives is fast. "The Streaker" records at a density of 10,000 flux reversals/in, R/W at 90 ips and transfers data at 648 kbits/s. It consists of a frame, motor/tachometer, 7-track bi-directional



head, and a single board containing servo and R/W electronics. Control, CODEC and interface electronics are left to the customer. The drive is an industry-standard 1/4″ ANSI/ECMA tape cartridge. $885. **Data Electronics, Inc.**, 370 N. Halstead St., Pasadena, CA 91107. **Circle 222**

LINE PRINTER CONTROLLER

This one-board Data Channel (DMA) controller, for use with high-speed line printers and Data General's Eclipse computer, provides operation and programming considerations for all popular model high-speed printers. Main features are horiz. tab memory, controlling printer VFU, and loading a printer elec-



tronic VFU. An optional feature permits operations of differential line drivers/receivers at distances greater than 3,000′. It has a switch-selectable programmable interval timer (PIT)/real-time clock (RTC). $1995. **MDB Systems, Inc.**, 1995 N. Batavia St., Orange, CA 92665. **Circle 219**

New Products

CRT RESOLUTION BASICS

Application notes "CRT Resolution Basics," an 8-pg. technical paper from Syntronics, describes practical considerations that affect CRT display resolution. Relationship of anode voltage and cutoff bias to spot size are discussed as well as the effects of electrostatic and electromagnetic focus. **Syntronic Instruments, Inc.**, 100 Industrial Rd., Addision, IL 60101. **Circle 210**

VISION ONE/20

Vision One/20 claims it has the widest variety and range for processing 2-D data from a single source package. This real-time, interactive, stand-alone system provides film-level photographic-quality images on a high-resolution raster monitor. With its large image-refresh data base memory, μP controller, and powerful operating system in firmware, it's said to be the most versatile image exploitation system on the market. $35,000. **Comptal Corp.**, Box 5087, Pasadena, CA 91107. **Circle 200**

FAST-ACCESS DRIVES

The M229X series of sealed drives are said to provide the industry's fastest access times with 20% better reliability (exceeds 10,000 MTBF, power-on-hours). The design is energy conservative and cool running. And for flexible expansion in existing disk configurations or software and controller development, the standard SMD interface is built-in. M2282: 66 Mbytes. M2283: 132 Mbytes. M2284: 165 bytes. Optional head-per-track capacity: 655 Kbytes. **Fujitsu American, Inc.**, 2945 Oakmead Village Court, Santa Clara, CA 95051. **Circle 231**

TALKING TRANSLATOR

This hand-held talking Language Translator speech synthesizer has modules for English, French, German and Spanish, and aids world travelers when communicating in foreign countries. It also assists students learning to pronounce foreign languages. It can vocalize thousands of phrases by linking spoken vocabulary words. Each module contains about 1,000 words – half spoken and sisplayed, and half displayed only. An earplug provides pri-

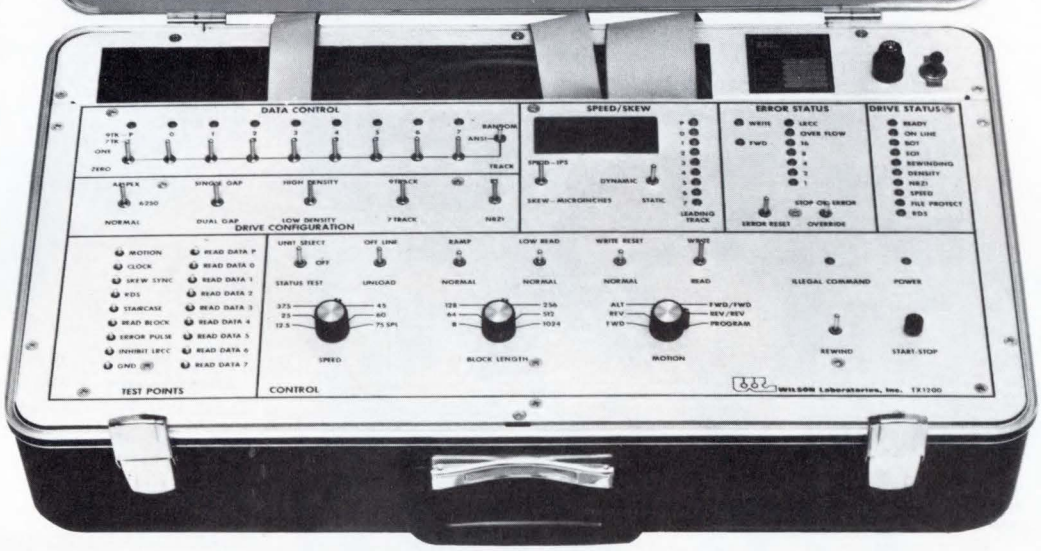
vate use. Five basic functions for users include. common phrases, partial phrases, translate mode, "memory" learn mode (to drill users on pronunciation and translation) and "learn" mode or programmed drill. Voices used for different languages were carefully selected to provide the best, most generally accepted accents. Spanish,for example, offers the Spanish of the Americas and of Mexico; French offers Parisienne. $250. **Texas Instruments**, Box 53, Lubbock, TX 79408. **Circle 234**

HIGH-SPEED MODEMS

Facom 1921A, a 9,600 bps modem with a digital automatic adaptive equalizer ensures fine performance under various line conditions. It conforms to CCITT V.29; easily switches to CCITT V.27 bis/ter, if desired. 8.40 x 5.08 x 16.80″; 17.6 lbs. **Fujitsu America, Inc.**, 2945 Oakmead Village Court, Santa Clara, CA 95051. **Circle 214**

WILSON EXERCISERS

THE ERRORS STOP HERE



TX-1200 Tape Drive Exerciser

IDEAL FOR BOTH Q.A. AND SERVICE TESTING

Floppy Disk Exerciser	Disk Drive Exerciser	Tape Drive Exerciser	Communications Exerciser	Storage Module Exerciser	Disk Drive Exerciser	Disk Drive Exerciser

To completely test tape drives, disk drives, floppy disk drives and other equipment, you can't beat Wilson exercisers.

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WILSON Laboratories, Inc.

Circle 60 on Reader Inquiry Card

New Products

STATISTICAL MULTIPLEXOR

Designated the SNP-1000, the intelligent concentrator and statistical time division multiplexor allows the user to poll a number of remote sites along a single tramsmission line. This permits the network designer to optimize telephone line savings in applications where a conventional concentrator, FDM, TDM or ITDM cannot be fully effective. The SNP-1000 is available in two-, four- and eight-channel models, concentrating asynchronous inputs into a single high-speed output for maximum operating efficiency. $1500. **Prentice Corp.**, 795 San Antonio Rd., Palo Alto, CA 94313. **Circle 105**

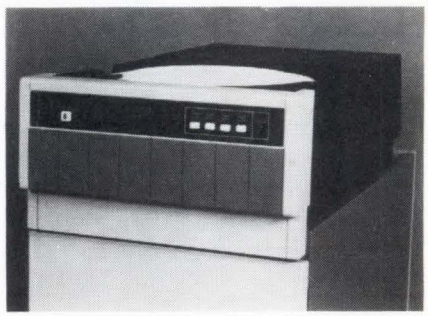
μP-BASED TERMINAL

The 5450VRL microprocessor cassette terminal is an 8080-based memory storage system that features an optional variable record length read capability for compatibility with NCR's variable record length systems. Storage capacity for the 5450VRL varies with record length; for the 5450, capacity is 442K formatted characters. The product line also includes the 5000 (221 K characters). All, except the 2500, incorporate high speed Skip, Search, and Edit capability. The terminals operate in

FDX and HDX modes; FDX provides Echoplex operation for each character. Dual RS232C I/O interfaces are standard; 20 ma current loop is optional. $1995. **MFE Corp.**, Keewaydin Drive, Salem, NH 03079. **Circle 122**

DISK DRIVES TO 100 M BYTE

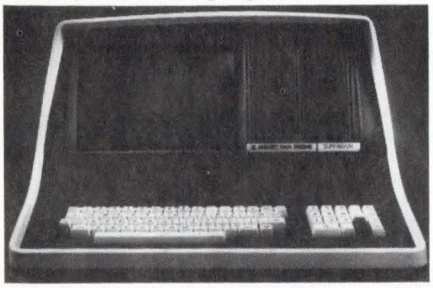
The H32, H64 and H96 disk drives — utilize one, two or three fixed disks providing 16.7, 50.3 and 83.9 Mbytes of storage, with 16.7 Mbytes of removable storage on a 5440-type cartridge. High-speed data transfer rate is up to four times faster than conventional 5440/2315 type drives, with a 25% improvement in data access time.



The single-servo Hunter has an average access time on a volume change of 9.37 ms vs. 13.37 ms for a competing dual servo drive. Hunter disks feature 833 cylinders, with 6060 BPI and 20160 bytes per track. The H-96 maps Trident T-80 or CDC 9762 SMD on to fixed media. **Century Data Systems**, 1270 North Kraemer, Anaheim, CA 92806. **Circle 101.**

"SUPERBRAIN GRADUATES"

The SuperBrain Video Computer is aesthetically packaged in a single, lightweight, table-top enclosure. Standard features of the system include: two double-density, 5-1/2″ floppy-disk drives with 320,000 bytes of storage, 48K bytes of user programmable RAM



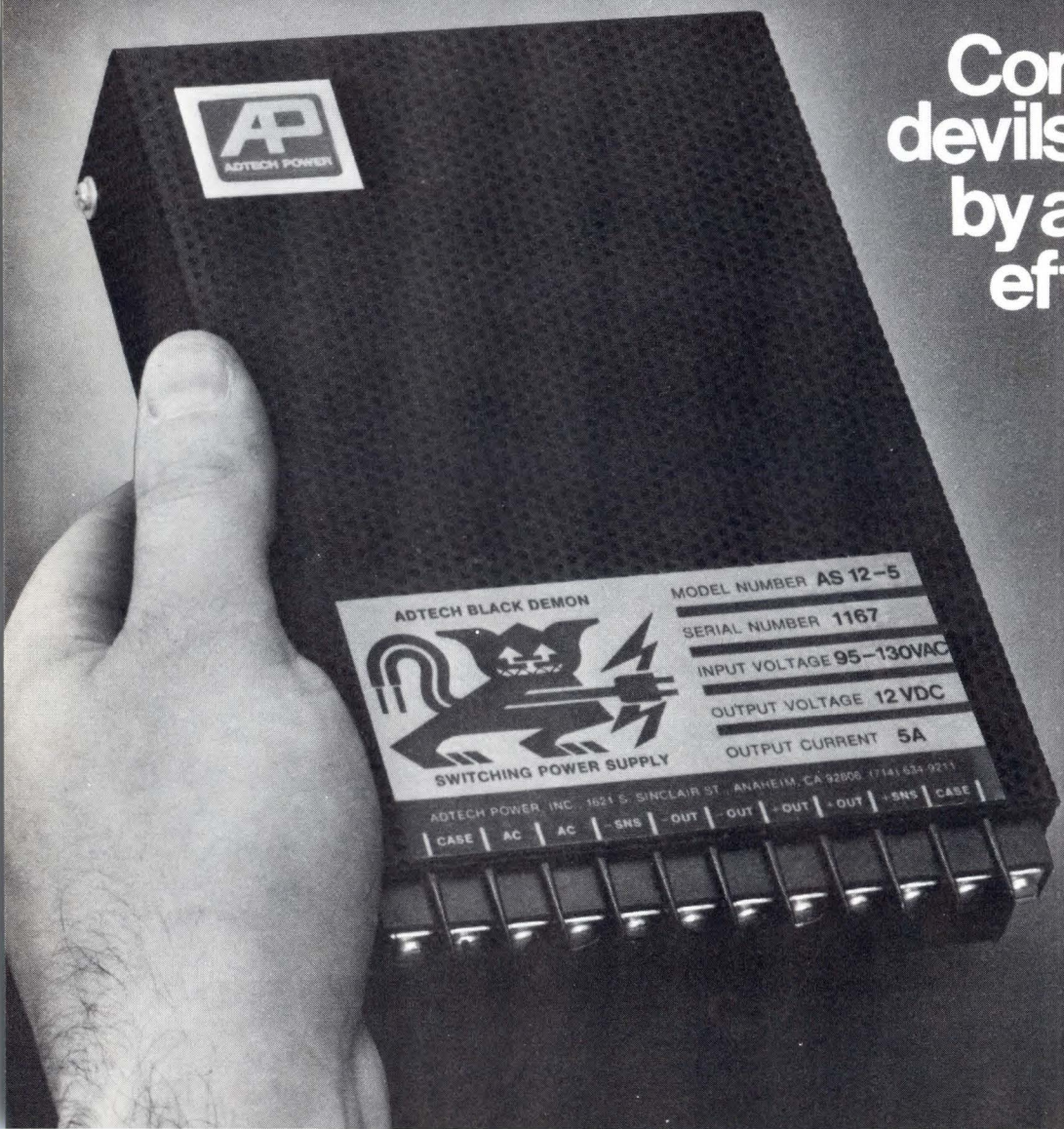
memory - on board expandable to 64K, a CP/M based Disk Operating System with a high powered text editor, an assembler and a debugger, an S-100 bus adaptor to permit connection of auxiliary peripheral devices to the system, twin Z-80 microprocessors which allow extremely efficient data transfer between the screen and peripherals, a full ASCII keyboard with numeric pad and function keys, a non-glare, dynamically focused 12″ screen, a universal RS-232C communications port for interfacing with an auxiliary printer and/or host computer, a single board microprocessor design to insure fast and efficient servicing, Intertec's new video power supply which combines both video and power circuitry on a single board, an abundance of available software designed to operate on the SuperBrain's Disk Operating System including Basic, Fortran, Cobol and even APL. $2,995. **Intertec Data Systems Corp.**, 2300 Broad River Rd., Columbia, SC 29210. **Circle 132**

DUAL DISK DRIVE/ DEVELOPMENT SUBSYSTEM

The Innotronics Model 3400 Dual Drive Sub-System is a modular 8″ floppy disk drive system that can integrate a single board controller or computer, or interface with any controller. Single or double density, hard or soft sectored units are offered; a typical double density, soft sectored unit has a 1MB

capacity. More than 30 performance options such as write protect, timed head load, and power disable may be user selected on the Innotronics Model 3400. $1,555. **Innotronics Corp.**, Brooks Rd., Lincoln, MA 01773. **Circle 133**

Adtech Black Demon Switchers.



Compact little devils possessed by a mania for efficiency... up to 80%.

With reliability of 70,000 HOURS MTBF AT 80°C BASEPLATE!

Unique, patented circuits make an extraordinary difference..at ordinary prices.

Black Demon switching power supplies utilize a pulse width modulated power conversion circuit to achieve 70,000 hour MTBF at 80°C baseplate for AC to DC models. At 40°C baseplate, where most companies specify 70,000 hour MTBF, ours is 350,000. Black Demons also feature an exclusive, patented one-transistor switch circuit controlled by a single DC voltage, eliminating the core saturation failure mode problems experienced in conventional switchers. It all adds up to a better buy at essentially the same prices as the others.

AC to DC Models 5.25 to 48V / 1.5 to 10A

Input Voltage: 95-130 VAC, 47-440 Hz, single phase or 130 to 180 VDC. (220V nominal AC input is optional)
Efficiency: 74% min. @ 5V output / 80% min. @ 48V output
Reliability: 70,000 Hr. MTBF @ 80°C Baseplate / 350,000 Hr. MTBF @ 40°C Baseplate

Model No.	Output Voltage*	Maximum Output Current**	Minimum Efficiency	Maximum Power Loss (Watts)†
AS 5-10	5.25 ±0.2%	10 A	74%	18.5
AS 12-5	12.00 ±0.2%	5 A	77%	18
AS 15-4	15.00 ±0.2%	4 A	78%	17
AS 28-2.25	28.00 ±0.2%	2.25 A	80%	16
AS 48-1.5	48.00 ±0.2%	1.5 A	80%	18

DC to DC Models 5.25 to 48V / 1.2 to 10A

Input Voltage: 10-14 VDC, 20-32 VDC, or 38-56 VDC
Efficiency: 62% min. @ 5V output / 80% min. @ 48V output
Reliability: 68,000 Hr. MTBF @ 80°C Baseplate / 320,000 Hr. MTBF @ 40°C Baseplate

Model Number	Input Voltage (VDC)	Output Voltage* ±0.2% (VDC)	Maximum Output Current**	Minimum Efficiency	Maximum Power Loss (Watts)†
1 DS 5-10	12	5.25	10 A	62%	32
2 DS 5-10	28	5.25	10 A	70%	22.5
4 DS 5-10	48	5.25	10 A	72%	20.5
1 DS 12-5	12	12	4.5 A	63%	32
2 DS 12-5	28	12	5 A	73%	22
4 DS 12-5	48	12	5 A	75%	20
1 DS 15	12	15	3.6 A	63%	32
2 DS 15	28	15	4 A	74%	21
4 DS 15	48	15	4 A	76%	19
1 DS 28	12	28	2 A	64%	32
2 DS 28	28	28	2.25 A	76%	20
4 DS 28	48	28	2.25 A	78%	18
1 DS 48	12	48	1.2 A	64%	32
2 DS 48	28	48	1.3 A	78%	17.5
4 DS 48	48	48	1.3 A	80%	15.5

*Optional voltage features available. See Literature.
**10% minimum load required for regulation.
Output voltage is limited for safe operation at less than minimum specified load.
†These specifications apply for nominal input voltage and maximum load.

Operating Specifications-All Models

Line Regulation:
±0.05% or ±10mV maximum (whichever is greater) over specified line range at half load.

Load Regulation:
0.2% or 10mV maximum (whichever is greater) from 10% minimum load to full load.

Ripple:
0.8% or 100mV peak to peak maximum from all sources, whichever is greater. (33 KHz typical)

Transient Response:
2% or 0.35V maximum over/undershoot with return to regulation in less than 250μ seconds after a 50% to 100% or 100% to 50% load change at a 1A/μ second rate.

Temperature Coefficient:
0.015%/°C maximum.

Temperature Range:
Operating: 0°C to +80°C baseplate @ full rated power. Storage: -55°C to +85°C.

Additional Features

Electromagnetic Interference:
Input and output filters and internal noise cancellation suppress radiated and conducted interference.

Remote Error Sensing:
Standard on all units.

Short Circuit/Overload Protection:
The unit will withstand a short circuit or overload of unlimited duration. Normal operation automatically resumes upon removal of short or overload.

Output overvoltage protection:
The output is internally limited to 130% of rated output voltage in event of internal failure.

Input Overvoltage Protection:
The unit will withstand 150% of nominal input voltage indefinitely. Normal operation resumes upon removal of overvoltage.

Reliability: See Tables at left.
@ 80°C to baseplate MTBF is 68,000 hours; @ 40°C baseplate MTBF is 320,000 hours. Calculations per MIL-HDBK-217B (π_E factor G_B with appropriate π_Q factors) are based on maximum input voltage and full rated output current.

Send for Literature Detailing Optional Features.

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Washington, Seattle
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ADTECH POWER

Europe: ADTECH INTERNATIONAL, Subsidiary of Adtech Power, 46 BD, Roger Salengro, 78200 Mantes La Ville, France. Tel. 477530l+

DISTRIBUTORS: Call Kathy Nelson, Distributor Products Group, (714) 634-9211, for the name of a distributor near you.

Black Demon Switchers are also manufactured in Europe. See Ad on next pages.

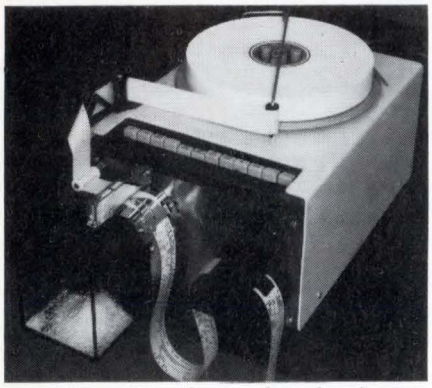
ADTECH POWER, INC., 1621 S. SINCLAIR ST., ANAHEIM,CA 92806. (714) 634-9211 ● TELEX 68-1498

Circle 42 on Reader Inquiry Card

New Products

PAPER TAPE TERMINAL

Designated the DLC Model 18 Paper Tape Terminal and powered by a TI 9981 microprocessor, the unit can be connected to a KSR printer, such as the Teletype Model 43 or DEC Model 34, to provide an ASR capability. The unit operates at rates up to 300 baud (30 cps), has dual ports with RS232C (CCITT V24) interfaces and weighs 18 pounds. Optional features include current loop interfaces, five level tape transmission for Telex, answerback, 4K to 8K buffer, code conversion for numerical control applications and editing capabilities. $1800. **Drillick LaManna Corp.**, 280 Midland Ave., Saddle Brook, NJ 07662. **Circle 126**



MOVING/FIXED DISK

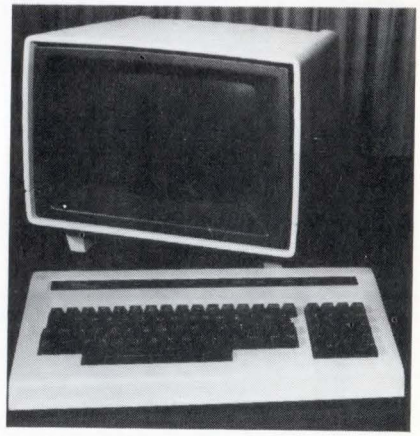
The Atlas has a moving head capacity of 10 or 20 Mbytes and an optional fixed head capacity of .25 or .5 Mbytes. Typical quantity OEM prices are $3,000 to $3,800. **Alpha Data Inc.**, 20750 Marilla St., Chatsworth, CA 91311. **Circle 137**

ROTARY PRINTER

The Series 1800 rotary printer utilizes 8½ inch wide electrosensitive paper to provide standard 8½ inch by 11 inch or 8½ inch by 14 inch printout capability. Two standalone models are available in the new Series 1800 rotary printer family. The Model 1800 is an alphanumeric printer with operator selectable modes of speed of either 4000 cps or 6600 cps. RS232-C serial and industry standard parallel interfaces are available. The second model, the Model 1870, utilizes an RS170 composite video interface for reproducing high-resolution graphics and/or alphanumerics from either an interlaced or noninterlaced terminal source. Graphic resolution exceeds 200 dots per inch horizontal and 100 dots per inch vertical. Features such as multiple copies, self test, and a paper empty indicator are available on both units.**SCI Systems, Inc.**, 8600 South Memorial Parkway, Huntsville, AL 35802. **Circle 281**

MICRO CRT TERMINAL

The Entry "81" low cost microprocessor controlled CRT terminal features a detached typamatic 81-key solid state keyboard with an English language typewriter style keyboard. The N-key roll over also allows high speed typing without loss of data. The DTI Entry "81" also features upper/lower case with descenders, conversational and block transfer, 128 user defined functions, 19 key numeric pad, and a transparent print mode which allows the Host CPU to print 132 column data at different baud rates through the CRT. $895. **DTI, Data Terminals Corp.**, 354 Woodland St., Holliston, MA 01746. **Circle 131**



Z-80 EXECUTIVE

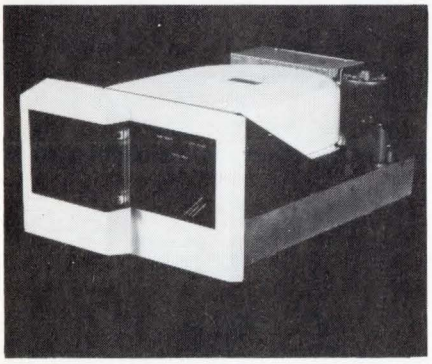
REX-80 (Real-time Event-driven Executive) is a real-time, multi-tasking executive designed for 8080 and Z-80 based microcomputers. The fundamental program unit under REX-80 is the Task. Under REX-80, up to 16 user defined tasks are prioritized and allowed to exist concurrently and share system resources. Prioritized preemption allows REX-80 to respond immediately to the tasks with the more important resource demands. Tasks are written and debugged separately as individual program modules and are later linked with the REX-80 System Module. The REX-80 System Module fits in 2K bytes of ROM and requires only 512 bytes of RAM. **Systems and Software, Inc.**, 2801 Finley Rd., Suite 101, Downers Grove, Ill. 60515. **Circle 141**

HIGH-RESOLUTION COLOR/ GRAPHICS FOR 2100

The 4600 series graphic display system for the Hewlett-Packard 2100/MX/XE/XF computers resides within the host computer, simplifying system integration. The display channel format is a 768 x 512 dot matrix, with from two to eight channels per system. A bipolar microprocessor accepts high level command sequences and generates the resulting graphic and alpha-numeric images. Standard functions include vectors, areas, perimeters, characters (multiple size), points, and image readback. Readback facilitates hardcopy with standard plotters, image repositioning, dynamic curves, data retrieval, and image reversal. $5750. **Intermedia Systems,** 10601 S. Saratoga-Sunnyvale Rd., Cupertino, CA 95014. **Circle 153**

DISK/TAPE DRIVE COMBO

The MSC-5900 provides as much as 87.8 Mbytes of sealed module storage as well as 17.1 Mbytes of removable tape storage. A built-in microprocessor controls drive functions, data formatting and buffering, dump and restore operations for the tape cartridge and



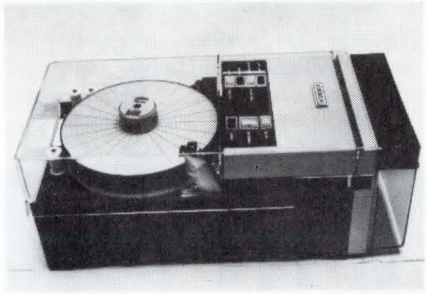
communications with the CPU. The MSC-5900 microprocessor also relieves the CPU from all instructions to the storage device beyond an initial command structure requesting data. $8,250. **Microcomputer Systems Corp.,** 432 Lakeside Drive, Sunnyvale, CA 94086. **Circle 103**

160 CPS MATRIX PRINTER

The new 160 cps matrix printer is available in two versions. The model 9621, equipped with a serial interface, may function as the system printer of the low cost Datapoint 1500 dispersed processor or as a local or remote terminal printer for any of Datapoint's Datashare business timesharing systems. The model 9622 parallel interface version may be attached directly to the I/O bus of any other Datapoint processor to serve as a system printer. The printer can achieve print throughputs as high as 500 lpm through the use of bidirectional printing and rapid head slewing. A 96 character ASCII character set is standard from the 9 x 9 dot matrix. **Datapoint Corp.,** 9725 Datapoint Dr., San Antonio, TX, 78284. **Circle 102**

TAPE PUNCHES

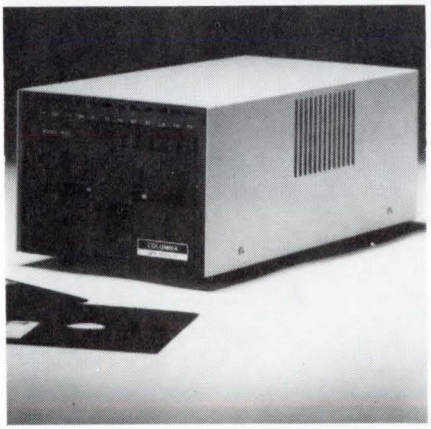
The MK II tape punches accepts either positive or negative logic TTL signal in parallel format. It is completely plug-compatible with REMEX 6075 punch. The MK 1 and MK III punches are intelligent tape punches designed to serve the intercode needs in data communications, word processing typesetting and numerical control applications. Us-



ing a microprocessor in the interface, it is possible to convert from any 5, 6, 7 or 8 level code to another 5, 6, 7 or 8 level code by change of the control memory. MK I accepts both RS-232C and current loop (20-60 ma) inputs. MK III is plug-compatible with Remex RPS 6075 punch. **Data Science,** 1189 Oddstad Dr., Redwood City, CA 94063. **Circle 120**

HIGH SPEED (19,200 BAUD) MINI-FLOPPY STORAGE

The model 400 floppy disk system stores up to 179,200 characters in a single sided, double density, Shugart mini-disk drive, and is designed to connect between asynchronous RS-232 or TTY compatible terminals and a modem/CPU for store and forward applications. Dual UARTs provide buffered on-line baud rate conversion between interconnecting devices of



equal or different data rates between 110 and 19,200 baud. High speed operation at 19,200 baud is made possible by a dynamic triple block buffering technique that allows continuous data recording and playback over the complete disk surface, without discontinuities between track changes. $1995. **Columbia Data Products, Inc.,** 9050 Red Branch Rd., Columbia, MD 21045. **Circle 118**

New Products

2-PAGE CRT TERMINAL

The standard Model DM30 provides for two pages of display memory, with scrolling and paging controls and introduces the stylized Micro Bee detachable keyboard case. Screen presentation is 24 lines X 80 characters with a 25th line utilized as a status line providing prompts on the terminal and system modes, error messages, and a real-time clock. Full editing and formatting

facilities are provided throughout the display memory including selectable entry parameters for alphanumeric, total fill, must fill, constant and modified mode. Twenty-one combinations of visual attributes are provided via non-space consuming codes. Communications facilities via the serial asynchronous RS232C main and auxiliary port are speed selectable via software or hard switches up to 19200 bps. An internal switch selectable protocol permits passing of data between ports at differing speeds while maintaining local data entry facilities for the operator. Standard communications facilities of the DM30 include, conversational, line, page, block or message modes. A Centronics plug compatible parallel printer interface is available as a standard feature to permit full utilization of all ports. **Beehive International**, 4910 Amelia Earhart Dr., Box 25668, Salt Lake City, Utah 84125. **Circle 123**

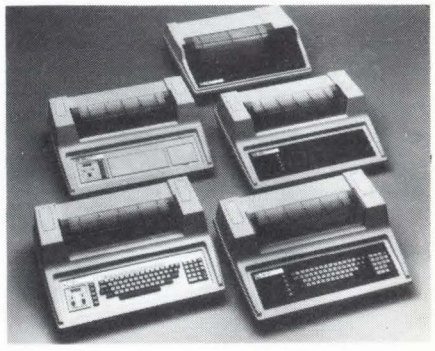
SOFTWARE INTERFACE

Colorware provides the software and hardware interface between the new Colorplot-100 color plotter from Trilog, Inc., and ISC's Intecolor Color Graphics Terminal. Multiple colors are achieved by separating the various colors in the display of the Intecolor into variable dot "mixed" during plotting by the Colorplot-100. The resultant plot is a direct hardcopy of the image displayed. The software is provided on EPROM's which plug into spare sockets within the Intecolor, and is called as a subroutine to standard Intecolor firmware. **Usdata Engineering, Inc.**, 14241 Proton Rd., Dallas, TX 75234.

Circle 104

TEXAS INSTRUMENTS EXPANDS OMNI 800 FAMILY

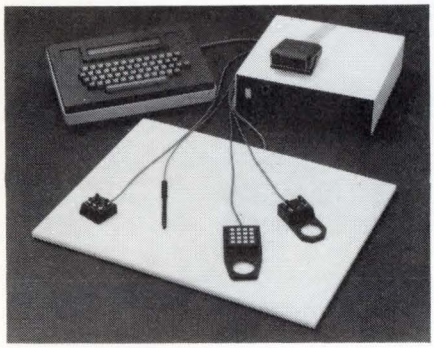
Three new additions to the OMNI 800 electronic data terminal family are the model 820 Receive-Only (RO) printer offering 150 cps; the model 825 Keyboard Send-Receive (KSR) and the model 825 Receive-Only (RO) data terminals which print at 75 cps. The 820 RO communicates at rates from 110 to 9600 baud and has a FIFO buffer capable of storing 1280 characters for added user ease. Standard features on the 820 RO also include optimized bi-directional printing with a 9 x 7 dot matrix character font and a full ASCII character set to produce an original and up to five clear copies. A front



panel operator control keypad and terminal status control panel with three-digit LED display are also standard. Compressed printing, international voltages and character sets and a range of other options are available on the 820 RO. 820 RO $1,995; 825 KSR, $1,695; 825 RO at $1,565. **Texas Instruments**, P.O. Box 1444, M/S 7784, Houston, TX 77001. **Circle 121**

DIGITIZING SYSTEM

The Micro Datatizer processes and converts graphic data into a useful display or printout of X-Y, length, volume and other calculated physical or chart values. The system consists of a digitizing tablet, an interchangable crosshair or pen cursor and a controller housing the microprocessor subsystem. The keyboard/display unit features a full set of TTY characters and displays up to 16 alpha-numeric characters. Tablets have an exclusive 2-year warranty and are available in eight stan-



dard sizes from 6″ x 6″ to 42″ x 60″ with resolutions of 0.001″ or 0.01″. Microprocessor versatility includes: scaling, rotation, origin presetting, general purpose calculations with accumulation and multiplier selection, six digitizing modes, five programmable output formats, six fixed or constant data strings, cursor pushbutton ID, two event counters, floating or fixed point output, error message diagnostics and multiple interface selection. **GTCO Corp.**,1055 First Street, Rockville, MD 20850. **Circle 119.**

VT-100 COMPATIBLE CRT

The DT80/1 CRT terminal has the ability to interface with a printer in three different modes: on line as data comes in, as a printer controller, and as a source for feeding data from the screen directly to the printer. The DT80/1 has a detachable keyboard. Capacity of its CRT screen is 24 lines x 80 or 132 characters. Internally, the DT80/1 houses an LSI CRT controller with two-serial I/O ports, which operate asynchronously with either RS232C and/or 20 mA current loop. Communications speeds are up to 19,200 baud. **Datamedia Corp.**, 7300 No. Crescent Blvd., Pennsauken, NJ 08110. **Circle 129**

FRONT-END PROCESSOR

The 6520 communications front-end processor supports IBM 360/370/303X mainframes and is a plug-compatible replacement for IBM 270X communications controllers and 370X communications controllers operating in the Emulation Program mode. The 6520 and Codex 6000 series of intelligent network processors can be integrated to provide cost-effective networking solutions. $50,000 to $200,000. **Codex Corp.**, 20 Cabot Blvd., Mansfield, MA 02048. **Circle 124**

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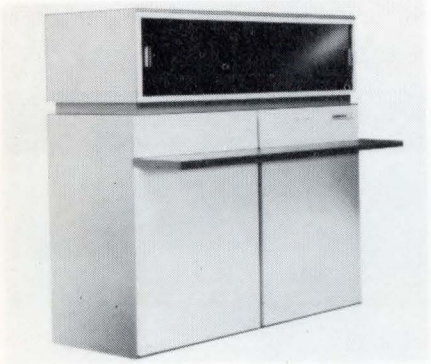
Sponsored by San Francisco Bay Area and Los Angeles Councils of IEEE, and the Northern and Southern California Chapters of ERA.

New Products

HIGH-PRECISION GRAPHICS UNIT ADDED TO CALCOMP'S COM LINE

Capable of producing 16,384 x 16,384 addressable units at a speed up to 400, 000 incrememts per second, the Model 1581 graphics only COM unit is an off-line recorder with a resolution of 80 lines/millimeter – easily meeting NMA specifications for archival film. The new COM unit uses a CalComp multi-format camera to record on 16mm or 35mm film. Automatic CRT intensity compensation is included to free the operator from frequent intensity adjustment, with additional system features including hardware image rotation under program control and automatic monitoring of lens, film and camera



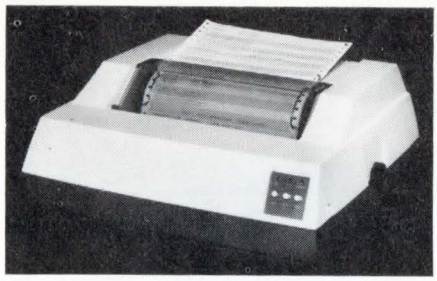
status. In addition, full supporting software is included with various CalComp compatible software packages optional. $94,600. **CalComp**, 2411 W. La Palma Ave., Anaheim, CA 92801. **Circle 130**

MEMORY SYSTEM

Among Series 90 products that make memory flexibility and easy expansion possible are a memory bus, a family of control interface modules and a series of static and dynamic memory modules. The BXP bus wiring, signal level and timing specifications provide a standard that permits interconnection of different memory types which share a common connection to the user's equipment. The BXP bus contains 24 address lines, 4 module address lines and a bus select function. The address lines provide addressing capability of up to 16 Mwords for each memory module. Static memory modules (CM-92s) have cycle times as fast as 100 ns, and a series of dynamic memory modules (CM-90s) have cycle times as fast as 350 ns. **Intel Corp.**, 3065 Bowers Ave., Santa Clara, CA 95051. **Circle 138**

IMPACT PRINTER

The Super Brain model LP-80 is a bi-directional, dot matrix impact printer with a print head designed for 100% duty operation, assuring a print life that exceeds 100 million characters. The precision sprocket feed mechanism permits printing forms from 4-1/2″ to 9-1/2″ wide. The Vertical Format Unit provides preprogrammed/



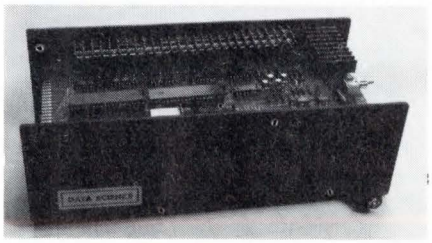
programmable tab positions. Top of Form, and Bottom of Form for complete formattting capabilities. Specifications include 125 cps, 60 lpm paper loading from bottom or rear, and Centronics compatible, parallel interface, $985. **Super Brain, Inc.**, P.O. Box 403, Los Angeles, CA 90073. **Circle 134**

20 MBYTE 8″ WINCHESTER

The 7720, a 20-Mbyte disk drive, features a 50 ms average seek time, with a minimum of 10 ms and a maximum of 100 ms. The disk speed is 3600 rpm with an average latency of 8.3 ms using a patented DC brushless drive motor. The drive requires 100 watts of DC power only. Maximum data accuracy is ensured by a closed-loop, track-following servo system. The recording density is 300 tpi and 6000 bpi. **IMI**, 10381 Brandley Dr., Cupertino, CA 95014. **Circle 143**

DATA HANDLER/CONTROLLER

The Data Sentinel is designed to scan and concentrate data from contact closure type transducers. Microprocessor-based, the unit is programmable and can communicate with remote minicomputer or microcomputer via RS-423/232C compatible lines. It can also be used as a standalone controller, utilizing the output port to control external equipment. The EPROM control memory can be expanded from 512 to 2,048 bytes. Power fail standby



is provided when the power pack is ordered. The optional relay module is a companion printed circuit assembly containing decode, latch and 16 output relays, each having SPST contacts with 1A current rating. This module is driven by the output port from the controller module to provide isolated outputs for controlling power devices. **Data Science**, 1189 Oddstad Drive, Redwood City, CA 94063. **Circle 127**

New Products

DEVELOPMENT TOOL

The ICE-49 in-circuit emulator allows users to emulate any of six Intel MCS-48 single-chip microcomputers – the 8049, 8048, 8748, 8039, 8035 and 8021. The 8049 is a more powerful,

double memory version of the standard 8048 microcomputer and the 8021 is a low-cost microcontroller. The ICE-49 unit resides in an Intellec microcomputer development system. Internal functions of the microcomputer chip can be emulated in single-step or real-time modes. The emulation techniques enable designers to test software and hardware designs, detect and diagnose errors, correct programs immediately with the Intellec development system, and verify that the bugs have been corrected. $4,200. **Intel Corp.**, 3065 Bowers Ave., Santa Clara, CA 95051. **Circle 139.**

AmZ8000 EVALUATION BOARD

In its basic configuration, the AMC 96/4016 evaluation board incorporates the AmZ8000 16-bit microprocessor; 8K bytes of RAM; 24 parallel I/O lines; two RS232C serial I/O ports; 12K bytes of EPROM/ROM sockets; system clock and resident monitor. Options include a full decoded keyboard and 20-character alphanumeric display assembled on a printed-circuit board, EPROM-resident, ASCII, one-pass, line-by-line assembler, and a universal prototyping board of the same family form factor. **Advanced Micro Computers**, 3340 Scott Boulevard, Santa Clara, CA 95051. **Circle 157**

I/O PROCESSOR FOR 8086

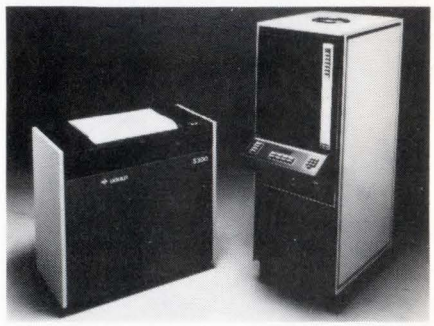
Functioning as a fully independent processor in either a 16-bit 8086 or 8-bit 8088 multiprocessor system, 8089 IOPs can significantly improve system performance by totally relieving the 8086 or 8088 CPU of all I/O control tasks necessary to control system peripherals. As a result of transferring the control of peripherals to the IOP, the 8086 CPU can have up to five times more time available for normal program and data processing. $194 (100), **Intel Corp.**, 3065 Bowers Ave., Santa Clara, CA 95014. **Circle 140**

SUITCASE PASCAL

The Pascal Blaiser features a complete computer system and dual flexible disk subsystem integrated into a compact unit the size of a suitcase. The computer consists of a Western Digital single-board WD/9000 Pascal Microengine housed in a PCC FD 3812 1Mbyte dual flexible disk drive assembly. Pascal Blaiser directly executes user-written Pascal programs as well as the Pascal-based University of California at San Diego Pascal Operating System, version III.0. $5,995. **Pertec Computer Corp.**, Computer Systems Division, 20630 Nordoff St., Chatsworth, CA 91311. **Circle 170**

OFF-LINE PLOTTING

The Off-Line Plotmaster system consists of a microprogrammed, multiple microprocessor-based vector information processor (V.I.P.) and up to eight Gould 5000 Series electrostatic plotters



of the same or mixed types. Inputs to the V.I.P. may be vector plot, raster plot or print information, all of which can be stored on the same nine track multifile tape and plotted or printed under control of the V.I.P. Standard IBM tape formats, labeled or unlabeled, are accepted. Double buffered memories in the V.I.P. allow overlapped data input, processing, and plotter data transfer for maximum hardcopy output speed with Gould electrostatic plotters. The standard double buffered raster memory of 16K bytes/buffer is expandable to 64K bytes/buffer – 128K bytes total. $25,750 to $36,250. **Gould Inc.**, 3631 Perkins Ave., Cleveland, Ohio 44114. **Circle 135**

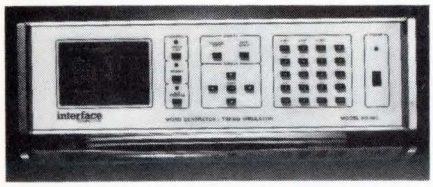
PDP 11/70 I/O DIRECT DATA CHANNEL

By allowing any standard Unibus peripheral to be connected to the 11/70's Cache Bus, the Direct Data Channel (DDC) permits systems to combine the features of readily available, lower cost, standard Unibus peripherals with the high data throughput rates obtained with the 11/70 high speed massbus. The DDC controller allows the system designer to specify peripherals that had been designed for pre-11/70 architectures, eliminates the need for expensive redesign of Unibus based peripherals and provides the key element in designing high performance,

low cost, PDP-11/70 based systems. The DDC controller plugs directly into the main frame of the PDP-11/70. Each DDC controller occupies one RH70 controller slot. $12,000. **Carl R. Boehme & Associates, Inc.** 2076-C Walsh Ave., Santa Clara, CA 95050. **Circle 144.**

DIGITAL TEST DATA

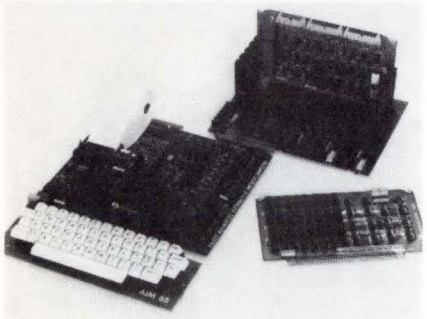
The Model RS-660 uses a microprocessor, built-in CRT and pre-programmed firmware to provide speed and simplic-



ity in the generation of digital test data. In addition to its use as a word generator, the RS-660 offers an eight-channel digital waveform generation mode for timing simulation. Operation in either mode can be single cycle, multiple cycle up to 4,096 repetitions, or continuous, using either front panel, or external triggering. It can be programmed from the front panel, from a remote device or from stored EPROM programs. Remote control interfaces include standard RS-232C and IEEE 488-1978 options. $5,945. **Interface Technology**, 852 North Cummings Road, Covina, CA 91724 **Circle 145**

μC System

The AIM 65 (R6500 Advanced Interactive Microcomputer) features an on-board 20-column thermal printer, an on-board alpha-numeric 20-character LED display and a 54-key terminal-style keyboard. Available in 1K- and 4K-byte on-board RAM versions, AIM

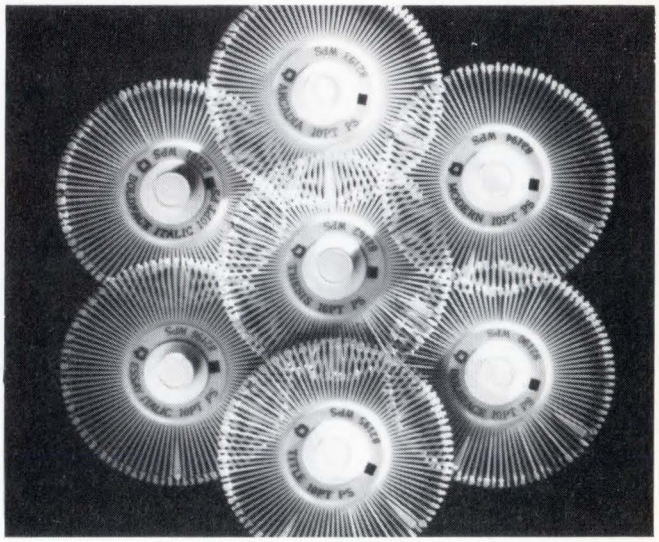


65 is designed around the R6502 CPU. The R6502 has 65K address capability with 13 addressing modes, true indexing and both decimal and binary functions. An 8K ROM-resident monitor program provides comprehensive self-prompting debug and text editor commands. Assembler and Basic language interpreters are also available as plug-in ROM options. **Rockwell International,** Electronics Devices Division, 3310 Miraloma Ave., P.O. Box 3669, Anaheim, CA 92803. **Circle 154**

New Products

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 208**

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 board can replace up to 16 DEC DZ-11 asynchronous-terminal interface boards (each DZ-11 only supports up to 8 ports) anda host-end multiplexor. **Digital Communications Associates, Inc.**, 135 Technology Park, Norcross, GA 30092. **Circle 226**

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 4 V; with typ. 3mA 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 S Street, Santa Clara, CA 95050. **Circle 209**

MICRO BEE TERMINALS

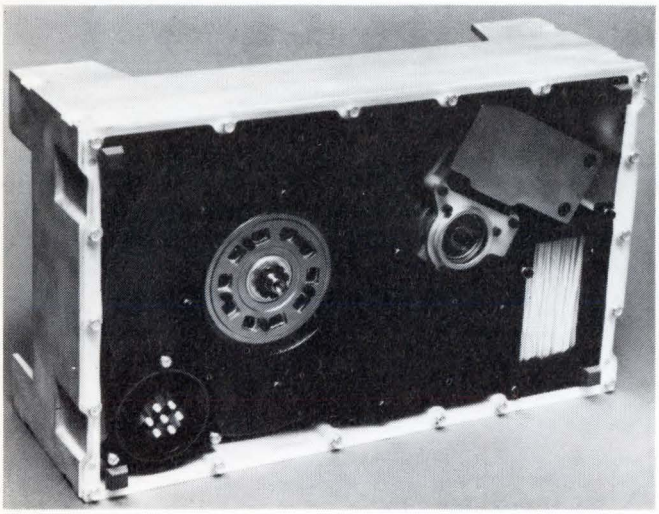
Model DM30 provides for 2 pages of display memory, with scrolling and paging controls in a new stylized Micro Bee detachable keyboard case. Screen presentation is 24 lines x 80 char. with a 25th line utilized as a status line providing prompts on the terminal and system modes, error messages, and a real-time clock. Full editing and formatting facilities are provided throughout the display memory including selectable entry parameters for alph-numeric, total fill, constant and modified mode. 21 combinations of visual attributes are provided via non-space-consuming codes. $1,995. **Beehive International**, 4910 Amelia Earhart Dr., Box 25668, Salt Lake City, UT 84125. **Circle 232**

WHIZZARD DYNAMICS

An optional 3D transformation module for WHIZZARD's 7000 vector refresh graphics series permits pictures to be scaled, rotated, or translated in 3 dimensions. Maximum vector utilization and throughput can display both 2D and 3D pictures at the same time! A special set of calls by Megatek Graphics' Software places three dimensional vector information in the WHIZZARD's display list. Addition of these calls allows vectors to be specified with twelve-bit resolution in all three dimensions. Once the display list for a picture contains three-dimensional vector information, the resultant display can be scaled, rotated, translated and clipped. The new hardware module joins a series of optional add-ons Megatek offers in support of its WHIZZARD terminals and systems. Modular approach to the equipment design allows end users and OEMers to choose particular needs for specific application. **Megatek Corp.**, 3931 Sorrento Valley Blvd., San Diego, CA 92121. **Circle 199**

45 MB 8″ HARD DISK

Micropolis' hard disk offers optional capacities of 9, 27 and 45 MB, respectively, in a unit profile that measures 8.55 W x 4.625 H x 14.25″ D. It's fully interchangeable with a typical 8″ floppy. Access time averages 34 msec. The lower half of the drive package contains platters, disk head and positioner, and is completely sealed. Air is drawn into and expelled from the cavity through 0.3μ filters. A brushless DC motor, custom-designed to accommodate the package's low profile, drives the spindle at 3600 RPM. The upper half contains the electronics package on 3 PC boards, including the optional intelligent controller board ($500, OEM qty). The controller allows selection of a number of standard hard-sectored formats. Other features include handling of drives, direct or buffered data transfers, automatic verification and re-tries, multi-sector transfers, error correction and



a versatile command structure. 25,000 MTBF hours. 1201-1, $1,350 (1000). **Micropolis Corp.**, 7959 Deering Ave., Canoga Park, CA 91304. **Circle 224**

8″ RIGID DISK DRIVE

Model 101 drive features 11.7 Mbytes of fixed storage capacity on two disks. Incorporating the motor to the hub, has eliminated belts, brackets, and side-loading bearing wear; greatly enhancing system reliability; and lowering costs by sharply reducing parts count. It is housed in the same small cabinet dimensions as a flexible disk drive. Weighing less than 20 lbs., and measuring 14″ x 8.55″ x 4.38″, the new Memorex drive is very accessible: its electronics package, for example, is mounted on the bottom of the head disk assembly (HDA) for easy access even when the drive is running. $1,560 (100). **Memories Corp.**, San Tomas at Central Expwy., Santa Clara, CA 95052. **Circle 223**

Advertisers' Index

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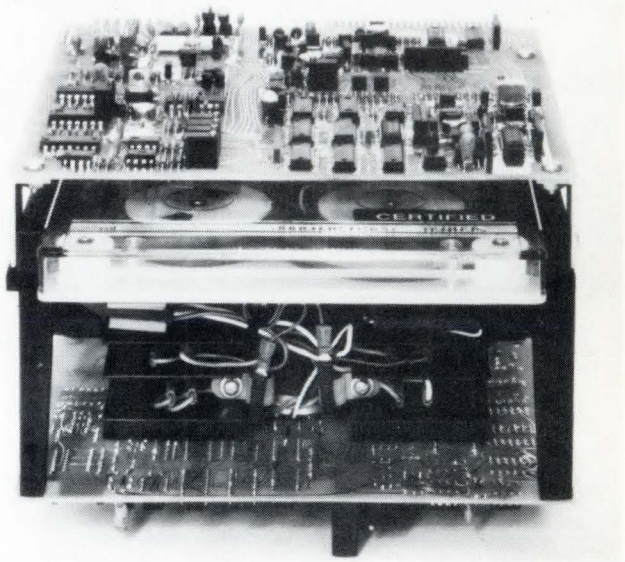
JAPAN: Hiro H. Irie **(03) 311-1746** Intl. Business Corp., 11-8 Narita-Higashi 1-chome, Suginami-Ku, Tokyo 160

New Products

WINCHESTER DISK BACK-UP

A 34-Mbyte digital cartridge tape drive, called "The Streamer," looks like a continuous 3150′ reel of mag tape. Accepting a stream of data at a transfer rate of 576 kbits/s, it becomes a "save-and-restore" medium for use with Winchester-technology fixed disk drives. It transmits track addresses and directional controls automatically at 90 ips R/W without stopping between data blocks. Interface is NRZ, and an internal error-correction procedure assures data reliability



$>$ 1 error in 10^{10} bits (less than 1 error/30 cartridges). Data is taped through group code recording (GCR), at a data density of 6400 bpi. **Data Electronics, Inc.**, 370 N. Halstead St., Pasadena, CA 91107. **Circle 216**

TERMINAL DATA ENTRY '

"Beeper" is an auxiliary storage device that improves efficiency of DP. It increases flexibility and reduces cost of entering data through Beehive International B500, B550, and MICRO B DM10, DM20, and DM30 video display terminals. "Beekeeper" is based on the 3M DC 100A data cartridge storage medium. Operating under terminal control. Beekeeper prepares information by recording data off-line onto cartridge for later transmission to a host computer at high data rates, thus reducing connect time/communication line costs. It operates at 30 ips with bidirectional search speed of 60 ips. Parallel data transfer rate from tape to terminal is 3100 bytes/sec. $1895. **Digital Datacom, Inc.**, 17951 Skypark Circle, Suite K, Irvine, CA 92714. **Circle 218**

80-BIT SHIFT REGISTER

Octal 80-bit static shift register MM5034 is a 22-pin DIP for CRT terminal applications requiring heavy use of memory to update screen information. The only 8-byte-wide shift register available, it is designed for use with the DP8350 CRT controller IC. MM5034 replaces two 4-byte shift registers, thereby lowering component count. Use the DP8350 as a recirculating line buffer between the CRT memory and a character generator IC to give the system controller greater access to the CRT memory. High board density a problem? If simple data-in/data-out operation is all you need, then try the MM5034, a 20-pin DIP. It's identical to the MM5035, except for its lack of TRI-STATE output control lines. MM5035, $8.16; MM5034, $8.40 (100-999). **National Semiconductor, Inc.**, 2900 Semiconductor Dr., Santa Clara, CA 95051. **Circle 221**

OEM America Meets
at the Invitational Computer Conferences

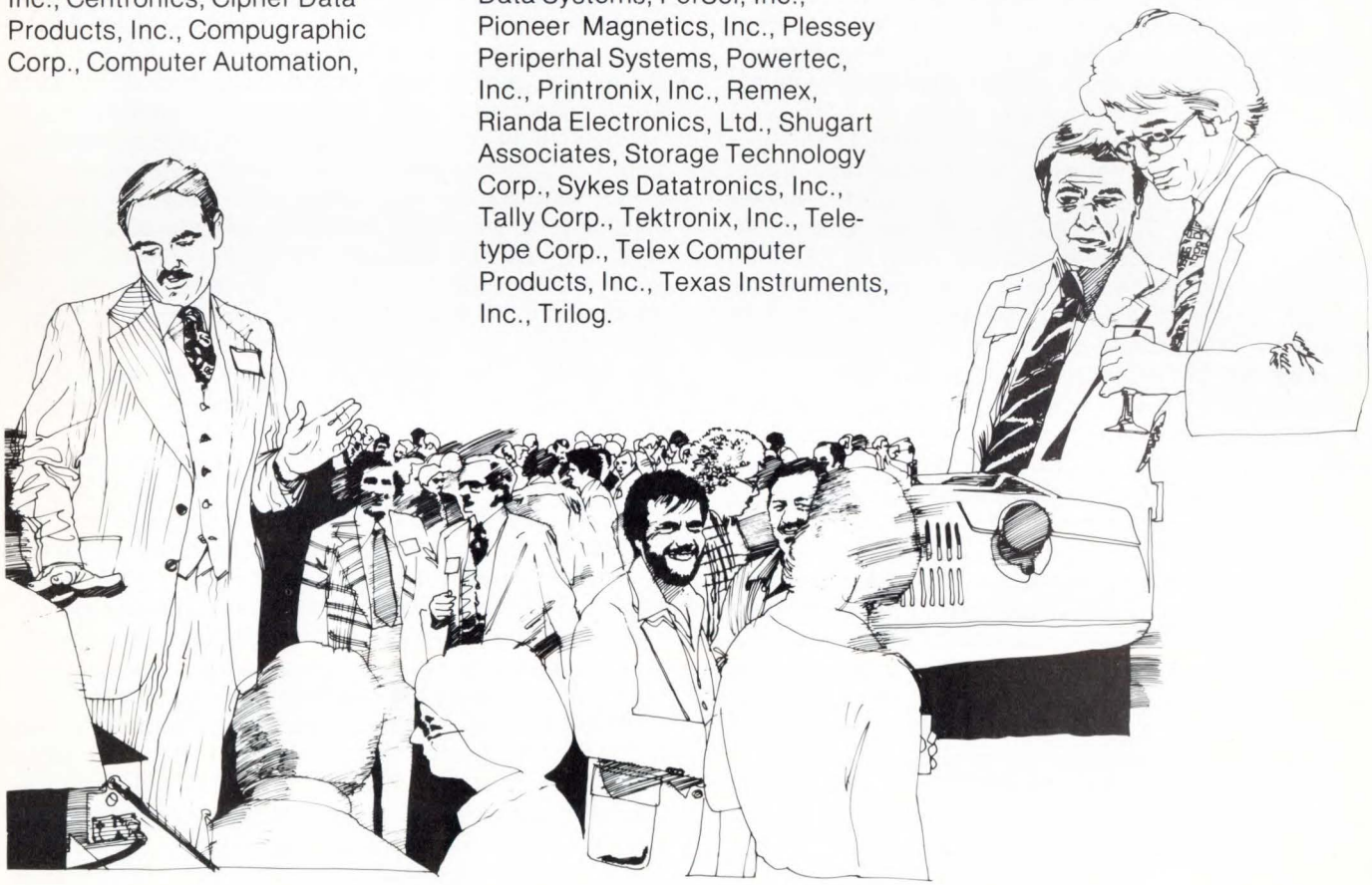
In Boston... in Ft. Lauderdale... in Palo Alto and seven other cities, OEM decision-makers meet the country's top computer and peripheral manufacturers at the Invitational Computer Conferences — the only seminar/displays designed specifically for the unique requirements of the quantity user.

In one day, at each 1979/80 ICC, guests will receive a concentrated, up-close view of the newest equipment and technology shaping our industry. Some of the companies which participated in the 1978/79 ICC Series were: CalComp, Cambridge Memories, Inc., Centronics, Cipher Data Products, Inc., Compugraphic Corp., Computer Automation, Inc., Computer Design, Computerworld, Control Data Corp., Data 100 Corp., Datamation, Datamedia Corp., Dataproducts Corp., Dataram Corp., Data Systems Design, Inc., Datum, Inc., Diablo Systems, Inc., Digital Design, Electronic Engineering Times, Honeywell Information Systems, Houston Instrument, ISS/Sperry Univac, Kennedy Company, Lear Siegler, Inc., MDB Systems, Inc., Microdata Corp., Mini-Micro Systems, Monolithic Systems Corp., National Semiconductor, NEC Information Systems, PCC/Pertec Division, Perkin-Elmer Data Systems, PerSci, Inc., Pioneer Magnetics, Inc., Plessey Periperhal Systems, Powertec, Inc., Printronix, Inc., Remex, Rianda Electronics, Ltd., Shugart Associates, Storage Technology Corp., Sykes Datatronics, Inc., Tally Corp., Tektronix, Inc., Teletype Corp., Telex Computer Products, Inc., Texas Instruments, Inc., Trilog.

The schedule for the 1979/80 Series is:

Sept. 6, 1979	Palo Alto, CA
Sept. 26, 1979	Minneapolis, MN
Oct. 10, 1979	Newton, MA
Nov. 1, 1979	Cherry Hill, NJ
Nov. 15, 1979	Southfield, MI
Jan. 15, 1980	Orange County, CA
Feb. 6, 1980	Ft. Lauderdale, FL
Mar. 25, 1980	Dallas, TX
Mar. 27, 1980	Houston, TX
April 28, 1980	Atlanta, GA

Invitational Computer Conferences



Invitations are available from participating companies or the ICC sponsor. For further information contact: B.J. Johnson & Associates, 2503 Eastbluff Drive, No. 203, Newport Beach, CA 92660. (714) 644-6037

Circle 43 on Reader Inquiry Card

Viewpoint

Senator Abraham Ribicoff
U.S. Senate

Will Computer Crime Slow Computer Growth?

It's one thing to be robbed at gunpoint. We all sympathize with the victim. But to be tricked by a crooked computer expert? To report computer crime is to admit vulnerability and a weak set of controls – and face embarrassment.

The sheer volume of data in a typical computer system often overwhelms the auditor inspecting it. Computer printouts, endless rows and columns of numbers, millions of pieces of data – all combine to exert a hypnotic effect on the auditor. Theft is often hidden in a deluge of paperwork cunningly designed to muddy the mind of the auditor.

How is the federal government responding to the challenge of computer crime? As Chairman of the Senate Governmental Affairs Committee, I directed an investigation into computer security in federal programs.

I wanted to know: (1) is the federal government taking necessary steps to secure its computers against fraud, accident and terrorism? and (2) is our criminal justice system properly equipped to detect, investigate and prosecute computer fraud? The answer is a resounding NO to both questions. Federal computers are *not* adequately secure, and the government is *not* properly equipped to prosecute computer fraud. In fact, federal officials in civilian agencies do not give computer security a very high priority.

How could a computer criminal use computerized tapes (from Social Security, for example)? To steal tapes means the criminal has access to them. So, he alters them, removes names of deserving persons and adds his own, names of accomplices, relatives, fictitious persons. Soon all these new names receive Social Security checks in the mail. Is anyone the wiser? No. There are millions of Social Security beneficiaries; millions of checks spin out of Social Security computers weekly. The potential for theft is incredible.

There is a tremendous potential for mailing list abuse in stealing government computerized tapes. It is worth a fortune to a business that specializes in products for the elderly to have 1 million names and addresses of Social Security beneficiaries. Wouldn't some businesses pay a lot of money for such a stolen list?

My Committee's investigation found the Federal Bureau of Prisons training and paying prisoners to write computer programs for the U.S. Department of Agriculture – programs that dispense hundreds of millions of dollars a year in soil bank, loan, emergency aid and Commodity Credit Corporation payments. But, many inmates who write the computer programs are in prison for white collar crimes (such as counterfeiting and securities violations). One computer program writer was arrested 25 times and convicted of 14 felonies – and he was still in his 30s! Prisoner rehabilitation?

I don't question rehabilitating prisoners. But a man with 25 arrests and 14 felony convictions! It's better to teach him to be an auto mechanic or something else; don't train him to handle sensitive financial transactions for the federal government. My Committee's investigation disclosed that prisoners in federal penitentiaries had cracked IRS computer codes and were filing bogus tax returns for which they then received large tax refunds.

Many other people – not just prisoners – have figured out the IRS computer code. Violators, who know how the IRS computers work, simply filed totally fictitious returns, and the IRS sent them refund checks. Although IRS is reluctant to give out details, stories of this computer tax scheme keep surfacing.

In January, I reintroduced the Federal Computer Systems Protection Act; it specifically defines computer crime and makes clear what is admissible as evidence. The bill, which I discussed at this year's Computer Security and Privacy Symposium, imposes heavy prison terms and stiff fines for electronic burglars – 15 years or $50,000 – or a fine of 2.5 times the stolen amount. This would be the first law enacted by Congress aimed directly at crime by computer.

The F.B.I. says the average loss for each reported computer crime is about $500,000 – compared with an average loss of $3,200 for bank robberies and $23,500 for bank frauds and embezzlement without computers. The Justice Department doesn't know what's being stolen. FBI experts say only 1% of computer crimes are detected; and of these, only 12% are reported to law enforcement authorities!

So, why is a computer crime bill needed? Because victims must be encouraged to call the police upon discovery that they have been beaten by a computer criminal. Does it work this way now? No, all too often victims of big computer crimes – insurance companies, banks, brokers, federal government – are so embarrassed that they *do not* report the offense to law enforcement agencies. My bill will encourage corporate victims to report their losses to the authorities.

Let's compare a traditional versus computer theft. A gunman walks into a bank and pulls off a $10,000 robbery. Do bank officials hesitate about calling in police? No. No one blames the bank for the robbery. But a slick white collar criminal manipulates that same bank's computers and steals $500,000 – and frequently bank officials say nothing. They prefer to absorb the loss than call in police. Why? They fear bad publicity. Justice Department officials inform me that many big computer crimes go unreported.

Worse, since no specific computer crime statute exists in the U.S. Code, no one's even sure if a crime has taken place! Victims of computer crime rationalize their unwillingness to report crime by referring to it as an "administrative error" or an honest bookkeeping mistake. But with the passage of this computer crime bill, there will be little doubt that the law has been broken. **Corporate officers will be obliged to report a fraud** when the law describes it as a crime in unmistakably clear fashion.

Our raster-scan systems are fast becoming leading contenders for top honors in the digital computer graphics and image display field. The clarity and conciseness afforded by monochrome resolutions as high as 1280 X 1024 and full-color versions to 1024 X 1024 pixels, are good reasons why. There's many more . . . let's peruse just a few.

16-Bit High-Speed Programmable Processor.

Consisting of 16 general purpose and 9 operational registers, plus a set of 55 mnemonic instructions, along with 16-bit writeable control storage, the processor can manipulate data at internal cycle rates of 150 ns.

And it provides automatic DMA access, selective erase, user selection from a range of over 16-million different color intensities, plus flicker-free operation.

Modular, Versatile Hardware.

Since Genisco's systems are capable of being expanded from a single monochrome memory plane to a number of planes that support the full range of gray scales or colors required, you can inexpensively start-out and add-on as needed. Our monitor control module lets you operate up to 12 monitors, mix TV/Video and remotely monitor — as well as fill areas outlined in the bit-map memory — and allowing RS232 interfacing with a keyboard, trackball, joystick or graphics tablet.

Genisco also provides a full complement of standard minicomputer interfaces or can economically build one to suit. Scroll/Zoom and high-speed Character-Vector Generator hardware are also available.

Cost-Effective Graphics for the OEM.

For applications where minimal cost without sacrifice in performance is a major consideration, Genisco offers the GCT-3400 OEM models.

FORTRAN Software.

In addition to the Basic Graphics instructions and diagnostics provided with the system, Genisco offers GRAFPAC II, the most comprehensive FORTRAN Callable Subroutine Package available for raster graphics.

Since space does not allow for greater enumeration of the many ways your computerized displays can be truly picture-perfect, contact Genisco — a name that has stood for technological expertise for over 30 years — 17805 Sky Park Circle Dr., Irvine, CA 92714, (714) 556-4916.

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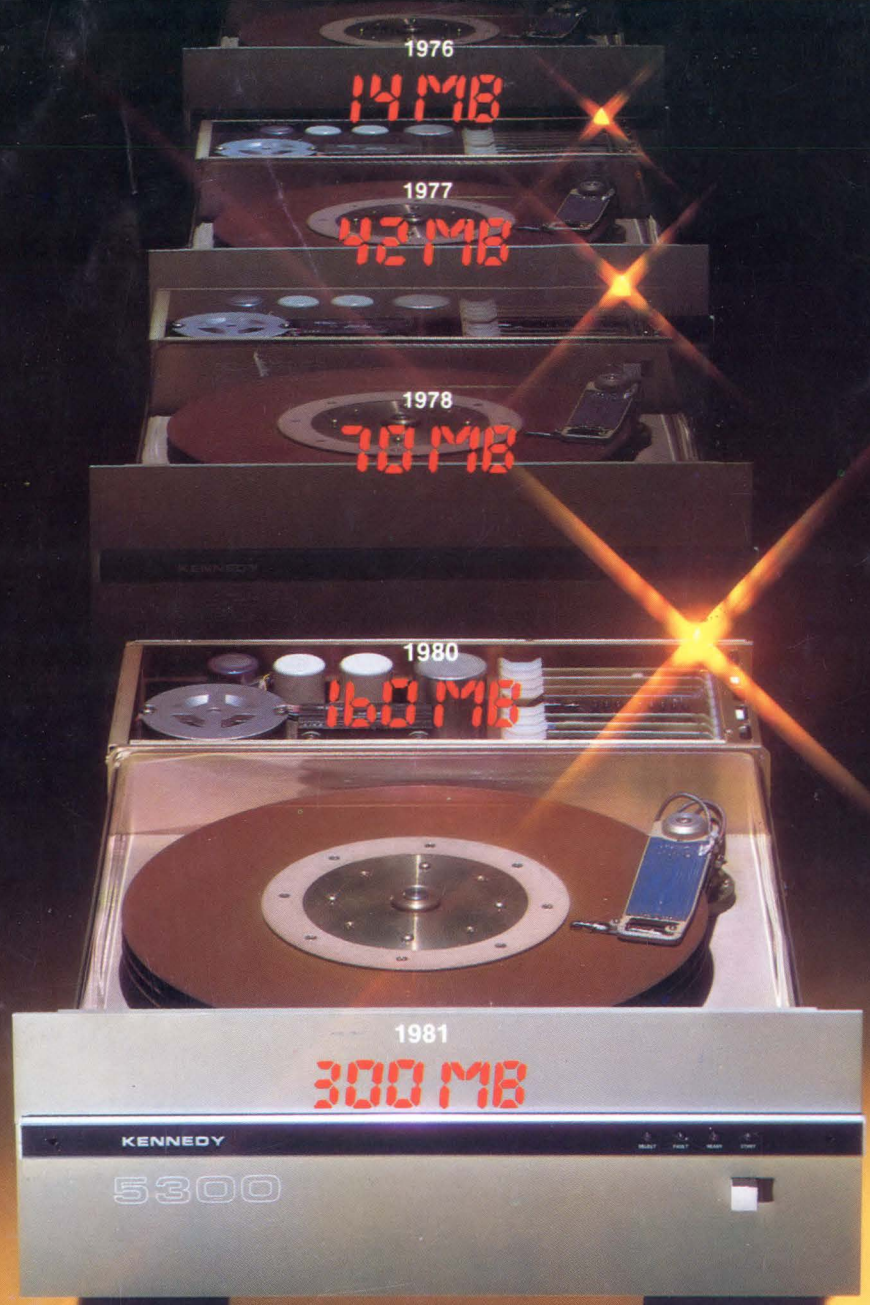

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