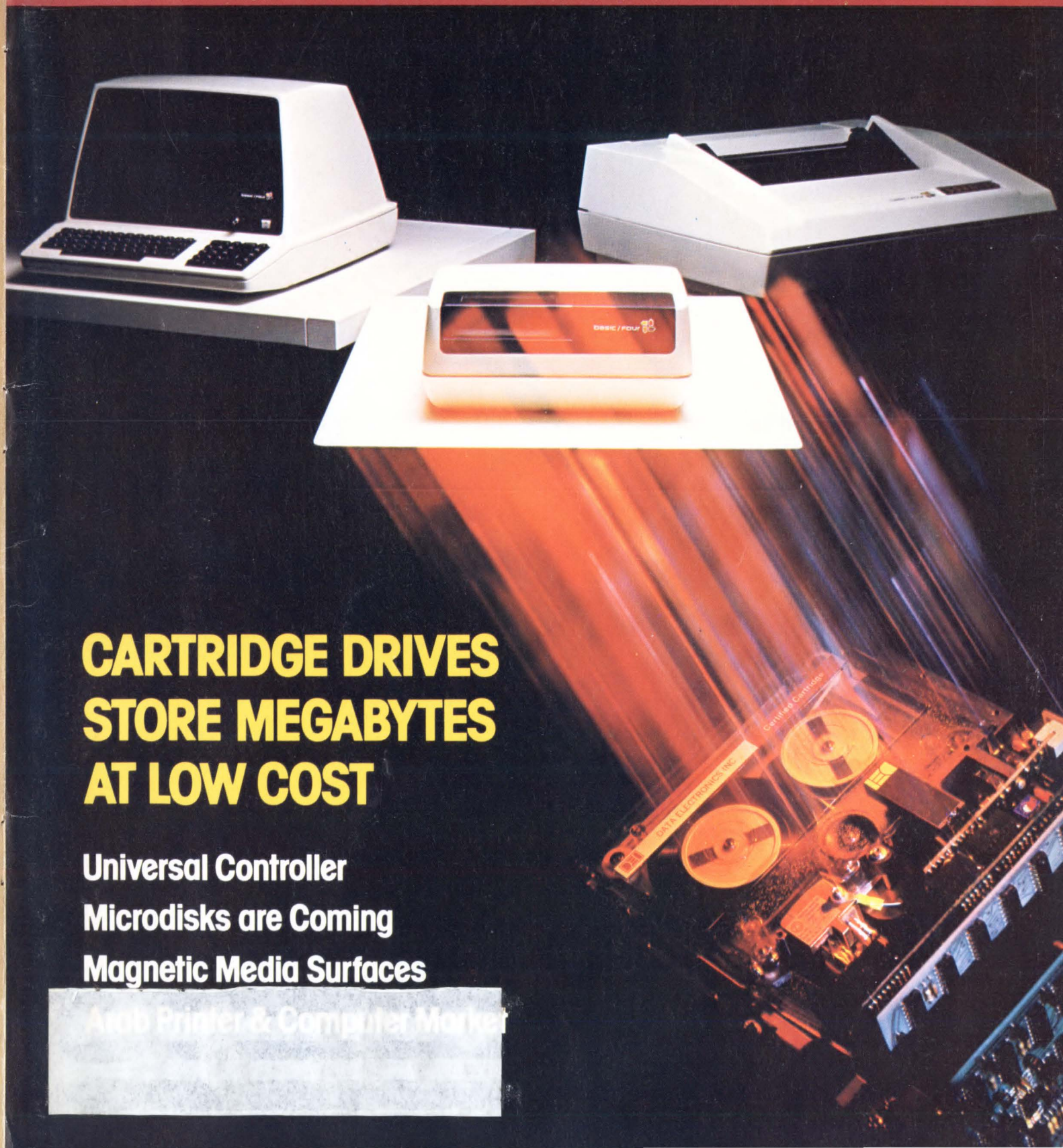
VOLUME 9, NO. 1

JANUARY 1979

# Digital Design

The Magazine of Systems Electronics






## CARTRIDGE DRIVES STORE MEGABYTES AT LOW COST

Universal Controller

Microdisks are Coming

Magnetic Media Surfaces

Anob Printer & Compliter Market

## Models 9100/9300 Vacuum Column Tape Transports . . .

# Proven. Period.

Kennedy's vacuum column digital tape transports weren't designed yesterday to grab a piece of a growing market. In fact, they virtually founded the vacuum column market. They were the first to have such features as a capacitive tape-location detector for improved tape life; air bearings and hardcoated read-after-write heads to reduce tape wear and improve data integrity.

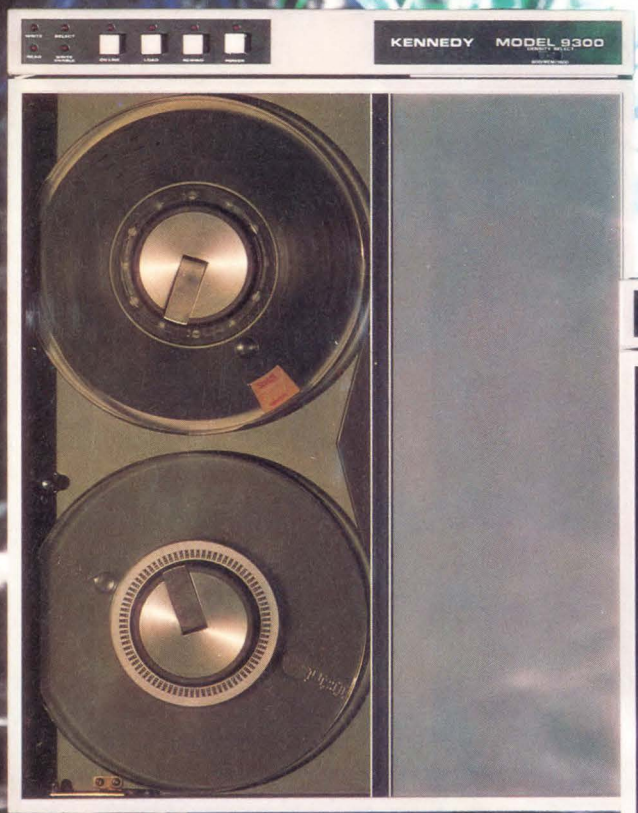
Model 9100 (75 ips) and 9300 (125 ips) offer crystal controlled timing, read-after-write shortened skew gate, front-accessible test panel, quick release hubs and simplified tape loading.

Data densities are 200/556 cpi or 556/800 on 7-track units and 800 cpi, 1600 cpi or 800/1600 cpi on 9-track transports. The format is NRZ1/PE.

Models 9100/9300 offer more features, more performance, and most important, more time-in-the-field than any competitive units.

Why do we think so? Simple. Our figures show that we are about 3000 satisfied users ahead at this point.

**KENNEDY CO.**
540 W. WOODBURY RD., ALTADENA, CALIF. 91001
(213) 798-0953





Circle 1 on Reader Inquiry Card

**KENNEDY- QUALITY- COUNT ON IT**

# The view from the top...

## Our customers put us up to it!

*"The high resolution and accuracy of the Talos lets the designer work to any level of detail at any scale without fear of error."*

**Computer Graphics, Inc.**
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Telephone (617) 481-4119

*"Accuracy and dependability are just two of the major reasons for use of these Talos equipments in our Hughes Aircraft Industrial Automation Systems."*

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Richard E. Potampa
6155 El Camino Real
Carlsbad, California 92008
Telephone (714) 438-9191

*"The Talos Digitizer allows rapid evaluation of alternatives for logging development by evaluating road spacing and logging systems. It is my conviction that we are only scratching the surface of what we can do with the Talos Digitizer."*

**MacMillan Bloedel, Ltd.**
A.J. (Tony) Kelly
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CANADA
Telephone (604) 723-7325

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**talos**

*"I have found that the use of our digitizer (Model 660) can decrease our data collection effort to less than 1% of the previous method. The staff at Talos has been most helpful, both in the procurement stage and in setting it up here at KSU."*

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Dept. of Geology
Kent, Ohio 44242
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*"P.S. We have also used (Brand X) tablets and have found the Talos to be far superior – keep up the good work. (You'll make mine easier!)"*

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Lanford Pritchett
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Des Moines, Iowa 50310
Telephone (515) 244-1166

**TALOS SYSTEMS INC./7419 E. Helm Drive/Scottsdale, Arizona 85260/(602) 948-6540 TWX (910) 950-1183**

## What's in a name?

# With the name Tandberg

Now available in 6400-bpi OEM version.

# you know it's gotta be good.

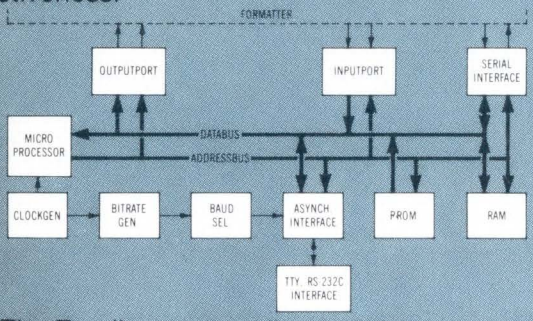
## Now Tandberg's TDC 3000 Digital Cartridge Recorder communicates with every computer. Every computer.

Begin with the industry-proven Tandberg TDC 3000 Digital Cartridge Recorder. Add our new RS-232 I/O controller/interface. And you have a highly cost-effective recording system compatible with every computer.

There's a complete family of interfaces for the Tandberg TDC 3000. From the original design conceived by Tandberg of Norway, the $150-million electronics firm that pioneered tape recorders internationally. The company that is to high quality electronic equipment what Rolls Royce is to automobiles. With a tradition of excellence that continues in a wide range of computer peripherals from Tandberg Data in the United States.

With total communications compatibility, the microprocessor-based RS-232 controller/interface from Tandberg Data is engineered according to EIA Standard RS-232-C, type D and E, and a "teletype-compatible current loop," recording in ANSI/ECMA/ISO-compatible format.

And from the substantial savings in line charges alone, the TDC 3000 with the RS-232 controller/interface will recoup its modest cost in a matter of months. It's hard to beat that kind of cost-effectiveness.




The Tandberg controller/interface is contained on one p.c. board which mounts inside the Recorder. Power is internal from the TDC 3000 built-in power supply. Two interface connectors are provided so that the Recorder can be connected both to a local I/O terminal (such as the Tandberg TDV 2100 Series CRT terminals) and a modem for remote operation.

Thirteen standard baud rates, 75-9600, are user selectable. Data buffers range from a minimum of 256 bytes up to 1024 bytes. The controller/interface responds to all ASCII command codes. Read and write speed is 30 ips and search speed 90 ips.

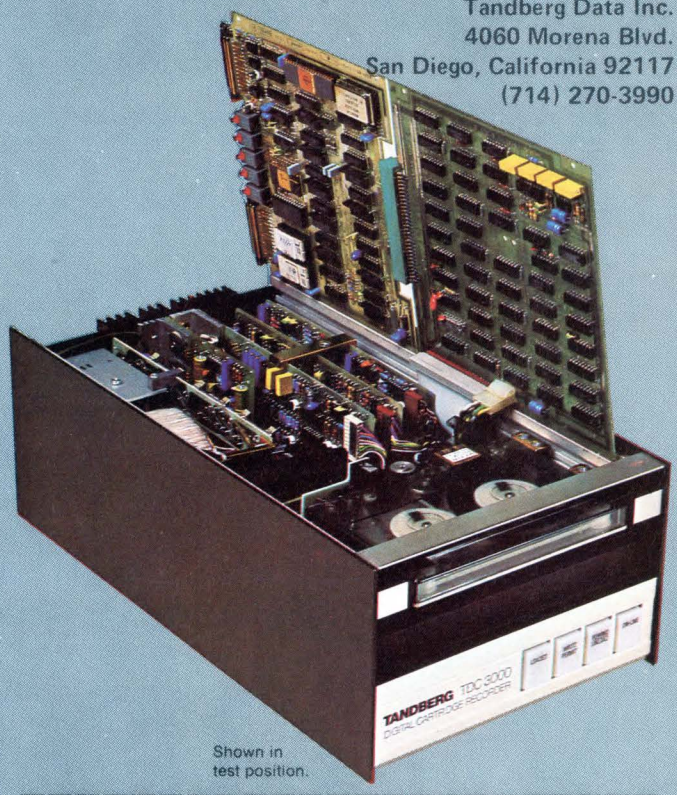
And for special communications requirements, the 6800 microprocessor allows the Tandberg controller/interface to be OEM-customer programmed.

Conceived in the rugged Norse heritage, the Tandberg TDC 3000 is no wilting lily when it comes to tough environments. Put it to work in subzero snow country or under a desert sun and don't worry about the bad vibes or emissions from nearby equipment. The TDC 3000 is engineered to roll with environmental punches.

You might ask us about some of our more difficult applications. Modular construction of the TDC 3000 enables the user to configure a system to individual needs. Applications include minicomputer input/output, minicomputer peripheral storage, terminal peripheral storage, software distribution, data entry via keyboard, local data collection, data transmission, and text editing. And a few other things yet to be dreamed up.

Besides RS-232, Tandberg Data provides TDC 3000 interfaces for HP 21MX, PDP 11, 8080 Microprocessor, AN/UYK-20 and 8-bit parallel general purpose. All give up to 48K bits transfer rate.

Tandberg Data Inc.
4060 Morena Blvd.
San Diego, California 92117
(714) 270-3990




Shown in test position.

Gary E. Pyles, Sales Mgr., Tandberg Data inc.
4060 Morena Blvd., San Diego, CA 92117

I'd like to know more about the RS-232 controller/interface for your TDC 3000. Please send me the RS-232 data sheet and have a Tandberg engineer give me a call to discuss my needs.

Name_____ Position_____

Company_____

Address_____

City_____ State_____ Zip_____

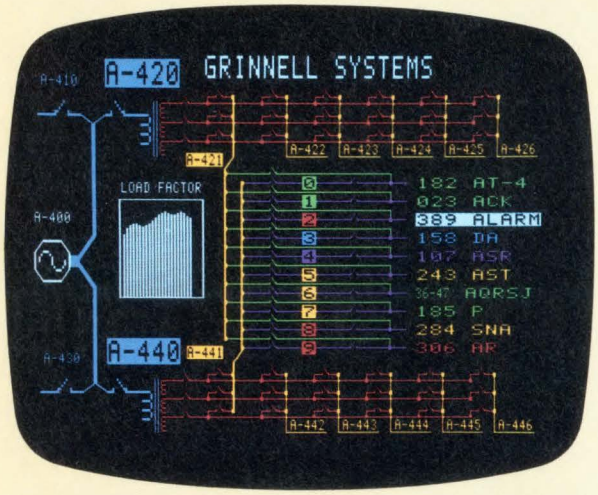
Phone_____

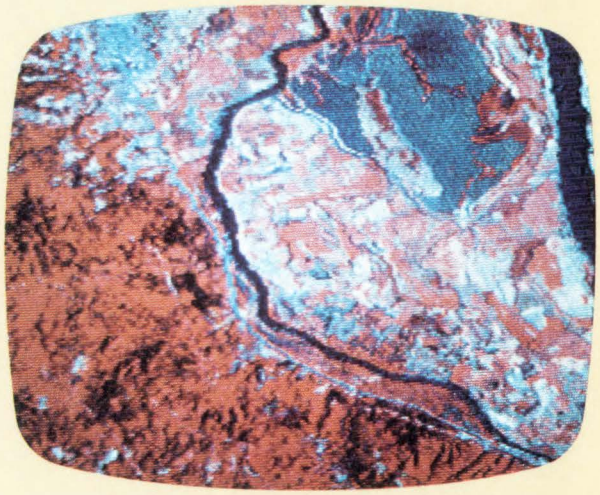
Computer/terminal type_____

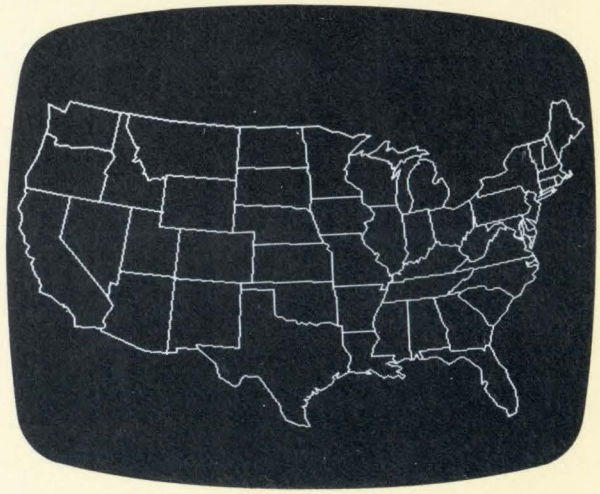
**TANDBERG**

CIRCLE 5 on Reader Inquiry Card

# Grinnell has your display...





## from low cost imaging and graphics to full color image processing

Our modular, solid state systems can meet your computer display requirement, easily and economically.

And, they're intelligent. Every system has a complete alphanumerics and graphics package, and a powerful instruction set that simplifies programming—no need for complex macro-instructions and high order programming languages.

There's also a choice of standard resolutions: 256 x 256, 256 x 512, 512 x 512 (30 Hz or 60 Hz refresh) and 1024 x 1024. Plus plug compatible interfaces for most minis.

Options include overlays, function memories, pseudo-color tables, zoom and pan, independent cursors with trackball and joystick controls, split-screen, image toggling, and real time digitizers that grab and store images and sum consecutive frames.

Grinnell displays are already used for tomography, ERTS imaging, process control, image processing, animation and much more. All systems drive standard TV monitors.

So before you choose a display system, let our experts show you how to maximize performance and minimize cost. For details, and/or a quote, call or write.

# GRINNELL SYSTEMS

2986 Scott Boulevard, Santa Clara, California 95050 (408) 988-2100

# THIS MONTH

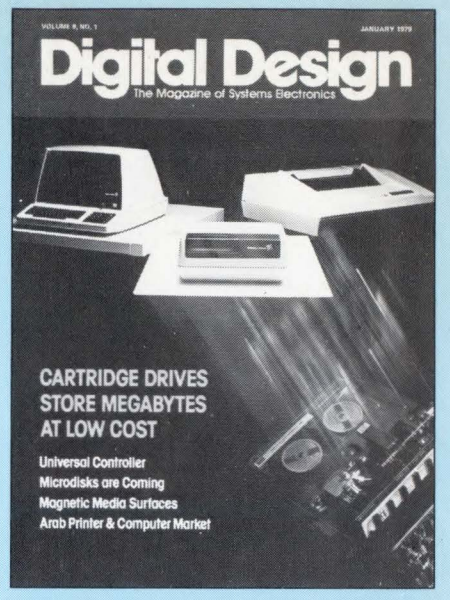
January 1979
Volume 9, No. 1

## Features

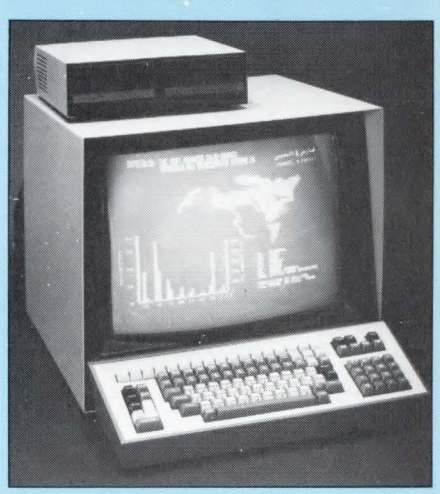


## Departments






**ON OUR COVER**
"The Funnel," a 6400 bpi digital cartridge tape drive is the sole tape peripheral for the Basic/Four System 200 computer system. This cartridge drive serves as tape back-up for an internal Winchester-technology fixed disc drive. (Photo courtesy Data Electronics, Inc.



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The Magazine of Systems Electronics

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# 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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* Trade name of Digital Equipment Corp.

# LETTERS

## Engineers are Individuals

Dear Editor:

Mr. J.N. van Lingen [Speakout, Oct. 1978] contradicts himself. He first states that it is very difficult for an alien to obtain a "green card," and then tells us of the "Brain Drain" of the 50's and 60's. If the "Brain Drain" engineers could be imported from Europe in great quantity, there is no reason to believe that the same thing isn't done today from Asia, Africa and South America!

I do not agree with Mr. Feerst that these engineers are a serious problem to American professionals. They are only a threat to the engineer who doesn't continue his education and update his skills.

The real threat to engineers are employers who have noticed that while laborers, secretaries — and yes, even managers — now join unions to protect themselves and further their finances, we individualists, creators and engineers will work long hours for relatively low pay under adverse conditions. We engineers do this because we love our work. We are like school teachers of a few decades ago that taught for love of teaching, frontier doctors who healed for love of humanity, and circuit riders and missionaries opening new frontiers. We can be taken advantage of, short changed, and passed over for promotion because we love our work. An engineer's work is his life and a part of him (ask his wife).

But this engineer may fast follow the Passenger Pigeon into extinction. Shot at from all sides by wage slashing, by lack of pensions, by being "too well qualified," and government regulations, he could disappear from the face of this earth and be replaced by a "New Breed" of engineers that could become, like the "New Breed" of teacher, turning out functional illiterates. He could become, like the "New Breed" doctor working in a clinic with many specialists, yet earning a fortune, a text book problem solver, immune through being anonymous.

If this happens, the U.S. will take a back seat in new technology to developing nations and foreign nationals will then flock back home; and probably, the few remaining real engineers could succumb to a reverse brain drain — drawn away not by money, but by the lure of being able to practice engineering under good conditions.

I hope and pray this never happens. However, until employers recognize us for our contributions, until they treat us as valuable individuals instead of square pegs that don't fit the neat round holes in organizational charts, and until engineers are treated and compensated well, this country will continue its technological slump.

Problems are crying for solutions, yet engineers are used as draftsmen! We import millions of barrels of oil and engineers redesign toilet seats to comply with O.S.H.A. regulations! There are millions of people unemployed and engineers are forced to defend the design of an auto that, due to front wheel drive, goes out of control if drivers release the steering wheels.

It is time to use our greatest resource, our engineers, fully. To do this, they must be compensated fairly. But they do not need protection from competition. Instead, they need a fair chance to do their work and will welcome any and all, aliens or not, to compete for the best design.

Engineers must remain individuals or perish.

Frank D. Gross
Manager E.L. Dept.
the Pannier Corp.
207 Sandusky St.
Pittsburgh, PA 15212

## No Exams?

Dear Editor:

In the October Speakout ("Nothing Is Impossible") you mentioned American International Open University in St. Louis. You stated that several prominent IEEE personalities are connected with it and asked if we should have more of this kind of education. I disagree. The answer must be an emphatic NO!

AIOU is a non-accredited "school" that awards degrees up to and including the Dr. Eng. to applicants. There is no full-time faculty, there are no formal course offerings, and there are no examinations. AIOU's existence cheapens our hard-earned degrees and IEEE's involvement with it shows how little IEEE cares for the working EE. Two former members of IEEE's Board of Directors – Mr. John Guarrera (a former president of IEEE) and Mr. Richard Benoit (a former Director from Region 1) – have received doctors "degrees" from AIOU. Indeed, Mr. Benoit refuses to answer when he is asked if he possesses even a bachelors degree. What's worse is that these individuals use the title "Dr." on their IEEE correspondence. IEEE's involvement is clear when one considers that the organization's monthly magazine, *Spectrum,* carried an article about AIOU in their February 1977 issue.

Recently, I spoke to a group of IEEE members in St. Louis and, by coincidence, was booked into a hotel one-half block away from AIOU. Naturally, I walked over to inspect their campus – all 600 sq. ft. of it. That's right: AIOU is located in an office building. The largest single piece of lab equipment I observed was a Xerox machine!

One mark of a viable profession is the willingness of its members to defend their credentials. We EEs must insist that only earned degrees from legitimate institutions be recognized. Unhappily, the president of IEEE (Suran) has an honorary doctors degree, yet insists on using the title.

Irwin Feerst
Committee of Concerned EEs
Box 19
Massapequa Park, NY 11762

P.S. In a new development, IEEE Spectrum has allegedly received an advertisement from an unknown open university. IEEE wisely refused to accept it. Unfortunately, however, the unknown open university then threatened to sue, possibly forcing IEEE to have second thoughts about refusing the advertisement.

*Ed. Note: How do you feel about "open universities"? If you approve, circle 28a on the front of the Reader Inquiry card; or if you disapprove, circle 28b.*

## Can't Find Time

Dear Editor:

In your October Speakout, "Nothing is Impossible," you stated that "Although not a true mail-order university, American International Open University awards PhDs without previous degree, formal work or attendance requirements, and has no full-time faculty . . . Awarding degrees for experience sounds noble. Should we see more of it?" Yes, I believe that we should see more of such schools. There are many technicians who deserve degrees but cannot find time to attend engineering colleges, so it is an idea whose time has come.

Robert Channey
38 Circle Dr.
Bristol, RI 02809

# A Beautiful Way To Interface

## IQ 140

SOROC's first and foremost concern, to design outstanding remote video displays, has resulted in the development of the IQ 140. This unit reflects exquisite appearance and performance capabilities unequaled by others on the market.

With the IQ 140, the operator is given full command over data being processed by means of a wide variety of edit, video, and mode control keys, etc.

The detachable keyboard, with its complement of 117 keys, is logically arranged into 6 sections plus main keyboard to aid in the overall convenience of operation. For example, a group of 8 keys for cursor control / 14 keys accommodate numeric entry / 16 special function keys allow access to 32 pre-programmed commands / 8 keys make up the extensive edit and clear section / 8 keys for video set up and mode control / and 8 keys control message and print.

Two Polling options available: 1) Polling compatible with Lear Siegler's ADM-2. 2) Polling discipline compatible with Burroughs.

## 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.

The IQ 120 offers such features as: 1920 character screen memory, lower case, RS232C extension, switch selectable transmission rates from 75 to 19,200 bps, cursor control, addressable cursor, erase functions and protect mode. Expansion options presently available are: block mode and hard copy capability with printer interface. The IQ 120 terminal incorporates a 12-inch, CRT formatted to display 24 lines with 80 characters per line.

SOROC TECHNOLOGY, INC.

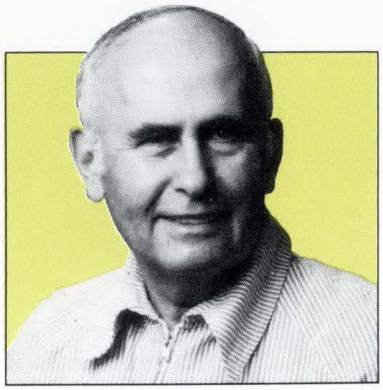
165 FREEDOM AVE., ANAHEIM, CALIF. 92801

(714) 992-2860 / (800) 854-0147

# SPEAKOUT

George King, *Editor*

# OUR NEW YEAR'S RESOLUTIONS



'Tis the season for instrospection and new year's resolutions. Just as many of you do, we, the editors of this publication, pick this time of the year to examine what we have done during the past 12 months to determine how we could improve DIGITAL DESIGN. Based on what we have found, we, too, have come up with a number of resolutions to upgrade our magazine.

First, let's restate what area in the enormous range of present day technologies we have aimed this magazine's coverage. We publish DIGITAL DESIGN specifically for engineers and their managers who design components, subsystems and systems that function within a field whose least common denominator is best defined by the use of digitally coded information. Thus, this magazine goes to those who design and specify modern digital systems or components in one form or another and who must find answers to the kinds of questions that implementing equipment for the digital world poses. Collecting, selecting, generating, controlling, measuring, sorting and applying digital information – these are the significant areas common to so much of modern electronic equipment and systems.

We try to help all of you who deal with digitally-based systems within such fields as manufacturing, chemical processing, machine tools, packaging, data processing, communications, instrumentation, testing, computers and its peripherals – in short, all and any areas in which the application of digital services makes design and economic sense.

To cover digital design, we discuss and illustrate these topics: • Semidonductor devices: microprcessors, RAMS, ROMs, CCDs, bubble memories, I/O chips, DACs, ADCs, codecs – all the chips necessary to design and build system circuitry; • Computers, micro, mini and macro – their design and application to many different types of systems; • Computer peripheral equipment and machines – their design and their interface with dedicated and time-shared computers; • Digital equipment, systems and instrumentation – their interface with the analog world of sensors and data transmission lines; • Software and languages – to help digital system designers program their equipment; and • Design tools and debugging techniques – instruments and equipment to shorten the design cycle.

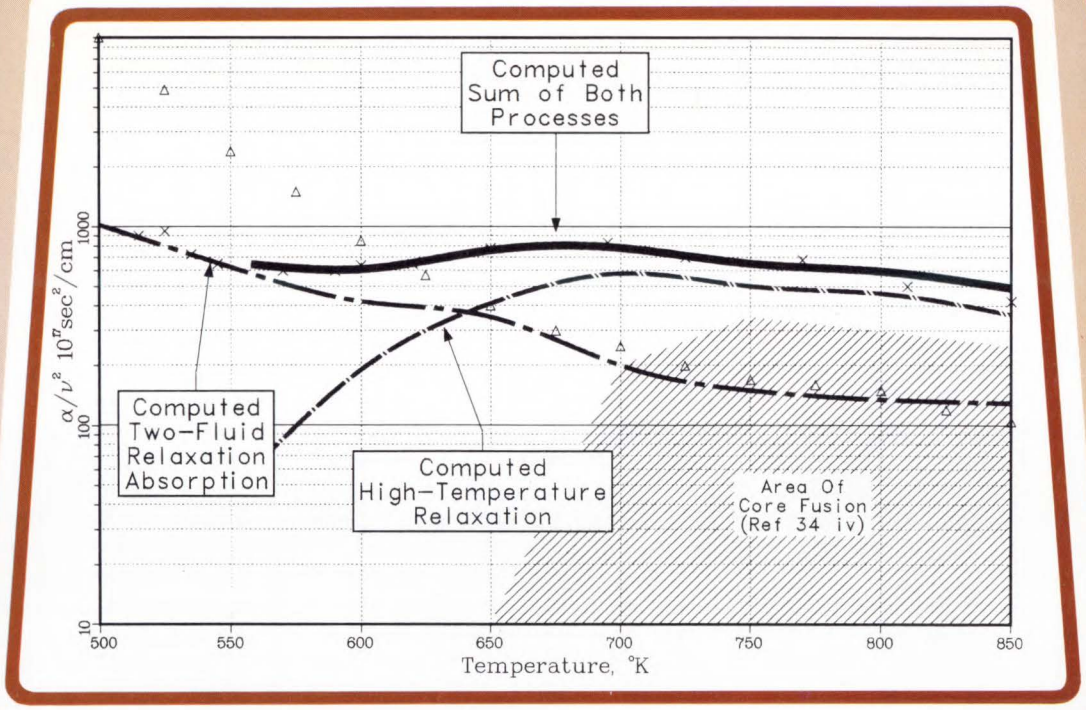
During the past year, we have published technical and product news, plus a large number of feature articles on a large number of different topics. We have aimed this mass of published material at supplying research, development and design information to plan and build systems with microprocessors, various size computers, input/output peripherals, semiconductor circuitry and the necessary hardware. We resolve to continue to supply the same type of infomation – only more of it, in greater depth, over a broader scope, yet more adaptable to the designer's job at hand.

Promises, promises, promises – they're easy to make, but hard to keep. However, we mean to keep them, because we are expanding our full-time editorial staff with people who are experienced design engineers.

And we mean to make 1979 the year we help you more than ever before do your job better, because of the information you find in the pages of DIGITAL DESIGN.

George King

# DISSPLA® Software




## There Is No Better Way To Present Your Data

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DISSPLA software puts truly professional graphics within reach. No longer is art department touch-up necessary. Total flexibility permits tailoring of XY-diagrams, bar charts, pie charts, maps, 3-D plots, and annotation to all special needs. Graphics for publications, presentations, management reports and internal documentation can be produced quickly and correctly. At last, sophisticated presentation methods can do full justice to advanced analysis techniques.

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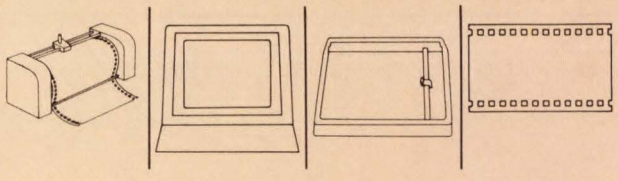

### MACHINE INDEPENDENT FORTRAN LIBRARY

DISSPLA is currently operating on all large-scale Amdahl, Burroughs, CDC, DEC, Hewlett Packard, Honeywell, IBM, TI, UNIVAC and XDS systems, plus the Harris midicomputer. The DISSPLA routines may be called from FORTRAN, PL/I, COBOL, ALGOL, etc.

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# TECHNOLOGY TRENDS

## Floppy Proliferation Causes Big Problems for Buyers and Sellers

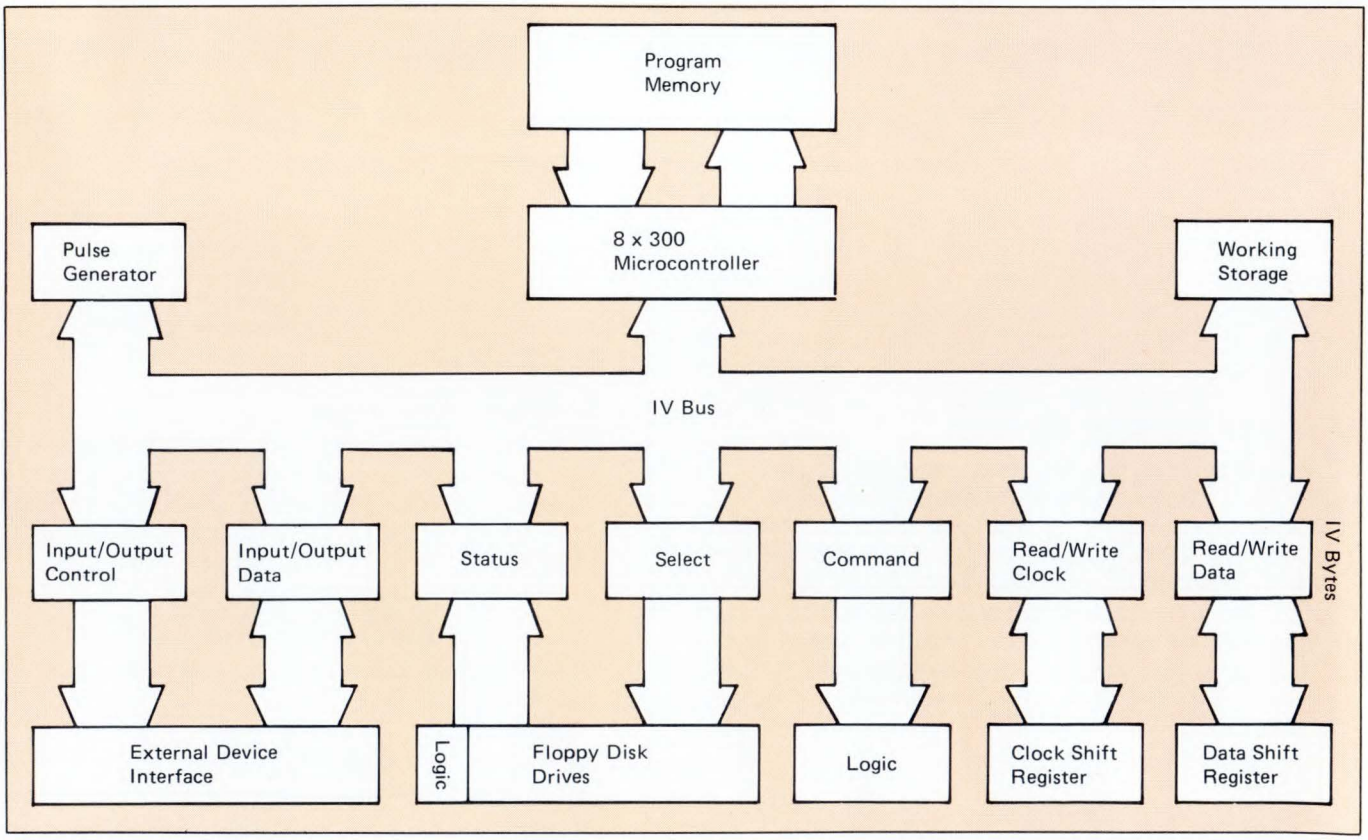
More and more computer manufacturers, systems houses and larger end-users are employing some type of floppy disk drive in their systems according to members of the Applied Data Communications' Staff. Because of this enthusiastic acceptance, the technology is changing at a rapid rate. Like many other users of large numbers of these drives, Applied Data Communications has discovered the hard realities of managing drives and media from several different vendors who have marketed products in different stages of the technology over the last few years.

Today, the floppy disk drive permutations are staggering. Let's look at all the variables: single/double density, single/two sided and standard-size/mini-size. Multiply these variable by a wide variety of formats for the possible configurations with hard or soft sectoring or both.

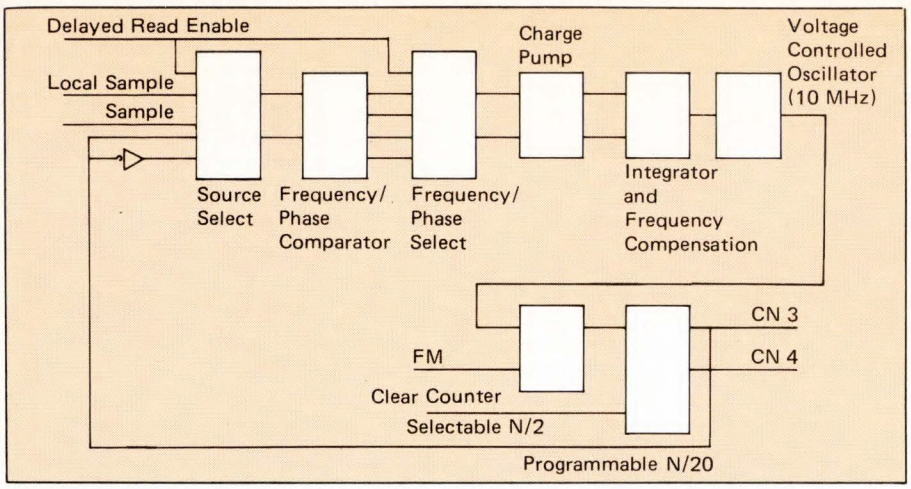
As a manufacturer of microcomputer-based systems for OEM scientific/engineering applications and end-user business systems, Applied Data Communications relies heavily on floppy disk drives for basic data storage in its systems. Because it had to meet ongoing problems of receiving inspection, testing and evaluation of various brands of drives and media, the company needed a versatile tester and until now could find nothing on the market to fulfill these requirements.

It decided to develop a programmable, multiple-density floppy formatter, to utilize different brands of drives with different formats. This formatter could interface to whichever brand of drive the customer might prefer. The programmable formatter employs a 8x300 microprocessor to handle up to eight drives with multiple formats – any combination of industry standard and nonstandard ones – both single (FM) and double density (MFM or MMFM), as well as single-and two-sided.

The Read/Write circuits enable the formatter to read and write single (FM) and double (MFM and MMFM) density. Double density encoding causes no greater flux reversal density on the diskette than single density. Although in single and double density, encoding data flux reversals are written in every bit cell, however, in double density, clock flux reversals and data flux reversals are never written in the same bit cell. Thus, in double density, you can double the bit packing density while maintaining the same flux reversal density as single




**The ADC programmable multiple format floppy disk formatter is a dedicated microcomputer system mounted on a printed circuit board utilizing an 8X300 microcontroller and contains 256 bytes.**




**Formatter uses a phase-locked loop oscillator (PLO) type data separator. Once synchronized, the PLO tracks the recorded information and generates the windows for clock bits. The data separator circuits adjust these windows according to the type of recording being used — FM, MFM or MMFM.**

density. Data recovery in double density is different, however. Since the double density bit rate is twice as great as single density, it halves the time available to detect flux reversals in MFM. In MMFM you can take advantage of the encoding characteristics and allot 60% of the bit time for detecting data flux reversals.

The finer resolution required by double density requires using phase-locked read recovery in which the read timing tracks the instantaneous bit rate from the disk drive to achieve the required precision. Write precompensation which also helps achieve better resolution is the minor adjustment of the time at which flux reversals are written to compensate for predictable bit shifting due to flux reversal crowding. Usually write precompensation is only required on the inner tracks where the flux reversal density is highest. Therefore, the formatter can enable or disable write precompensation as necessary.

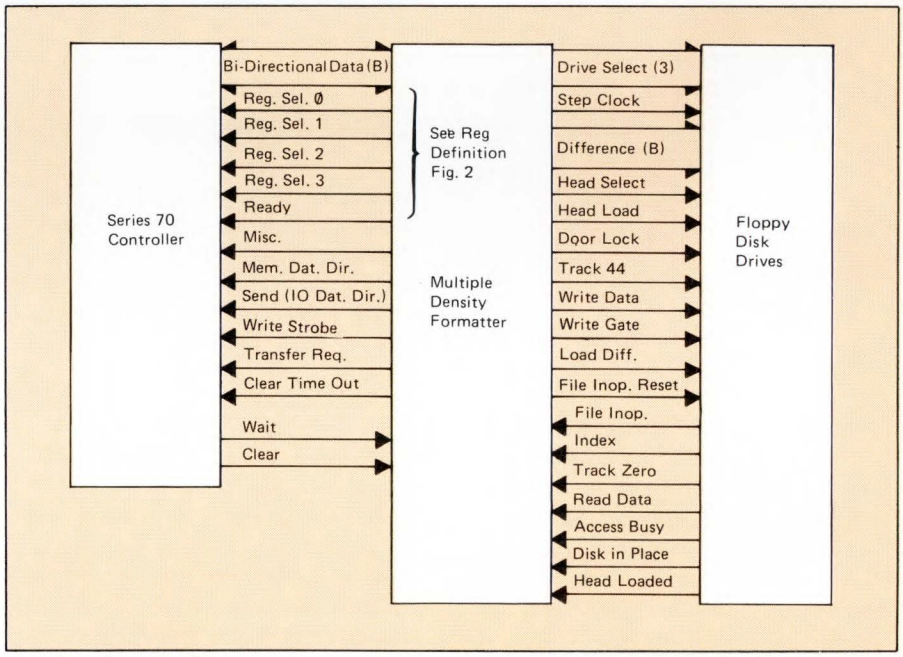
When ADC's 70F-600 formatting unit is implemented with a controller, a formatter and one or more floppy disk drives, the host CPU, under program control, can operate up to 8 floppy disk drives. The single board formatter performs all the overhead functions necessary to format floppy disks in single or double density, position the head (Seek) and Read or Write data. Because the formatter is intelligent, it can perform functions such as Format Track, Format Disk, Read/Write 1 to 255 Sectors, and Write with Automatic Verify of CRC, or Data and CRC. The host device can specify all the soft-sectored track format parameters. In addition, the ROM on the formatter stores one default set of parameters which the user can specify.

The 70F-600 controller became the heart of a programmable multiple format floppy drive test system. The first version of that system, called 70T-300, was designed specifically to test standard 8" floppy disk drives and media. This system uses an ADC Series 70 micro-computer system and a special controller board, interfaced to the 70F-600 formatter. It includes routines for Read/Write maintenance, error testing, variable stop rate and window margining for bit shift with the capability of multiple test sequencing and repeats.

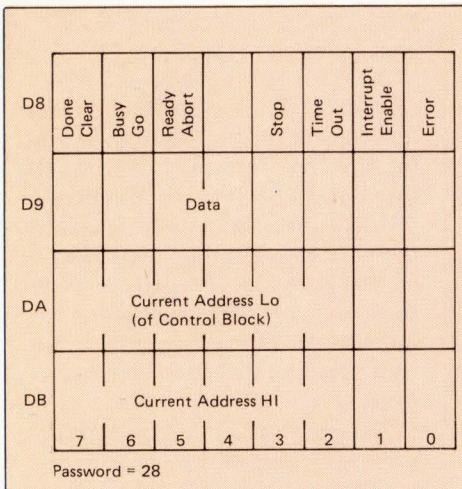
ADC's larger floppy drive OEM customers, which manufacture mainframes, terminals and system bought these testers. This tester not only allowed them to check out purchased diskette drives without tying up one of their systems, but they soon discovered that once they'd tested the drives, they could use that same station to initialize media and to produce multiple copies of diskettes from one master.

Shortly thereafter, ADC began using minifloppies. Its engineers rewrote the software for the tester and redesigned it to accommodate standard 8" and the newer 5 1/4" diskette drives. This piece of equipment, the 70T-400, tests standard and mini drives and media and initializes both sizes of media. The tester can be used as a media conversion station and also provide multiple copies of the floppy disks for mass distribution of the updated programs.

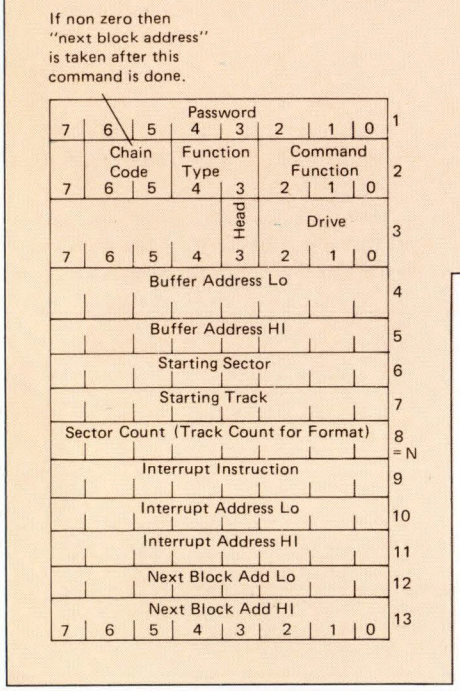
The 70T-400 system provides over 40 different diagnostics for dynamic testing and a much more sophisticated




**Seven addressable I/O ports provide communication paths from the 8X300 to the host device, the read/write circuits and the floppy disk drives. Three 50-pin connectors on the board supply interfaces to the host device, the floppy disk drives, CPU bus and control signals; they are large enough for system expansion. Interface signaling to the formatter essentially travels over 8 bi-directional data lines and 12 control state lines. Normally, the identity of these signals appear as shown; however, the actual definition of any interface signal may be altered and is a function of the operating program for the 8X300 microprocessor in the formatter. Interfacing to the host device controller travels via a 50-conductor flat cable with alternate wires grounded. The formatter requires only 5V at 4A to operate.**




**Top figure shows the four device registers in the controller that contain these commands for program control of the floppy disks: Common/Status (D8), Data (D9), Current Address LO (DA) and Current Address HI (DB). These registers report status, supply commands and provide a Control Block: start address (current address registers) that defines a 13-byte block in memory that gives the multiple density formatter its "instructions" for performing any disk operation. Upon initiation of a command (bottom figure), the current Address HI and LO Device Registers point to the start of the control block, which the controller never alters.**




technique for bit shift analysis. Its write precompensation allows you to select write precompensation in incremental amounts as small as 50 nsec.

The test program for the system includes routines for read/write maintenance, error testing, variable step rate and window margining for bit shift — all with multiple test sequencing and repeat capabilities. Although the program presents the floppy disk diagnostics in a ready-to-use sequence, the user can vary it easily according to his needs. Also, the test system's documentation presents step-by-step procedures for writing additional routines, if required.

Since the test program is prerecorded on a floppy disk ready to load, you use a pretested floppy disk drive for initial loading and subsequent reloading of the test program. A special capability automatically loads this program when the test system is powered on.

The tester's operating system includes a central processing unit, CRT and workstation desk. A rack-mounted version with permanently installed drives permits you to use the system exclusively for media initialization, conversion and copying (and not for testing). In various configurations, the system can handle 2, 4, 6 or 8 standard size drives; 3 or 6 mini size drives; or 2 or 4 standards in combination with 3 minis. The system comes with DC power cords and industry standard interface-to-drive cables, and a built-in interface for adding an optional Centronics hard-copy printer; an optional interface accomodates the Teletype Model 40 line printer.

Pricing of the 70T-400 depends upon the number and type of drives to be tested or interfaced. Pricing ranges from $10,500 to $12,350 for various configurations.

# 6800 Operates Customized Artificial Leg

An artifical leg using a 6800 to calculate swing-damping can have its responses modified to suit a specific amputee's needs. A doctoral candidate at MIT's Dept. of Mechanical Engineering, Mark Tanquary with assistance from George Dalrymple and Dr. Derek Rowell, demonstrated that a programmable above-knee prosthesis can operate unattached to stationary computers.The experimental $\mu$C fits into a hip case measuring only 8" x 4 1/2" x 2 3/4" and hangs from the shoulder, but further miniaturization should reduce it enough to fit inside the prosthesis. In designing the experimental version, space efficiency was not a priority.

Inputs to the $\mu$C consist of ten voltages set by a pot. The ten voltages correspond to ten angle-positions of the prosthesis while their voltage drops reflect damping coefficients chosen for those angles.

Position of the prosthesis, $\Theta$, is determined by using the variable resistance on a goniometer, a potentiometer attached above the artifical knee with a sliding contact tied to the artificial leg's lower shaft. An analog differentiator converts position into rotational velocity, $\dot{\Theta}$. Foot switches on prosthesis convey presence of heel and toe contacts.

The ten damping coefficient values, $b(\Theta, \sin \dot{\Theta})$, from the pots are converted into a table of b versus $\Theta$ for each $\sin \dot{\Theta}$ by the 6800 in about 40 $\mu$sec. When the prosthesis is in use and the $\mu$P receives values for $\Theta$ and $\dot{\Theta}$, the desired damping torque is calculated from the experimental formula: $T=b(\Theta, \text{sign } \dot{\Theta})\ \dot{\Theta}^2$. This formula, developed outside of MIT, is generally accepted in the physical therapy field as approximately accurate. We feel that further research may show $\dot{\Theta}$'s exponent is not exactly two. The damping torque is achieved by sending current to a dissipative device called a magnet-

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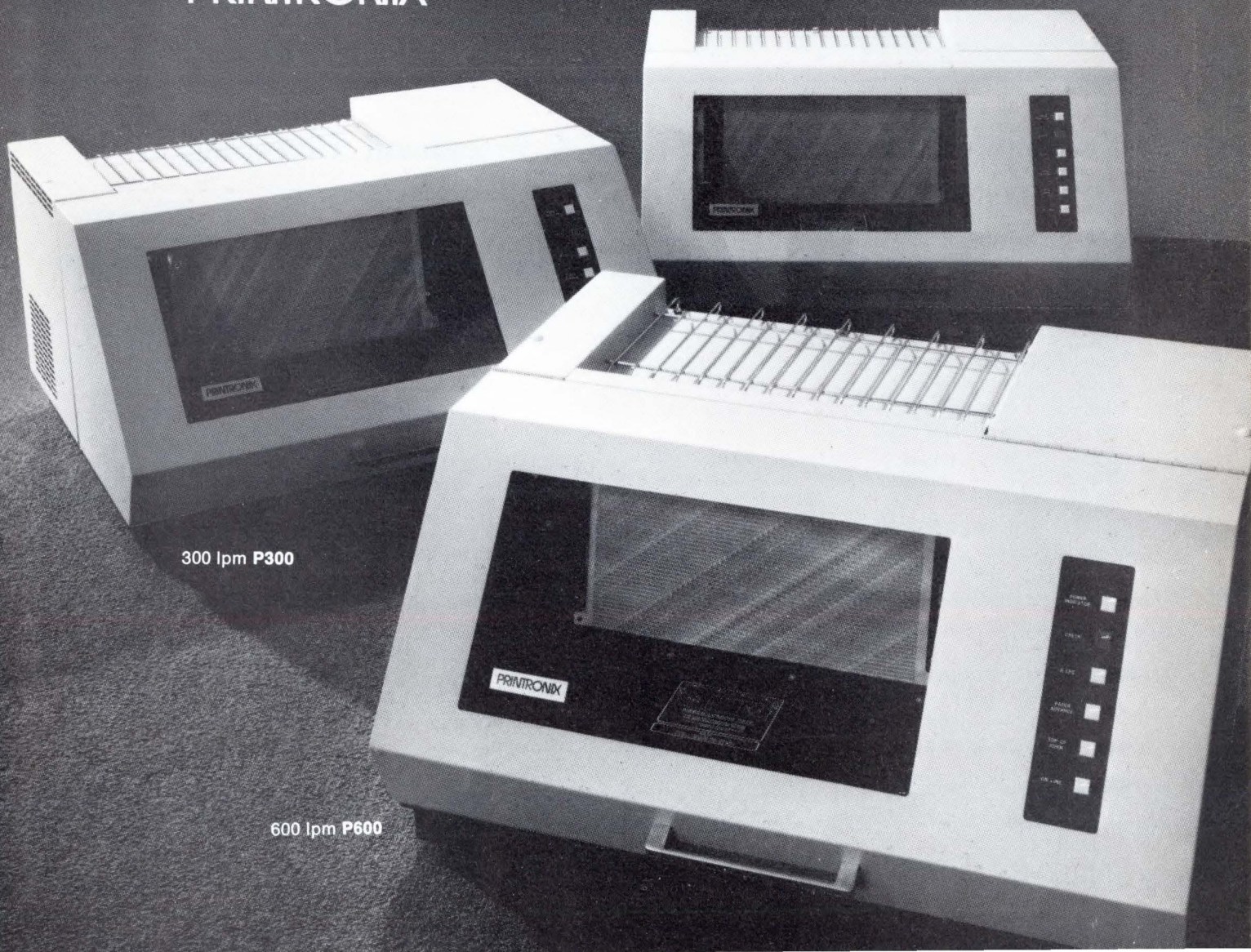
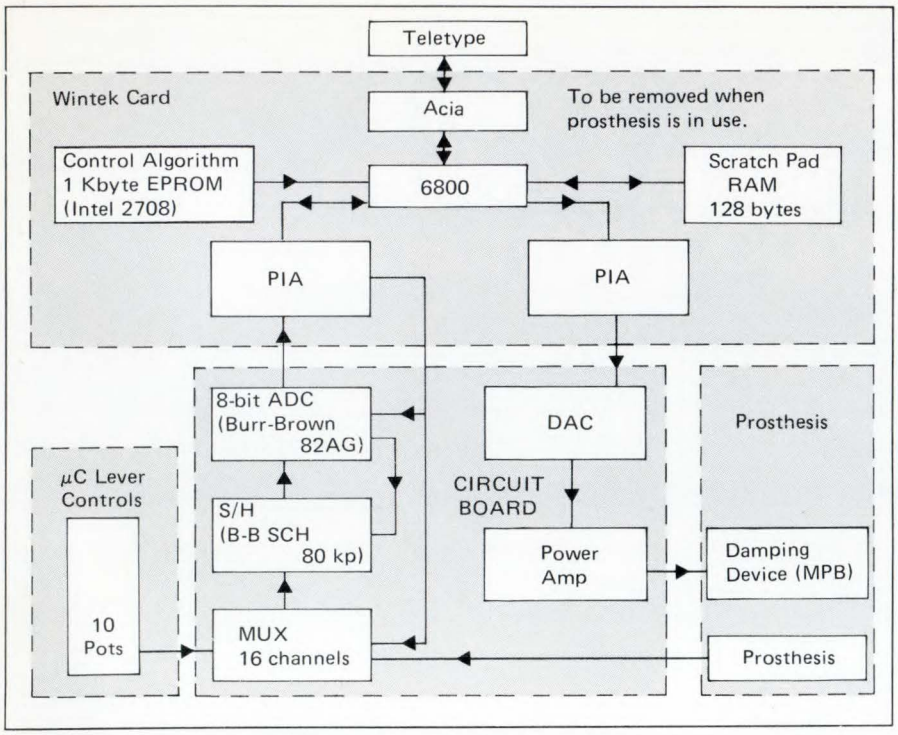
150 lpm **P150**




300 lpm **P300**

600 lpm **P600**




**This block diagram illustrates how a microcomputerized artifical leg can be made to simulate natural leg activities, customizing a prosthetic leg's response by constantly switching to a different set of characteristics with the wearer's movement.**

ic particle brake (MPB), housed in the prosthesis.

Currently $b(\Theta, \sin \dot{\Theta})$ is determined experimentally by the observations of Mark Tanquary and Steven Cornell, the cooperating amputee. Other MIT researchers, such as Donald Darling (who is working on damping profile optimization with a PDP 11/40), also are providing information on improvement of the $b(\Theta, \sin \dot{\Theta})$ graph.

While the memory is too limited to catalog all incoming data, cumulative values are kept of maximum heel rise, average duration of weight bearing and average swing velocity. Recognition of stumbling causes detailed information to be recorded for preventive future modifications in programming.

Power requirements for the experimental model are 5V at 1.2A. On NiCad batteries, the unit runs for 3.5 hours, but on a lithium battery, it can run for 20 hours. Future models will consume even less due to technical advances and elimination of unused chips that were included in the experimental model just in case they were needed later. —**Joel Zimet**

# Cryogenic Power Source Supplies Josephson Junctions

IBM is pinning its hopes for a supercomputer on the Josephson junction and has had some recent breakthroughs in this promising technology. One of the remaining obstacles, the power supply, has been overcome.

Designed to maximize the electrical characteristics of Josephson junction circuits and to cope with the electrical problems of ultra-high speed operation, an innovative IBM circuit design provides the power supply for the circuitry. The power supply, like other Josephson circuits, operates in a cryogenic environment at the temperature of liquid helium – 4.1°C above absolute zero, or - 273°C.

Under development at IBM Research, Josephson logic and high-speed memory circuits have the operating characteristics shown in **Fig 1**. The figure shows the relationship between the current in a control line and the current in the Josephson gate.

### Gate signal resets the latch

A control signal puts the latching circuit into a resistive state, where it remains regardless of subsequent control signals. Can the circuit be reset to the zero resistance state? The circuit can be reset to the zero resistance state by turning off the gate current. Thus, the power supply must turn off gate current at each cycle, or every 5 nsec. (As circuits are made smaller, time will become shorter.)

In each cycle, control currents switch some Josephson circuits into the resistive state. Now, because Josephson switching is fast, this happens in about 50 psec. Each circuit supplies control currents to several other circuits so that in the 5 nsec cycle, a complete operation (such as the addition of two numbers) can be carried out. The supply then turns off the gate currents, resetting the circuits for the next cycle.

### Voltage regulation presents problems

Unfortunately, complications exist. Since Josephson circuits operate at low voltage levels, the supply is designed to deliver 10 mV ±10% and must hold voltage to within 1 mV. This is no easy task with Josephson circuits, because when they switch,

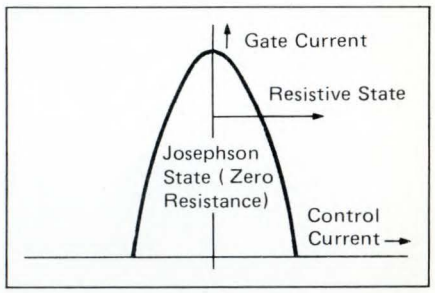



**Fig 1 Basic switching operation is from zero-voltage (Josephson) state under the curve to the resistive state outside the curve.**

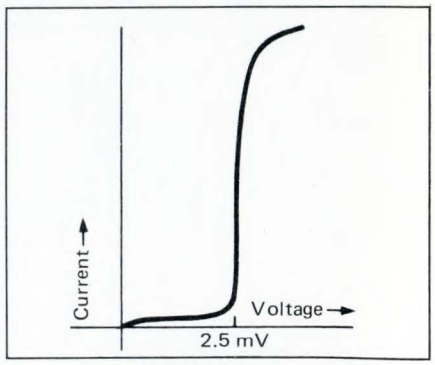



**Fig 2 Josephson junction current voltage curve shows regulation at 2.5 mv.**

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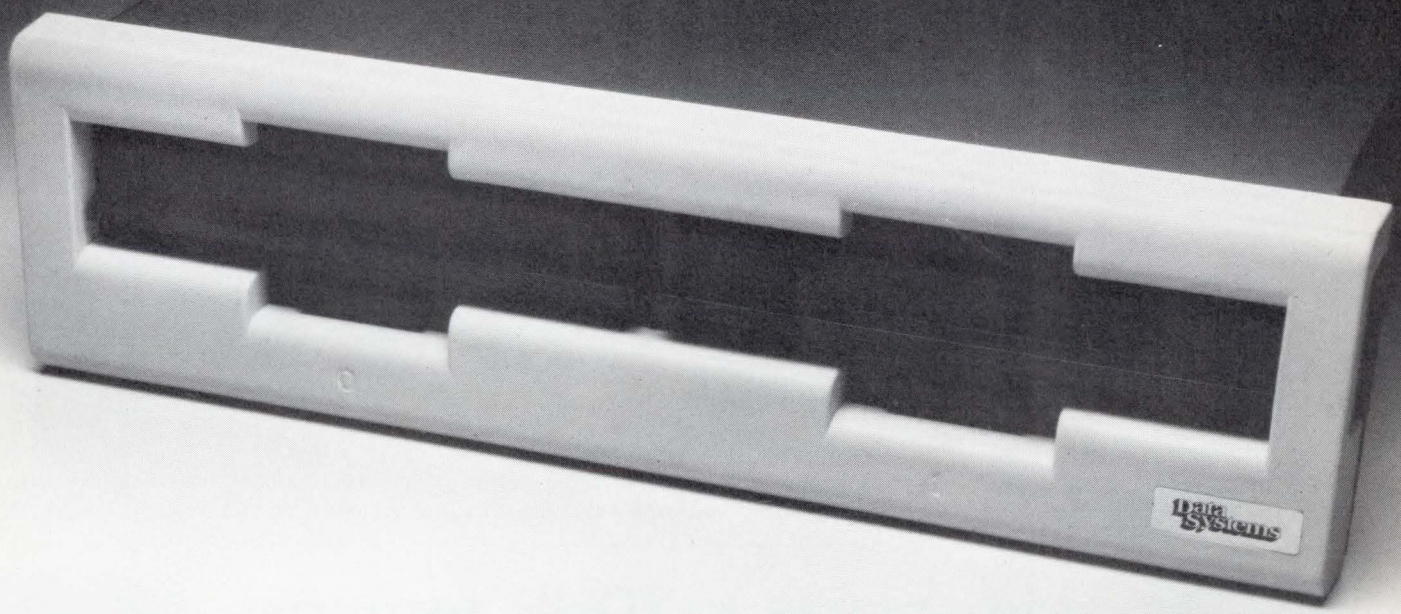


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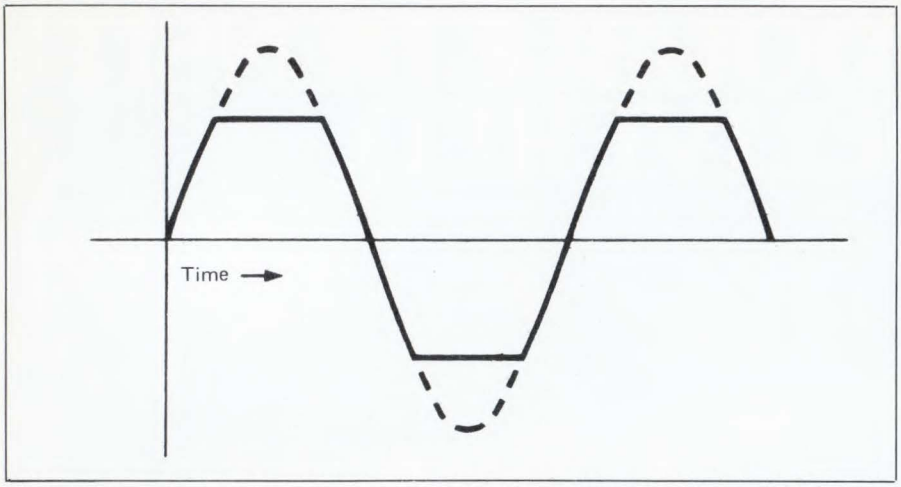


**Fig 3 Input to the Josephson power regulator circuit is a sine wave. The circuits clip this into the wave form shown.**

current drawn from the supply changes in 10 psec, inducing a voltage in the supply proportionate to its inductance and rate of change. The Josephson circuit power supply must keep induced voltage below 1 mV, despite this rapid change.

IBM researchers overcame this problem by putting the Josephson junctions that regulate power supply voltage on the same chip as the logic circuits to minimize inductance, which is largely a function of the supply-to-circuit line length.

Four 2.5 mV junctions in series supply the 10 mV level desired to drive the logic circuits and to localize disturbances caused by switching.

### Supply synchronizes logic circuits

The power supply's second job is to switch current on and off every 5 nsec. The externally applied 100 MHz sine wave enters the supply and interacts with the Josephson circuits according to their current-voltage characteristic **(Fig 2)**. In the 2.5 mV region of the current-voltage curve, voltage is regulated, clipping the top and bottom off the sine wave **(Fig 3)**. What is desired is a wave shape showing a constant voltage for a half-cycle (5 nsec) followed by a rapid decrease to zero. Because Josephson junctions have the same characteristics in both directions of current flow, both positive and negative half-cycles are used to provide two cycles of logical operations during each period of the sine wave. This arrangement also permits using a simple external power source – a sine-wave generator.

An additional advantage of supply circuits being on-chip with logic circuits is that the supply itself synchronizes logic circuit operation. No separate clock signal is required. – **Snigier**

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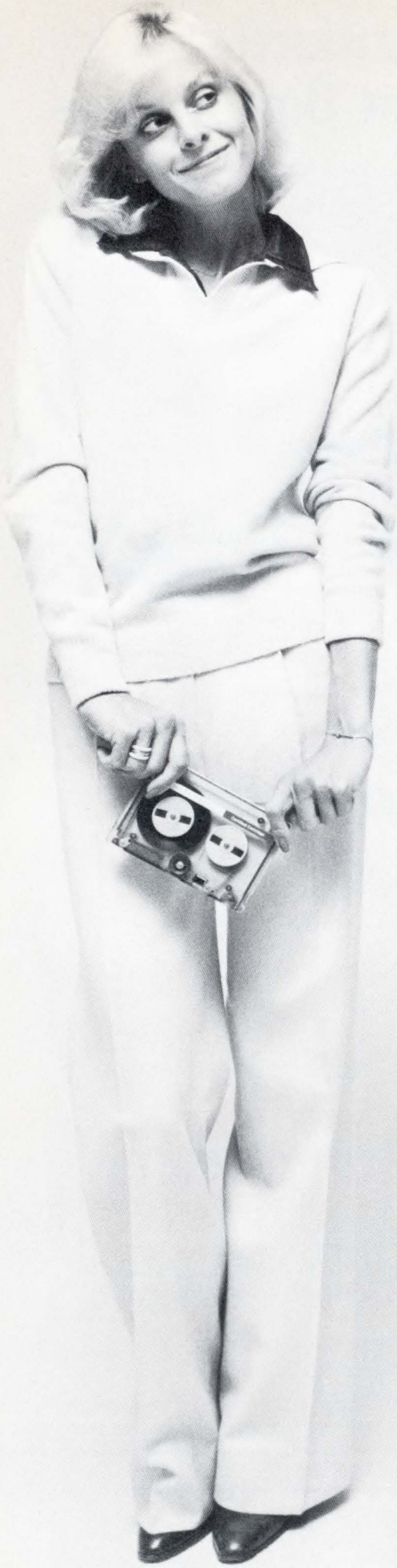

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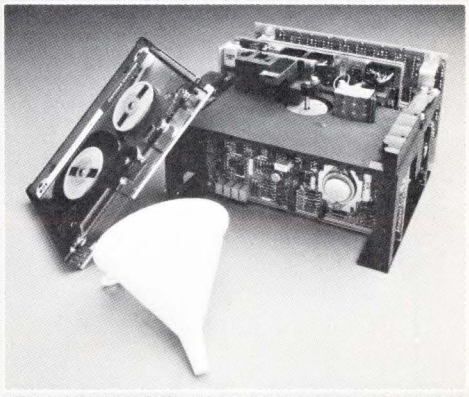

**DEI WE STORE BYTES IN M'S NOT IN K'S**

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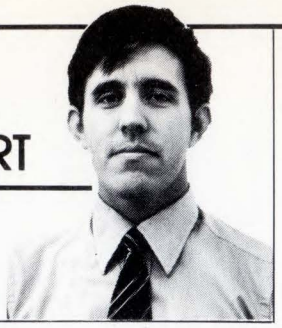
# TELE-DATA
## COMMUNICATIONS REPORT

**Douglas C. Mason**
*Computer Transmission Corp.*



# Communications Programming

In our context, communication is simply the transfer of information from one entity to another. Regardless whether space, time, air or wires separate these entities, communication occurs when compatible and meaningful information spans this gap and is transferred.

To explore this definition, let's consider three examples from a variety of environments: a person speaking to another person, a program writing a file onto a disk drive and a capacitor charging.

In the most obvious example, when a person communicates with another, three things must happen.

First, they must be able to pass information back and forth in a variety of ways, such as mouth via air to ear, or hand via teletypewriter to eye. The sensory inputs to the human and the linkages used (air, typewriter) may vary and are numerous. Note also that in the interchange errors can occur, due to such sources as sound or typographical mistakes.

The second step involves a common means for exchange of information. The form of data transfer must be understood at both ends to be effective – in language (spoken words) and signs. For transfer in language, both parties must understand the language used for a transfer to really take place; for transfer in signs, a more universal interchange might occur based on some concept common to both parties (such as experienced by a traveller in a foreign country who doesn't know the language).

For the third step to occur, the higher level information content of the exchange must be understood. For example, an interchange between an electronic engineer and a programmer, in which the engineer relates his current involvement in building a board with a certain kind of chip, may fall on deaf ears, if the programmer has no idea what an integrated circuit is.

Now let's apply the three steps in a person-to-person communication just outlined to the second two examples, that of program writing a file onto a disk drive, and capacitor charging.

In program writing, the means of transfer may be via input/output operations over some common bus, or via direct memory access to the CPU's memory. In capacitor charging, the transfer takes place via an electrostatic field through the dielectric to the two plates of the capacitor. The "language" used in writing must be some compatible data structure on the word level (for example, mapping a 32-bit word in the CPU to 4 bytes on the disk). For charging the capacitor, the unit of interchange is charge, because as one electron flows onto one plate, another flows off the second plate in response to the electric field.

The higher level of communication must be apparent. For the disk, some file-oriented structure must exist or else the information can never be retrieved. For the capacitor, the idea of charging is pertinent to such a device. If we were to hook a resistor across it instead of a battery, nothing much would happen.

Typically, a communications device is associated with the transfer of information from one point in space to another (or it could be a point in time). Such devices may be as simple as two teletypewriters connected by a 10-mA current pair of wires, or as complex as a Pacuit[T] switching network. In any case, we can associate the processes relative to the functions and control of these devices to common concepts.

Programming is used either in the control or operation, or both aspects, of many communications devices. The problems encountered in such programming range from mundane to the esoteric, from simple questions in a 500-word program to complex interactions in a 128,000-word data switch. As variable as the field may be, some commonalities tie these programs together. Some of the more obvious are: the event-driven nature of such programs, the tailoring of such programs to speed or memory constraints and the quality of most programs where the program is designed to meet the needs of a device rather than of a user.

We can note that in event-driven programs the transfer of data is typically done in discrete quanta and thus the processing, itself, of these quanta provides event-driven characteristics. Constraints, such as doing it twice as fast in half the speed available, are the programmer's bane. However, for communications devices, timing is often critical and usually tricky. Meeting a device's needs acknowledges that the design is usually optimized to the communications job to be performed and not to the user. This requirement profoundly affects the overall design of a communications program.

Thus, we see that the type of job and device that it relates to characterize communications programming. Often, special critical areas in the field of communications are not present or not important in other areas of programming.

### ABOUT THE AUTHOR

**Doug Mason** holds a BS and an MS from the California Institute of Technology. Doug joined Computer Transmission in 1974 and worked on RJE equipment, front ends and circuit/packet switched networks, and is now assistant director of product development at TRAN.

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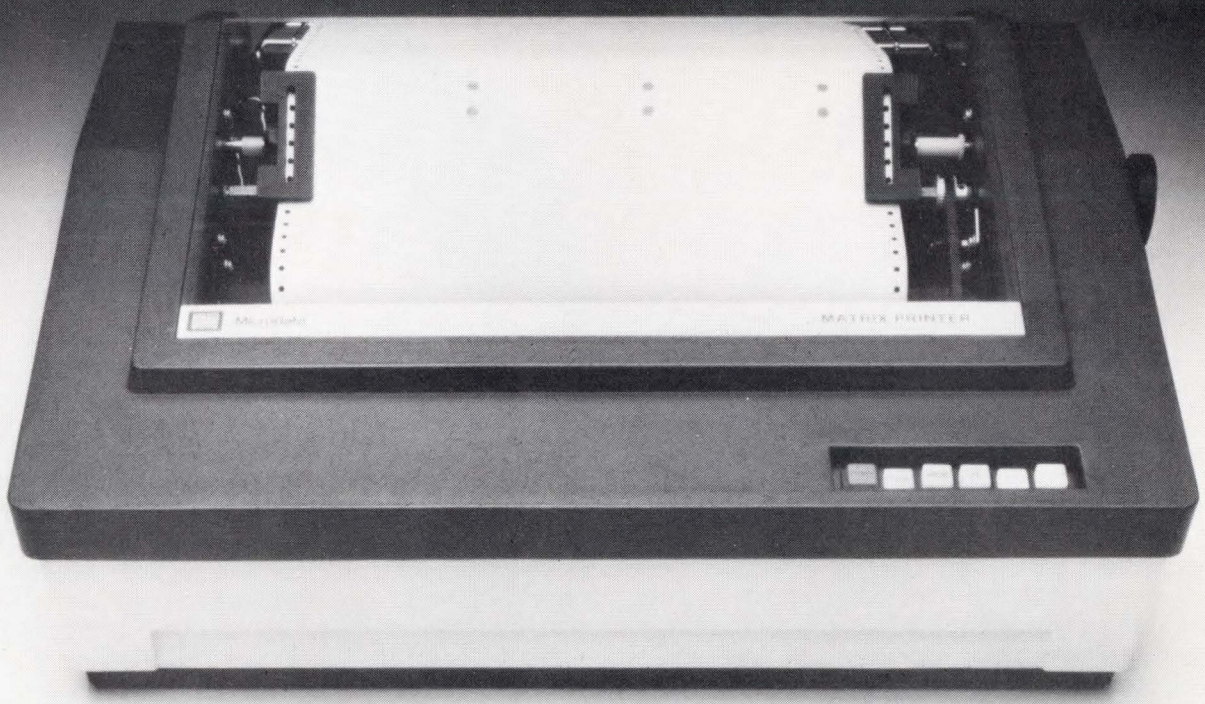

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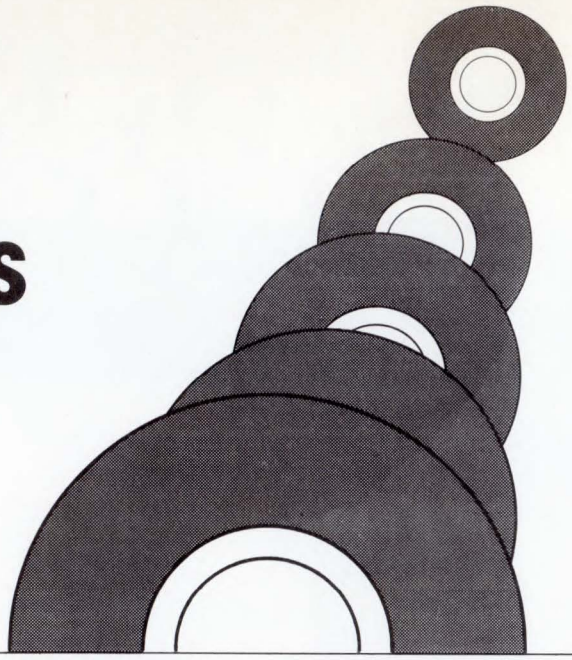
# THE MICRODISKS ARE COMING

George King, *Editor*



Persistent rumors place 12 companies in the 8" hard disk (microdisk) drive market, according to a Shugart spokesman. Although a drive of this type would certainly be compatible with his company's marketing emphasis, Shugart does not plan to introduce a microdisk drive in the near future. If Shugart doesn't, who does? Even though we asked at least 10 or those most likely to be interested in entering the market, only International Memories, Kennedy, Micropolis and Pertec answered our request with a positive answer. And only three of those four filled in our mailed questionnaire with enough information to help us compile the rudimentary chart of what designers can expect from microdisks when they become available.

In place of specific information, one of the four respondents, Pertec, allowed us to interview William T. Chambers, a division vice president of marketing. Although a great deal of what he said parallels and reinforces the material Stuart Mabon, Micropolis, presents in "Here Come the Microdisks", published elsewhere in this issue, the following paragraphs digest what he talked about.

Expecting 8" microdisk drives to use Winchester technology, Bill Chambers does not forsee his company's first units using a fixed sector format. Although Pertec is aiming a physical package that would fit in the same space as the standard 8" floppy disk drive, he does not believe that a product could be designed that simply replaces the floppy

**8" MICRODISK DRIVES**

| Company | Internat. Memories | Kennedy | Micropolis | Pertec |
|---|---|---|---|---|
| Approx Size L x W x H (in.) | 19 x 8.5 x 5.25 | 15 x 8.5 x 5.25 | 15 x 8.5 x 5.25 | 15 x 8.5 x 5.25 |
| Approx Wt (lbs) | 22 | 15 | 20 | NA |
| Head Position. Technique | Track Following Servo | Track Following Servo | NA | Track Following Servo |
| Power Used (watts) | 100 | NA | NA | NA |
| Voltages | ±5V, | 5 Vdc, 36 Vac RMs | NA | NA |
| Bit Density (bpi) | 5868 | 5280 | NA | NA |
| Storage Cap. (megabytes) | 11 | 12 | 25 | 20 |
| Compatible With? | NA | (See Comment) | NA | NA |
| Formatter? | NA | Not yet determined | Yes | Optional |
| Price W/O Formatter (lots of one) | NA | NA | NA | NA |
| Introduction Date | End of 1st quarter, 1979 | 2nd or 3rd quarter, 1979 | NA 1979 | NA |

**Comment:** Designed to be used with a microprocessor-based controller, this 8" microdisk drive contains an 8-bit bidirectional bus that transfers address information to the drive and also provides status information to the controller. Separte from the bus, radial lines carry high-speed data and clock signals to or from the drive.

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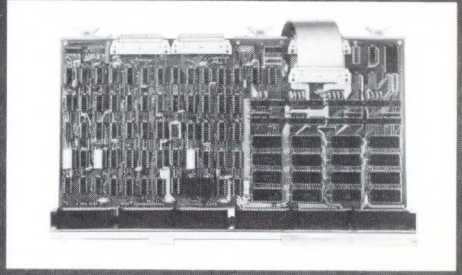

## Able, the computer experts

**Model 7710 hard disk storage system from International Memories used two 200 mm disks and Winchester-type read/write heads positioned by a linear voice coil actuator that uses a closed loop, track-following servo system.**

without making other changes. The microdisk controller, for one, must be capable of operating at higher data rates than existing floppy controllers. Redesign could produce a single-board controller that could serve the two types of drives.

Power consumption also complicates the direct replacement of an 8" floppy with an 8" microdisk drive. Although the voltage levels could be compatible, the microdisk unit will consume from 1½ to 2 times as much current at the 12 or 24 V level.

Pertec expects to use a mixture of off-the-shelf components with a number of custom and dedicated special chips to reduce board device count and conserve the space devoted to drive electronics. It will also offer an optional formatter, but the company has not yet decided whether space limitations will allow it to be integral with the drive package.

By the end of 1980, the volume of 20 Mbyte microdisk drives, selling for $1500 in OEM quantities, should reach 50,000-to 100,000-level per year, predicted Bill Chambers. These units will go mainly into small business systems and various types of dedicated data processing applications that need larger storage capacities. DD

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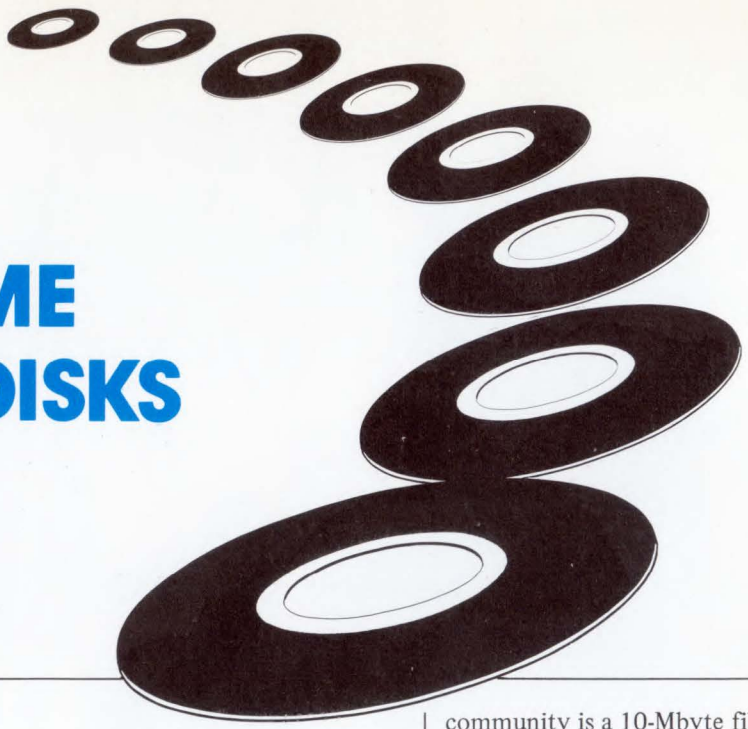


# HERE COME THE MICRODISKS

**Stuart Mabon,** *President*
*Micropolis Corp.*

In 1979 and most certainly in 1980, designers can expect OEM quantities of 8" diameter hard disk (microdisk) drives to become available. While we can only estimate prices, capacities, delivery schedules and interface standards, we can conclude from what is known a number of generic characteristics of these drives which will use – in all probability – the so-called Winchester technology.

## Why microdisks?

During the past two years product demand has so overwhelmed most manufacturers of small business systems built around low-cost microcomputers that only recently have they begun to realize that their systems are running out of capacity. That condition should hardly come as a surprise, since the reaching and surpassing of thresholds more or less tell the history of large mainframe computers, then minicomputers, and now microcomputers. The unexpected nature of the capacity problem is, perhaps, the speed with which a supposedly neophyte community of business and professional users with relatively mundane applications has outgrown these systems.

Technically, you can usually remove capacity constraints by upgrading the CPU, by increasing main memory by improving system software, by adding to online mass storage and by various combinations of any or all of these methods. Activities in all of these areas exist today, and most likely, the next generation of small business systems will boast 5 to 10 times current capacities by improvements in CPU throughput, concurrent handling of multiple users and tasks, and records storage.

Forthcoming contributions by the semiconductor industry, such as 16-bit microprocessors and higher-density memory boards, will increase capacity without a corresponding increase in price. Unfortunately, electromechanical mass storage devices are subject to a completely different set of technical and economic influences.

Floppy disk drives, which certainly have done their share to fuel the growth of microcomputer-based small business systems, do not lend themselves universally to high-capacity systems and applications. Originally developed as merely a transfer medium, floppies have evolved from single-drive, single-sided devices to multiple double-sided, dual-drive subsystems in an effort to keep up with file storage demands. Attempts to handle two or three simultaneous users have encountered intolerably slow operating speeds because of the long rotational delay and head positioning times of the floppies. At this point in time, increases in cost of storage is proportional to the increase in capacity.

To the OEM system manufacturer, the most obvious step upward in mass storage involves the use of 14-inch rigid disk drive, on which the minicomputer industry depended for several years. At an end-user cost of $7,000 to $10,000, however, the price of a 10-Mbyte file overwhelms the microcomputer price.

What the industry needs today to make its gain in semiconductor technology feasible to the small business community is a 10-Mbyte file retailing in the range of $3,000. Clearly the demand for low cost file storage exists and, equally clear for the present, a new class of product – the scaled-down 8-inch rigid magnetic disk drive – will meet the requirements of OEM small business system designers.

Designers can expect such a product to be available to the OEM marketplace from multiple sources during 1979 and 1980. While much is still unknown as to pricing, capacities, deliveries and interface standards, we can draw certain generic characteristics and conclusions from what is known.

In examining advances in magnetic recording technology as applied to 14-inch drives, we see densities of 3 million bits per square inch available today and 10 million bit densities as the predicted next step. On the basis that the effective data area of a typical 14-inch disk surface equals 55 square inches, the unformatted data per surface will therefore increase from today's 20 Mbytes to 60 Mbytes in two to three years. For small business applications requiring 5 to 10 Mbytes, the 14-inch drive is "overkill" in capacity and cost.

Since disk capacity is roughly proportional to the square of the radius, we would expect to see 8-inch microdisks exhibit a useful capacity of about one-third of the corresponding 14-inch platter. Using today's technology, a microdisk can store 7 Mbytes unformatted, or 5 Mbytes formatted on one surface disk, with expected future expansion to 15 Mbytes. Remember that current disk file technology employs so-called 'track following'

head positioners that require dedicating one whole surface of one disk to recorded reference tracks on which a special head flies and returns radial position information to the head positioner servo. In theory, any expansion or contraction of the reference surface will remain the same for the data surfaces, even if these surfaces are on other disks. Since considerable quantity of air flows over the disk surfaces and only small temperature differences within the airstream exist, the long and short term data track alignment between the reference surface and other surfaces is adequate.

We have seen that the 8-inch microdisk can provide sufficient data storage capacity to appeal to the small business microcomputer users. However, can the new size meet the ultimate test of price? We can count on the microdisk to reduce costs in a few areas. For example, the drive requires only one head per disk surface (compared to two heads on the typical 14-inch disk); lower power for the head positioner and disk drive motors reduce the cost of those components; in general, the smaller physical size of castings, bearings and other mechanical parts result in cost reductions. Is the 8-inch disk drive inherently cheaper than the 14-inch disk drive? Time and the efforts of perhaps a dozen disk file manufacturers will tell.

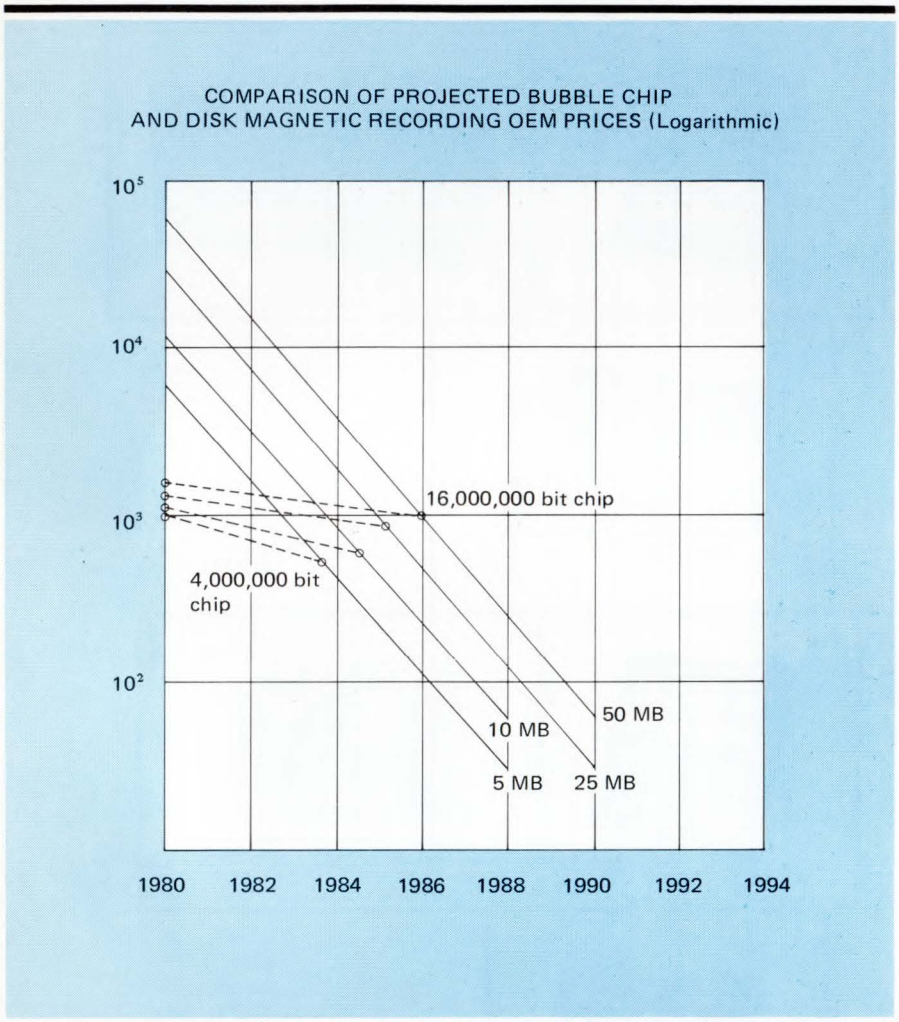



**Fig 1 Semilogarithmic plot of the decline in prices for various sizes of bubble memories (dotted lines) and rigid magnetic disk drives indicates that the cost of bubble memories will not drop as precipitously as disk units.**

Perhaps as important as the price of the disk drive are the cost savings resulting from the small physical size, weight and power requirements of the 8-inch drive. Packaging and power supplies together can cost up to 25% of the system builder's total cost.

## Microdisks vs. other storage

So far, we have made the case for 8-inch rigid disks only in comparison with 14-inch disk drives. What about the 4-Mbyte floppy? What about bubble memories?

High-capacity 5-1/2 inch and 8-inch floppy disk drives will continue to serve a need – a large need. They will operate as extensions of the current 1-Mbyte floppies in small, single-user systems, as off-line back-up storage for rigid disk files and for data interchange. The inherently slower access time of the slowly rotating floppy disk will tend to limit its application to single user systems, and capacity limitations will relegate it to the corresponding section of that market.

The natural competitor of the small fixed-disk drive is bubble memory. This semiconductor device offers these inherent advantages: shorter access time (though slower data rates) and incremental capacity. Coupling these advantages with the apparent identification of that market by the semiconductor industry as the next 'home' for infinite quantities or identical dual in-line packages force disk file manufacturers to consider the magnitude of the threat seriously.

For the purposes of quantification, let us consider the following model. Let's assume the following OEM prices of bubble-memory chips:

- Large volume price per DIP (Dual In-line Package) will be $25 (regardless of capacity).
- Bits/chip will double each year.
- The first year of the 25-dollar 256,000-bit memory will be 1980.

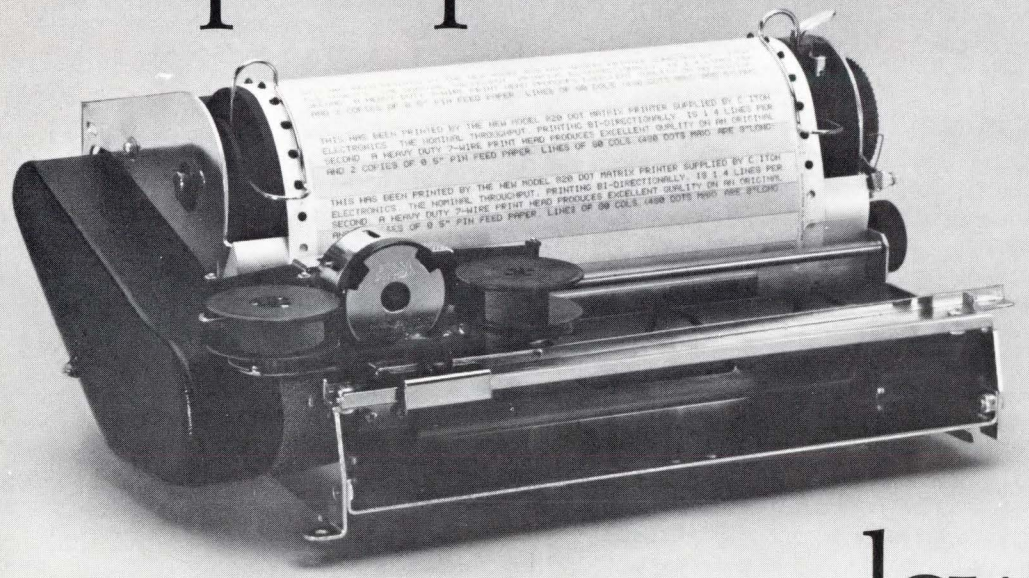
Thus, according to these assumptions, we can expect that 1982 will be the first year of the 25-dollar 1,000,000-bit chips, and so on.

Now, let's assume the following concerning the OEM price of rigid disk files:

- Fixed overheads result in a much lower rate of cost reductions for small files.
- In 1980 the OEM price of 10-Mbyte files will be $1,100.
- Due to next generation of 10,000,000-bits/in.$^2$ density the price will erode by approximately 40% by 1984.

If we ignore power supplies and controllers for both types of storage and add 20% of chip costs for bubble chip installation on printed circuit boards, we can plot the costs of several file sizes as a function of dates **(Fig 1)**. Note that only the availability of a 25-dollar 4,000,000-bit bubble chip can compete in price with the smallest of the rigid disk drives. Only when the 25-dollar 16,000,000-bit chip is available will the typical small business file of 50 Mbytes affect applications for which normal disk file access times are adequate. If **Fig 1**'s assumed dates for availability of such chips are incorrect,

# Model 820, 150 cps, 80-column, dot matrix impact print mechanism...



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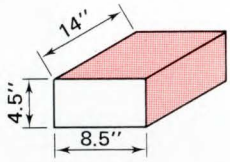
system designers can make their own estimates of cost crossover dates based on the projected availability of low-cost 4-Mbit and 16-Mbit bubble chips.

## An 8" rigid disk file standard?

A number of disk manufacturers and disk file manufacturers appear to have settled on a 200mm diameter (slightly less than 8") with a magnetic oxide coating capable of using the widely-available "Winchester" technology heads similar to those used in IBM 3340 and IBM 3350 large disk files. Recently announced, but not yet delivered, disk files from IBM suggest the use of approximately 210mm diameter disks. Extrapolating from scanty data provided by IBM suggests a bit density slightly higher than the current standard. Since medium interchangeability is not a feature of fixed disk drives, the industry will most likely use the 200mm disk for current products, perhaps switching to a higher-technology disk for products to be delivered in three years.

The trend in rigid disk drives towards higher track and bit densities demands sealed, ultra-clean environments. This trend works against the traditional removable disk pack, because removing a sealed enclosure generally involves the transfer of most of the mechanical parts of the disk drive – a costly operation. For this reason, although the need for low cost off-line back-up files remains as strong as ever, most likely only low-cost serial transfer devices, such as tape cartridges

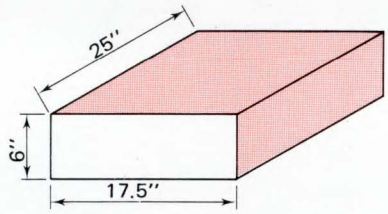



**(A) 8-Inch Microdisk Drive (estimated)**
Width- 8½ inches
Height- 4½ inches
Depth- 14 inches
Weight- 25 pounds
Capacity- 5 to 10 Mbytes
Price- ? ? ?

or low cost, high capacity floppies, will perform this task.

Other possibilities for standardization extend beyond the basic technology to more mundane areas, such as physical size, power requirements, interface specifications and performance. Although there appears to be an understanding in the industry that it would be highly desirable to package the 8-inch rigid disk drive within the same overall envelope as the typical 8-inch floppy disk drive to avoid the necessity for packaging changes by OEMs, some of the announced microdisk entries have not been able to achieve this. Similarly, the ability of the 8-inch rigid disk drives to utilize the same power supplies as floppies would simplify the OEM task of integrating a floppy and a microdisk into the same system.

The question of interface standards opens a pandora's box of conflicting historical, emotional and cost issues. Very little interface standardization currently exists for rigid disk drives, though a number of large file manufacturers developed the storage module interface. The salient characteristic of this interface involves splitting the data signals from address and status lines. The data signals are radially distributed from the controller (one



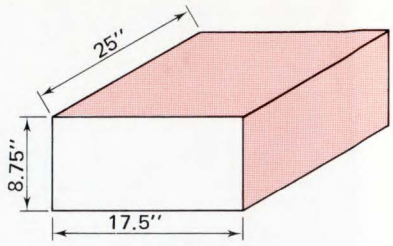

**(B) 14-Inch Rigid Risk Drive**
Width- 17½ inches
Height- 6 inches
Depth- 25 inches
Weight- 60 pounds
Capacity- 10 to 20 MBytes
Price- $2600 to $5700 (in quantities of one)

cable for each disk drive) and the address and status lines, which use a multiplexed bus approach, are daisy-chained from one drive to another in a multiple drive system.

Technically, two separate interface cables satisfy the need for high integrity of edge timing of the data signals. For large disk drives physically separated by several feet, the daisy-chained approach has lacked the necessary timing integrity. This technical problem disappears with the proximity of adjacent microdisk drives. Although it appears that from a strictly technical point of view the need for the radial interface for data may have diminished, for such historical reasons as conservatism and existing controller designs, industry may well continue the practice through the new generations.

## Microdisk applications

Any microcomputer business system using more than two floppies could be considered a candidate for the physically similar microdisks. The OEM floppy disk sales are heading for 500,000 units per year. A number of large OEMs now routinely use four




**(C) Removable Platter Disk Drive**
Width- 17½ inches
Height- 8¾ inches
Depth- 25 inches
Weight- 75-80 pounds
Capacity- 5 to 10 MBytes
Price- $7000 to $10,000 (in quantities of one)

and even six 8-inch floppy disk drives in their small business systems. Since such systems need diskette drives for software distribution, transactions recordings and file back-up, they will still require at least one and probably two floppies. However, the capacity and speed advantages of the microdisks, together with their potentially similar physical characteristics, will tend to displace the usage of additional floppies, especially in multiple user systems.

A number of disk file manufacturers have chosen to fight what might be regarded as a rear guard action by combining 14" disks and floppy disk type stepping motor/head positioner technology. While this approach results in a relatively low OEM price, it does so at the expense of access time. For orders of magnitude larger than floppy index files, which perhaps require as many as five positioner movements for each record access, the accommodation of three or four users can result in undesirable operation delays. The matter of physical size and power usage are almost as important to an OEM as the performance of the hardware. For this reason, as well as the lack of expansion capability to a further doubling of track density, stepping motor/14" rigid disk drive combinations appear to be marketable for a relatively short period.

Expect 1979 to be the year of the 8" rigid disk drive now product announcements and 1980, the year for OEM-level production. System designers configuring products for the 80s will be advised to evaluate the new generation of storage equipment. DD

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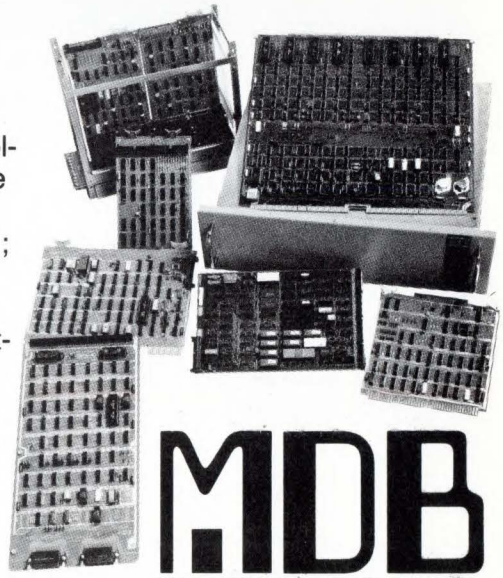

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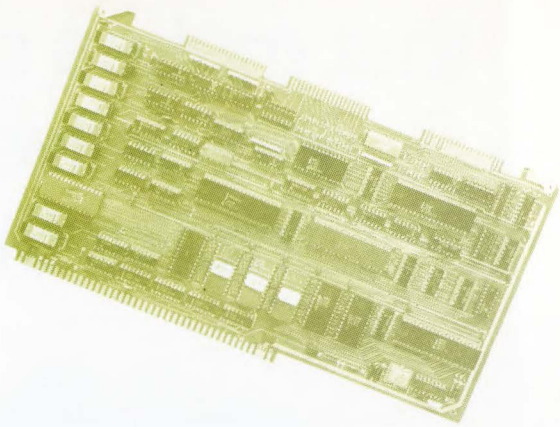

**Philip Monego,** *Zeta Research, Inc.,*
**Robert G. Pomeroy,** *Information Processing Techniques*

One key advantage of half-inch magnetic tape is near universal transferability. No other media has the standardization of recording format and technique that allows interchange between the mightiest main frame computer and the simplest microcomputer. But the farther you get from the physical tape, the greater the variations in interfaces. The MTC-80 is designed to bridge the variations and link two industry-standard interfaces.

In designing an off-line controller for their plotter, Zeta Research needed the ability to interface to the variety of industry half-inch magnetic tape drives, densities, formats and recording modes.

The components for a typical tape system would be a tape transport, formatter/controller, computer interface board with direct memory access and software drivers to include control and error recovery. Constraints of the application made such a system unacceptable for a number of practical and business reasons.

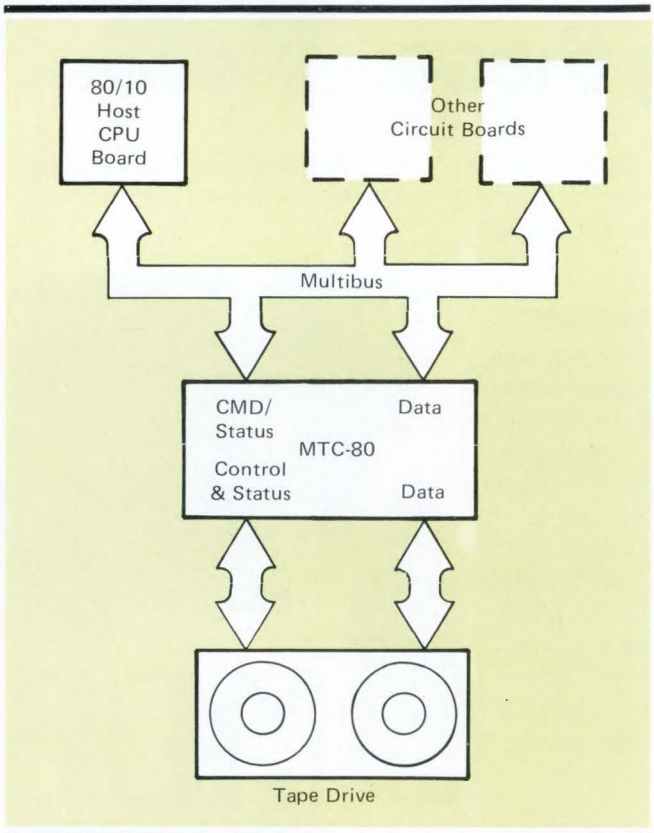


**Fig 1 Magnetic Tape Controller, MTC-80, interfaces to host CPU and other PCBs via Multibus. One port ("CMD/Status") handles commands and status; the other, data.**

The controlling computer, an Intel 80/10 compatible board, was fully time saturated and could not support typical tape I/0 control overhead or bursts of date from a tape system without degrading its prime function, i.e., complex, high speed plotting.

Few interface boards for half-inch tape compatible with the Intel MULTIBUS were available. All were designed for a particular manufacturer's tape formatter, severely limiting the required universality. Although one interface board offered an on-board buffer to handle the data, the burden of transport control and error recovery remained on the host computer. Formatter boards were available from tape transport OEM's but were expensive and often had to be mounted outside the transport cabinet. Universality would require a NRZI formatter, phase encoded formatter, some means of changing speeds and density without changing straps. And there was a relative lack of standard electronic interface existing in these areas.

The solution was the development of a single board controller that incorporated the functions of the formatters, interface, system software drivers and more. The Magnetic Tape Controller, MTC-80, controls tape transport, formats NRZI or Phase Encoded, handles error recovery, preprocesses data and interfaces to the host computer system.

The MTC-80, designed and developed by Information Processing Techniques Corp. for Zeta Research, interfaces to the host computer through two bi-directional ports on the MULTIBUS as shown in **Fig 1**. One port handles data, the other handles commands and status. The key commands Read File and Write File cause the MTC-80 to accept or present data at the data port without regard to interrecord gaps, recoverable errors or other control overhead. Other commands handle Rewind, Go Off-line, Skip files forward or back and select from three data repacking modes for 7-track drives. Data is transferred by the host computer with simple IN and OUT commands.

On the transport side, the MTC-80 interfaces to the industry Pertec standard available on almost all mid-size tape transports. Signals identifying the transport variations (recording format, density, number of tracks, and number of gaps) is available on this interface. Four switches on the MTC-80 identify speed and determine which (of three NRZI densities) is high and which is low. Thus dual den-

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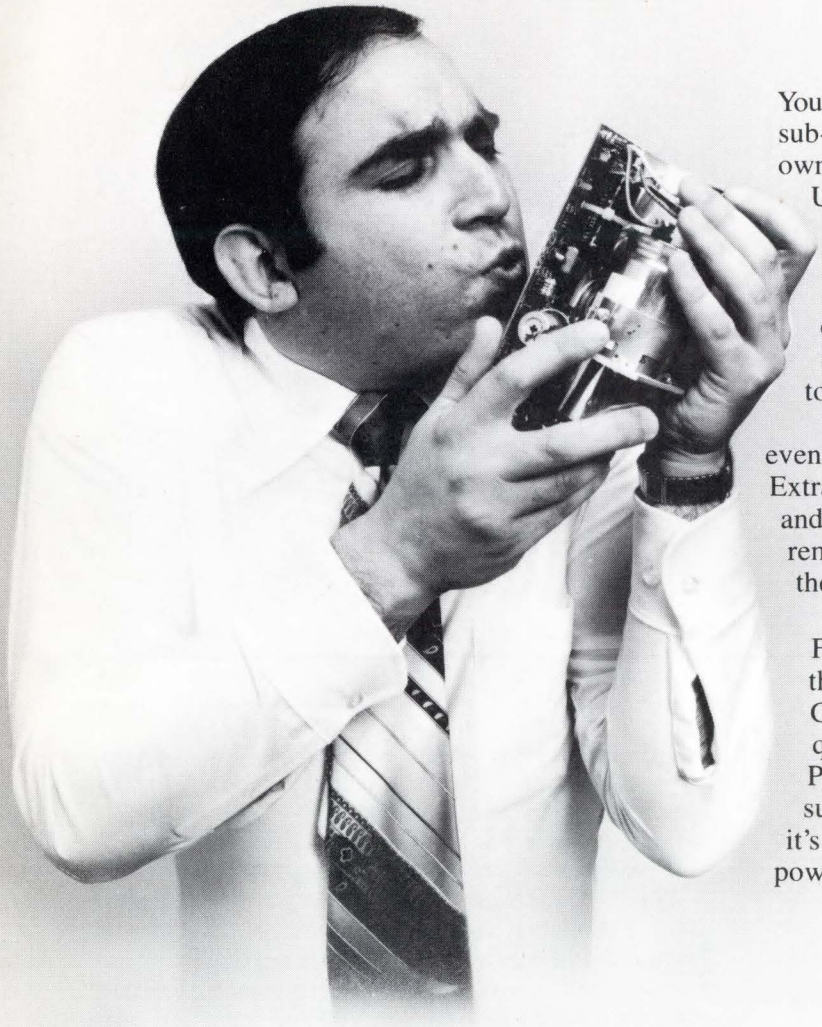

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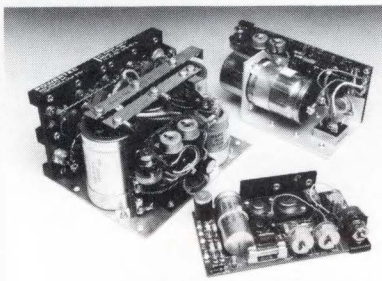

| | VOLTAGE RANGE | | | | | | |
|---|---|---|---|---|---|---|---|
| MODEL | 1.20V to 4.75V | 4.75V to 7.0V | 7.0V to 10.5V | 10.5V to 15.75V | 15.75V to 22.0V | 22.0V to 30.0V | 1–24 PRICES |
| 22AA | .40A | .40A | .29A | .23A | .19A | NA | $ 20.00 |
| 22A | 1.0A | 1.0A | .725A | .575A | .475A | .425A | $ 30.00 |
| 22B | 3.0A | 3.0A | 2.2A | 1.7A | 1.4A | 1.2A | $ 35.00 |
| 22C | 6.0A | 6.0A | 4.4A | 3.4A | 2.8A | 2.5A | $ 50.00 |
| 22D | 12.0A | 12.0A | 8.8A | 6.8A | 5.6A | 5.0A | $ 70.00 |
| 22E | 18.0A | 18.0A | 13.2A | 10.2A | 8.4A | 7.5A | $ 85.00 |
| 22F | 24.0A | 24.0A | 17.25A | 13.7A | 11.2A | 10.0A | $115.00 |
| 22G | 36.0A | 36.0A | 26.0A | 20.6A | 16.8A | 15.0A | $150.00 |
| 22H | 50.0A | 50.0A | 35.9A | 28.5A | 23.3A | 20.8A | $200.00 |
| 22J | 75.0A | 75.0A | 53.9A | 42.8A | 35.0A | 31.3A | $275.00 |

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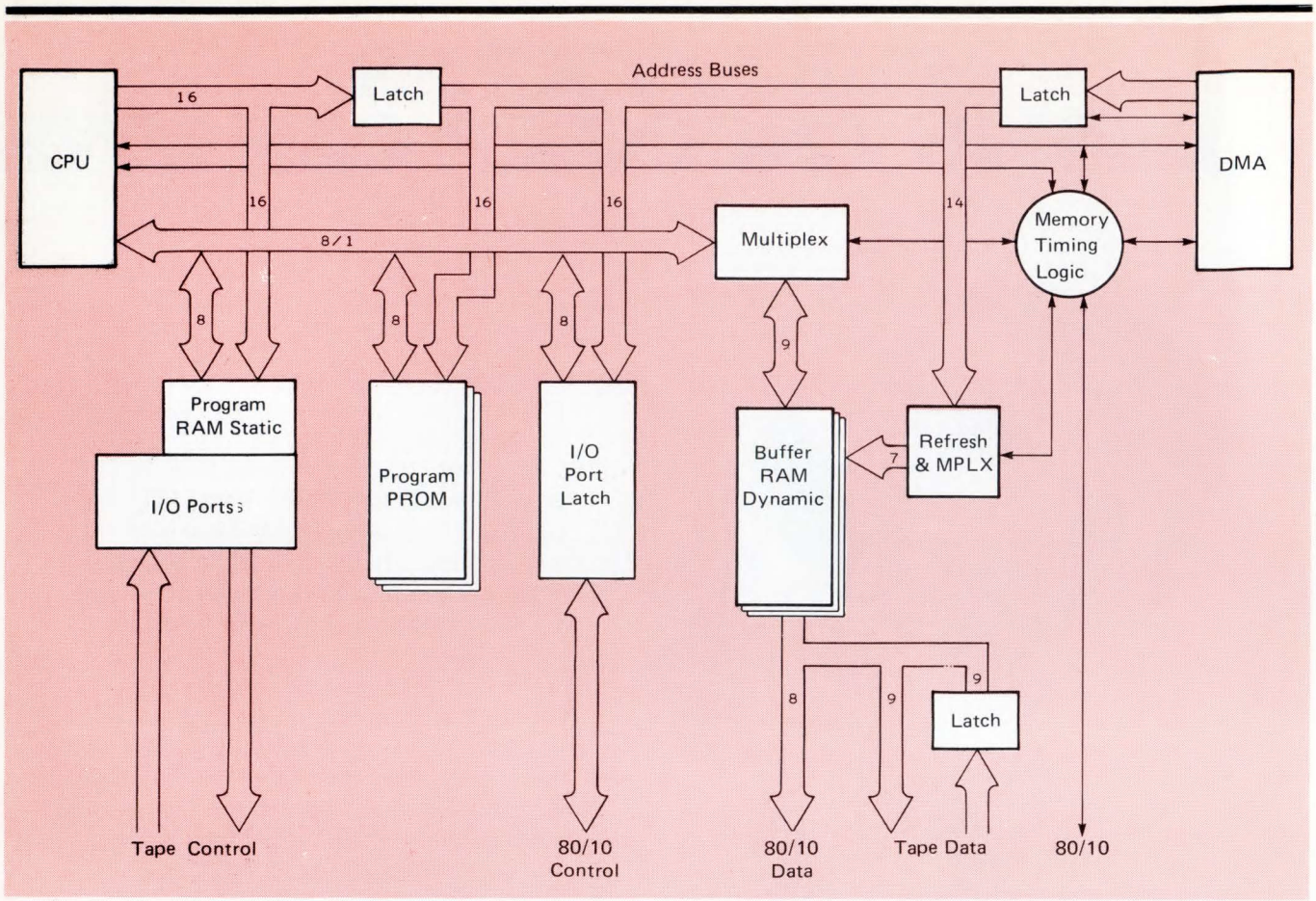


**Fig 2 MTC-80 block diagram shows bus arrangement, CPU and how data is transferred.**

sity, dual format and even 7 and 9-track combination drives are front panel configured and recognized by the MTC-80 when placed on-line. Here are the variations handled by the MTC-80: format – NRZI and phase encoded; tracks – 7 and 9; gaps – single or dual; speeds – 25, 37.5 or 45 ips and densities – 200, 556, 800 and 1600 bits per inch.

The method used to handle the variety of standard formats was to store the record from the tape in dynamic Random Access Memory on the MTC-80. NRZI data is simply strobed into memory by the transport under the control of a direct memory access controller. Phase Encoded data, on the other hand, is sampled at a rate 12 times the data rate and reconstructed between records. In order to read a 1K record in PE, it was therefore necessary to provide a 16K RAM array, nine bits wide. In the write direction, data is accumulated from the host into RAM in appropriate format and then strobed out to the tape transport at the correct frequency.

The RAM array is mapped so that the tape transport reads or writes nine bit words. The host computer, which does not need the parity bit reads, writes eight bit words under DMA control. The MTC-80 CPU handles the eight bit data portion in the normal fashion, but accesses the parity bit in a virtual 16K address space containing eight bit words with parity in the least significant bit. This is described in **Fig 3.**

Every design constraint applied: space, speed, cost. The design had to fit on a single six by twelve inch board, maintain rapid data availability, attain a minimal target production cost and work reliability.

To concentrate the electronics, which in some current systems takes over $1500^2$ of circuit board, into 72 $in^2$ and obtain the required flexibility, liberal use of LSI circuits and microprocessor technology was required. The MTC-80 block diagram is shown in **Fig 2.**

The 8085 was chosen over bipolar and other processors due to availability, cost and relative ease of development. The transfer of data between the tape transport, buffer memory and the host computer is controlled by an LSI DMA controller chip. Although a discrete logic controller would have been faster and easier to synchronize, this was ruled out by the board space constraint. Two LSI peripheral interface adapters provide the control and status interchange and latching between the MTC-80 and the transport and the host computer. Software controlled hardware logic signals also originated here. Intel's 8155 combination chip provides the transport control and status ports, the program scratch-pad RAM and the programmable timer required to time the system for various tape speeds and densities.

Speed of operation is a mixed issue. The MTC-80 must accept data in bursts from the transport at rates from 5 to 750 KHz and provide it only on demand to the host at up to 100K bytes per second. At the higher data rates it was not possible to perform the reformatting and error checking functions in real time, so data is transferred in under DMA control, processed during interrecord gaps and transferred out again under DMA control.

The major software challenge in development of the MTC-80 was the reconstruction of the original data record from the sampled PE read representation in under 500 mil-

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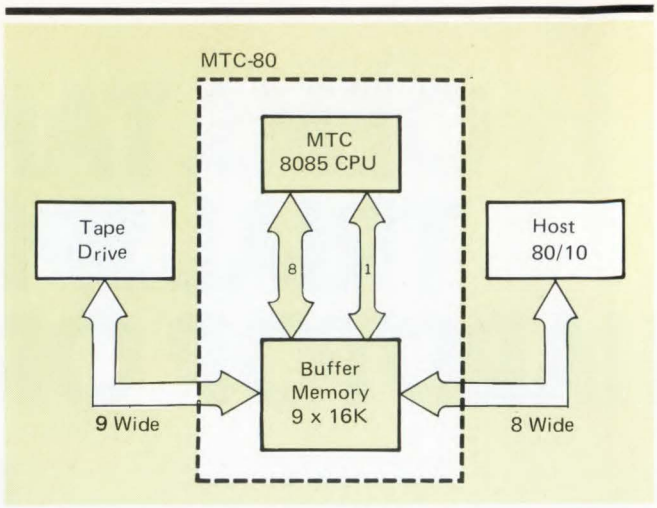


**Fig 3 This MTC-80 block diagram memory configuration shows how the 8085 CPU handles the 8-bit data portion and accesses the parity bit in a virtual 16 K address space.**

liseconds. Each of the nine channels has to be reconstructed, taking into consideration up to 20% short term fluctuation in position and the requirement to detect signal dropouts. The algorithm searches through 117,000 bits for the data transitions, assembles the data words and then checks parity. NRZI read and write and PE written formats require considerably less processing.

Dual buffering would make the interrecord gap time invisible to the host computer, but was not required for the application and would have increased board size. The average worst case read data rate is about 2400 baud; the average write data rates approach 50 kilo baud.

An additional benefit of this smart type interface is data preprocessing, thus further off-loading the host computer. In the Zeta application, plot files have a unique start-of-file delimiter and a specific subset of characters used for plotting. Preprocessing is invoked when the host computer issues a Plot Mode command. During Read File and Skip File commands the MTC-80 searches each physical tape file for the delimiter in one of six languages: ASCII, EDCIDIC, BCD, Honeywell BCD, Display Code or Fieldata. This process occurs after repacking, if required, in the use of 7-track tape. After finding the delimiter, further preprocessing continues in that language. Each valid character is translated from the language to a binary byte for use by the host plotter controller. Non-valid characters and non-plot files are ignored.

Other forseeable applications of this off-loading are label recognition, fixed language translation, and even data accumulation. The future of small, flexible, integrated controllers brightens continually as new denser, faster devices are announced.

Since the MTC-80 was released, components which were previously too expensive and newer, faster and more compact have become available. Examples are faster DMA controllers that would enable the higher sample rate (not quite achieved for 45 ips Phase Encoded reads), more complete dynamic RAM controllers, and higher density packaging of MSI devices and programming logic arrays which might provide room for a second buffer bank.

Other advances should improve speed and space needs, for less development and build cost, and make complex peripherals into simple, low overhead devices for use by $\mu$P-based machines. DD

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COVER FEATURE

# CARTRIDGE DRIVES
## Store Megabytes at Low Cost

**Sam Thompson**
*Data Electronics, Inc.*
*Pasadena, CA*

A compact and economical medium for storing multiple megabytes of data available today is the data cartridge. Let's look at the ANSI/ECMA 1/4-inch Data Cartridge. It is a rugged envelope that completely encloses and protects the magnetic tape during shipping, handling, loading and unloading the cartridge from its drive. The metal base plate and overall precision design assure interchangeability among cartridges, and make mailing the cartridge a practical matter. Tape tension, an integral function of the cartridge, simplifies the drive design. In fact, all tape guidance and handling is built into the cartridge. The cartridge is so rugged that it can be used in severe environmental applications.

Perhaps the greatest benefit of all is the storage capacity. At 1600 bpi recording density, the 300-ft. version of the cartridge holds 2.8 Mbytes (unformatted), and the 450-ft. cartridge holds 4.2 Mbytes. Quad-density (6400 bpi) allows capacities of 11.5 Mbytes (300 ft.) and 17.28 Mbytes (450 ft.). This is incredible capacity on a device that easily slips into your pocket and is sold for under $20.

Cartridge drives find wide application. Broadly, digital cartridge tape drives are used for program or file loading and dumping (including fixed Winchester-technology disc back-up), continuous monitoring (endless-loop tape applications), data acquisition and real-time operating system.

### What is the ANSI data cartridge?

The ANSI/ECMA 1/4-inch Data Cartridge contains 1/4-in. magnetic tape wound on two coplanar reels. Tape tension is maintained by a unique isoelastic band that contacts both reels of tape, two belt guide rollers and the belt drive pulley. The cartridge is driven at a single point – the drive pulley. The cartridge contains features that enable beginning-of-tape (BOT) and end-of-tape (EOT) sensing and file (write) protection.

With a precision metal base and a clear plastic enclosure, the cartridge is an accurate and rugged package. Common usage of the cartridge includes four-track recording and driving at speeds of up to 90 ips.

Data cartridges have many advantages. One of the major ones is that the cartridge is driven at a single point and it in turn drives the tape (i.e. the cartridge is the tape drive). This insures

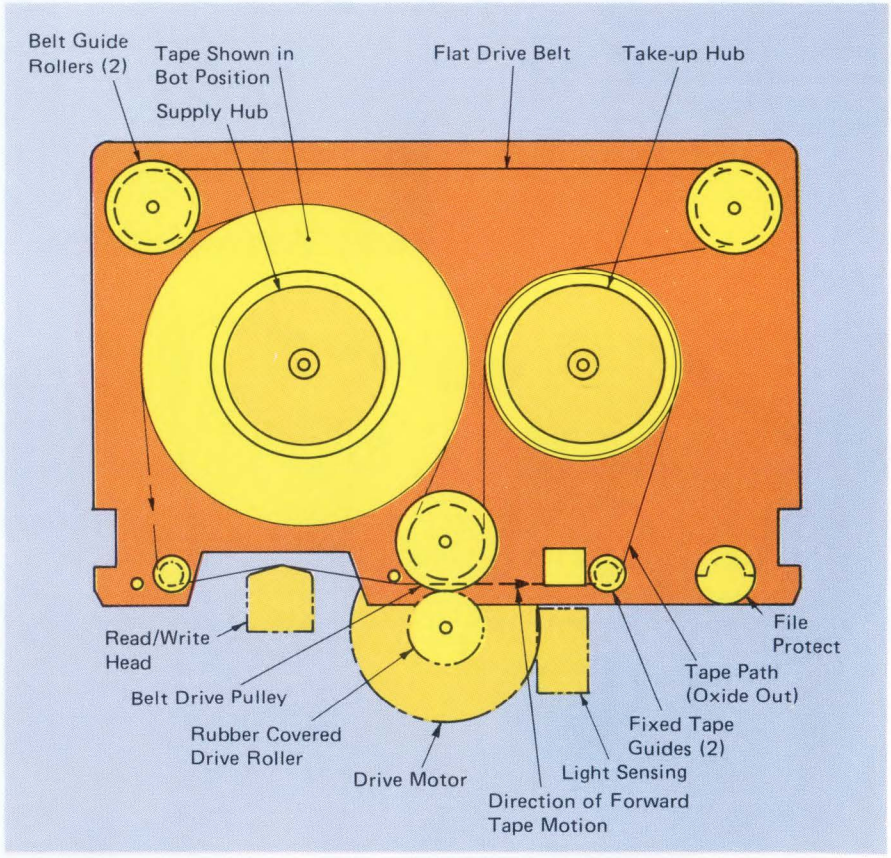
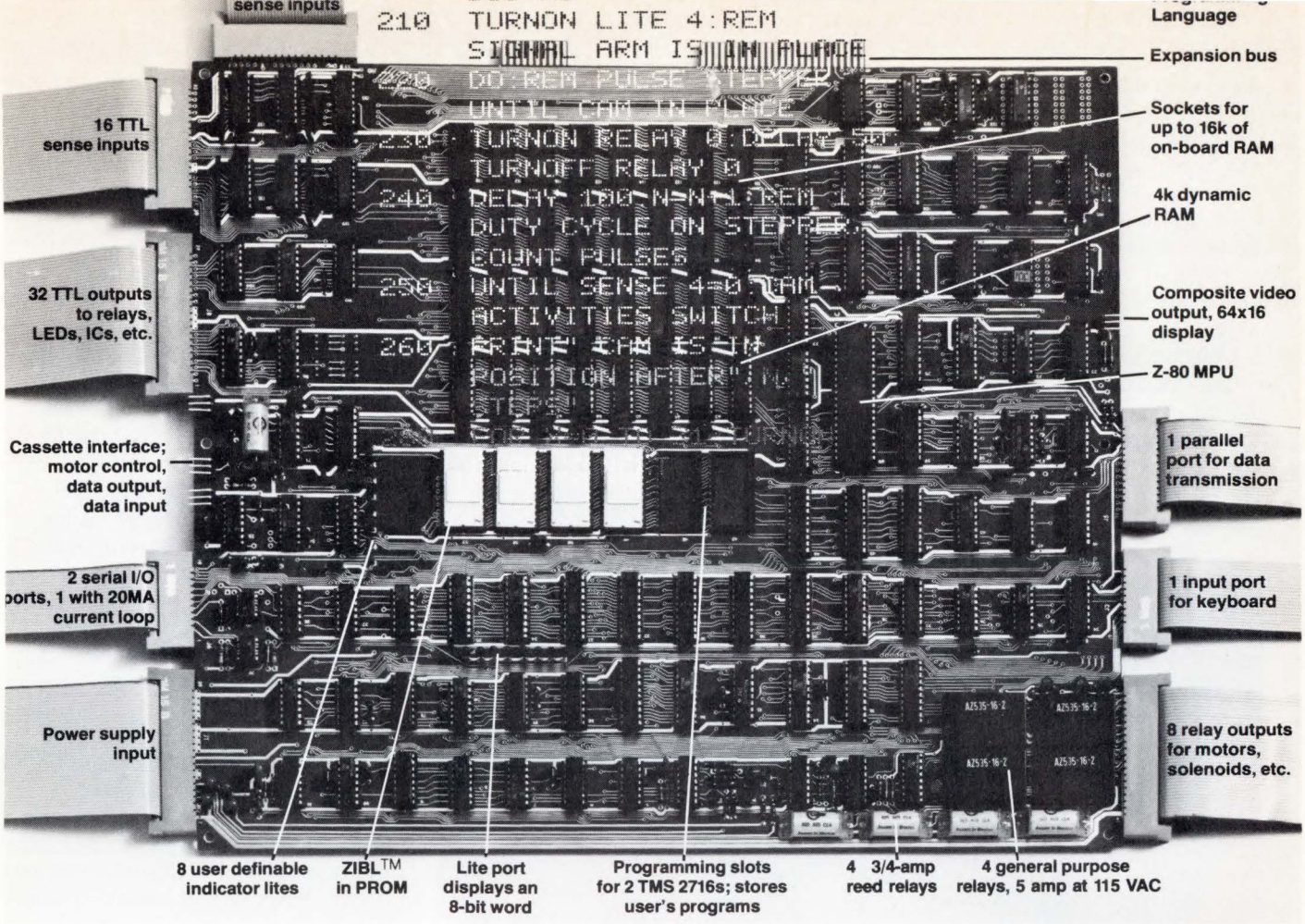



**Fig 1 The 1/4-in. ANSI/ECMA Data Cartridge is driven at a single point and contains magnetic tape wound on two coplanar reels. Tape tension is maintained by a unique isoelastic band that contacts both reels of tape, two belt guide rollers and the belt drive pulley. Cartridges currently are available with either 300 or 450 feet of tape.**

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gentle tape handling and commensurate long tape life. The cartridge manufacturers guarantee 5000 pass lifetime. Our actual experience shows several times that. This represents a significant improvement over standard digital tape drives.

Capacity versus volume is another advantage. The cartridge stores 17.28 Mbytes in a package that you can slip in your pocket.

An offshoot of the compact size and ruggedness of the cartridge is a sharp savings in data transportation costs. It costs far less to ship small tape cartridges than it does to ship reels of tape or hard discs. Floppy discs are also inexpensive to ship. However, they are much more prone to damage and require many more discs (more than 10 times) to store an equivalent amount of data. Due to the transportation convenience of the cartridge, users can enhance data security by taking a current data dump away from the computer in a pocket or briefcase. Thus, if anything were to happen to the computer overnight, the data would not be lost.

An important advantage of the cartridge is its ease of use and self-compensation. It is easy to use because the operator just slips it into the drive with no threading or other special handling. If the cartridge is dropped or otherwise mishandled, the built-in tensioning mechanism will automatically re-establish tape tension by the action of the drive moving tape.

The final advantage must be cost. According to a study by Information Terminals Corp. (**Table 1**), the 1/4-in. cartridge even costs less per megabyte than a sheet of typing paper.

## Are there any limitations?

Like most things in the real world, data cartridges have limitations. For one thing, drive design is constrained by the low tape tension inherent in the cartridge. While most digital tape drives have 7-oz. tape tension, ANSI specifies only 1 to 3 ozs. for the data cartridge. Thus, the drive designer must contend with not only low tension, but also a 200% variation from the low to the high end of the tension range.

Tape capacity is also limited in the cartridge, as it is with all other media. However, higher capacity cartridges have already been developed with a 50% increase in tape. It is likely that further advances will be made in this area.

Another complication for the drive designer is the variation in the lateral tension profile as the tape is presented to the head. This must be considered in the head contour design.

Finally, cartridge dynamics dictate higher short-term speed variations due to resonances that add to the inherent drive short-term speed variations. These factors must be considered in the design of the data recovery circuits.

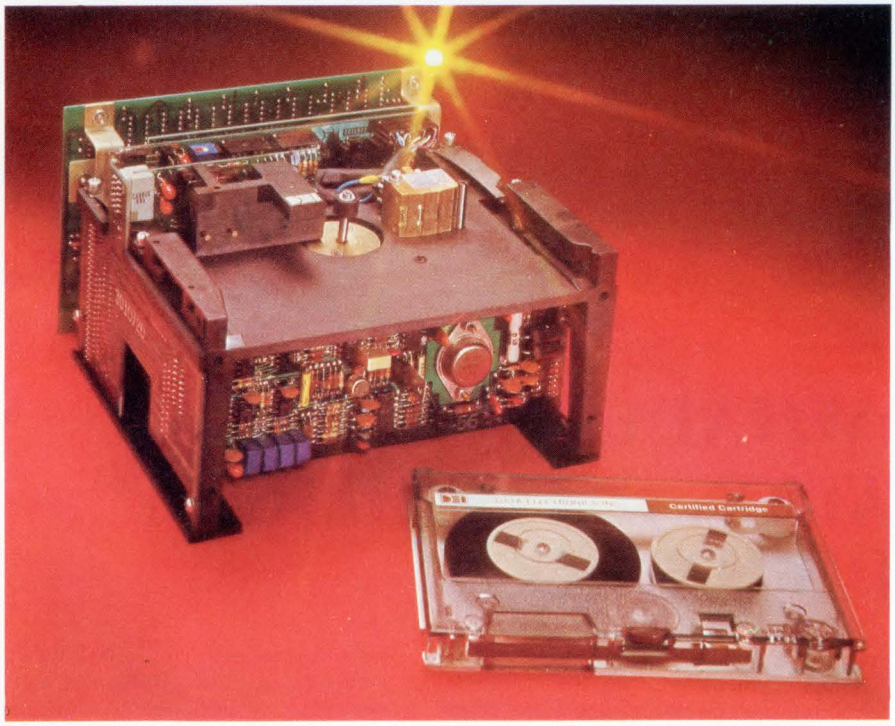



**Fig 2 Cartridge drives such as this one from Data Electronics, Inc. are available with capacities of up to 17.28 Mbytes of data.**

## The Cartridge drive: What is it?

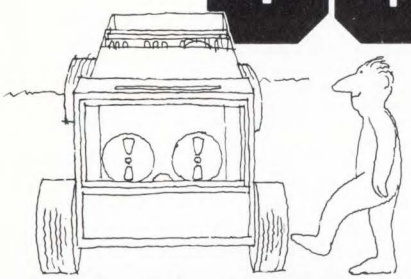
Cartridge tape drives are generally composed of three basic parts – the servo system/drive motor, sensor assembly and data electronics (which includes the R/W head). The motor and servo electronics start, stop and drive the cartridge at constant speeds (both forward and reverse) for the purpose of reading and writing data. Typically, two speeds are available; 30 ips for read and write, and 90 ips for high-speed search and rewind. These speeds are not sacrosanct – the cartridge can certainly be driven faster or slower if the application demands it. Note that the drive motor does not drive tape directly; rather, it drives the cartridge, which in turn drives the tape. Since the data cartridge itself contains both long-term and short-term speed variations, it is essential that the cartridge be driven while adding as little as practically possible in additional speed variations. While various schemes are possible the direct drive has the smallest speed variation addition. A high-performance, closed-loop servo system is required to maintain tight speed control under conditions of varying temperature, and over time.

## The four senses

The sensor assembly senses four things: upper and lower tape holes, cartridge in place condition, and file protected or unprotected state. The tape hole sensing circuitry must be capable of performing adequately under normal ambient lighting circumstances and at tape speeds varying from 90 to nearly 0 ips. Since the sensing is optical, it is important to note that extreme care must be given to avoid the pitfalls arising from a fluorescent lighting environment.

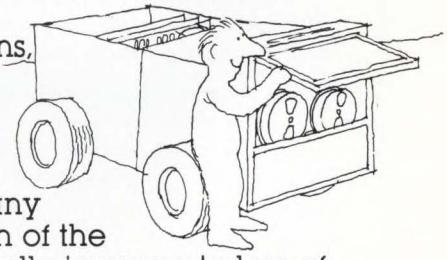
Conservative design of the file-protect circuit should assure that the actual write/erase head current will be interrupted when the file protect switch is in the "safe" position. This assurance should be fail-safe, so that even simple component failure cannot allow the write/erase heads to become active. One of the main concerns in read/write head design is the maintenance of proper head/tape contact in the low tension condition present with the cartridge. The head must be designed to ensure the required contact

# TEST DRIVE OUR DRIVE.

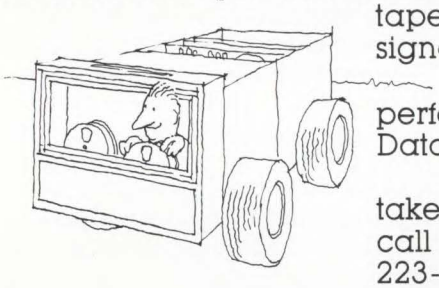


Not the tire-kicking, door-slamming kind, of course. But all the tests that quality cartridge drive should have to pass. Then you'll see why OEMs have been choosing our drives for their systems for more than five years now.

Go ahead. Run our DCD-3 through thousands of cycles. Even under changing environmental and load conditions, its long term speed accuracy will always stay the same. That's because we build it with a unique, motor-servo unit, complete with a tachometer, that can take punishment like that without any change in performance.



Or, put our DCD-1 through its paces. You'll never have any track location problems. Because it records over the total width of the tape. Which means the system is virtually immune to loss of signal from transient error.



For more good reasons why we think our drives outperform any others, just take a look at the other products in our Data Products line.

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3M

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**TABLE I COST, SPEED, AND CAPACITY COMPARISON OF REMOVABLE MAGNETIC RECORDING MEDIA VS PAPER MEDIA**

| Media Type | $/Mbyte | Typical Unit Capacities (Bytes) | Typical Transfer Rates (Bytes/Sec) | Avg. Access Time (sec) |
|---|---|---|---|---|
| MAGNETIC CARD | $80 | 5,000 | 200 | 10 |
| MINICASSETTE (Blocked, 50 ft.) | 60 | 64,000 | 200 | 320-150 |
| MINICARTRIDGE (Blocked, 150 ft., 2 Tracks) | 55 | 270,000 | 4,000 | 15 |
| MINIDISKETTE (35 Tracks, One Side) | 32 | 109,000 | 12,000 | 0.47 |
| PUNCHED PAPER TAPE (1000 ft., Reel or Z Fold) | 30 | 120,000 | 30-120 | 500 |
| CASSETTE (Incremental, 290 ft.) | 21 | 360,000 | 3,600 | 20-100 |
| DISKETTE (Single D , 77 Ttacks, One Side) | 20 | 250,000 | 31,250 | 0.45 |
| MINIDISKETTE (35 Tracks, Two Sides) | 15 | 437,500 | 25,000 | 0.31 |
| CASSETTE (Blocked, 290 ft.) | 14 | 540,000 | 200 | 20-100 |
| DISKETTE (Single D., 77 Tracks, Two Sides) | 14 | 500,000 | 31,250 | 0.45 |
| DISKETTE (Double D. 77 Tracks, One Side) | 14 | 500,000 | 62,500 | 0.45 |
| PUNCHED CARD (80 Columns at 600 Cards/Min.) | 10 | 80 | 800 | 150 |
| 1/4-IN. CARTRIDGE (1600 BPI, Blocked 300 ft.) | 9 | 2,160,000 | 6,000 | 20-60 |
| MINIDISKETTE (Double D., 77 Tracks, Two Sides) | 8 | 1,000,000 | 30,000 | 0.80 |
| DISKETTE (Double D., 77 Tracks, Two Sides) | 8 | 1,200,000 | 62,500 | 0.09 |
| TYPING PAPER (One Page, Single Spaced) | 5 | 2,000 | 15 | 60 |
| 1/4-IN. CARTRIDGE (6400 BPI, Blocked, 300 ft.) | 2.10 | 10,000,000 | 24,000 | 0.43* |
| 1/4-IN. CARTRIDGE (6400 BPI, Blocked, 450 ft.) | 1.73 | 15,000,000 | 24,000 | 0.43* |

***Average access time based on one Mbyte storage** *(Data from Information Terminals Corp.)*

pressure in the gap area, or both read/write and erase gaps. The traditional 1/2 tape-head contour is inappropriate for cartridge tape drives. A considerably different model is required to provide the proper operating pressures and a constant wrap angle for the cartridge. Additionally, Data Electronics, Inc. has developed a method for mounting the head without any mechanical adjustments. This allows for head interchangeability in the field without special tools.

## What kind of head?

Cartridge tape drives may be purchased with different types of heads. The trade-offs involved with respect to the application needs must be carefully analyzed before a decision is made on this matter. The most conservative design will provide, on each track, an erase-head of a given width, followed by a write-head of slightly less width, followed by a read-head of even less width. This is required to effectively cancel tape/cartridge position indeterminacies due to the production tolerances of each. The result of this approach is to produce a cleanly erased band on tape, which then has data written on a slightly smaller portion of this band. When this same data is read, the read-head samples even a smaller width. The net result is to insure the exclusion of any erroneous signals in the data path. This type head is called a dual-gap (read and write), with separate erase. This is the most expensive design, both from the viewpoint of the head itself, and the associated electronics.

Economies can be achieved by eliminating the separate erase head, and using the write head to provide the erase function when it is not writing data. This will still result in a satisfactory level of data reliability and cartridge interchangeability when proper protocol is applied to switching the write head from one function to another. This is referred to as a dual-gap head without separate erase. The least expensive approach is a single-gap head in which the same head is used for erasing, writing, or reading. While this offers the greatest economy, there is a significant danger in using this approach in that much reduced margins for cartridge interchangeability between drives will accrue due to the fact that one head gap is erasing, writing and reading exactly the same track width. Since the track position on tape will vary slightly from cartridge to cartridge , and from drive to drive, be-

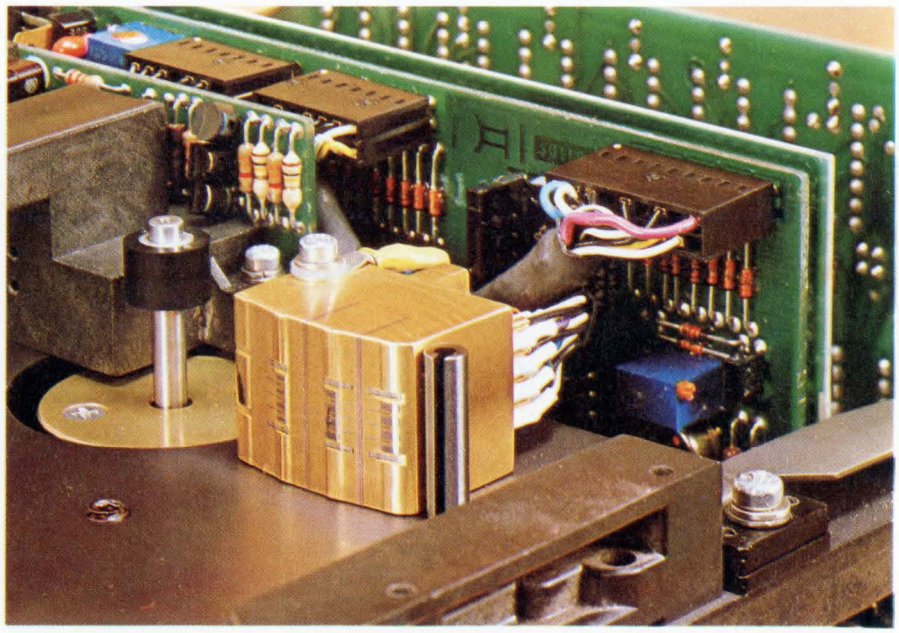

**Fig 3 The tape head, tape cleaner and single-point motor drive from Data Electronics' high density (6400 bpi) cartridge drive are shown here. The unique contour of the tape head assures proper contact with the magnetic tape in the cartridge.**

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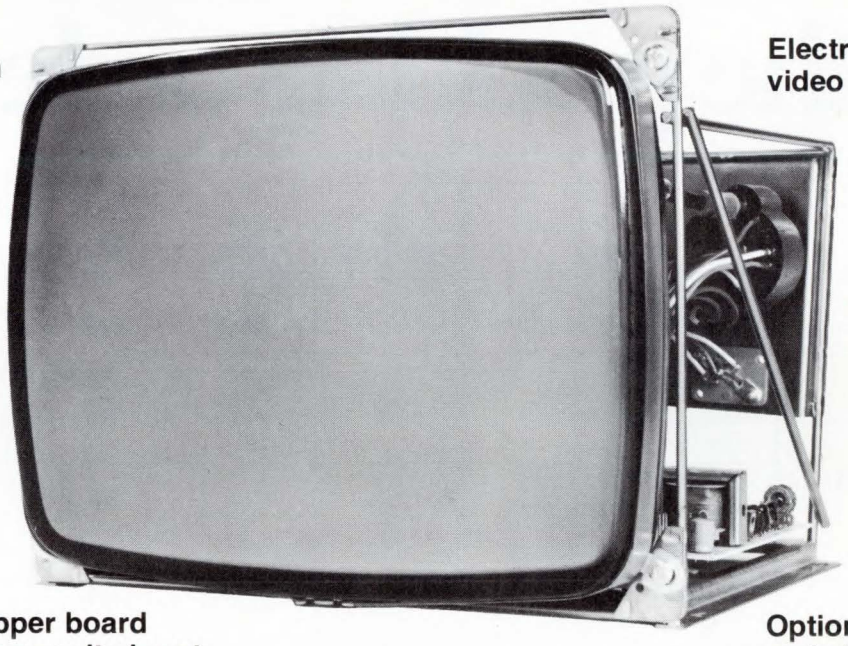
**20 MHz bandwidth**

**100% silicon circuitry**



**Electronic horizontal video centering**

**Electronic vertical linearity control**

**Modular sync stripper board converts to EIA composite input**

**Optional dynamic focus and skip-scan**

## The new low price will save you money today.

Ball's 2nd generation TTL-series monitors cost less to operate because of the way we build them — built for reliable service with long life and low maintenance requirements.

For example, we've added more electronic controls for faster set-up and service. Widened the bandwidth to 20 MHz for better performance. Expanded our simple subassembly interconnection idea for greater versatility. We've even reduced the size of our 12″ model so it fits where no competitor can.

For video quality, our specially selected CRT gun and deflection assembly delivers the kind of bright, well detailed characters you demand in a high performance unit.

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If you've been waiting to upgrade to Ball quality, now's your chance. Not only are our new TTL-120 and 150 monitors fully interchangeable with our present TTL-12 and TTL-15 units, but drop-in models for other makes are available as well.

Give us a call and find out how Ball can lower your costs at a new low price.

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Ball Electronic Display Division

Circle 36 on Reader Inquiry Card

# The Bantam. The cocky new $599* CRT that just changed the pecking order.

| User Need | Feature | P-E BANTAM | LSI ADM-3A | Hazeltine 1400 | Hazeltine 1500 | Adds Regent 100 |
|---|---|---|---|---|---|---|
| Easy to read display | 7 x 10 matrix for highly legible characters | Yes | No | No | Yes | No |
| | Black on white or white on black display | Yes | No | No | Yes | Yes |
| | Display set deep in hood to reduce glare | Yes | No | No | No | No |
| | Full 24 x 80 display | Yes | Yes | Yes | Yes | Yes |
| | Full upper and lower case | Yes | Option | No | Yes | Yes |
| | Non-glare screen | Option | Yes | No | Yes | Yes |
| High operator throughput, low operator fatigue | Tab stops/tab key | Yes | No | No | Yes | Yes |
| | Backspace key | Yes | No | No | Yes | Yes |
| | Repeat key | Yes | Yes | No | No | Yes |
| | Shiftlock key | Yes | No | No | No | No |
| | Separate print key | Yes | No | No | No | Yes |
| Convenient switching Local/on-line | Local—remote key | Yes | No | Option | Option | Yes |
| International Character sets | French/German/ Swedish/Danish/ British/Spanish | Option | Option | No | Option | Option |
| High speed numeric | Integrated numeric pad | Yes | Option | No | Yes | Yes |
| Convenient system interfacing | RS-232/CCITT-V24 | Yes | Yes | Yes | Yes | Yes |
| | Current loop | Option | Yes | No | Yes | Yes |
| Simplified program debugging | Transparent mode and displayable control characters | Yes | No | No | No | No |
| Faster maintenance | Self-test | Yes | No | Yes | No | Yes |
| Minimum desk space | Small size | 15Wx 19Dx 14H | 15.5Wx 20.2Dx 13.5H | 15.5Wx 20.5Dx 13.5H | 15.5Wx 20.5Dx 13.5H | 21Wx 23Dx 14.5H |
| Printer port | Printer port | Option | Yes | No | Yes | Option |
| Cost effectiveness | Qty. 100 OEM price | $599† | $740 | Less than $550 in quantity 1000 | $860 | $895 |

*In quantities of 100.
†Qty. 1, End User Price $966.

Nobody ever offered you a tough, high quality, compact CRT like the BANTAM before. At $599 or any price. Designed for hectic office environments. And, human engineered to make an operator's life easier.

**You get everything you need for cleaner input and faster throughput.** An upper and lower case character set displayed on a sharp 7 x 10 dot matrix. A full 24-line by 80-character screen. A complete, sure-touch keyboard with shadow numeric pad.

You get complete tabbing. Full cursor addressing. Repeat, backspace and shiftlock keys. A transparent mode with displayable control characters to simplify host program debugging. And, a self-test mode for easy maintainability.

**And, you get everything your operators need to make their jobs a joy.** A hooded display that cuts glare. A wide bandwidth monitor for sharp images everywhere on the screen. Below-the-line character descenders to make reading easier. A switchable white-on-black or black-on-white display, whichever your operator prefers. An easy-to-find cursor that frames the entire character position in a transparent, inverted video block.

**Plus plenty of options you can't get with CRTs costing much more.** Like our low-cost Pussycat page printer. A full range of foreign language character sets. We even have a model you can switch from ASCII to full overstrike APL.

**But that's not all.** The BANTAM's compact good looks fit any decor. It's handsome enough for executive row and rugged enough for the stockroom. Silent? The BANTAM's fan-free design makes it quieter than an electric typewriter. And, the BANTAM only weighs 28 pounds.

**Only an industry leader like Perkin-Elmer could do it.** We designed a powerful, custom LSI controller chip that makes the BANTAM the one and only high quality CRT in its class.

But see for yourself. Use the comparison chart. Learn why we're so proud to add this $599 CRT to the 250,000 peripherals that bear our good name.

And, remember our terminals come equipped with a No Hassle, 800 toll-free service phone number.

**One call does it all.** We give you service *where* you need it, when you need it. We're there. Not just "worldwide," but wherever you are.

For more information call or write Perkin-Elmer Terminals Division, Randolph Park West, Route 10 & Emery Avenue, Randolph, N.J. 07801 (201) 366-5550. Or contact any of our sales offices. Then watch the feathers fly.

## The Bantam's available at all these places

**PERKIN-ELMER SALES OFFICES**

Santa Clara, CA (408) 249-5540.
Tustin, CA (714) 544-9093.
Atlanta, GA (404) 393-8440.
Arlington Heights, IL (312) 437-3547.
Waltham, MA (617) 890-1305.
Oceanport, NJ (201) 229-4471.
McLean, VA (703) 827-5900.
Singapore, Republic of Singapore 2200949
Sydney (North Ryde), Australia 887-1000.
Toronto (Mississauga), Canada (416) 677-8990.
Slough, England 753-34511.
Paris, France 664-1858.
Munich, Germany 089-753081.
Schiphol-Oost, The Netherlands 020-458-269.

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Randolph, NJ; Oceanport, NJ; West Long Branch, NJ; Rochester, NY; Boston, MA; Hartford, CT; Philadelphia, PA; Pittsburgh, PA; Washington, DC; Atlanta, GA; Orlando, FL; Cleveland, OH; Dayton, OH; Englewood Cliffs, NJ; Detroit, MI; Chicago, IL; Minneapolis, MN; Kansas City, KS; Tulsa, OK; Dallas, TX; Houston, TX; Denver, CO; Phoenix, AZ; Seattle, WA; San Francisco, CA; Los Angeles, CA; Orange County, CA; San Diego, CA.

PERKIN-ELMER
Data Systems

Circle 30 on Reader Inquiry Card

cause of the normal tolerances and allowable variations in edge guidance, the resultant signal/noise ratio will be significantly worse than other approaches.

### Control and status at the drive?

Additional electronics are typically available at the drive level in the areas of control and status, as well as encoding and decoding. A control card can provide the drive the required tape control algorithm. This relieves the controller of a substantial task, which in multiple drive applications may not be possible at the controller level. The output of this control card can be high-level status signals such as BOT or EOT, as opposed to the upper and lower tape hole type of signal. In addition, the control card makes it possible for the drive to share a common 8 unit bus. In a single or dual drive system, the designer must decide whether these functions should be incorporated in the drive or the formatter/controller.

Data encoding and decoding can also be provided at the drive level. The data format on tape will be phase encoded at 1600 bpi or MFM, GCR or some other high-density code at 6400 bpi. It may be advantageous from the designer's viewpoint to have this code conversion performed as an integral function of the drive electronics though there is no consensus on this matter.

One additional drive feature worth having is an integral tape cleaner. Since drives are not always used in a computer-room environment, any foreign material that gets on the tape should be removed.

Many manufacturers also offer versions of cartridge drives for various different environments. Data Electronics, for example offers: drives with either commercial, hi-rel or MIL-standard parts; housings for hostile environments; EMI/RFI shielding; as well as extended temperature and/or shock and vibration models to meet airborne or ship-board applications.

### What performance is available?

ANSI standard data density is 1600 bpi serial by track. This gives a data transfer rate of 48 kilobits/second. 1600 bpi, four-track parallel is also available, which gives four times the transfer rate (192 kb/s) and considerably easier file management. The same transfer rate as four-track parallel recording is now also available with quad-density recording at 6400 bpi. This density range is similar to the 6250 cpi recording found on larger reel-to-reel machines.

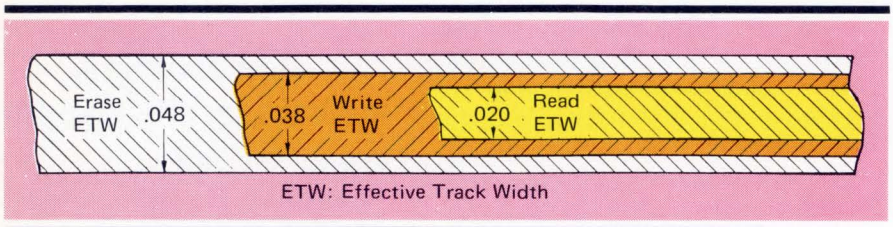



**Fig 4 The tape tracks that result when a dual-gap, with separate erase head is used are illustrated here. The track widths that are given, are nominal dimensions for efficient operation.**

The industry standard speeds are 30 ips for read/write and 90 ips for high speed search and rewind. Actually, the data cartridge can operate and perform these functions at speeds of from 15 ips to 120 ips.

All 1600 bpi recorders use some form of phase encoding (per the ANSI spec or other similar encoding methods). Quad-density recorders commonly use such codes as GCR (Group Code Recording - often used on high-density tape drives) and MFM (Modified Frequency Modulation – frequently used on high-density disc drives).

### Where should cartridge drives be used?

In addition to the general categories mentioned earlier (file load and dump, continuous monitoring, data acquisition and real-time operating systems) some of the most important specific applications include:

- Disc backup - the new small Winchester-technology fixed disc drives require a removable media backup. The quad-density cartridge drive is the best selection, due to its 17.28 Mbyte capacity on a single cartridge.
- Transportable data files - mailable updating systems are important in many applications, and due to the ease of handling and the low cost of shipping of the data cartridge it is well suited to this need. Typical applications include: distributed parts inventory systems; credit-card verification; automated bank teller.
- Electronic PBX - cartridge drives are finding wide use for program load and dump in electronic PBX systems.
- Continuous real-time monitoring for failure analysis - any time that a block of data must be monitored in real time, cartridge recorders are ideal. Examples include: communication line monitoring; power line monitoring; flight recorders; etc.
- Tape peripheral - digital cartridge drives can replace 1/2-in, 9-track reel-to-reel drives and offer improved environmental specs and higher packaging density, while fulfilling the traditional tape peripheral requirements.

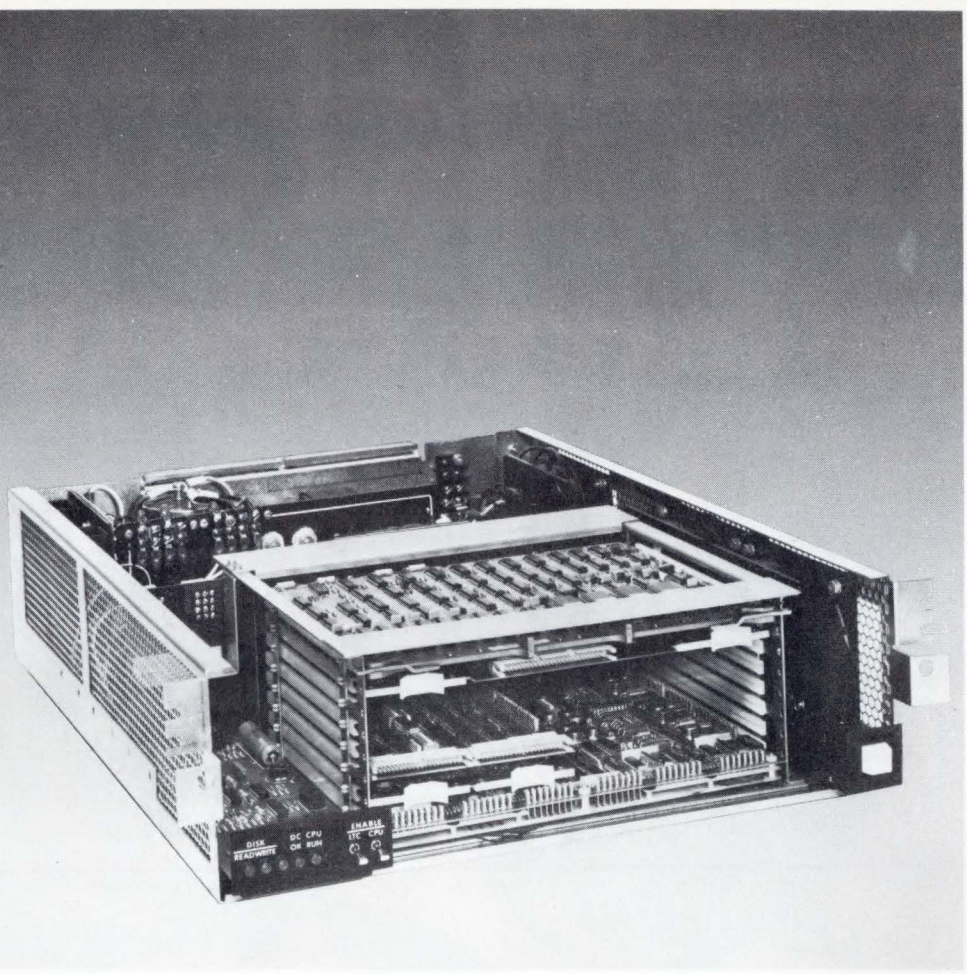
### What about interfacing?

Control of digital cartridge drives is not much different from the control of any digital tape system. A formatter/controller must be designed that addresses the functions of tape motion control, buffering, adding and stripping preamble and postamble, adding, checking and stripping CRC (Cyclic Redundancy Code) or some other form of error detection, and generally interpreting the commands and requests for status from the host processor and converting them into the appropriate signals to activate the tape peripheral in accordance with the wishes of the processor. Add to this the data recovery requirement of compensation for the long and short term speed variations, and you've got it all.

The complexity of the formatter/controller will be affected by the level of electronics purchased with the drive. This decision must be made in each application, based on cost goals as well as a realistic estimate of engineering manpower available. Add prior experience in the design of controllers for tape peripherals, and the equation is completed. DD

## ABOUT THE AUTHOR

**Sam Thompson** is vice president of marketing with Data Electronics, Inc. Prior to this, he has held management posts in marketing and sales with Motorola and Bell & Howell. Thompson earned a BSME degree at Drexel University.



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Dataram Corporation offers LSI-11 users a PDP®-11/03 compatible chassis with a wide range of memory and controller modules that lets you enhance your LSI-11 configuration, and save money while doing it.

They're available now from Dataram, 30 days from order, and include —

| | |
|---|---|
| B03 | 5¼", eight slot chassis (24 amps on 5-volt supply) |
| KD11-HA | DEC® LSI-11/2 microcomputer |
| 32K x 18 | DR-115S dual board, semiconductor ADD-IN |
| 16K x 18 | DR-115 quad board, core ADD-IN |
| C03 | RF-11/RF-05 compatible cartridge disc controller |
| T03 | TM11/TU10 compatible magnetic tape controller |

We've been noted for our leadership in core and semiconductor memory systems, and now, as a result of our acquisition of Dynus Incorporated, we are offering the well-accepted disc and tape controllers previously marketed under the Dynus name. If desired, we can also supply the DEC-manufactured KD11-HA dual LSI-11 microcomputer board.

I'd like to learn more about LSI-11 compatible modules

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☐ Please send information.

☐ Please have a salesman contact me.

Name _____

Title _____ Phone _____

Company _____

Address _____

City _____ State ____ Zip _____

☐ Also send me information about Dataram's LSI-11 compatible fixed head disk emulation systems.

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PRINCETON-HIGHTSTOWN ROAD CRANBURY, NEW JERSEY 08512

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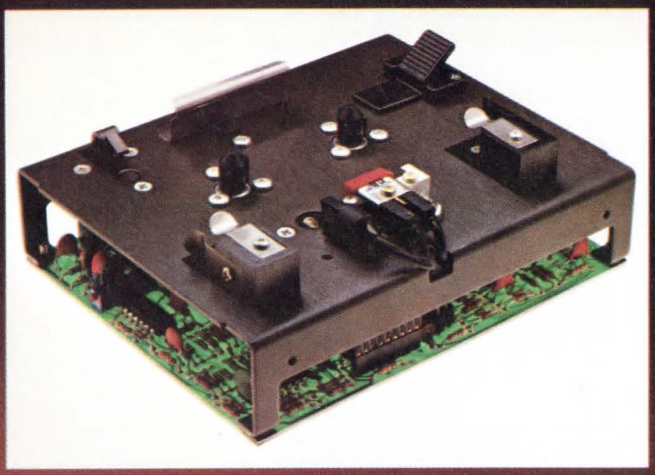
# And threw them out.



## The remarkably simple MFE cassette drives make cassettes a viable, reliable storage medium.

Those innocent-looking little pieces of plastic and metal are responsible for just about all the problems you've come to expect from cassettes.

That's why we don't use them.

No finicky solenoids and clutches. No whirling pinch rollers, capstans, belts and pulleys.

MFE cassette drives have only two moving parts. Which means there's practically nothing to go wrong. The result is an impressive 15,000 hour MTBF.

**Data Integrity.** Our revolutionary tape transport system also greatly improves data integrity. Patented servo-controlled reel-to-reel tape handling results in a constant tape speed within ±1% and a low bit-to-bit jitter of ±3%.

We even include a RAW head as a standard feature. Because read-after-write checking is the best way to guarantee data integrity.

Here are a few more reasons MFE cassette drives will change your thinking about cassettes:

**Widest speed range.** Continuously variable tape speed from 2-120 ips.

**Highest data transfer rate.** Up to 32K bps ANSI/ECMA compatible.

**More options.** Both serial and parallel I/O.

**Low power requirements.** Only ±5V at 5W total power consumption.

We even have a model that's qualified for hostile environments. It operates at temperatures from −40°C to +70°C.

The MFE 250B cassette drive. If you hate cassettes because they're cranky and unreliable, you need another reason.

For details, contact MFE, Keewaydin Drive, Salem, New Hampshire 03079, Tel. 603-893-1921/TWX 710-366-1887/ TELEX 94-7477.

Europe: MFE Products SA, Vevey, Switzerland, Tel. 021 52.80.40/TELEX 26238.

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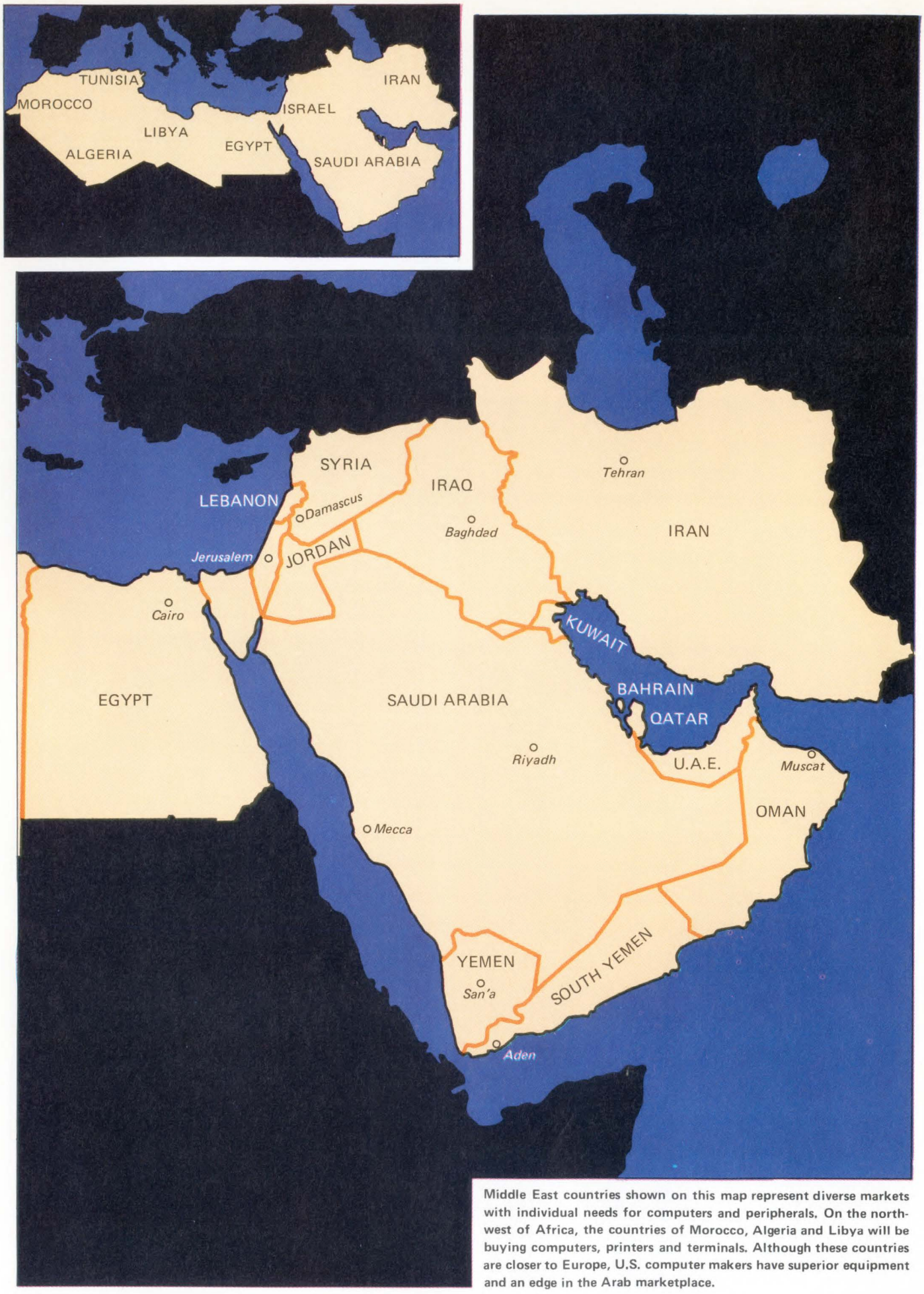
CIRCLE 31




Middle East countries shown on this map represent diverse markets with individual needs for computers and peripherals. On the northwest of Africa, the countries of Morocco, Algeria and Libya will be buying computers, printers and terminals. Although these countries are closer to Europe, U.S. computer makers have superior equipment and an edge in the Arab marketplace.

# THE ARAB PRINTER & COMPUTER MARKET

**OyKue Brogna**
*Contributing Editor*

## Breaking into the Arab market requires a new viewpoint

Fueled by a mind-boggling cash inflow from oil sales, Arab nations are having trouble disposing of their vast cash hordes. A good deal of this cash is wisely being spent for high technology products. For computer and printer manufacturers, this spells bonanza sales in these new, lucrative markets.

### A new ball game?

But beware: doing business in the Middle East is a totally new ball game with a different set of rules. Patience is one. It usually takes a long time to get a foothold there and involves a great deal of time in filling out proposals and making presentations. How long? A year-and-a-half – perhaps two years. And if you think it's easy to go over there, sell some systems, get out and not provide adequate field service, you'll find things don't work that way. With so many people trying to sell the Arabs all kinds of crazy things, the Arabs have become very suspicious.

So, the question is one of trying to establish a relationship of trust with the Arabs and to develop a good reputation. Pitfalls exist for the unwary – field service, training, and, for the printers and software, that of language.

To get the answers to these problems, **Digital Design** went behind the scenes to exhaustively interview U.S. computer and printer makers now in the Arab market, or about to enter the market. And to gain a better perspective on the Arab market for our special article, we not only interviewed Arabs, but personally interviewed Red China's top computer spokesmen to see the similarities and differences between their approach and that of the Arabs.

### It's the tip of an iceberg

Of the many U.S. computer and printer companies dealing with the Middle East which **Digital Design** interviewed for this special article, all told us that we've only seen the start. Let's look at some figures. At the leading edge of this market, the U.S. has sold $42 million worth of computers and peripherals to this part of the world since 1975. Last year's computer sales amounted to $48 million as compared to $37 million in 1976. Total export to the Middle East in 1977 amounted to $12 billion with a projected 13% increase for 1978. U.S. exports are expected to exceed $27 billion by 1984 according to the U.S. Department of Commerce. The increasing Arab interest in computer purchases has prompted the USDC to organize a trade mission to the Mid-East in 1980.

This trade mission approach will help ease the difficulties of dealing with 20 separate countries with varied wealth and political systems. Still, the Arab nations are forging along or planning their socio-economic development. Their attempts in modernization will invariably lead to the widespread use of computers. Time and again, the U.S. firms currently doing business in that part of the world told us that they foresee great business potential, particularly for Arabic/Farsi printers.

### What's a Farsi printer?

Centronics, IBM, Intelligent Systems, Megadata and Hewlett Packard are just some of the big-name companies that have sold Arabic/Farsi, Arabic/English, Arabic/Farsi/English printers to the Arab countries and Iran. According to Centronic's International Accounts Manager, Peter Banhazl, his company could not have entered the market without a Farsi or Arabic printer.

But companies that produce Arabic/Farsi printers have encountered technical difficulties because of the language. Arabic, unlike English, is read from right to left and has 29 characters with as many as eight variations for each character! In Arabic, characters change depending on word position, the shape of it. Some computer/printer makers generate several codes for each character, but this brute-force approach is wasteful.

What are the three-biggest stumbling blocks for U.S. designers? According to Fereydouni Taslimi, Director of Middle Eastern Operations at Intelligent Systems Corp., it's "language, language and language."

### Why is Japan software-poor?

As a brief aside, the Arab printed language lends itself to computers, printers, terminals and software not as well as Roman characters, but far better than does the Japanese and Chinese printed word, which have thousands of odd characters, and don't exactly lend themselves to printer outputs or CRT displays! Japan borrowed its printed language from the Chinese; and though their characters are less descriptive, they also are numerous and unadaptable to computers. It is partly because of the burden of their printed language that the Japanese lag so far behind the U.S. in software programming. The Chinese, recognizing

# SALES OF U.S. COMPUTERS AND PERIPHERALS TO THE NEAR AND MIDDLE EAST

| | Dig. Elec. Computers, Main Frame and Central Memory, including Indstrl. Proc. Computers | | | Analogic Electronic Computers, Main Frame &Central Memory including Industrl. Proc. Computers | | | Hybrid Electronic Computers, Main Frame & Central Memory including Industrl. Proc. Computers | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1975 | 1976 | 1977 | 1975 | 1976 | 1977 | 1975 | 1976 | 1977 |
| ALGERIA | 253,655 | 1,223,832 | 579,918 | | | | | | |
| √ ARAB EMIRATES | 75,374 | 347,000 | 556,060 | | | | | | |
| √ BAHRAIN | 248,002 | 791,475 | 167,610 | | | | | | |
| √ EGYPT | 1,395,813 | 1,391,881 | 376,344 | | | 136,466 | | | |
| IRAN | 14,304,110 | 3,249,833 | 4,164,611 | | | | | | |
| √ IRAQ | | 532,919 | 261,802 | | 127,903 | | | | |
| ISRAEL | 4,825,371 | 2,857,780 | 6,141,678 | 66,979 | 136,573 | | | 113,435 | 443,172 |
| √ JORDAN | | 930,275 | 165,240 | | | | | | |
| √ KUWAIT | 100,816 | 152,440 | 1,610,279 | | | | | | |
| √ LEBANON | 396,351 | | | | | | | | |
| √ LIBYA | 248,491 | 464,118 | | | | | | | |
| MOROCCO | | | | | | | | | |
| √ OMAN | | 437,922 | | | | | | | |
| √ QATAR | 127,242 | 195,154 | 77,076 | | | | | | |
| √ SAUDI ARABIA | 1,333,164 | 2,008,312 | 6,277,917 | | 525,051 | | | 101,500 | 200,000 |
| √ SYRIA | | 557,942 | | | | | | | |
| TUNISIA | 293,509 | 193,750 | 240,184 | | 366,174 | | | | |
| √ YEMEN | 91,440 | | | | | | | | |
| √ YEMEN, S. | | 225,478 | | | | | | | |
| TOTAL | 23,693,338 | 15,690,105 | 20,844,197 | 66,979 | 1,155,701 | 136,466 | | 214,935 | 643,172 |

√ *indicates countries observing boycott*

Source: U.S. Exports schedule B FT410/Dec 1977

**Intended for accounting, general ledger and inventory control in small Middle East businesses, ISC's eight-color Intercolor 8001 data terminal is the first Arabic and Farsi μC system that provides I/O statements in Arabic, Farsi, English or mixtures. Based on the 8080, the 8001 is programmed in BASIC but provides all I/O in the native language. The 8001 has a mini floppy, RS-232C interface, baud rates to 9600, 16K of RAM and 22K of ROM containing BASIC.**

this obstacle, have instituted a massive re-education program in their schools to introduce Roman characters, which is far more suitable to our modern technology. Linguists recognize that the Chinese printed language is simpler, streamlined and far advanced beyond our Western Romance languages. Still, this advantage has now become a serious handicap for the Chinese and Japanese in this computer age. The Arabs, though their characters aren't clean and computer-compatible like Roman characters, still are far better off than the Chinese or Japanese.

So, you might expect Arab programmers to prefer software in their own language. Not so. IBM is reported to have tried that and ran into a stone wall: the Arab programmers and their managers strongly resisted this and preferred programming in English! The reaction of Israeli programmers was the same, with the same arguments voiced. It turns out that it's a case of higher salary and more job security; programmers in Arab countries are hard to come by, and by making it necessary to learn English, they effectively make it even tougher for companies to train newcomers. The tight job situation will worsen.

Fortunately, English is a second language in the Middle East (and most of the world, for that matter) and all programmers know English without any question. Most software is in English, but some systems are in Arabic, but there's no point in it; there's not much market there. Of course the Arab user of a printer or CRT terminal will use Arabic. This isn't bad when you remember that one software package written by an English-trained programmer is put into a thousand or so systems and used by an Arab end-user who doesn't need to read English.

(sales value in U.S. $)

| Computer related machines for preparing tape or punched cards | | | Input devices for Electronic Computers and parts, N.E.C. | | | Output devices for Electronic Computers, and parts, N.E.C. | | | Combination I/O Devices for Electronic Computers, and parts, N.E.C. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1975 | 1976 | 1977 | 1975 | 1976 | 1977 | 1975 | 1976 | 1977 | 1975 | 1976 | 1977 |
| | | 216,324 | | | | 86,749 | | | | | 99,069 |
| | | 108,028 | | 64,368 | 76,239 | | | | | 123,144 | 431,499 |
| | | | | | | | | | | 136,689 | 121,720 |
| | | 453,005 | 80,359 | 92,519 | | 281,251 | | | 142,110 | 83,937 | 152,525 |
| 381,627 | 123,052 | 184,544 | 432,819 | 372,470 | 112,788 | 197,538 | 513,761 | 106,323 | 764,723 | 914,244 | 1,032,189 |
| | | | | | | | | | | | 74,138 |
| 293,289 | 94,052 | 65,119 | | | | 419,160 | 245,312 | 1,112,840 | 3,574,914 | 3,412,356 | 2,506,452 |
| | | | 351,781 | 270,405 | 213,801 | | | | | | 112,439 |
| | | | 84,379 | | 214,020 | | | | 91,332 | 194,662 | 376,314 |
| | | | 104,337 | | | | | | 243,902 | | 73,715 |
| | 672,628 | | | | | | | | | 204,904 | |
| | | | | | | | | | | | 125,100 |
| | 86,546 | | | | | | | | | | |
| | | | | | | | | | | | |
| 152,715 | 190,924 | 126,863 | | | 154,477 | | | 453,945 | 116,507 | 432,061 | 524,931 |
| | | | | | | | | | | 102,038 | 102,330 |
| | | | | | | | | | | 60,482 | 82,272 |
| | | | | | | | | | | | |
| | | | | | | | | | | 71,922 | |
| 827,631 | 1,167,202 | 1,153,883 | 1,053,675 | 799,762 | 771,325 | 984,698 | 759,073 | 1,673,100 | 4,993,970 | 5,675,957 | 5,814,693 |

(Continued)▶

## Can you circumvent the boycott?

Other difficulties are the Arab boycott and procurement of trained after-sales service personnel.

Companies contributing to the economic development of Israel by investing, licensing agreements or setting up joint ventures are not welcome in Arab countries observing the boycott. However, according to Jack Hearn, a Saudi country specialist, companies selling directly or through a distributor to Israel are not banned from Arab soil. Firms with investment in Israel can still sell to the Arabs directly or through a representative, although they cannot invest in countries observing the boycott. The Arab boycott regulations do not label computers as boycottable item, Hearn said. He added "there is no hard and fast rule, since a great deal depends on how the Arab boycott authorities view a particular transaction." Fourteen countries in the Middle East now observe the boycott (see **Digital Design**'s table for a list of countries). Of course, surreptitious deals do go on, and scraping company logos off IC components and equipment does take place. Both sides have been involved.

## Saudi Arabia holds great promise

Saudi Arabia, one of the wealthier Arab countries in the Middle East, is a staunch boycott advocate. Firms selling to Saudi Arabia must use a Saudi agent. However, Saudi firms' interest in joint ventures has grown, and the Saudi government's initiative has made these partnerships attractive to U.S. companies. The March 1977 tender regulation gives priority to wholly or partially-owned Saudi firms in granting government tenders. Financial institutions such as the Saudi Arabian Industrial Development Fund give concessioned financing to joint ventures owned at least 51% by local entrepreneurs with tax concessions based on the percentage of joint ownership. These developments reflect the Saudi government's committment to developing the private sector, which can become as great as the present government market.

Saudi Arabia's 1975-1980 plan calls for industrial development to transform the Kingdom into a modern advanced country. Their goals are to:

- maintain a high rate of economic growth by developing economic resources, maximizing earning from oil over the long term and conserving depletable resources,
- reduce economic dependence on export of crude oil,
- develop human resources by education, training and raising standards of health,
- develop the physical infra-structure to support achievement of the above goals.

Their development plan includes constructing an industrial complex at the port of Jubail on the Gulf. The project when completed will transform the small fishing village of 125,000 into a modern city. A similar scheme is being laid for the port of Yenbo on the Red Sea.

## How big are Saudi Arabian markets?

Electronic data processing is and will become increasingly important because the demand for prompt access to information (plus a shortage of trained clerical personnel) forces greater reliance on technology. According to a report from the Department of Commerce, software and desk top computers – which handle simple inventory and payroll functions – are already in demand.

*(continued)*

## SALES OF U.S. COMPUTERS AND PERIPHERALS TO THE NEAR AND MIDDLE EAST

| | Storage devices, Random Access for Electronic Computers and parts, N.E.C. | | | Storage Device (except Random Access) for Electronic Computers & Parts. N.E.C. | | | Multiplexers (Line Interface Communication Devices for Electronic Computers) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1975 | 1976 | 1977 | 1975 | 1976 | 1977 | 1975 | 1976 | 1977 |
| ALGERIA | | 147,454 | | 121,943 | | | | | |
| √ ARAB EMIRATES | | | | | | 99,927 | | | |
| √ BAHRAIN | | | | | | | | | 123,004 |
| √ EGYPT | | | | | | | | | |
| IRAN | 485,986 | | 546,550 | 122,613 | 150,911 | 204,186 | 381,268 | 332,662 | |
| √ IRAQ | 105,262 | | 148,676 | | | | | | |
| ISRAEL | 1,143,126 | 2,226,709 | 4,871,411 | 636,462 | 1,102,437 | 759,897 | 192,910 | | |
| √ JORDAN | | | | | 71,705 | 81,240 | | | |
| √ KUWAIT | | | 102,570 | | | 81,211 | | | |
| √ LEBANON | | | | | | | | | |
| √ LIBYA | | | | 151,393 | | | | | |
| MOROCCO | | | | | | | | | |
| √ OMAN | | | | | | | | | 79,027 |
| √ QATAR | | | | | | | | | |
| √ SAUDI ARABIA | | 102,000 | 185,710 | | | | | | 512,215 |
| √ SYRIA | | | | | | | | | |
| TUNISIA | | | | | | | | | |
| √ YEMEN | | | | | | | | | |
| √ YEMEN, S. | | | | | | | | | |
| TOTAL | 1,734,374 | 2,476,163 | 5,854,917 | 1,032,411 | 1,325,053 | 1,226,461 | 574,178 | 332,662 | 714,246 |

√ *indicates countries observing boycott*

Source: U.S. Exports schedule B FT410/Dec 1977

In 1975, Saudi Arabia purchased $1,753,833 worth of computers and peripherals from the U.S. In 1977, the sales figure increased six-fold to $10,653,967, making Saudi Arabia the second major Middle East hardware purchaser of U.S. computer equipment. Total 1977 Saudi import was estimated at $14 billion; 22% came from the U.S.

### Some Do's and Don'ts

Although the market in Saudi Arabia holds great promise, those U.S. computer firms with current dealings with the Arabs all told us any firm needs patience when trying to establish a foothold in the area. For example, a bid for a contract can last from half a year to two years, according to Fereydoun Taslimi, Intelligent Systems International marketing manager. Personal contact, he added, also plays an important role in such dealings.

However, Hearn of the USDC (and a Saudi specialist) said that "getting into the Middle East market is not difficult, but it's a little different." He further advised that companies seriously considering the Mid-East market should actually conduct an on-the-spot appraisal and search out a good local representative. As the Saudi marketplace is highly personalized, to be effective, a sales representative must be able to conduct business in the traditional friendly face-to-face manner.

In the choice of agent or distributor, you should proceed with care. Why? In a close-knit business community like Saudi Arabia, agent switching can lead to disastrous consequences. The USDC further recommends that you do not appoint Saudi sales representatives as sub-agents to non-Saudi commercial firms because most Saudis may resent or even reject appointments as sub-agents. It might affront their national pride, undermine morale and lower efficiency, besides reducing price competitiveness and/or service because of the resultant commission splitting.

The capability to provide after-sales support should be an important consideration for you in selecting an agent. Most U.S. computer companies selling in the Mid-East have distributors that possess service capabilities. Companies such as Centronics and Intelligent Systems train their representatives for services and maintenance. Do you want more information on trade with the Middle East? Then we suggest you contact the U.S. Department of Commerce, Commerce Action Group on the Near East (Jack Hearn), RM 3203, Washington, DC 20230.

### Iran's industries need computers

Governmental development programs, the rising cost of labor and an increasing competitive manufacturing atmosphere – all these will contribute to an excellent market for computers and peripherals in Iran through the early 1980's. Total computer placement increased from 63 in 1970 to 268 in 1975. "Iran: A Survey of U.S. Business Opportunities" projects that by 1980, computer installations in Iran would number about 500. It predicts the value of computer and peripheral equipment import at over $10 million in 1980.

Plans to improve governmental management and information gathering systems necessitate using computers. Projected applications include development of climatic, logical and mineralogical data, industrial and agricultural statistics, as well as census data.

The Plan and Budget Organization's (PBO) intends to link up all Iranian Government organizations to its data base

(sales value in U.S. $)

| Modem (Line Interface Communication Devices for Electronic Computers) | | | Communication Devices for Electronic Computers, N.E.C. and Parts, N.E.C. | | | Parts and Accessories, N.E.C. for Basic Electronic Computers | | | Total Sales | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1975 | 1976 | 1977 | 1975 | 1976 | 1977 | 1975 | 1976 | 1977 | 1975 | 1976 | 1977 |
| | | | | | | 510,012 | 85,920 | | 971,359 | 1,457,206 | 895,311 |
| | | | | | 60,000 | | 245,436 | 221,451 | 75,374 | 779,948 | 1,493,204 |
| | | | | | | 179,064 | 61,434 | 122,769 | 427,066 | 989,598 | 535,103 |
| | | | | | | 142,500 | 282,912 | 311,399 | 2,042,033 | 1,851,249 | 1,429,739 |
| | | | | 61,590 | | 2,189,381 | 878,839 | 1,165,029 | 19,260,065 | 6,597,362 | 7,516,220 |
| | | | | | | 117,205 | 91,530 | 77,313 | 222,467 | 752,352 | 561,929 |
| 325,281 | 341,736 | 130,065 | | | | 2,002,946 | 3,860,589 | 3,688,522 | 13,832,219 | 14,661,384 | 19,932,957 |
| | | | | | | 83,905 | 105,042 | 146,816 | 83,905 | 1,107,022 | 505,735 |
| | | | | | | 122,686 | 135,574 | 515,128 | 399,213 | 482,676 | 2,899,522 |
| | | | | | | 324,911 | | 162,048 | 1,099,501 | | 235,763 |
| | | | | | | 65,238 | | 259,375 | 465,122 | 1,341,650 | 259,375 |
| | | | | | | | | 105,529 | | 355,472 | 230,629 |
| | | | | | | | | | | 524,468 | 79,027 |
| | | | | | | | | | 127,242 | 195,154 | 77,076 |
| | | | | | | 151,447 | 428,691 | 2,217,909 | 1,753,833 | 3,788,539 | 10,653,967 |
| | | | | | | | | | | 659,980 | 102,330 |
| | | | | | | 196,705 | 103,278 | 178,360 | 550,696 | 663,202 | 500,816 |
| | | | | | | | | | 91,440 | | |
| | | | | | | | | | 225,478 | | |
| 325,281 | 341,736 | 130,065 | | 61,590 | 60,000 | 6,116,000 | 6,279,245 | 9,171,648 | 41,401,535 | 36,432,740 | 47,908,703 |

by the early 80's. If you're a computer maker, look for increased purchases in computers and/or terminals. The computer currently used by PBO is the IBM 370/158 model, and by 1980 the core capacity of the system will be increased to 10 megabytes. The funds for this improvement and expansion will come from the $2 million budget during the sixth plan period (starting this year). Though the supplier for the expansion of the main frame computers will be IBM, the PBO will remain open to competitive suppliers for minicomputers.

## Other government groups will buy

What other government organizations plan to purchase new computers or expand memory capacity of existing computers during the 1977-80 period? They include the Ministry of Post, Telephone and Telegraph (MPTT), National Iranian Radio and TV and the Iran National Tourist Organization. The MPTT has ordered a Honeywell "mass memory" unit which will be delivered in 1980.

The Iran National Tourist Organization's (INTO) plan to install a computerized reservation system for its hotel network will result in installation of terminal facilities and smaller computer systems in the country's hotels.

In 1976 19 companies representing the manufacturing, transportation, banking, printing and publishing and service industries decided to purchase computers or expand existing capacity during the 1976-80 period; 10 have yet to fulfill their plans.

## Iranian business needs computers

"Iran: A Survey of U.S. Business Opportunities" projected the 1975-85 as a decade of real industrial expansion for Iran. Rapid rise of industrial activity, tighter government controls, high wages for employees and constant expansion of government, the survey added, will contribute to the constant growth in the use of computers and printers. Market forces, high costs for raw materials and higher taxes will force Iranian companies to modernize operations by 1985.

Private firms are expected to continue purchasing computers to improve accounting procedures and to meet government requirements for more accurate business records. Don't expect increasing business activities to be handled by abacus, or even adding machines It necessitates using computers in management, inventory control, specialized processing and business functions. If we can believe present business trends, the banking industry should be a major purchaser of small business computers. In 1976, 19 of the country's 34 banks had installed computers, while the remainder had budgeted funds for computerization over the next few years. The introduction to centralized bank clearing operations will result in further automation in the Iranian banking system.

## Software sales growing

There will be an increase in computer software sales because of the critical shortage of programmers and analysts, as well as the shortage of keypunch operators. This makes procurement of software packages attractive. In the mid 1970's there was considerable over-capacity in computer processing capability; thus, many users who initially employed computers for only payroll and accounting purposes will be looking for more advanced applications for their equipment. Government agencies employing the integrated data and information system are expected to purchase software packages for

data storage and retrieval, statistical analysis, resource inventory and evaluation, mapping and other specialized applications.

Computer time sharing was in its infancy in 1976, but improved telephone communications will increase time sharing to about 25% of total usage by 1980. This will lead to opportunities for sales of various on-line and interactive software packages to government and business users.

### How do I start?

Business dealings with Iran and Arab countries are similar; success generally depends on long term commitment, thorough homework, frequent visits to the country, patience and persistence. Joe Yusif, executive director of the American Arab Association of Commerce and Industry, told **Digital Design** that, like Saudi Arabia, business relationships in Iran are highly personalized. So, if you're smart, you'll get a reliable and capable representative. Furthermore, a good representative will keep you fully informed of new business opportunities and other shifts in the market, and will cultivate and maintain necessary personal contacts in government and the private sector. A local representative can be especially valuable in dealings with the public sector, Yusif added, since doing business successfully with government organizations usually requires more time than a rep from the home or regional office could reasonably spend in the country.

How do you identify a good local associate? It requires that you follow-up with conventional sources such as trade and banking references, U.S. businesses in Iran, the Embassy Commercial Section and Chamber of Commerce.

After-sales service is a critical problem in Iran, worsened by Iran's riots. U.S. firms which place their own technical service rep in Iran, or in the region enjoy a decided advantage over those that rely entirely on the local sales organization. Every Iranian distributor who has attempted to develop a good service capability has had a difficult time retaining competent technicians because of Iran's continued rapid industrial development. So, to solve this problem, a group of American manufacturers is trying to form a service consortium. If successful, it may be adopted by computer makers.

An excellent source of basic information about Iran is the "Area handbook for Iran" prepared by Foreign Area Studies of the American University, Washington, D.C. For a detailed sector-by-sector survey of the Iranian economy consult "Iran: A Survey of U.S. Business Opportunities." Copies of these books are available at $9.20 and $4.75, respectively, from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Finally, we recommend that you bone up on the culture of those countries you intend to do business in (and talk about "women's lib," some countries do not allow women to even drive in the compound!). The laws are also stricter; criminals don't get suspended sentences or dare default on court appearances. Also, you should talk to those who have been there. Many U.S. EEs go there for two years with their families, usually live in a compound, make good salaries, and then return home.

### UAE, Bahrain and Kuwait

Though Israel, Saudi Arabia and Iran are to become big U.S. computer purchasers, officials interviewed by **Digital Design** all said that future U.S. computer sales look bright for the United Arab Emirates (UAE), Bahrain, Kuwait, Libya and Algeria.

UAE, one of the world's richest countries in terms of per capita wealth, imported $500 million worth of U.S. goods in 1977. The USDC expects the figure to rise to $560 million in 1978. With a high surplus balance of payments and ambitious technologically-oriented development goals, the UAE is an attractive market in which to sell U.S. computers and peripherals. The accelerated industrialization is creating a need for computers and peripherals.

Bahrain's traditional role as a regional service and commercial center expanded in the past two years. A central location, availability of office space and private housing, and good communication and transportation systems – these and other pluses make Bahrain attractive to many foreign firms.

A 1975 program of "off-shore banking units" attracted forty international banks to Bahrain, including several prominent U.S. banks. So, not surprisingly, the number of U.S. firms with offices in Bahrain doubled in 1976 to approximately sixty. In December 1977, the Bahrain government issued regulations governing a new program of "exempted" commercial companies, thus permitting firms to organize regional headquarters without Bahrain sponsorship or partnership. What does this expansion in commercial activity mean for you? It means that Bahrain will need modern equipment, computers and peripherals to carry on daily commercial activity.

Kuwait, the second largest cash-paying buyer of U.S. exports in the Arab world, should reach $540 million sales in 1977 and increase to almost $700 million in 1978, according to S. Dickson Tenney of the Bureau of Export Development. Kuwait has one of the highest per capita incomes in the world, increasing foreign exchange reserves and a large buying propensity in both government and business sectors. Kuwait's development plan through 1981 aims at further industrialization and plans to invest over $16 billion during the next five years. The Industrial Bank of Kuwait, which has a $350 million low-interest loan from the government, encourages the development of private, medium-sized industries.

Libya and Algeria's oil export provide the countries with very sizable revenues. But, these two countries are virtually unknown markets to many U.S. firms. Some American companies feel inhibited from approaching these markets by the fact that both countries have socialist governments and traditional ties with European suppliers. However, both Libya and Algeria plan to develop their countries industrially. DD

## ABOUT THE AUTHOR

**OyKue Brogna** is managing editor of *Technology Transfer Times* (Benwill Publishing, Boston), a technical newspaper that covers patent activity, suggests technology transfers into new fields for small and large businesses, and also covers inter-disciplinary applications. OyKue, a former science instructor in Hong Kong, has travelled extensively throughout Asia, holds BS and MS degrees, and recently co-ordinated a personal computing ($\mu$C) show in Boston.

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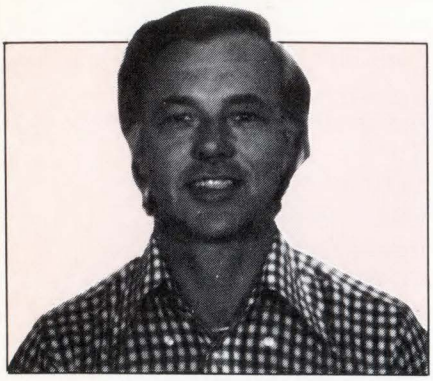


*Interview*

# MAGNETIC MEDIA SURFACES

## Digital Design talks to Lew Whitaker

*An article titled "Magnetic Media Maintenance Saves mC/μC Data" appeared earlier in Digital Design (June 1978, pp. 24-26). This article, written by Lew Whitaker, urged minicomputer and even microcomputer users to examine and adopt magnetic media maintenance measures. We received a number of reader inquiries, asking for more information on magnetic media maintenance. So, to shed more light on this important subject, we decided to get the answer. The following dialogue covers highlights of our interview with Lew Whitaker, vice president of marketing at Innovative Computer Products in Tarzana, CA.*

**DD**: What does Innovative Computer Products do?

**LW**: ICP is a little over two-year old California corporation, involved with developing and manufacturing preventive maintenance cleaning devices for removable magnetic media used with computer systems. During this two year period, we have become a leader in our field, according to our customers.

**DD**: What do you mean by magnetic media?

**LW**: Any plastic or metal base stock coated with material capable of being magnetized to record data serves as magnetic media. Examples include magnetic cards, cassette tapes, diskettes, disk cartridges and disk packs.

**DD**: Why has an interest in all forms of media maintenance appeared?

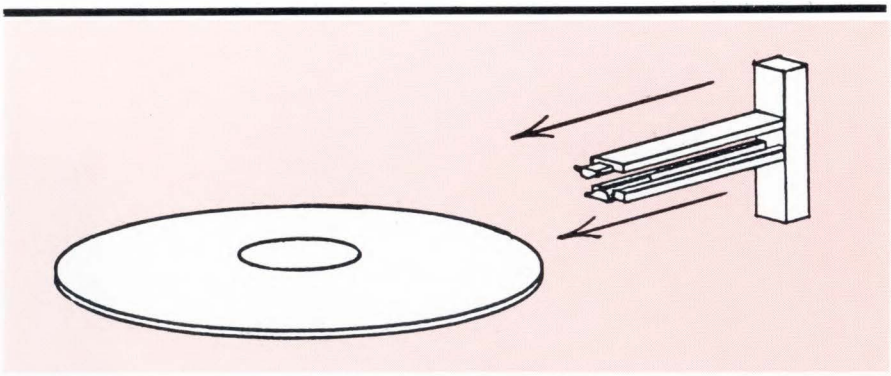
**LW**: Media maintenance has existed in various forms for over 15 years. Basically, the media is the same now as then. However, what has changed is the environment where data is being processed. Large scale computers require clean-room conditions, temperature and humidity controls. Today's minis are found in factories, offices, warehouses and basements – just about any place you can imagine.

**DD**: You say that media is basically the same now as 15 years ago. What are the differences?

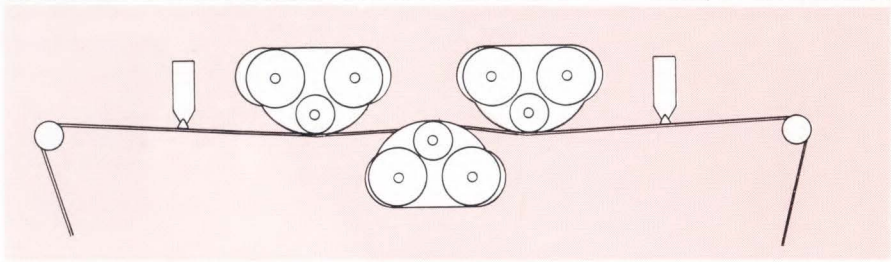
**DD**: While the forms of media, tape and disk have remained substantially the same, higher recording densities and the much closer operating tolerances have made a dramatic entrance. For example, tape densities have increased over the years from 200 bpi to the current 6250 bpi. In addition, read/write heads now fly only a few microinches above disk surfaces.

**DD**: Do these higher densities and closer tolerances require better, cleaner media?

**LW**: Absolutely. On magnetic tape with data recorded at 200 bpi density, you could read individual bits. Small bits of dirt create problems – none of them disastrous. However, at 6250 bpi, a micro-sized particle of dirt could wipe out the Gettysburg Address. On rotating disk systems, read/write-heads now fly only a few microinches from the disk surfaces. Any contaminant on the disk surface, such as smoke, dust, fingerprints or oil, for example, could not only keep data from being read or written, but cause a catastrophic head crash – the worst thing a user can experience.



**Disk cleaner using polyurethane pads saturated with volatile, non-flammable solution.**



**Tape cleaner using blade and tissue concept.**

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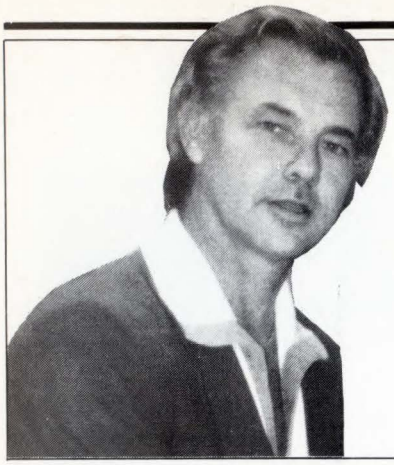
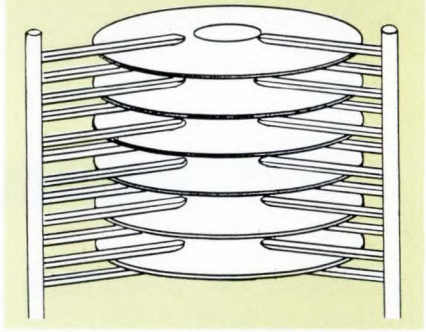


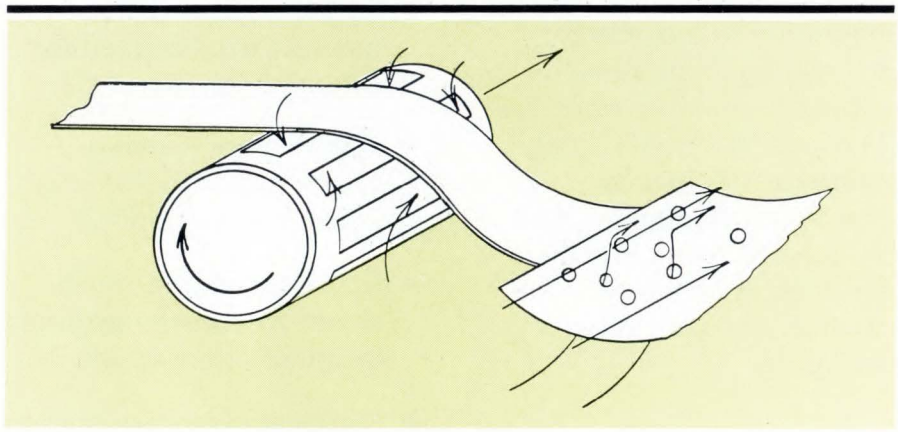
**"Since contamination is the most common cause of media problems, a regular program of media cleaning guarantees more hours of error-free operation."**

**DD**: Does recording on various types of media use the same techniques?
**LW**: Similar, but not identical. Flexible media, such as 1/2" computer tape, audio cassettes, video tape and floppy disks, make head-to-media contact. Dirt does not usually damage a head, but pressure and contact can grind contamination into the oxide surfaces. Disk cartridges and multiplane packs use a flying head that does not actually touch the media. However, a particle of dust can interrupt the aerodynamics of the flying head and cause the head to bounce into the media to force a disastrous head crash.
**DD**: Should users clean all forms of magnetic media?
**LW**: Yes, because all surfaces get dirty and need cleaning.
**DD**: Surely you don't mean such low-cost items as cassettes or floppy disks? Wouldn't it be cheaper to throw them away and buy new ones?
**LW**: First of all, you very seldom throw the media away before they cause serious problems (read failures). Even after a catastrophe, you often set aside – not throw away – the troublesome cassette or diskette, which another unsuspecting operator may use. Secondly, since contamination is the most common cause of media problems, a regular program of media cleaning guarantees more hours of error-free computer operation – and incidentally, lower media costs. Although, I don't have statistical data to back my claim, I believe that a user can easily double the life of his media with regular cleaning. Finally, while media such as floppy disks or cassettes may be inexpensive, the data recorded on them is often priceless. Pennies expended on cleaning often returns your investment many times through more efficient operations.
**DD**: Do you have competitors in the magnetic media cleaning equipment business?
**LW**: Most of our competitors offer equipment for various segments of the media cleaning and inspection market. Each of them approaches the problem from a different technical viewpoint



**Disk cleaner using a two pad system. One saturated with isopropyl alcohol and one drying pad to remove residues.**

and none approaches the whole magnetic media area as we do. Some clean only tapes and some clean only disks. They all do it differently than ICP.
**DD**: What do you mean by the phrase, "different technical viewpoint"?
**LW**: One firm uses a detergent and water solution to clean disk platters. Other companies use a 90% isopropyl alcohol solution to clean disks. All companies supplying magnetic tape maintenance equipment use a blade for removing dirt, but some get rid of the scrapings with tissue wipes, others with vacuum.
**DD**: How does your approach differ?
**LW**: First, we analyzed the types of contaminants to be removed. Then we developed a solution and pad technique for effective removal of this type of contamination. Interestingly, we found that all types of media surfaces contained surprisingly similar contamination. This fact makes our way of contaminant removal effective on tapes and disks. We use a proprietary nonflammable fluid for each type of medium.
**DD**: Who are your competitors?
**LW**: For disk cleaning, Randomex uses a detergent, Kybe uses isopropyl alcohol for 5- and 10-high packs, Texwipe and Computerlink use a manual device for disk packs, and Data Devices uses prepackaged isopropyl alcohol pads for cartridges. For tape cleaning, Kybe and Computerlink make use of a similar blade and tissue concept, while Data Devices equipment uses a rotating blade and vacuum system.
**DD**: Which cleaning method is best?
**LW**: I can speak only for ICP and not the others. The disk engineering departments of four very large computer companies found that ICP solutions and equipment clean media safely and very effectively. Burroughs and Digital Equipment Corporation are marketing ICP products worldwide.
**DD**: How much does it cost to clean a cassette or disk?
**LW**: On ICP equipment, you can clean a cassette for about 15 cents and a top- or front-loading disk cartridge for less than 70 cents.
**DD**: Who are your typical customers?
**LW**: About the only thing that typifies



**Tape cleaner using rotating blade and vacuum concept.**

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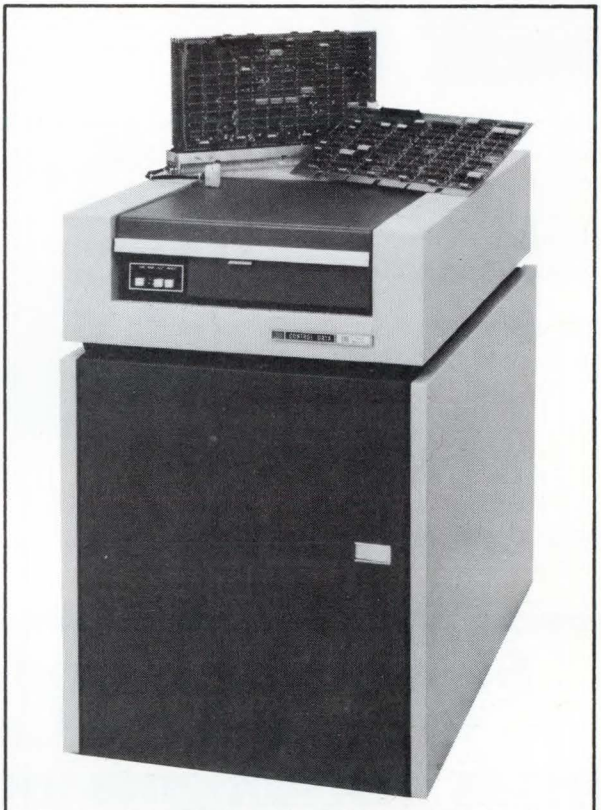

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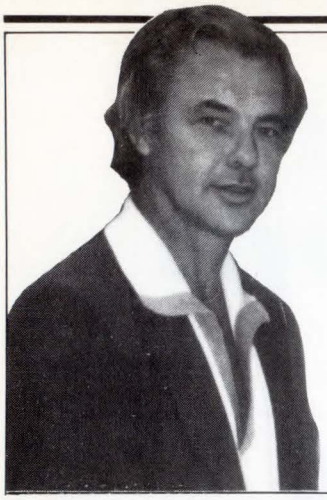


**"Cleaning resembles life insurance — you only need it when you really need it."**

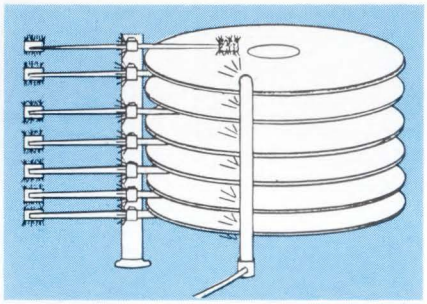
our customers is that they use magnetic media in their computer systems. And their systems range from microcomputers to some of the largest mainframes in industry. Some maintain small software libraries; others, large ones.

**DD**: What would you advise a computer user who has never cleaned his media before to do?

**LW**: Start now. Many potential customers have told me that they have been using magnetic media for a number of years without problems that they have attributed to the lack of cleaning. I explain to these people that cleaning resembles life insurance — you only need it when you really need it. Sooner or later, they will, for like the ad says, "Pay me now, or pay me later".

**DD**: Is media maintenance here to stay?

**LW**: Yes. Since cleaning does not harm magnetic media, there is no one I know of who could possibly take the position that cleaning magnetic media is harmful. Now, as more and more minicomputer and even microcomputer users discover that cleaning magnetic media is desirable and necessary, the inroads that magnetic media cleaning has made will continue.



**Disk cleaner using nylon bristle brushes and detergent solution.**

## ABOUT THE AUTHOR

**Lewis A. Whitaker** is currently Vice President of Marketing for Innovative Computer Products in Tarzana, CA. Before coming to ICP, he held sales mangement positions for Data Devices Inc. and KYBE Corp., both firms that manufacture media maintenance equipment. His articles appeared in "Journal of Data Management" and 'The Communications of the ACM."

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# DESIGNERS' NOTEBOOK

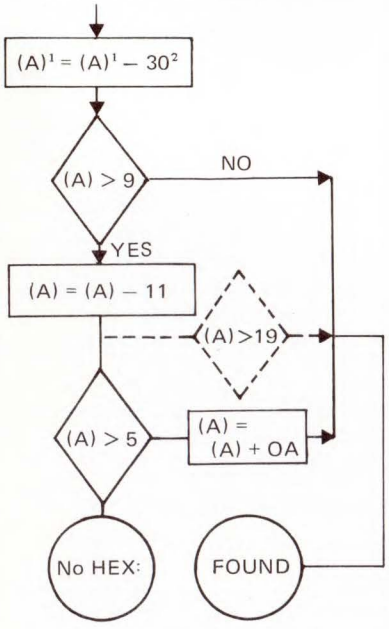
## Hex-to-Binary Converter Runs on 8080/6800

This program identifies the hex character from its 7-bit ASCII representation (parity bit zero) and converts it to its binary value. The number of instructions used is minimum, and it runs on both the 8080 and 6800, as far as their assembly language is concerned (source code will be different). It assumes the 7-bit ASCII character in the accumulator and leaves the binary result in the accumulator if the hex number is identified. Alpha-numeric characters can be identified by the same program by just changing one location; and in that case, the instruction used to adjust the number in accumulator to hex will also be eliminated, thus leaving a 6-instruction program.

B.K. Gupta, 50 (SD), Computer Section, Bhabha Atomic Research Center, Trombay, Bombay 85, India.

**FLOW CHART**

**(a) Solid lines refer to HEX characters**
**(b) Dashed lines refer to ALPHA-NUMERIC identification**




**NOTES:**
1. **(A) = Contents of Accumulator**
2. **ALL Nos. are HEX**
3. **# refers to 'Immediate' addressing**
4. **CY = CARRY FLAG**
5. **'Y' = '06' for HEX**
   **'Y' = '1A' for ALPHANUMERIC**

| LABEL | OPERATION | | OPERAND | COMMENTS |
|---|---|---|---|---|
| | 8080 | 6800 | | |
| FIND | SUI | SUBA# | '30' | Subtract '30' from (A) without Borrow |
| | CPI | CMPA# | 'OA' | Compare (A) with 'OA' |
| | JC | BCS | FOUND | No. is numeric if CY was set by previous operation |
| ALPHA | SUI | SUBA# | "11" | Subtract "11" from (A) without Borrow |
| | CPI | CMPA# | 'Y' | Compare (A) with '06' or '1A' |
| | JNC | BCC | No HEX | If CY = 0, No. is not the required one |
| | ADI | ADDA# | 'OA' | Adjust the Accumulator to true binary |
| FOUND | | | | |
| No HEX | | | | |

## A Dedicated Computing Process Controller

Process industry requires continuous comparison of a process parameter with a set value to control the processs accordingly. Coarse control can be done **(Ref 1,2)** using a chain of 4-bit magnitude comparators (7485s). For obtaining a finer resolution, here's a versatile technique of comparison in which the exact difference is available as modulous with sign to drive proportional position controllers. To compute the difference, this system accepts data directly in BCD form (normally available from digital measuring instruments) and does not require any interfacing code converters (viz., BCD-to-binary), thus economizing in hardware.

In the circuit of **Fig 1**, the Process Parameter "P" is loaded into the Input Counter (74190s) and the Set Value "S" is loaded into the Input Latches (7475s) simultaneously by narrow load pulses $\overline{Q}_2$ and $Q_2$ respectively. $\overline{Q}_2$ also clears the Display Counter (74144s). The values of P and S are then compared in a Comparator (7485s) whose outputs control the Up/Down and enable functions of the Input Counters, and Enable function of the Display Counter. If at the time of loading P≠S, the Display Counter is enabled to count and simultaneously the Input counter is also enabled to count up (if P < S) or down (if P > S). When the Input Counter reaches a

state equal to S, both the counters are disabled and $MS_1$ gets triggered. The status of the Display Counter at this instant represents the absolute difference between P and S ( |P-S| ) which is transferred to the Display Latches (of 74144s) by the pulse $\overline{Q}_1$ for flicker free LED display. The sign bit information is latched into a D-Flip Flop at the trailing edge of the load pulse $\overline{Q}_2$ before counting starts. The trailing edge of $Q_1$ triggers $MS_2$ to generate load pulses $Q_2$ and $\overline{Q}_2$ thus starting next repetitive cycle.

If at the time of loading P = S, the feed back from $Q_2$ to $A_1$ triggers $MS_1$ at its trailing edge, as no positive transition occurs at $B_1$ input of $MS_1$. Thus $MS_1$ and $MS_2$ form a free running multivibrator to keep the cycle of operation repeating **(Fig 2)**.

The $R_1C_1$ (4.7k, 1$\mu$F) combination is used to generate the load pulses ($Q_2$ & $\overline{Q}_2$) as soon as power is switched on (at $t=t_0$) to the system. The computation time T depends on |P-S| and the frequency of the 'Oscillator' formed by schmitt gates (74132), and the rate of sampling further depends on the periods $T_1$ and $T_2$ of $MS_1$ and $MS_2$ respectively.

In addition to the LED display, the difference of P and S is also available in the BCD form (from 74144s) along with polarity bit for use with position controllers.

We wish to thank Dr. Amarjit Singh, Director and Dr. G.N. Acharya, Head of EI Group, for their constant encouragement.

M.V. Subba Rao and Dilsukh Jain, Geeri, Pilani-333031, India.

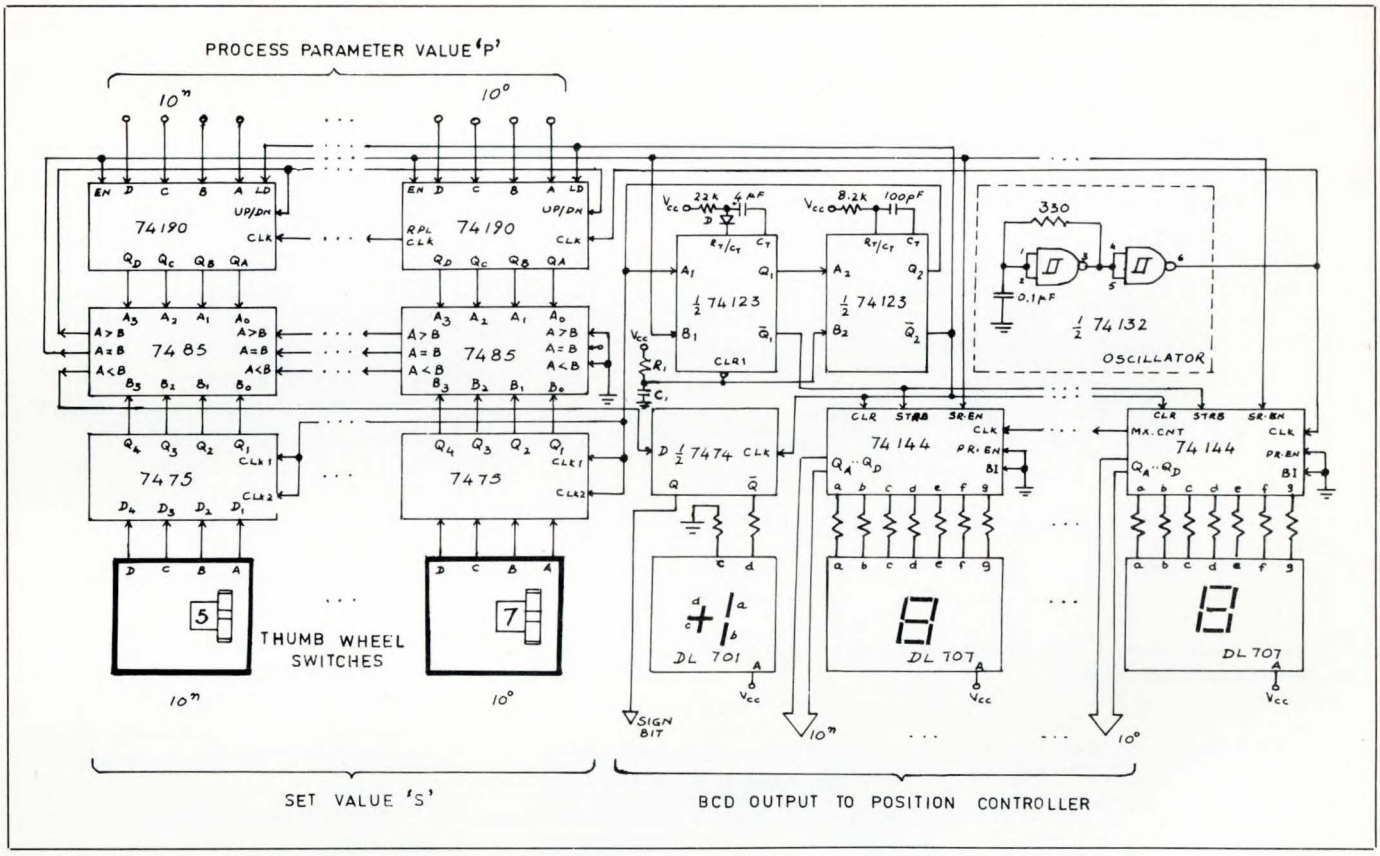



**Fig 1 Circuit diagram of a dedicated computing process controller.**

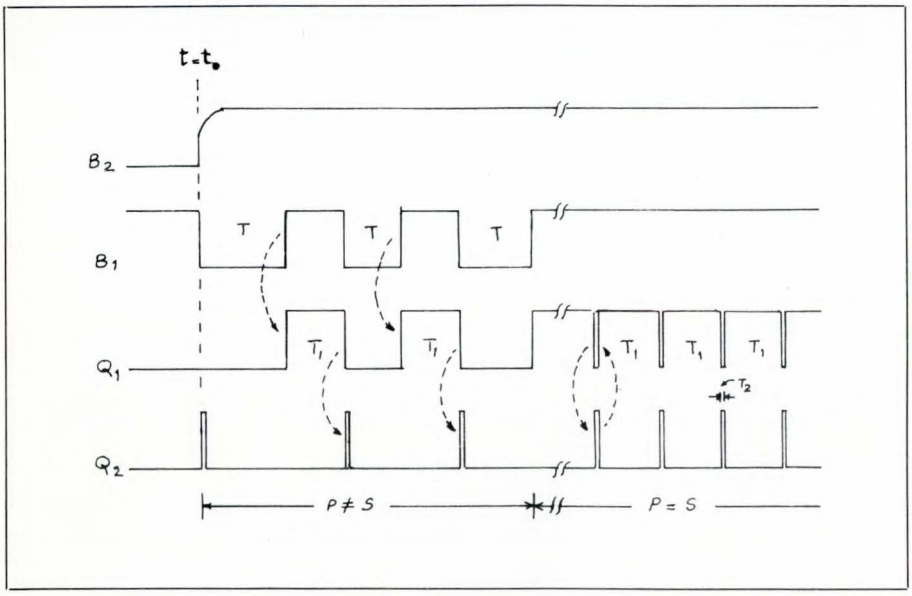



**Fig 2 Timing waveforms of circuit shown above.**

## References

1. M.V. Subba Rao & S.C. Mittal, "SN7485 gives carry look ahead digital comparison", *Electronic Engineering*, Vol. 50, No. 603, March 1978, Pg. 21.

2. M.V. Subba Rao, "Modified digital comparators with carry look a ahead can be cascaded." *Electronic Engineering*, in press.

# Pulse Time Delay for Digital Lock-Out

Gate pulse propogation delay provides a simple lock out circuit in a system which has only one central logic system and several I/O terminals.

**Fig 1** shows the system circuit of two I/0 terminals. Common signal line is for signaling the central logic for data input or output. MM74C902 is hex open-drain P-channel buffer gates which make wire-OR connection possible. **Fig 2** provides the circuit's timing diagram.

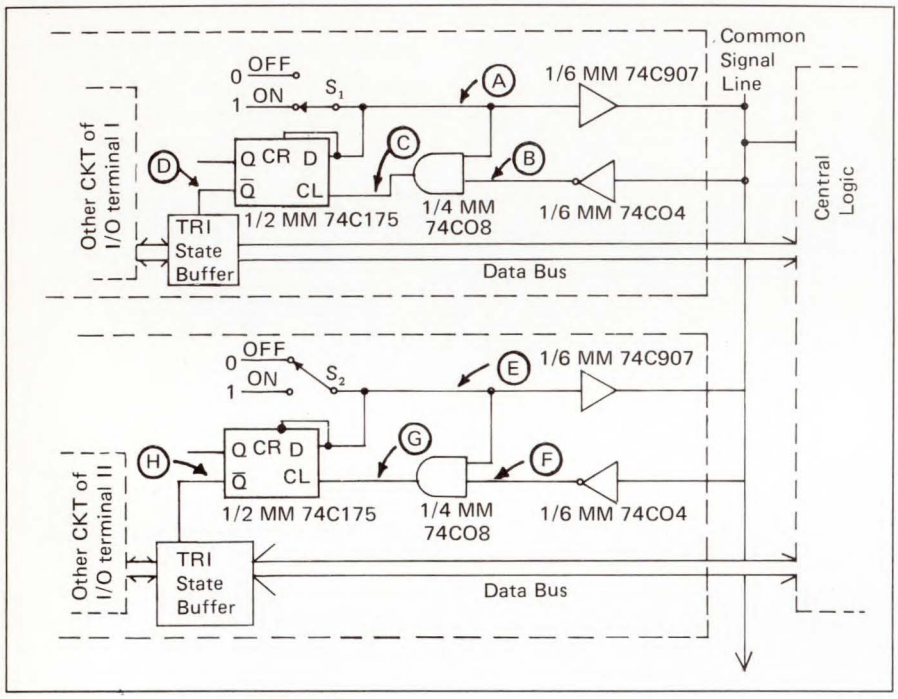



**Fig 1 System circuit logic diagram**

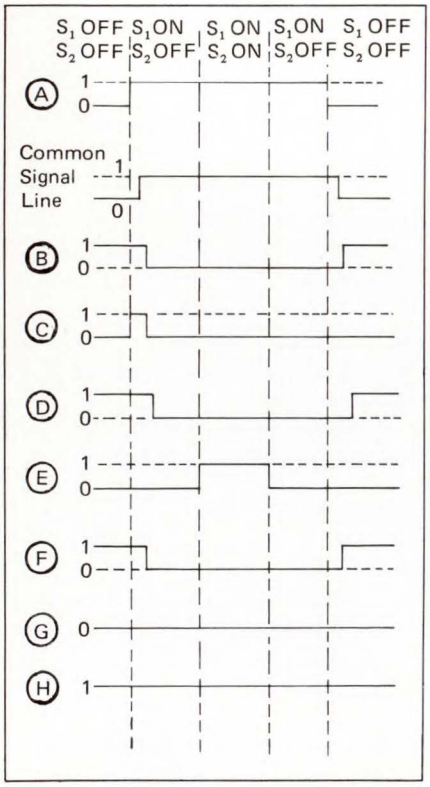



**Fig 2 Timing Diagrams**

When none of the terminals is ON, the common signal line is always LOW; point C, HIGH. Suppose $S_1$ is ON; then point A is HIGH. Because of MM74C907's propagation delay time ($t_{pdi}$—150ns typically for $V_{cc}$—5V) and of MM74C04 ($t_{pdo}$—50ns typically for $V_{cc}$—5V), point C is still HIGH for a short duration (200ns, for typical value). This short pulse from the AND's output is long enough to clock the MM74C175 D-type flip-flop (typical minimum clock width is 130ns for $V_{cc}$—5V), and set the D flip-flop's output level. This output level change can be used to enable the tri-state buffer or to turn on other analog circuits in the I/O terminal.

The lock out logic works when some other I/O terminals try to turn ON. In this diagram, $S_2$ turns ON. Since $S_1$ is already ON, common signal line is HIGH; F, LOW. It implies that no matter if $S_2$ is ON or OFF, output from the AND is always LOW. The D flip-flop can never be clocked; its output cannot be set. The rest of this I/0 terminal circuit cannot be turned ON.

When $S_1$ turns OFF, it resets the D flip-flop, irrespective of whether there is a clock pulse or not. It is because the CLEAR and D input of the D flip-flop connect directly with $S_1$. This provides individual turn-OFF function of each I/0 terminal. Common signal line resets, and is ready for another ON signal.

Suinin W. Wong, Qume Corp., San Jose, CA.

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And in case you have a nifty circuit or unique software routine sitting in your files, and you would like to see your name in print, why not send it along for publication in this column?

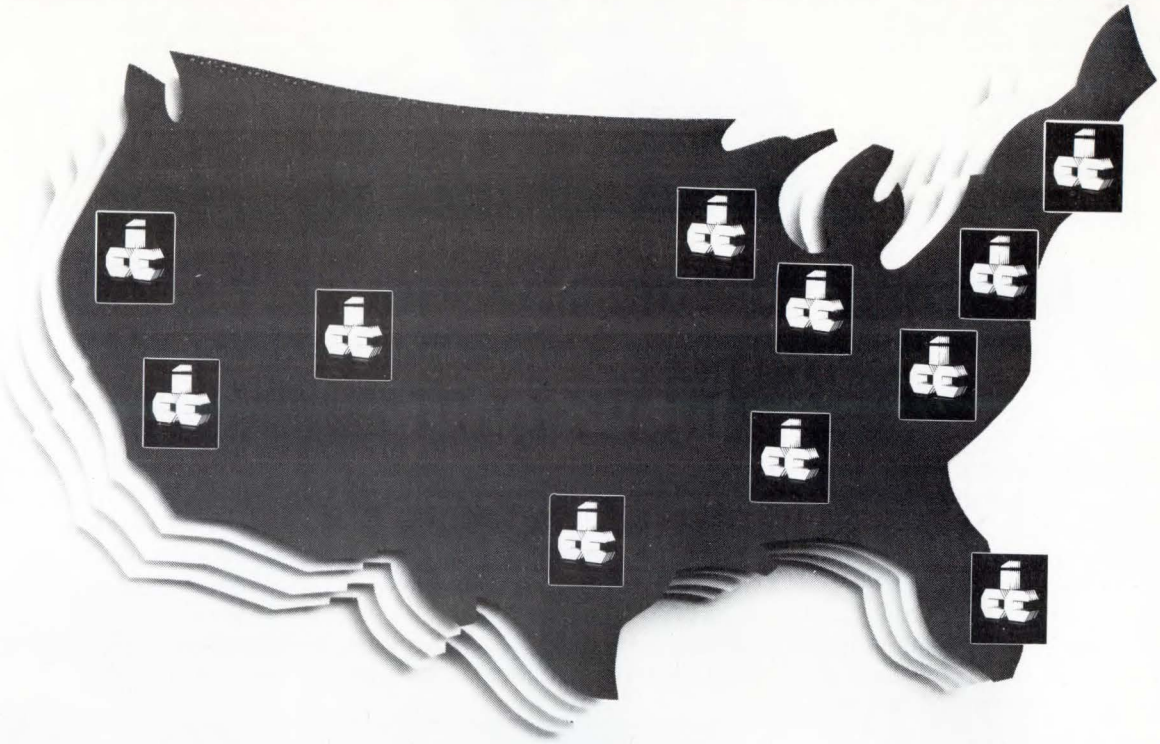
Whether you're writing a brief Designer's Notebook or longer article for us, don't try to be formal or worry about grammar, spelling, punctuation and style. Write as you speak, as you would explain it to another engineer.

If you can't type, then don't let that stop you: just write out your description. But be sure to enclose schematics, block diagrams, flow charts or computer printout, detailed descriptions and—most important—a one to three page description.

Circuits and software programs must not be previously published (house organs excepted). Finally, we ask one more thing—that you include schematics, block diagrams and that your program be debugged and your circuit bench-tested.

Send your software and hardware ideas to: Circuits Editor, **DIGITAL DESIGN**, Benwill Publishing Corp., 1050 Commonwealth Ave., Boston, MA 02215.

# OEM America Meets



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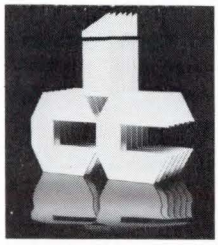

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# SOFTWARE DESIGN SERIES

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# Debugging Microprocessor Programs

Most engineers (and certainly most managers) cannot understand the need for an elaborate development system, such as the one shown in **Fig 1** to support an inexpensive microprocessor. After all, they see prototyping boards and kits advertised for a few hundred dollars. Such boards are even included in the cost of many popular short $\mu$P courses.

Why are these boards inadequate? Couldn't the adding of features somehow bridge the gap between evaluation boards costing a few hundred dollars and full development systems costing many thousands of dollars;

One of the major problems with simple boards **(Fig 2)** is lack of adequate debugging tools. Consequently we will discuss the aims of debugging, describe the most common tools, and show how they are implemented in simple prototyping boards and by expensive development systems. Since the basic tradeoff is one of man hours vs. development equipment, the rising cost of labor and the pressures of schedules obviously operate to make expenditures on improved hardware and software tools worthwhile.

The aims of debugging are simple enough: finding and correcting errors as quickly as possible. But notice some of the complicating factors in microprocessor-based systems:

- Since the microprocessor chip is monolithic, we cannot observe its internal workings directly. Registers, flags and internal buses are all hidden from our view.
- Hardware and software are usually developed concurrently and errors may occur in either or both. Note, for example, the combination of keyboard, display, dials and LORAN receiver in the Internav SIMRAD LORAN-C navigation computer shown in **(Fig 3)**.
- Errors may be time-dependent and occur sporadically.
- Vendors sell microprocessors without supporting hardware or software. The cost of CPUs is far too low to allow the bundling of support. Furthermore, supporting hardware and software are unnecessary in the final configuration for most dedicated applications.

Any computer system may contain other typical debugging problems:

- The errors may be very subtle and difficult to pinpoint. A careful selection of test data is essential. Although you must omit extraneous complications, you must cover all cases. Note that you must plan for debugging and testing very early in the development process.
- Corrections may themselves introduce additional errors. Modular and structured programming will produce programs with a simple flow of control that allows easy correction.

Good design and coding practices can greatly reduce the frequency of this problem. An unstructured program may seem more efficient than a structured program, but may be almost impossible to debug.

- The errors may be in the central structure of the program. Top-down design allows the programmer to build a core that is correct.
- Errors may occur only after a relatively long time. The programmer may find it very difficult to determine when the error begins and what causes it. He can waste a large amount of time sequencing through sections that are correct.

The debugging procedure must isolate the error and make its effects as obvious as possible. Commonly used tools include:

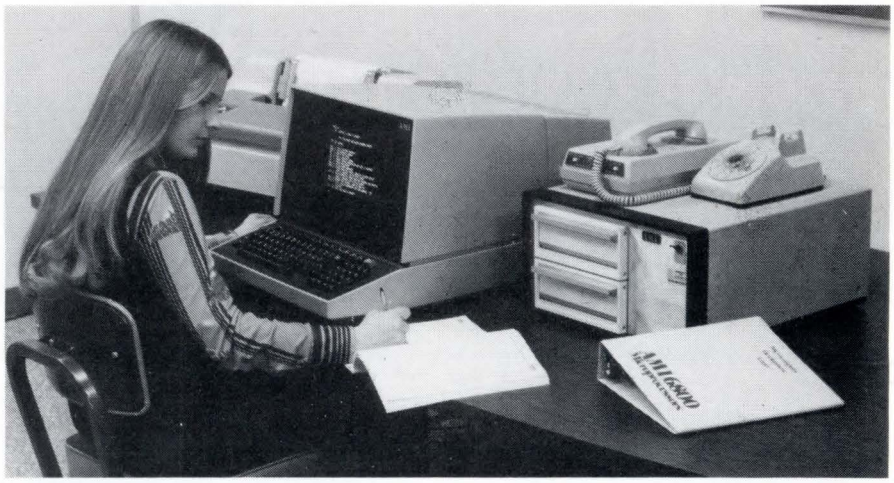


**Fig 1 AMI 6800 microcomputer development system (Courtesy of American Microsystems, Inc., Santa Clara, CA).**

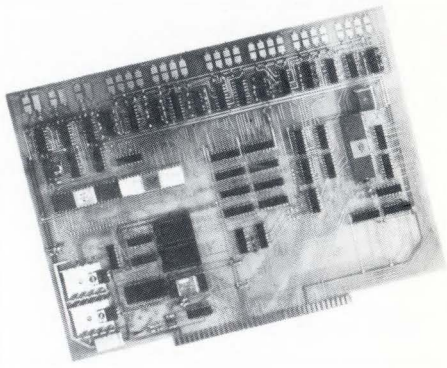


**Fig 2 Datac 1000 Computer tutorial card (Courtesy of Datac Engineering, Southampton, PA).**

• A breakpoint that halts the entire microcomputer system at a certain specified point so that you can observe all the intermediate states.
• A trace that provides a time history of program execution.
• A single-step mode that allows you to execute the program one step at a time.
• A dump that allows the contents of a group of registers or a display or printout of a section of memory.
You may implement these tools partly in hardware and software. We will mainly discuss the software versions here, because this magazine has discussed hardware tools such as logic analyzers and in-circuit emulators elsewhere **(Ref 1,2)**. Of course, even after you have used tools to identify and isolate the errors, you need facilities for actually correcting them.

Let us see what debugging facilities most simple boards can provide. Typically they supply:
• Breakpoints that may be automatically or manually inserted by placing jump instruction at the specified memory location.
• A trace that lists register contents at each step.
• A single-step mode,
• Memory and register dump facilities.

Many of the problems with such facilities quickly become obvious to the user. Traces and dumps are practically worthless without some kind of printer. Otherwise, you can spend endless amounts of time copying numbers from a CRT or display. Unless the error is very simple, you must work with a printed output during analysis. Simple breakpoint facilities are highly inconvenient and lack flexibility. You must identify the specific addresses at which program execution is to be halted. You must also try to keep track of which breakpoints have been implemented and why. Most simple systems lack the ability to insert breakpoints on specific instructions, at specified times, or when particular memory locations or I/O addresses are being used. The insertion of breakpoints is impossible, if some, or all, of the program is in ROM. Since the single-step mode is unbearably slow, it distorts system timing. A single-step mode is only useful, if the error has been isolated to a small section and if adequate trace facilities are available. The debugging facilities (and the system monitor) may interfere with the user program and make some of the microcomputer's facilities unavailable. There is nothing more annoying than finding that an interaction between the program and the monitor has caused an error.

Even after you have located an error, correcting it remains a problem. The only errors that you can easily correct on most simple microcomputers involve a single memory location or minimal reorganization. Otherwise, you must start all over again or patch in corrections. Patching results in documentation problems and can produce a program that looks more like a patch-work quilt than a logically designed system.

Expensive development systems typically offer a large number of facilities, many of which may be combined into a debugging package or monitor. The development system usually includes a printer, CRT display and mass storage for saving user and system programs. Thus, breakpoints become far more flexible and powerful, traces more useful, and corrections easier to implement. The debugging package, which generall includes entirely separate facilities from the user programs, does not interfere with their operation. For a program of even small to moderate length, these facilities can save a lot of time.

An intermediate approach to the continuous use of the development system employs a local prototyping board for simple applications and attaches it to the development system only when required. The prototyping board must, however, contain reasonable debugging facilities and be compatible with the larger system.

A good, typical example of an intermediate approach, the Rockwell AIM-65 **(Fig 4)**, costs under $500. The AIM-65 is fully compatible with Rockwell's larger development systems. While such boards cannot replace full-scale development systems, their range of debugging tools makes them very useful for education, laboratory applications and prototyping. For anything except simple education and familiarization, a microcomputer without such debugging facilities wastes time and money.


**Fig 3 Internav Simrad CC-2 navigation computer includes LORAN receiver. (Courtesy of Simrad Inc., Armonk, NY).**


**Fig 4 Rockwell AIM-65 μC contains a 20-character alphanumeric display and a 20-character thermal printer.**

## References

1. K. Pine, "What Do Logic Analyzers Do?" *Digital Design* September 1977, pp. 55-72.
2. G. Miller, "Using Microprocessor Development Systems", *Digital Design*, September 1977, pp. 101-104.

# PRODUCT HIGHLIGHT

**Unique Design Lowers Price/Boosts Performance**

# Array Processor Opens New Applications

Boasting a $7,500 price tag for its 375 IC, four-board set, with a full system (5.25Hx19Wx20"D, 20 lb.) priced at $12,500, the AP-400 array processor (AP) is aimed at new applications where APs were not previously practical or cost-effective. The AP-400 is a fully programmable (Fortran, host assembly, AP-400 assembly language or combination) 24-bit mantissa, 16-bit exponent floating point high-speed computer peripheral processor that performs $10^7$ arithmetic and logical operations/sec. It performs data-dependent table-lookup operations at 1.0 MHz. Host-to-AP data transfer is DMA, while direct data input is at 2.1 MHz. It executes a 1024-point complex FFT in 7.4 msec; a real convolution (512 data and 1024 kernel) in 7.3 msec; and 1024 point real vector-vector multiplication in 0.5 msec.

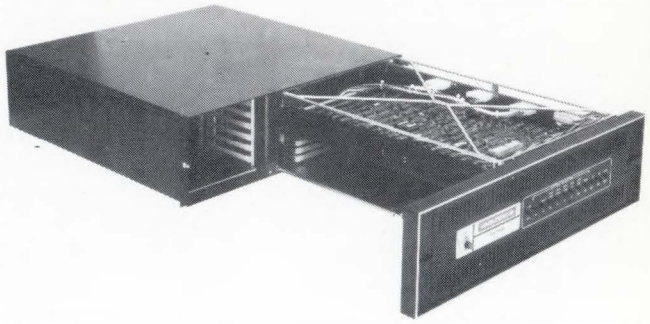
Data may be acquired through a host interface or directly through a standard auxiliary input port. A multilevel interrupt structure and powerful executive provide realtime capability for applications requiring concurrent asynchronous data acquisition processing and output.

The standard AP-400 software package includes complete utility, system and computational software to meet all host and AP-400 development, test and application needs.

Enclosed in a standard rack-mounted cabinet, the AP-400 system includes built-in supply, provision and ample space for built-in, wide-dynamic-range, low-noise, multichannel data acquisition circuitry and substantial memory expansion capability. The computing circuitry, laid out in standard DEC card sizes, comes as a card set for inclusion within other host cabinetry or within the standard Analogic system cabinet.

For users needing more than the normal block-floating-point, 24/16-bit format, they can use double precision integer and block FP, and true FP formats. Data memory is directly expandable to 64K of 24-bit words. Its arithmetic pipeline provides the power of "table based functions" at pipeline throughput rates of 1.92 $\mu$sec. During the course of a pipeline period, AP-400 can carry out 4 multiplications, 12 additions and can simultaneously perform several table lookups and logical operations. For example, it can carry out a logarithmic transformation at 1.92 $\mu$sec/point with an error of less than $2 \times 10^{-6}$.

Table-look-up parameters are totally user-specified and up to 24 256 pairs of 24-bit word word/table may be allocated anywhere in memory. Based on its 2.1 M/sec multiplication, 6.3 M/sec addition, simultaneous table lookups and other logical operations, the AP-400 opens up new vistas of application. An extensive library of macrocoded instruction sets, used in the AP-400 design, provides versatility and easier programming.



**The AP-400 array processor in rack mounting case with integral supply, showing space available for additional data memory. Note space provided at left for Analog data acquisition cards.**

Since most control, status and data transfer between the AP and its host is via DMA, the AP-400 doesn't waste its time on mundane data transfers, thus simplifying programming and unburdening its host.

AP-400 has four PCBs – the 2901 $\mu$P-based control processor, data memory and command- and address buffer, pipelined AU and interface card. AP-400 has a dual-pipelined processor; both data to be manipulated and instructions are pipelined.

The heart of any AP is the hardware that performs high speed computations. In most AP's, the arithmetics are "pipelined" to achieve high throughputs – typically, $10^7$ computations/sec. Computation rates can be increased by using BCL or by configuring several pipelines in parallel and splitting the computation load.

AP-400's three-stage arithmetic pipeline performs complex functions (Cross Product, FFT butterfly step, filter pole-pair step) in response to a simple machine-language call. To perform each such function, the pipeline is configured by a Pipeline Arithmetic Command (PAC), stored in ROM. The cobination of arithmetics and data memory is controlled by specifying only three parameters: input-data addresses, function to be performed, and output-data addresses. Furthermore, one PAC follows another without waiting to clear the pipeline; pipeline reconfiguration time is zero. Also, transport lags required to execute a command are invisible to the user, simplifying software.

For full utilization of the arithmetic logics, a buffered command and address pipeline parallels the arithmetic pipeline. The control signals for the adders, shifters, and multipliers in the arithmetic pipeline are created in, and transmitted along, this second pipeline as

*Continued*

INTERFACE 79

# TO CHICAGO

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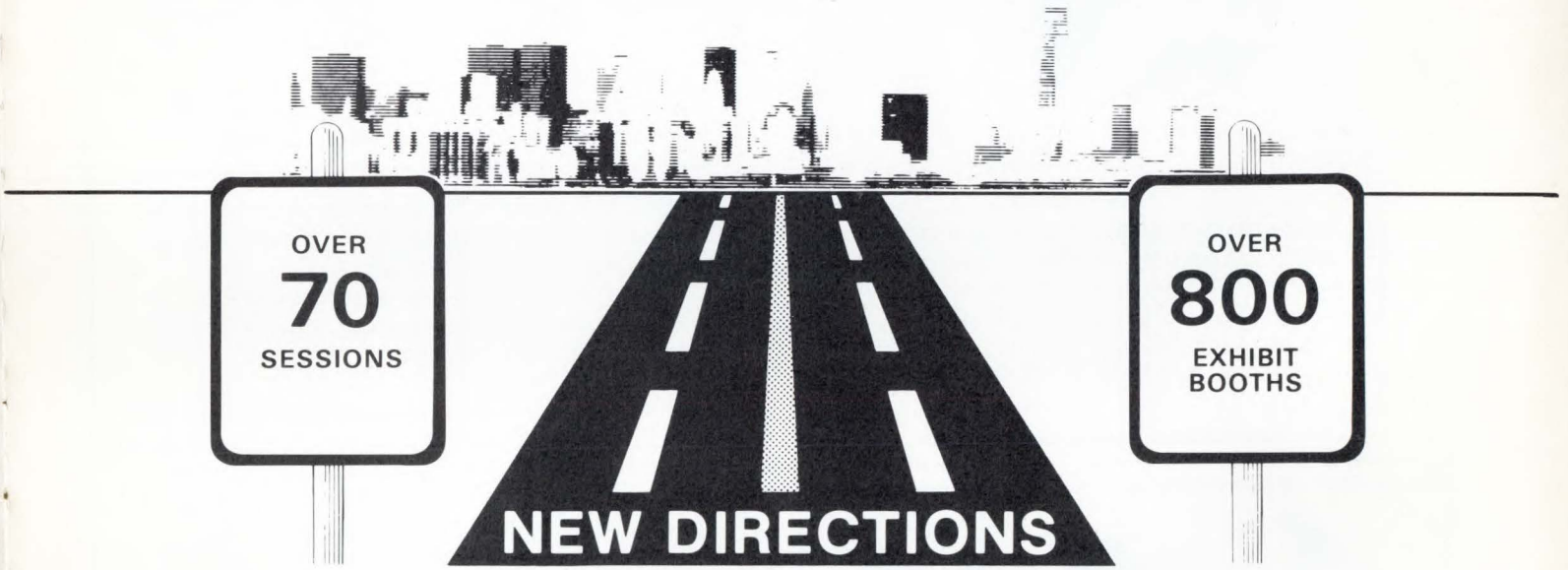


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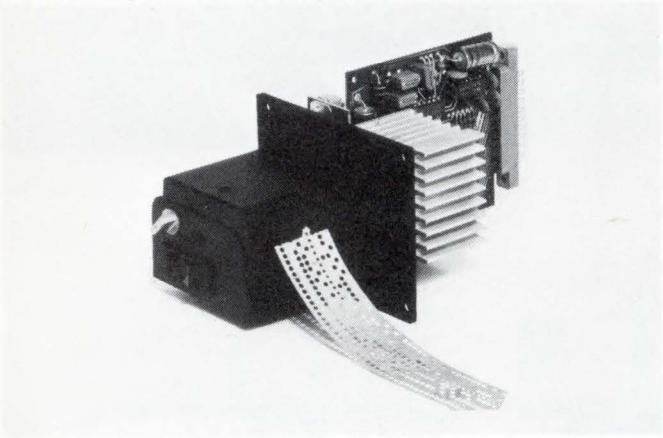
## $231 PAPER-TAPE READER HAS ONE MOVING PART

This paper-tape reader comes with TTL interface and has only one moving part. It reads any standard tape at 150 cps, asynchronous. Bi-directional, the unit stops on character and automatically detects taut tape and end of tape. The reader's user-furnished clock input is a positive-going pulse that advances tape at the input's negative-going edge and

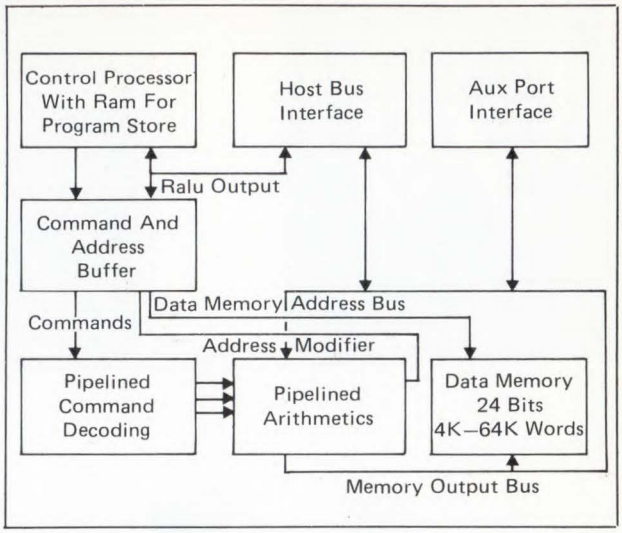


may also strobe the output data. Power requirements are +5V at 200 mA and 24V at 600mA. Stand alone versions with parallel or serial RS 232 outputs, fanfold box and spooler are also available. Price $231 (100 units). Addmaster Corporation, 416 Junipero Serra Drive, San Gabriel, CA 91776. (213) 285-1121.

**Circle 43 on Reader Inquiry Card**



**PRODUCT HIGHLIGHT** *Continued*




**Architecture of the AP-400 shown in this simplified block diagram illustrates four main array processor functions.**

the PAC's are decoded. Since the Control Processor's commands to the pipeline are buffer-stacked, the pipe line functions with high efficiency.

These two concepts – a structured arithmetic pipeline with built-in function decoding, plus buffering between the arithmetics and the rest of the AP – are keys to the AP-400 Series.

How many applications can users find for lower-cost APs? No one knows, but obvious uses include lower-cost computerized X-ray tomographic scanners, side-scan sonar, radar, vibration analysis, audio and video digitizing, geophysical and seismic exploration, research, sorting fruit, real-time speech enhancement, nuclear medicine, signature analysis (faster FFT/DFT convolutions to handle more samples), real-time industrial control, simulation, monitoring and signal processing applications that extract information from a noisy, distorted signal masked by random and systematic effects.

With its full programmability and user-programmable lookup tables, AP-400 corrects and linearizes data, compensating for detect and/or electronics offsets by making corrections for system geometries, non-linear detector gain characteristics, and interaction between beam and target (such as differential absorption of different wavelengths). Finally, ability to modify system characteristics to match new detectors, movement of detectors or increased/decreased data points makes it possible to move or replace (defective) detectors without re-running tests.

AP400 is supported with complete system software for driving and managing it from the host computer. User interface begins with host FORTRAN while using the benefits of pipelined macrocode. The extensive library of host FORTRAN Function Calls maximizes programming efficiency. Available packages include the AP-400 assembler (PL40-008) to provide users the choice of developing additional functions, and the AP-400 Virtual Front Panel Handler (PL0-007) for interactive software diagnostics. Further customer support includes customer training programs, technical support and a user's group.

**Analogic Corp., Audubon Rd., Wakefield, MA 01880 (617) 246-0300**

# PRODUCT HIGHLIGHT

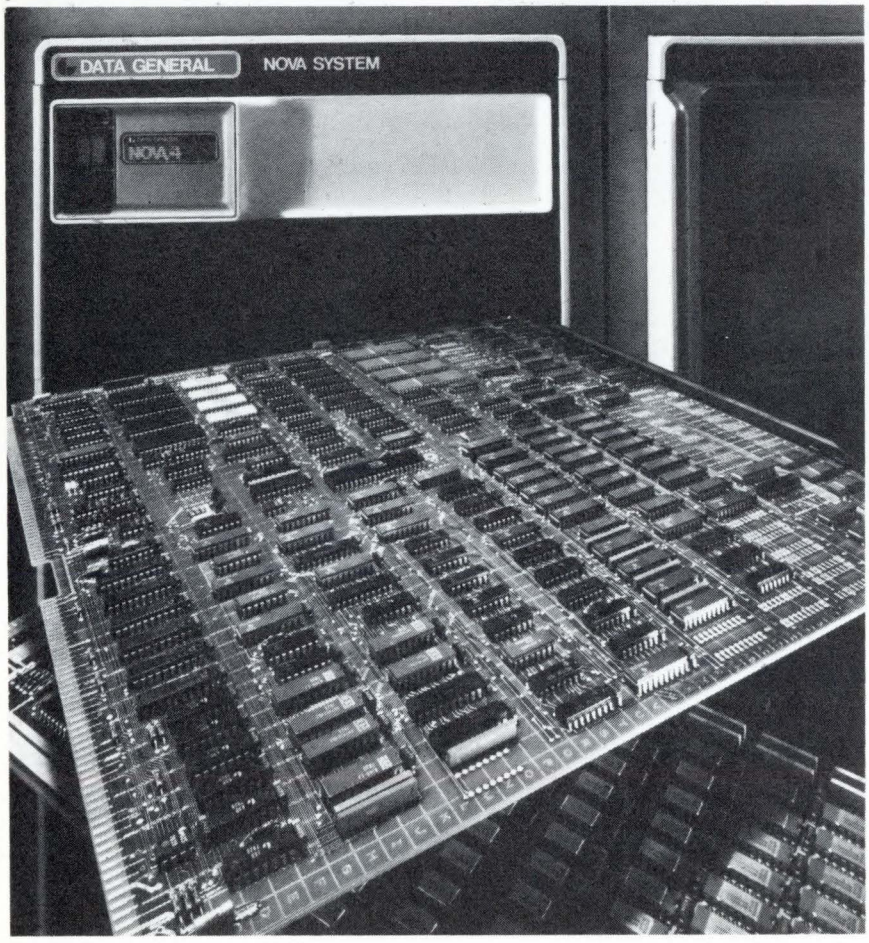
Focus on Minicomputers

## Three Nova 4 Computers Offer 50% Increase in Speed, Handling

A family of three NOVA 4 computers provides up to 50% faster speed than the NOVA 3. NOVA 4/C has a 64 K-byte computer on a single board; NOVA 4/S, a higher performance model, has up to 64 K-bytes on two boards; and extended memory NOVA 4/X has a standard Memory Management and Protection capability, with a 256 K-byte computer on two printed circuit boards. All are available in either a 5-1/4 -in- high, 5-slot chassis or in a 10-1/2 -in- high, 16-slot chassis.

NOVA 4/C has a NOVA 3's speed on a single board; the two-board NOVA 4/S and 4/X models are 50% faster than the NOVA 3. Instruction set enhancements add new byte manipulation and integer arithmetic capabilities to the NOVA 3 instruction set.

The CPU board in all three models contains an asynchronous terminal interface, real-time clock (optional in NOVA 4/C), Memory Management and Protection Unit (in NOVA 4/X only), automatic program load, power fail/auto restart, virtual console, and optional hardware multiply/divide. In the NOVA 4/C, the CPU board also contains up to 64 Kbytes of semiconductor memory.




**The two-board design of Data General's NOVA 4/X computer shown above incorporates CPU, MMPU, async interface, real-time clock, automatic program load, and power fail/ auto restart on the CPU board, an up to 256 Kbytes on a single memory board.**

The microprogrammed NOVA 4 incorporates the 16-bit NOVA 3's architectural features including hardware stack and frame pointer, high-speed DMA channel and 16-level priority interrupt structure.

The NOVA 4/S and 4/X prefetch processors store instructions in a high-speed buffer in the CPU, often eliminating memory fetch. High-speed 400-nsec memories are accelerated with standard four-way interleaving, allowing the prefetch processor to load instructions at 20 MB/sec, thus reducing memory conflict on memory modification instructions. This produces typical instruction execution times of 400 nsec for STORE and 200 nsec for ADD. An optional Floating Point Unit operates in parallel with the CPU and executes a double-precision STORE in 200 nsec and double-precision ADD in 1.6 $\mu$s.

Memory boards come in 32 and 64 Kbyte increments for the NOVA 4/S, and 32, 64, 128 and 246 Kbyte increments for the 4/X. NOVA 4/C comes with 16, 32, and 64 Kbyte memory on the CPU board. NOVA 4/X's memory management and protection hardware performs logical-to-physical address translation, providing user programs with access to 256 Kbytes of main memory through four address extension tables – two program maps and two data channel maps.

NOVA system and application software is executed under a multitasking Real-time Disc Operating System, Real-time Operating System, or Disc Operating System. NOVA 4 language support includes FORTRAN IV with ISA real-time extensions, globally/locally optimizing FORTRAN 5, Business BASIC, single- and multi-user extended BASIC, and ALGOL. Communications support includes the Communications Access Manager, the Sensor Access Manager, RJE80 (IBM 2780/3780) and HASP II remote batch terminal emulators. NOVA 4/C (Model 8390-H), $3500; NOVA 4/S (8393-H), $7600; NOVA 4/X (8395-N), $56,886.

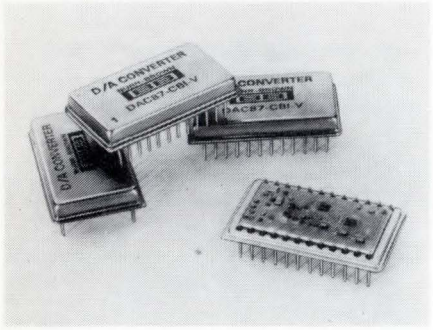
**Data General Corp.**, Rte. 9, Westboro, MA 01581. (617) 366-8911.

**Circle 168**

# NEW PRODUCTS

### 12-BIT DAC

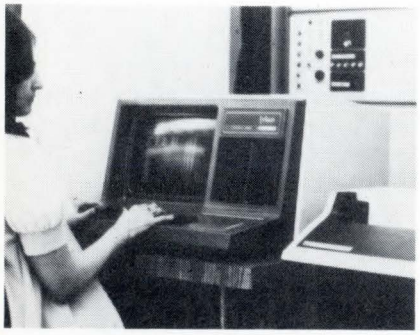
A total error of 0.3% over wide temperature ranges (-55 to +125°C) is offered by the DAC87. This hybrid is guaranteed monotonic and linearity error less than or equal to 1 LSB over the temperature range. Gain Drift is under 10ppm/°C. A later generation of the DAC85, DAC87 is pin compatible with its DAC80 and DAC85 families and




maintains standard pin configuration for complete 12-bit DAC's. DAC87 is housed in a 1.4 x 0.8 x .22" welded, leak proof, hermetically sealed package. It's designed for use in hostile environments, but in applications where the cost of a MIL screened part is impractical. DAC87-CBI-I, $93(100). **Burr-Brown,** Box 11400, Tucson, AZ 85734, (602) 746-1111. **Circle 126**

### PROCESS CONTROLLER

A distributed μP-based control system intended for semiconductor diffusion equipment features English language commands—the Tycom 800—provides precise computer control of time-and event-oriented flow processes in the manufacturing of semiconduc-



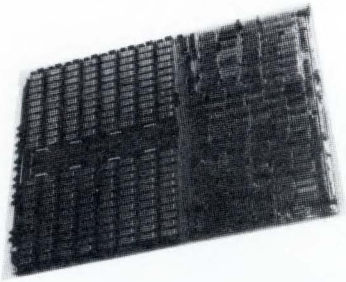
tors, fiber optics and a variety of other industrial flow sequences. It has a 15-in. CRT, keyboard and floppy disc drive packaged in a compact console. An on-line printer for hard copy of data can be accessed to the Tycom with the use of printer commands. **Tylan Corp.,** 19220 S. Normandie, Torrance, CA 90052. (213) 532-3420. **Circle 127**

### PAPER TAPE READER

Model-612 Stand Alone Paper Tape Reader has greater capacity than earlier models. It reads 5 to 8-level tape and transmits 7 to 11 frames/character at 50 to 9600 baud. It starts and stops on character at all speeds, has choice of manual control or X-on, X-off, 90 to 260 V, 50 to 60 Hz power and even, odd or no parity. RS-232, current loop or parallel outputs are available as is a choice of desk top or rack mounting. Model 612, $625-$761. **Addmaster Corp.,** 416 Junipero Serra Dr., San Gabriel, CA 91776. (213) 285-1121. **Circle 128**

### 128Kx22 CARD MEMORY

The MicroRAM 3500 Semiconductor Memory System of the Micromemory 3000 family of cards boasts on-card options such as ECC (single bit error correction and multiple bit error detection) and word or byte parity generation and checking. The card is also available with features such as page mode, byte mode, and error stop and fault location LED display which operates in conjunction with the ECC option. Provisions have been made for battery back up. In page



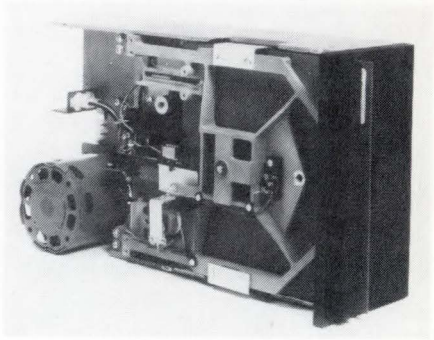
mode with a match condition a cycle time of 270 nsec. is achievable, a no match condition would yield a cycle time of 450 nsec. Non page mode cycles are completed within 400 nsec. The card operates on ±5 and +12 VDC but can also utilize +5 and±15 VDC as an alternative. $4,995, OEM qty. **EMM,** 12621 Chadron Ave., Hawthorne, CA 90250. (213) 644-9881. **Circle 129**

### TERMINAL ATTACHMENT

Comm-Stor III, when attached to the user's asynchronous RS-232 terminal, provides a sophisticated data entry station. Standard business forms and user-defined formats are easily set up on the system to simplify data entry. Comm-Stor III requires no intelligence in the user's terminal and, through an internal μC, provides all intelligence necessary for forms data entry, validation, diskette storage and data transmission. Primary application of Comm-Stor III is source data entry of documents, such as: sales orders, job reports, freight weighbills, insurance claims, tax forms and registrations. Data on diskette can be automatically converted by Comm-Stor III to the IBM 3740 Data Exchange Format for immediate entry into IBM systems. $3375. **Sykes Datatronics Inc.,** 375 Orchard St., Rochester, NY 14606. (716) 458-8000. **Circle 131**

### DUAL-HEAD DISKETTE DRIVE.

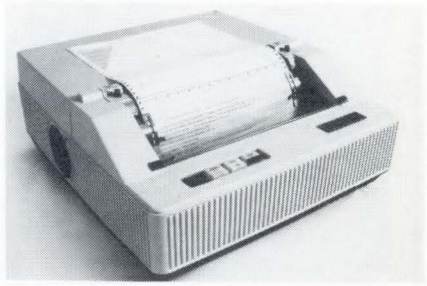
RFD 4000, an IBM media-compatible, flexible disk drive incorporating a test proven dual-head design that features band drive positioning, improving data track significantly over traditional lead screw systems. It is media compatible with the single-sided IBM 33FD and the two-sided IBM 43FD single and double density drives. It stores up



to l.6 Mbytes of unformatted data and 1 Mbyte in IBM 128 byte sector format. Access time of the dual head drive is 3 msec. track-to-track, providing an average seek of only 91 msec. (including settle). The RFD 4000 provides electrical/physical interface compatibility with Shugart's SA 850/851. $740. **Remex, Inc.,** Box C-19533, 1733 Alton St., Irvine, CA 92713. (714) 557-6860. **Circle 132**

### MATRIX PRINTER

This high speed (600 cps) character matrix printer, intended for high-print volume applications, has a print head developed and manufactured by Florida Data Corp. The basic PB-600A ($4300) has standard fea-



tures of a μP controller, 894 character buffer, internal test, and optional switch selectable to 4 different print fonts. The firm has just introduced the BNY printer which also features graphics and plotting capability and a 2-pass character font that looks like a solid character print. This feature is interesting in OCR and labeling applications. **Florida Data Corp.,** 3308 New Haven Ave., West Melbourne, FL 32901. (305) 724-6080. **Circle 137**

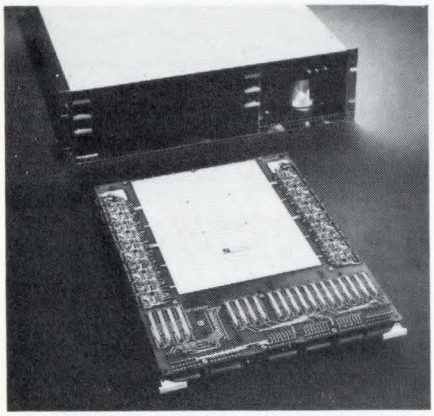
### CRT TERMINAL

The VT-4800 Video Computer Terminal offers 48 lines, 80 characters, 5x7 matrix, u & l case, single board and vector graphics

option. The VT-4800 has its own 4K bytes of RAM (expandable to 16K bytes), complete cursor control, direct cursor addressing by keyboard or software, character read at cursor position (on 8 bit bus), scroll up and scroll down through data (up to 16K bytes), five clearing functions, and page increment and page decrement. It also provides video inversion on any character, decoded and user strappable ASCII control codes, standard RS-232 serial I/O (TTL serial and parallel also), selectable BAUD rates from 110 to 9600, and composite and separate video outputs are available. The VT-4800 can be upgraded to a vector graphics terminal by adding a GT-4800 graphics board. Basic configuration is 256 by 240 (X,Y), and can be expanded to 512 by 480 (X,Y) by adding more RAM and software. $1395. **SLM, Inc.,** 2366 Walsh Ave., Santa Clara, CA 95050, (408) 727-1030. **Circle 130**

### 32K-WORD CORE MEMORY

An enhanced 32K-by-20-bit word core memory system, the STORE/3220, has a 250 nsec. access time and a full cycle time of 650 nsec. The nonvolatile memory is intended for μCs, process control systems and



applications where data integrity and speed is important. The self-sufficient planar memory is fabricated on a single 11.75" wide by 15.4" deep by 1.0" high card. Up to four cards may be linked in one chassis for max. storage capacity of 128K x 20-bit words or 64K x 40 bits. The STORE/3220 is a plug compatible with the Micromemory-3000 interface. Worst-case power requirements are +5V, 3.9A; and -15V, 0.55A. The boards may be housed in an optional 19" wide by 22.4" deep by 5.25" high chassis with a self-contained supply. A self-test card option is available. $2K. **Dataproducts Corp.,** 6219 DeSoto Ave., Woodland Hills, CA 91364. (213) 887-8451. **Circle 134**

### MICROCOMPUTER DESIGN

"Microcomputer Design," a 190-pg. introduction to microcomputers by Carol Anne Ogdin shows how other designers have successfully applied μCs and μPs in the past, and how their experience can be used in your daily work. The emphasis is on how to use μPs – not on how they work or are made. Cloth, $12.95; paper, $8.95. **Prentice-Hall, Inc.,** Englewood Cliffs, NJ 07632. **Circle 290**

# NEW PRODUCTS

### 16-BIT μC SEMINARS

This seminar, to be held March 5-8 at The Ramada Inn, Woburn, MA, details the operation, architecture, instruction set and design techniques for 16-bit μCs. Fully developed case studies illustrate applications and tools and techniques for hardware and software integration are demonstrated. Obtainability and selection of equipment for developing programs and debugging systems are discussed. A comparison of available systems and devices is given (with a preview of products due for near-term introduction). Call Prof. Donald D. French, (617) 964-1412 or write **Institute for Advanced Professional Studies,** One Gateway Center, Newton, MA 02158. **Circle 175**

### DOUBLE DENSITY DISK

Said to be a major breakthrough in disk technology, the STC 8650 double density disk drive offers 635 MB of data storage/spindle by doubling track density from the standard STC 8350 to the highest recording density achieved. STC 8650 is housed in the same physical dimensions as the STC 8350. Users can satisfy immediate needs now with the STC 8350, and later these units can be field upgraded to double their capacity. The new disk is for use in those on-line, real-time applications where higher performance, lower cost products are needed without an increase in space. **Storage Technology Corp.,** 2270 South 88th St., Lousiville, CO 80027. (303) 666-6581. **Circle 173**

### 80 CPS THERMAL PRINTER MECHANISM

The T-80M includes the print head assembly, servomechanisms and servoelectronics; purchasers need only supply external TTL-control signals and power. The operator-replaceable print head is an alumina substrate with thick-film heating elements. T-80M can print in a 5 x 7 dot-matrix or graphic with a 70-dot/in. horiz. and vert. resolution. Typ. character format is 80 col./line with 6 lpi. Min. line feed is 0.0166 in. and paper advance speed is 80 msec/line. Horiz. spacing is 10 cpi; chariage return time is 420 msec. It uses standard 8.75-in.-wide roll-feed thermal-sensitive paper available from Dataproducts, NCR, 3M and Nashua. Max. power requirements are 5V, 0.5A; 5V, 1.75A; 20V, 3.75A; and -20V, 0.9A. Size is 10.5 in. wide, 4.75 in. high and 7.09 in. deep. Weight: 5 lbs. $890 (1), $595 (100). **Dataproducts Corporation,** 6219 DeSoto Ave., Woodland Hills, CA 91364. (213) 88708451 **Circle 172**

### μP-CONTROLLED 125 IPS TAPE DRIVE

Said to be the first μP-controlled 125 ips vacuum volume tape drive featuring total tape control, very low power consumption, small size, built-in diagnostics and a significant reduction in drive design complexity, the quiet "whisper drive" Z-80 based drive is part of Cipher's 900X Series. It maintains total servo control during critical load and unload functions, completely eliminating tape snap, whip or slack. Servo control is retained in power fall situations, even during high speed rewind. (The Z-80 draws power from the servos and transmits it to the electronics so that a controlled stop can be effected.) Other μP functions include precise BOT/EOT sensing (there is no tape overshoot); optical write protect, eliminating need for all switches, solenoids and mechanical adjustments; and built-in diagnostics and service aids to automatically test ROM and RAM logic, indicating any fault conditions on front panel indicators. The drive incorporates 3" wide vacuum columns (versus 2" on traditional designs) arranged in an L-shape. The column design, noted for gentle tape handling, makes possible use of an efficient, low power, multi-stage centrifugal vacuum pump. With a 3400 RPM, beltless, direct-drive motors, this reduces total consumption to 300 W, or less than many tape drives require to run their vacuum columns alone. Size: 19" x 24". It features LED light sources, a hard chromed face R/W head and sapphire tape cleaner, and is available in a 75 ips model as well as with embedded formatting capability. $4,300. Delivery: 60 days ARO. **Cipher Data Products, Inc.,** 5630 Kearny Mesa Rd., San Diego, CA 92111. (714) 279-6550. **Circle 177**

### S-100 DOUBLE–DENSITY DISK CONTROLLER

The DOUBLER, a double density floppy disk controller for S-100 bus computers, increases floppy disk system capacity to over 500 KBytes/side of standard 8" diskettes. Data transfer rate of double density systems is increased to 250 KBits/sec. The doubler is designed for installation in any 8080 or Z-80 S-100 μC operating at 2-4 MHz. On-Board CRC checking is done in hardware, so the controller is capable of reading and writing consecutive sectors. Data is transferred under program control to assure reliable operation. An on-board 2708 EPROM contains the system bootstrap. The board also includes a hardware UART with RS-232 interface for communication with a console device. It's easy to install: the controller interfaces with the CP/M operating system and includes all software to support a CP/M system using the board's serial port as the console device. No software or hardware changes are necessary to begin operation in single or double density. Files may be transferred between single and double density diskettes without operator intervention. System software includes utilities to format and copy diskettes. Versions support most popular single- or double-headed floppy disk drives (both full- and mini-floppy size), as well as a version utilizing the IBM 2D standard. $495. **Micromation Inc.,** 524 Union St., San Francisco, CA 94133. (415) 398-0289. **Circle 176**

### ADD-ON MEMORY FOR IBM 303X COMPUTERS

Add-on Memory for the IBM 3031, 3032, and 3033 mainframes, changed from 933X to 833X family, provides up to 16 Mbytes of main memory. Memory is in 1 Mbyte increments for the 3031 and 3032, and 2M Mbyte increments for the 3033. Said to provide advantages over IBM's, National's memories use latest technology, as 16K RAMs give better eliminate price/performance and higher reliability, take less space, use less power and generate less heat. The design is modular: each Logical Storage Unit (LSU) can be upgraded to requirements of the next 303X model by changing a couple of cards. As for reliability and intelligent maintenance, each LSU has a terminator/display board which gives error information. Field engineers can capture detailed failure information even while the system is running, thus improving reliability by replacing chips with single bit errors. Single bit errors are automatically corrected by system, so early detection and replacement reduces uncorrectible double bit errors. The power modules are switching regulated and twice as efficient as linear supplies. The power modules run for 50 msec without input power. Size: 32" (w) x 18" (D) x 70" (H). **National Semiconductor Corp.,** 2900 Semiconductor Dr., Santa Clara, CA 95051. (408) 737-5000. **Circle 178**

### 8001/2-MSD INTERFACE

TEKLD , an up and down-line load interface between the Tektronix 8001/2 series of in-circuit emulators and MSD systems, provides the necessary protocol for transferring object files from the software development system to the in-circuit emulator and insures correct transfer by constant error checking. TEKLD complements BSO's multi-user, multi-μP software development system, consisting of a computer, peripherals and necessary cross-software. This cross-software is available for any DECsystem10 and 20, any PDP-11 (11/03 through 11/70) and any Data General computer. TEKLD is available at no charge to anyone interfacing a Tektronix in-circuit emulator to any of BSO's software products. **The Boston Systems Office, Inc.,** 469 Moody St., Waltham, MA 02154. (617) 894-7800. **Circle 174**

### TAPE TRANSPORT SUBSYSTEM

Featuring 6250 bpi, Group Code Recording (GCR), the FT6250 conists of the T1940 tape transport and F6250 formatter. T1940 allows users to record four times more data on a reel of tape than conventional 1600 bpi tape drives, moving at up to 125 ips. Capable of controlling up to four T1940 tape drives, the F6250 formatter's built-in keyboard lets operators perform diagnostic functions off-line. The "Smart Bus" interface handled 16 bit word parallel transfers. **Pertec Computer Corp.,** Pertec Div., MS40/04, 9600 Irondale, Chatsworth, CA 91311. (213) 999-2020. **Circle 171**

# NEW PRODUCTS

### FET OP AMP MODULE

Intended for high-speed, high-voltage applications – such as electron beam deflectors, beam intensity modulators, automatic test circuits, and high voltage pulse drivers – Model AM-303's output range is ±10 to ±140V when using a supply range of ±150V. Output current is ±20 mA with internal dissipation limiting. Input CMVR is also ±10 to ±140V with a CMRR of 100 db min. Output settling time of 0.01% of final value is 2.5 $\mu$ for a 10V step, slew rate limitation is 100V/$\mu$ min. and gain bandwidth product


is typ. 10 MHz. Input impedance is $10^{12}$ Ω; max. input bias current, 100 PA. There are two grades of the amplifier by input offset voltage drift: 50 $\mu$V/° C maximum for the AM-303A and 20 $\mu$V/°C max. for the AM-303B. Supply voltage is ±15V to ±150V at 12 mA max. quiescent current. Module size is 2.4 x 1.8 x 0.61" with an aluminum base for max. heat sinking capability. AM-303A (50$\mu$V/°C). $95; AM-303B (20$\mu$V°/C). $126 (1-9). **Datel Systems, Inc.,** 1020 Turnpike St., Canton, MA 02021. (617) 828-8000. **Circle 238**

### PRINTER/PLOTTER

The 150 1pm T-1100A is software and plug compatible with Versatec's electrostatic printer/plotters, utilizes raster matrix and plots at 15 ipm with dot density of 200 dots/in on plain paper. T-1100A uses standard fan fanfold paper at 0.5¢/sheet – not the 2.0¢ special sensitized paper uses – and handles forms 4 to 16 in wide and up to 6 parts, using no chemicals. **Trilog,** 17845 Skypark Cir., Irvine, CA 92714. (714) 549-4079. **Circle 154**

### TI 9900 FAMILY SUPPORT

Pivot software enables the Intel MDS-800 or Series II user to design with 9900 family $\mu$Ps. All Pivot software is specifically contructed to function within Intel's ISIS-II operating environment. Source and object modules used and produced by Pivot are compatible with TI's 9900 family software development tools. Pivot 9900, ($1500), the first in the Pivot line, provides: 9900 Relocating assembler, 9900 Linking Locator, 9900 Simulator, 9900 PROM programming utility, complete documentation and a one year software upgrade subscription. Pivot 9940 adds TMS 9940 development to the Intel MDS and is available as an add-on package to Pivot 9900 or a stand-alone package. **Processor Innovations,** 118 Oakland St., Red Bank, N.J. 07701. (201) 842-8110. **Circle 148**

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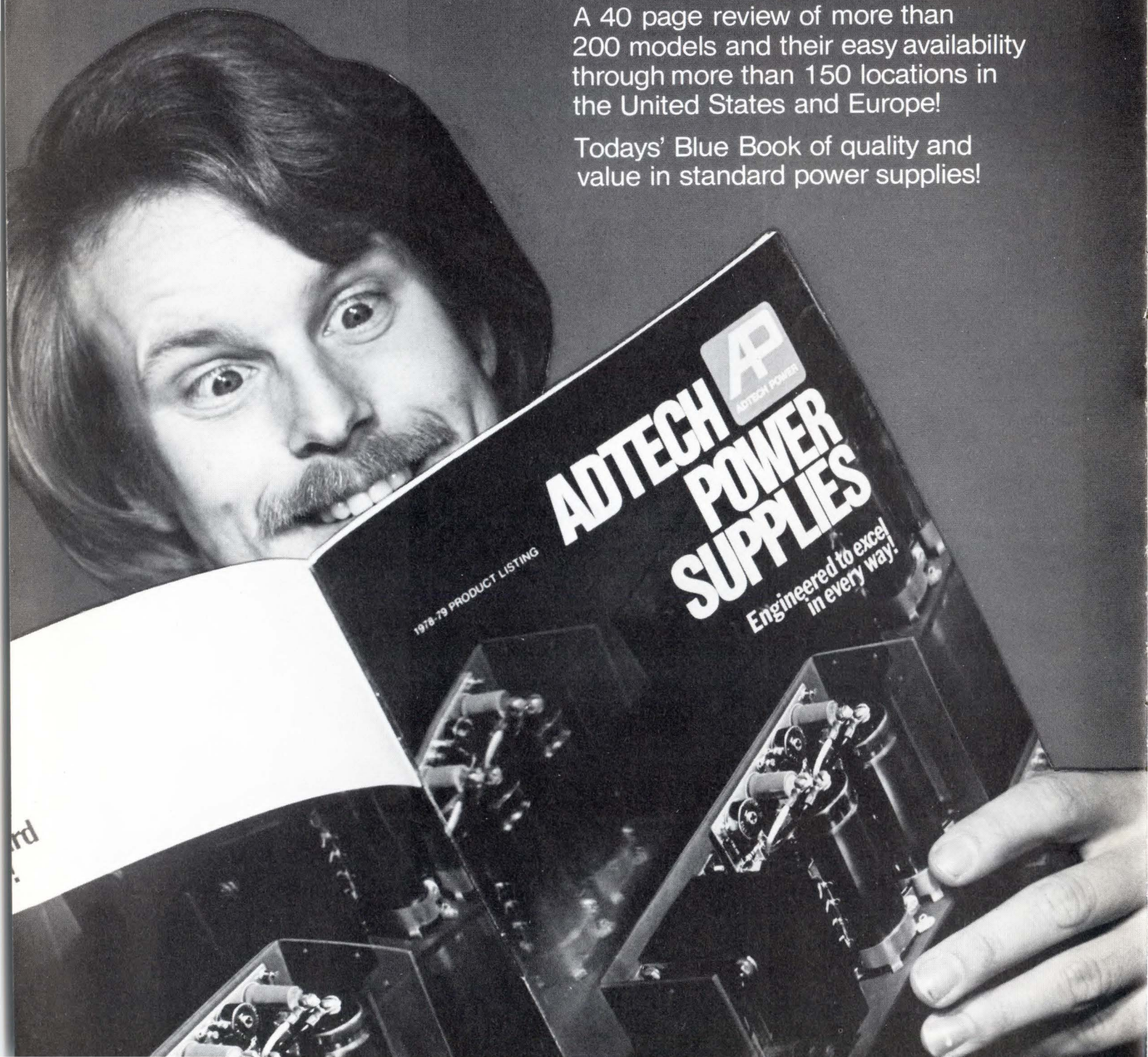

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# NEW PRODUCTS

### TERMINAL ATTACHMENT

Comm-Stor IV, a BASIC programmable terminal attachment, includes, in addition to BASIC commands, a second command set of unique and powerful data communication and file management functions, thus simplifying programming data entry, storage and transmission applications. It comes with either a single or dual floppy diskette drive, 4K to 40K bytes of user program memory

and communication ports for connection to an asynchronous RS-232 terminal, printer and modem. The Extended Basic interpreter, sophisticated file manager and flexible data communication system are all resident as firmware in an additional 40K bytes of ROM. The minimum configuration – with a single diskette drive, 4K of memory and two ports – is priced at under $4,000. **Sykes Datatronics, Inc.**, 375 Orchard St., Rochester, NY 14606. (716) 458-8000. **Circle 141**

### F8/3870/3872 EMULATOR SUPPORT

The Tektronix 8001/8002A Microprocessor Development Labs provide total μP design and debug environments. Both support several μPs – including the 6800, 8080A, 8085A, Z-80 and TMS 9900 – and now the F8 and 3870/3872 in a single support package, with a commitment to support the M6802. A complete software development system, the 8002A solves designers needs for every phase of the design task from software development to software/hardware integration and hardware debugging. The 8001, a work station version of the 8002A, is used with software developed on the user's host computer to provide software/hardware integration capability. This critical phase of μP development takes about 50% of design time. 8002A, $13,700; add-on F8/3870/3872 emulators for existing 8002As, $2450. Logic Development Products, **Tektronix, Inc.**, Box 500, Beaverton, OR 97077. (503) 644-0161. **Circle 136**

### IMAGE PROCESSING SYSTEMS

VISION ONE/20, a complete digital image processing system, features full stand-alone image processing capacility up to 134 Mbits of refresh memory up to 512 bits deep. It has multiple use features for operators in a wide range of research and analysis. VISION ONE/20 has a capacity for 8 million colors, pseudo color and true color. It offers real-time processing (1/30th sec. response time), and unparalleled bright transforms in addition to convolution, sharpening the image under review. The system also has built-in full competence for arithmetic functions–adding, subtracting, multiplying and dividing. Classification capability is built-in: multiple scenes may be given assigned color codes. The VISION ONE/20 also has feedback of all processed images for storage and retrieval. **Comtal, Inc.**, Box 5087, Pasadena, CA 91107. (213) 793-2134. **Circle 133**

### PAPER TAPE SPOOLER

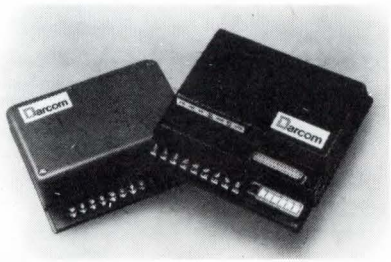
Model 650 Paper Tape Handler, for use with the Addmaster 601 Paper Tape Reader, is completely self-contained, including the reader supply and is available with the Addmaster Paper Tape Reader. It reads "step-by-step" on external command, or runs on the internal clock at 150 cps. It is bi-directional in both read and high-speed slew mode, and needs only two control lines. The Reader-Spooler combination stops on character and has automatic end-of-tape/broken tape sensing and fully proportional servos. Model 650 has standard 19" rack panel, 5-¼" high and uses 5-¼" diameter reels. Spoolers, $370-$461; Readers, $184-$325. **Addmaster Corp.**, 416 Junipero Serra Dr., San Gabriel, CA 91776. (213) 285-1121. **Circle 135**

### ZIF IC CONNECTOR

Installing and removing card file ICs without placing stress on lead pins or substrate is possible with these Zero Insertion Force connectors. Actuating bars on each connector side open and close the contacts, which hold the IC firmly in position. Edge-wipe contact design provides highest contact pressure and tapered entry ramps condition and guide IC leads into spacious, semi-closed contact entry area. Contacts are CA770 and available with gold plating, P/N 11857-01 or bare, P/N 11857-02. **Zero Corp.** Scanbe Div., 3445 Fletcher Ave., El Monte, CA 91731. (213) 579-2300. **Circle 140**

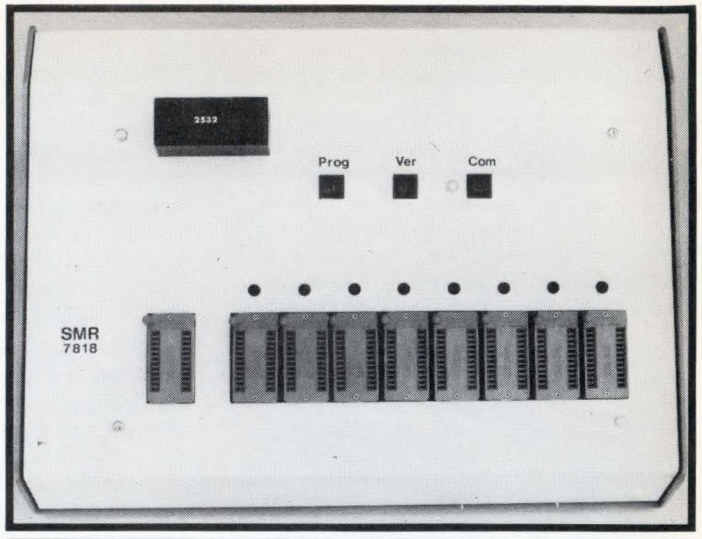
### DATA COUPLER

The D101 Data Coupler provides an automatic interface between a phone line and customer-owned equipment, such as a modem or data terminal. It has standard Bell




CBT functions, operates from a single +5 V supply and requires no adjustment. Ring indication, off-hook control and balaced data transmission are standard features. The data coupler is registered as required by Part 68 of the FCC Rules and Regulations. $149.95. **Darcom**, 268 N. 115th St., Omaha, NE 68154. (402) 333-9858. **Circle 139**

# THE EPROM COPIER FROM SMR




## Description

The Model 7818 is a self-contained EPROM copier designed for production line applications. Low cost personality plugs permit copying of a wide variety of EPROMs and virtually insure the Model 7818 against obsolescence. Both 3-supply and single supply type EPROMs can be copied.

Operation of the Model 7818 is exceedingly simple:

1. Insert the appropriate personality plug in the connector on the panel face.
2. Insert a master EPROM in the "Master" socket.
3. Insert one to eight erased EPROMs in the "Copy" sockets.
4. Depress "Program" switch.

The Model 7818 automatically checks to see that the copy EPROMs are erased. If any failures are found, the LEDs above failed units light and the program is inhibited.

After the programming cycle, a verification check of each copy is made with LED indication of any failures. The verify cycle may also be used independently. The "Verify" lighted pushbutton flashes to alert the operator to any failures on either verification pass.

Supply power is present at the EPROM sockets only during the active operations of program and verify to provide protection for the EPROMs during insertion and removal.

## Specifications

| | |
|---|---|
| Modes: | Program; Verify; Complete (Ready) |
| Size: | 13" w (33 cm) x 5.5" h (14 cm) x 9" d (23 cm) |
| Operating Temperature: 0° to 50° C | |
| Power Input: | 115 - 125 VAC, 25W approx. |

## Ordering Information

| | |
|---|---|
| Pricing: | Model 7818 - $1,325<br>Personality Plugs - $20 ea.<br>(order personality plugs by EPROM number -2704, 2708, 2758, 2716-3, 2716-1,2516, 2732, 2532) |
| Delivery: | 45 - 60 days ARO |
| Warranty | Parts and Labor for 1 year: |

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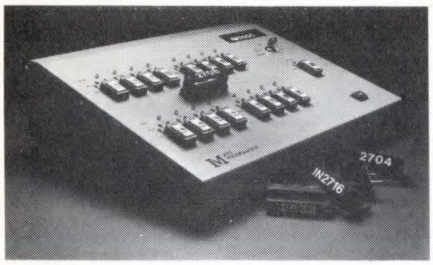
**SMR electronics**

**3 HAVEN ROAD MEDFIELD, MA 02052**
**(617) 359-7697**

# NEW PRODUCTS

### GANG PROM PROGRAMMER

Said to be the first human engineered GANG PROM Programmer, IM2020 programs 16 PROMs simultaneously and supports the 2704, 2708, 2758, TI 2716, Intel 2716 and 2532. Various automatic operating modes of the IM2020 are selected using a lockable switch. Operator prompting and programmer status are provided by a 10-digit alpha numeric display, two status LEDs/PROM socket and audible buzzer. The operator initiates all functions through only one lighted push button switch. $2895 with one personality module; additional modules, $100. **International Microsystems, Inc.,** 11554 C Ave., Auburn, CA 95603. (916) 885-7626. **Circle 149**




### 1640 SERIES TERMINALS

The Model 1640 series of terminals and printers uses a plastic daisy wheel in three configurations: a keyboard send/receive terminal, receive only terminal and OEM printer mechanism. Standard features include: programmable line spacing, pitch, margins, tab control and graphics capability, a 256-character buffer and self-test diagnostic maintenance routines. Firmware options include automatic underscore, automatic bold overprint, automatic shadow printing, automatic proportionally spaced printing, automatic right margin justification, automatic line centering, 2741 communications protocol, HyPlot vector graphics, APL and external diagnostics. Hardware options include power supplies, control panel, type of cover set, forms tractor, an option board, current loop interface, an expanded buffer, special keyboards including APL and logical bit, and forms handling equipment. The serial interface feature of the 1640 permits operation at rates to 9600 baud, while operating speed for parallel mode is to 2000 cps. KSR version, $2,280. **Diablo Systems, Inc.,** 24500 Industrial Blvd., Hayward, CA 94545. (617) 237-3200. **Circle 142**

### MODEL 1650 TERMINALS

Model 1650 receiving only metal-wheel processing terminals incorporate the Diablo-designed universal interface and permits serial printer operation at up to 9600 baud or parallel operation at up to 2000 cps. The 1650 series contains many standard features: programmable line spacing, pitch, margin and tab control, true proportional spacing, a graphics capability, a 256-character buffer and self-test diagnostics routine. Optional features include: automatic proportional spacing, underscoring, bold overprinting and shadow printing, 2741 communications protocol and HyPlot vector graphics. **Diablo Systems, Inc.,** (A Xerox Co.) 24500 Industrial Blvd., Hayward, CA 94545. (415) 786-5207. **Circle 152**

### HIGH-SPEED DRUM PRINTERS

This well-illustrated, 38-pg. technical assistance manual, "5321/5301/5031 High-Speed Drum Printers," describes the 5321 buffered console printer, 5301 unbuffered console printer and 5031 printer mechanism. Also included are interface specs, as well as a section on general information such as warranties and recommended spare parts. **Mohawk Data Sciences Corp.,** 781 Third Ave., King of Prussia, PA 19406. (215) 337-1910. **Circle 147**

### SINGLE-DISK CARTRIDGE

A Winchester-type disk in 180 series single-disk cartridge models, allows users to store from 18M to 47Mbytes, 5 to 8 times the capacity of conventional high-density cartridges. Models 180 (37 Mbytes), 181 (47 Mbytes), 182 (18 Mbytes), and 183 (25 Mbytes) may be used with front- or top-loaded disk drives such as the Data General Corp. 6070, Hewlett-Packard Co. 7905A, Wangco 2400 and EMM 312 Series. The cartridges are especially suitable for higher speed R/W operations of mC, $\mu$C and System/3-level environments. **BASF Systems,** Computer Products Dept., Crosby Dr., Bedford, MA 01730. **Circle 144**

### LINE PRINTER CONTROLLER

DEC PDP-11 Line Printer Controller (DLP 11) supports either Centronics or Dataproducts type printers, operates on any DEC PDP-11 computer without software or hardware modification. DLP 11 has cabling and connectors to interface directly to the printer used. A self-test mode simplifies installation and testing. $750. **DataSystems Corp.,** 8716 Production Ave., San Diego, CA. (714) 323-7491. **Circle 143**

### MICRO800 CURRENT LOOP INTERFACE

Micro800 data concentrator, available with a current loop adapter, permits attachment of terminals with 20 mA current loop interface. The adapter, 2" square, plugs into the 25-pin connector of the Micro800 channel interface. It uses statistical multiplexing techniques to allow up to 16 asynchronous terminals to share a single phone line, with efficiency double that of a conventional time-division multiplexer. It provides automatic retransmission on error for all terminals using the system. Current loop adapter, $60. Models from 2-channel to 16-channel, from $1,150. **Micom Systems, Inc.,** 9551 Irondale Ave., Chatsworth, CA 91311. (213) 882-6890. **Circle 145**

# NEW PRODUCTS

### LSI-11/2–COMPATIBLE MEMORY

NS 11/2P, new 64K byte "double-height" LSI-11 compatible memory card, provides features normally found only on larger "quad height" cards. The 32K 18-bit dynamic NMOS RAM has on-board parity generation and parity check circuits, external or internal refresh functions, battery backup provisions and expanded address-space operation. The 5.187" x 8.43" x 0.50" card is plug compatible with the LSI-11, LSI-11/2 and PDP-11/03. The memory may be operated with, or used in place of the MMV11-D and -E or MSV11-D and -E series modules in H9281, H9270 or DDV11-B backplanes. No special tools or adjustments are required to install and operate the memory. The NS11/2P has a read-access time of 250 nsec, a read-cycle time of 500 nsec, a write-time of 130 nsec/word or byte, a write-cycle time of 545 nsec, and a read/modify/write-access time of 250 nsec/byte with a R/M/W-cycle time of 1115 nsec. **National Semiconductor Corp.**, 2900 Semiconductor Dr., Santa Clara, CA 95051. (408) 737-5000. **Circle 163**

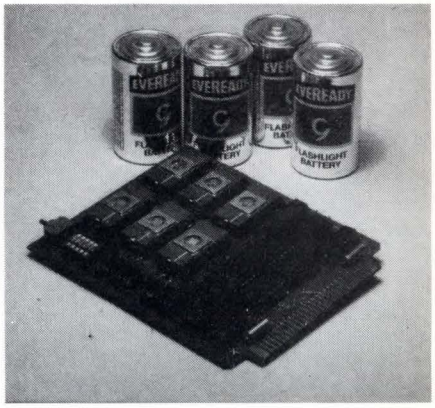


### 8086 MEMORY BOARDS

These Error Correcting Memory boards are iSBC 86/12 (8086 Based) Multibus Compatible. The new memory boards are available in four memory sizes–16K, 32K, 48K and 64K words. The boards are strappable for either 16-bit word or 8-byte memory transfers. All four sizes come in three configurations: single-bit error correction and double-bit error detection, single bit parity, or without parity or error correction. All error-correcting configurations have diagnostic indicators that pinpoint precisely the erring memory chip. The error status is also available to the CPU via software control. This feature is convenient and cost effective in the field service and manufacturing phases of iSBC-based products. (16K words/32K bytes memory), $1375; 64K words/128K bytes, $4250. **Mupro,** 424 Oakmead Pkwy., Sunnyvale, CA 94086. (408) 737-0500. **Circle 164**

### CMOS UV EPROM/RAM BOARD

This low-power, UV eraseable PROM card (2K 12-bit words), LP-12J, has sockets for 6 Intersil IM6603 EPROMs and includes




256 x 12 CMOS RAM (3-IM6561's). Memory organization permits 4" x 5" card to be stuffed with either 1K or 2K of EPROM. $170. **Cybertek, Inc.**, 10395 Seminole Blvd., Seminole, FL 33540. **Circle 243**

### DATA ACQUISITION UNITS

This 24-page book shows new data acquisition products and applications. 14 pages cover $\mu$P-compatible devices. Typical circuits are shown for popular $\mu$Ps. Key specs are given for over 175 D/A and A/D converters, S/H, instrumentation and programmable gain amplifiers, thin film resistor networks and precision function generators. **Micro Networks Corp.**, 324 Clark St., Worcester, MA 01606 **Circle 159**

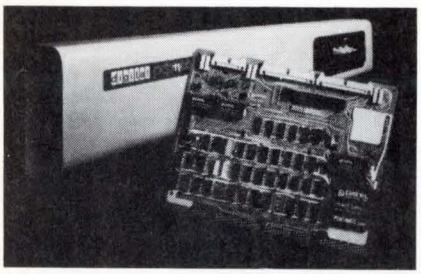
### FIBER OPTIC LINK

A complete fiber optic link for data communications applications requiring no expertise in optical design, calibration or adjustment? HFBR-0010 low-error rate fiber optic link system comes ready to hook up and has a digital XMTR, digital RCVR, single fiber 10 connector/cable assy. and complete tech. literature. Each component is available separately, and connector/cable assemblies come in 5 std. lengths, with a

max. distance of 100 m. System specs include a dc to 10 Mb/sNRZ data rate, no restrictions on data format, 0 to 100 m link distance, $10^{-9}$ maximum at 10 Mb/sNRZ bit error rate, TTL-compatible data input and reinforced, polyurethane jacketed, single fiber, glass core and cladding cable construction. $570. **Hewlett-Packard Co.,** 1507 Page Mill Rd., Palo Alto, CA 94304. (415) 856-1501. **Circle 242**

### LSI-11 ANALOG I/O BOARDS

Intended for the LSI-11 and PDP-11/03, the ST-LSI features: 32 A/D and 2 D/A analog channels on a single board that slides directly into DEC's LSI-11 and PDP-11/03, direct expansion to 64 SE or 32 Diff (A/D channels



on 2 boards), 20 μs A/D throughput, 16-frequency programmable pacer clock time base, and optional programmable gain amp or fixed gain instrumentation amp. $625 (16 ch.). **Datel Systems, Inc.,** 1020 Turnpike St., Canton, MA 02021. (617) 828-8000. **Circle 250**

### DIRECT WRITING RECORDERS

This portable, 50 mm single-channel direct writing recorder, the 2100, is compact and lightweight (22 lbs.) for easy portability, yet withstands rough handling. Two input power options (115 V, 60 Hz ±10% and 230 V, 50 Hz ±10%) permit operation from conventional ac power sources. A high-stiffness servo controlled penmotor provides dc to 30 Hz FS frequency response at 50 mm, and dc to 80 Hz at 10 mm, 3 dB down at 125 Hz. Linearity is 99.5% over the full 50 mm channel width, rise time is 8 ms and overshoot is 1% on square waves and transients. Trace presentation is rectilinear for ease and accuracy of waveshape interpretation, and 8 chart speeds from 0.4 to 125 mm/s are provided. The 2100 accepts the full line of Gould 4600 Series plug-in amps for max. flexibility in industrial, scientific and biophysical measurement applications. **Gould Inc., Instruments Div.,** 3631 Perkins Ave., Cleveland, OH 44114 (216) 361-3315. **Circle 146**

### ANALOG I/O BOARDS

This I/O system interfaces μP logic to industrial controls. The system has a universal mounting rack and four plug-in modules, AC output, AC input, DC output and DC input. Each color-coded module contains its function, so you can "modify" your system simply by adding, subtracting or changing modules. Boards hold from four to 24 modules. All modules provide 2500 V rms photoisolation, immunizing the μP from transients and RFI. All mounting racks use a 50-pin edge connector for μP control connections. Module price, $10.50 (100); 16-module board, $57. **OPTO 22,** 5842 Research Dr., Huntington Beach, CA 92649. (714) 892-3313. **Circle 161**

### INTEL SEMICONDUCTOR DATA

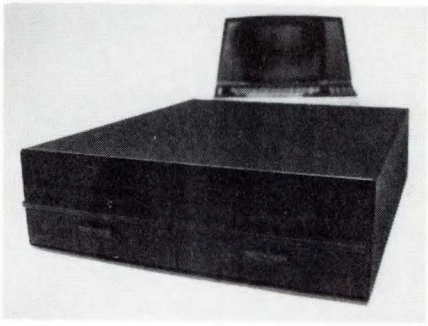
"THE SEMICONDUCTOR MEMORY BOOK" (524 pp.) is said to offer the most extensive collection of Intel memory application and reliability information available in a single volume. Computer technicians, electrical design engineers, electronic hobbyists, libraries, and educators should find it a valuable reference and working tool. Future Wiley/Intel publications will cover other aspects of memories, μPs, μCs and related subjects. $14.95. **John Wiley & Sons, Inc.,** 605 Third Ave., New York, NY 10016. (212) 867-9800. **Circle 166**

### ACOUSTIC COUPLER

The 1200 bps AJ 1234/VA3434 full duplex acoustic coupler will have a major impact on users of acoustic couplers who have had to settle for 300 bps full duplex operation. Now merely replacing present couplers increases their full duplex data transmission speed by four, yet retains portability an acoustic coupler provides. Users select either a 1200 bps full duplex acoustic coupler or 1200 bps full duplex modem. **Anderson Jacobson, Inc.,** 521 Charcot Ave., San Jose, CA (408) 263-8520. **Circle 246**

### FLOPPY DISK SYSTEMS

This family of 8" floppy disk drive systems has three members: the single drive, single-side, single-density LFD-1 system; dual drive, single-side, single-density LFD-2 system (both using Shugart SA-800 drives); and



a dual-drive, double-sided, single-density DFD-2 system based on Shugart's SA-850 drive. Each of the new systems comes complete with a disk controller board, regulated supply, chassis, fan, diskette and interfacing cables. The disk controller board drives up to 4 drives. LFD-1, $1395; LFD-2 $1895; DFD-2 $2495. **Smoke Signal Broadcasting,** 6304 Yucca Street, Hollywood, CA 90028. (213) 462-5652. **Circle 248**

### LINE PRINTER/PLOTTER

Working with PDP-11s, LXY11 outputs 300 1pm for char and 170 1pm for plots. Its double- and single-height char are in full ASCII 96-char set. You plot thru PLXY-11M software, a library of FORTRAN-callable subroutines. $14,400. **Digital Equipment Corp.,** Maynard, MA 01754. (617) 493-2777. **Circle 153**

# NEW PRODUCTS

### GRAPHICS IMAGING SYSTEM

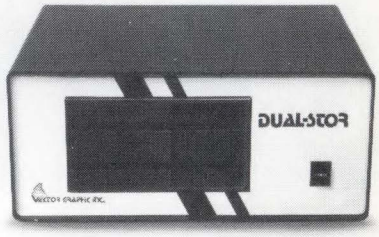
Said to be the industry's first complete graphics imaging system on a single printed circuit board, the RGB-256 card features a dense 256 X 256 X 4 image memory, built in composite color and grey scale encoders and a phase lock loop. This permits the RGB-256 to directly drive standard low-cost color or B & W TV monitors to display up to 256 colors or shades. RGB-256 allows system designers to obtain high quality graphics imaging at a fraction of the usual cost. The card includes built in NTSC (American) or PAL (European) color and grey scale encoders which can provide up to 16 shades or colors. The encoders permit the RGB-256 to directly drive standard low cost color or black and white TV monitors on a single 75 Ohm cable. In addition, the card includes an on board PLL, permitting the output to be synchronized to an external video source (such as a TV camera). This allows the RGB-256 to be used in broadcasting, or wherever its output will be mixed with other video signals. Combining multiple RGB-256 cards can obtain more bits/pixel. Two RGB-256 cards give 8 bit planes. The two-card system with no additional hardware gives a total of 256 colors or grey levels. A separate frame grabber card, the FG-01 will be available soon, allowing RGB-256 to store TV pictures. RGB-256 uses standard +5V, and ± 12V supplies and features the Intel Multibus, making it directly plug compatible with all Intel and National single-board computers. $1595 (1), $1295 (100). Delivery: 4 wks ARO. **Matrox Electronic Systems Ltd.,** 2795 Bates Rd., Montreal, Que. H3S 1B5, Canada. (514) 481-6838 or 735-1182.

**Circle 169**



### DUAL-FLOPPY DISK

Fully integrated, this S-100-compatible dual-floppy disk system – "Dual-Stor" – comes with controller and dual FD drive in a cabinet that matches the Vector 1 μC. Its 243K




bytes/8" diskette utilizes std. IBM-compatible recording format. Using programmed data transfer, Dual-Stor operates with both static and dynamic memories at 250K bps. $2300. **Vector Graphic Inc.,** 31364 Via Colinas, Westlake Village, CA 91361. (213) 991-2302. **Circle 245**

### ERROR-CONTROL CODING

Dr. Dimitri Wiggert's "Error-Control Coding and Applications" addresses the communications engineers' most vexing question–is what you're sent what you get? And, if not, how can you reliably detect and correct errors in data transmission with a maximum of speed and efficiency with a minimum of costly equipment and storage space? Wiggert's treatment of error-control techniques is applications-oriented; practical examples illustrate the text's decoding schemes detailed in the text. Error-control techniques include: parity check codes, cyclic codes, convolutional codes, and BCH and R-S codes, and threshhold, sequential, block and Viterbi decoding schemes . . . Chapters treat communications theory, matrix algebra, impulse noise and trade-off analyses. $28.50. **Artech House Books,** 610 Washington St., Dedham MA 02026 **Circle 167**

### PRINTER/PLOTTER

This instrument (and on one tape) provides readouts in either 5 x 7 dot matrix characters or graphic formats. PP-101 accepts inputs directly from any TTL-compatible parallel data source. Once you decide which display format is needed (either tabular or graphic), simply ground the appropriate terminals on the interface connector with pieces of wire, with manual switches, or under program control from external logic. An onboard μC provides all necessary in-

terface and control functions, including (self-strobing). The PP-101 is also supplied without the cabinet. $595 (1-9), $395 (100). **B-G Instruments,** Box 67, Alta Loma, CA 91701. (714) 989-4802. **Circle 160**

### 32K PROM BOARD

This Intel SBC-80 Multibus-compatible PROM-32 accepts 16 2716 RPROMs. All ICs, including PROMs, are socketed. Base addresses fall on 16-K boundaries and are jumper-selectable. Any number of 2K memory address blocks may be deselected by jumper removal. Memory access time is 475 nsec max. The board uses 5 V at 0.38 A typ. and 0.72 A max fully loaded. **Electronic Solutions, Inc.,** 7069 Engineer Rd., San Diego, CA 92111. (714) 292-0242. **Circle 156**

### TRIMMING POTS

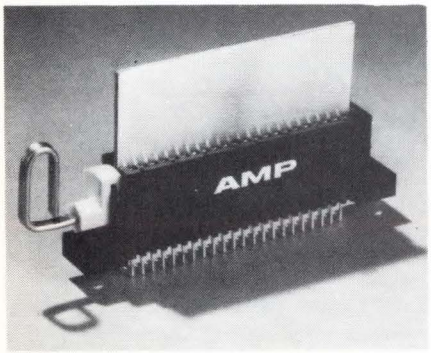
This 150-pg. book shows a broad line of precision and trimming pots, digital and concentric turns-counting dials, and mini rotary switches. Full spec sheets are available for each product. **Spectrol Electronics Corp.,** Box 1220, City of Industry, CA 91745. **Circle 157**

### TEST INSTRUMENTS

A broad line of electronic test instruments are described in this catalog. There are scopes, labgrade strip and X-Y recorders, supplies, signal and function generators, counters, digital and analog multimeters, and accessories such as probes and interconnecting cables. **Heath Co.,** Dept. 570-030, Benton Harbor, MI 49022. **Circle 158**

### SEQUENTIAL ZIF EDGEBOARD CONNECTOR

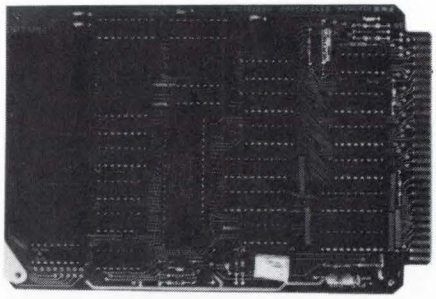
Said to be the only available sequential ZIF connector, this device includes a contact timing mechanism to ensure that signal, power and ground circuits make and break in proper sequence during PC board mating and unmating. Placement of the rotary-cam actuator, combined with an open board slot at one end of the connector housing permits PC board entry for packaging versatility.




(Top-entry versions are available.) A safety lock prevents contacts from closing unless the board is properly positioned and helps hold the board in place. Double-sided or multilayer boards 0.054" to 0.070" thick with up to 130 contact pads (65 per side) on 0.100" centerline spacing, or up to 100 contact pads (50 per side) with 0.125" centerlines, or up to 86 contact pads (43 per side) with 0.156" centerline spacing can be used with this new connector family. Tandem arrangements with up to 240 contacts (120 per side) are possible. Gold-over-nickel-plated phosphor bronze contacts are rated at 3 A. Life expectancy exceeds 5000 mating cycles. Operating temperature range is -55° to +105° C. 5¢ contact (OEM qty). **a AMP Inc.,** Harrisburg, PA 17105. (717) 564-0100. **Circle 165**

### SINGLE-CARD Z-80 SYSTEM

Pro-Log's latest addition to its family of single-card, 8-bit microprocessor PLS-898, is based on the popular Z-80 processor. PLS-898 has a 2K-byte, 2114-type RAM



capacity (1K included) sockets for up to 8K bytes of 2716-type EPROM, a 400-ns state time, on-card XTL clock, masked and unmasked interrupts, 2 input ports, and 3 output ports. The number of input and output ports is expandable to 8 ea. with a ribbon-cable expansion system; the card is TTL-compatible and operates from a +5Vdc supply. $185 (100). **Pro-Log Corp.,** 2411 Garden Rd., Monterey, CA 93940. (408) 372-4593. **Circle 244**

### VT-52 CRT TERMINAL REPLACEMENT

The Monarch-52, a cost-reducing alternative to the DEC VT-52 CRT Terminal, can reduce the high cost of data-entry for your System 8, 10, 11, or similar computer. The Monarch-52 offers operator ease: changing from a typewriter to the Monarch-52 keyboard requires no training, since the operator has complete familiarity with the keyboard. It operates in complete silence or the operator can turn an audible response switch to produce a key-stroke click that encourages rhythmic keying. Monarch-52 has a full range of cursor controls and offers both incremental and extended movement commands utilizing the escape sequences. Its edit feature offers extended movement commands, greatly increasing operator throughput in form-filling, Monarch-52's specs include: 1920 characters/screen, with 24 lines of 80 characters each; switch selectable from 75 baud to 9600 baud asynchronous data transmission; full ASCII – 128 codes (including escape sequence commands); full cursor control, including x-y positioning; horiz. tab and selective erasing; ease of interfacing with 20mA current loop/and RS-232C levels; and N-key roll-over protection. $1360. **Dataview, Inc.,** 23A Dana St., Malden, MA 02148. (617) 322-2244. **Circle 170**

## NEW PRODUCTS

### DIP BATTERIES

Need standby power that directly mounts onto PC boards? Said to be the first standardized auxilliary power sources compatible with DIP microelectronic components, DataSentry, DIP-type nickel-cadmium batteries have four standard pin locations for direct mounting to PC boards. These batteries render volatile LSI non-volatile. These batteries hold up a memory drawing 10 $\mu$a for 3 mo. (or a larger memory drawing 0.5 A-for 5 min). Rated for a capacity of 65 mA-hr at a 1 hr. discharge rate, they have a 6.5 A discharge capability for 1 sec. They continuously overcharge at 7 mA. It comes in two voltage ratings – 2.4 and 3.6V. The former has a 0.3 by 0.1 in. centerline dimension; the 3.6 unit is set on 0.6 x 0.1 in. 2.4 V model, $5.50; 3.6V, $8.25 (1-49). **General Electric Battery Dept.,** Box 861, Gainesville, FL 32602. (904) 462-3911.

**Circle 162**

### ELECTRONICS MANUFACTURING

"Handbook of Electronics Manufacturing Engineering," a 394-pg. book by Bernard Matisoff, offers guidance in facilities planning, processes, plant and equipment layouts, tool and equipment selection, design and development, value analysis and cost control, integration of new equipment or production techniques into existing facilities, and R&D of new manufacturing methods. It provides work-saving tips on soldering, tool care, repair of electronics parts and PCBs, design and production of electronic assemblies, handling and storage of hazardous materials and maintaining safe working conditions in the general plant. $32.50. **Van Nostrard Reinhold** (Litton Ind.), 135 West 50th St., New York, NY 10020. (212) 265-8700.

**Circle 155**

## Do You Want to Write a Paper?

Are you qualified to write a talk on packet switching in digital transmission networks? If you are a packet switching expert and want more details, call or write us to let us know what specific part of packet switching that you want to handle.

The technical session will take place at the INTERFACE 79 Conference, to be held in Chicago, April 9–12, 1979. It will be part of a program on digital transmission and switching systems, which is expected to cover such topics as digital switches, fiber optics, digital telephony and packet switching. Interested? Call or write George King, 442 Begonia Ave., Corona del Mar, CA 92625. (714) 675-7123.

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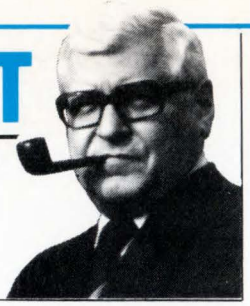
# VIEWPOINT

**John R. Welty**, *Vice President*
*Motorola Inc., Phoenix, AZ*



# Who Says Discretes Are Dead?

Ever since the development of the IC, many observers of the semiconductor scene often downplayed discrete components' future. The usual gloomy scenario called for the discrete industry curve to generally flatten during the 1970's, continue on a descent throughout the 1980's and almost fall completely off the charts by the 1990's.

The reason for this outlook was the phenomenally rapid growth of IC technology, in which more discretes were integrated into silicon chips, losing their identity as discrete components. As you know, ICs quickly advanced from 10 or 15 transistors/chip to 30,000 to 40,000 in the same-sized silicon chip. And there isn't much doubt that it will escalate to 200,000 or so by the early 1980's, and to perhaps a million/chip by 1985 or so.

I honestly believe that the microprocessor will be one of the most important – if not the most important – industrial developments of the 20th century. The amount and speed of change that it will bring to worldwide social, political and industrial institutions during the next decade will stagger even the most fertile imaginations. The number of new or improved electronic products for the home, automobile, factory, office, school, government and military organizations not only in our country, but around the world, will number in the thousands. And that's only the beginning: The U.S. semiconductor industry will double its present size in the next four or five years. More than 50% of μPs produced today are for new product applications previously unfeasible for technical or financial reasons.

These new μPs have a negative impact on conventional standard logic but a positive impact on discrete components. μPs cannot function by themselves. Depending on the application, different types of discretes are required for rectification, voltage regulation, power handling and carrying out the actions determined and ordered by the μP.

Almost a month ago, in my capacity as chairman of the Semiconductor Industry Association, I unveiled our industry outlook at the Association's Annual Forecast Meeting in Palo Alto. By 1981, industry sales should climb to 1.75 billion dollars, an increase of a quarter of a billion dollars. During the four-year period, 1978 – 1981, we expect a compound growth rate for discrete components of six per cent.

Markets most impacted by MPU and discrete combinations are computer, industrial and consumer sectors, in reverse order of importance. Computer applications will be large and varied, with discretes used in rigid disks, electrostatic printers, line printers, matrix printers, floppy-disk systems and both CRT monitor and keyboard terminal systems. A wide variety of discretes will drive hammers in MPU controlled printers, position heads in MPU controlled disk memory systems, and in horizontal and vertical circuits for CRT monitors, and in computer product supplies.

In industrial markets, volume and variety of discrete MPU-related applications will be greater than in computer markets. Most obvious usage of μPs will be in automated process control and production equipment, and everything from making steel to McDonald hamburgers will improve in speed and precision. Again, discretes will handle power and carry out MPU orders. It's impossible to peg a precise discrete usage number for these applications, but it will be in the tens of millions/year.

Other industrial applications I would like to mention briefly, because they possess potential for extremely high discrete component usage, include large displays, such as animated sign boards appearing in major sport stadiums. The display technology is quickly evolving, and I think we will see a proliferation of this type of equipment over the next few years, not only for sporting events, but in promotional and advertising signs of every description.

Another market is energy management. States are beginning to legislate "time of day" or "demand" measurements of energy usage, with higher charges during peak load periods. As legislation gains momentum, many energy management systems will emerge. One of the first, new electric meters, will use MPUs and discretes.

Traffic control, a new market for discretes, will replace conventional logic with μPs. Another growth area for discretes and μPs is telecommunications, with its shift from electromechanical to digital switching. Potential for discretes in switching should exceed 15 million dollars in the next five years. Discrete usage in telecommunications due to fiber optics will be another 15 million dollars over the next five years.

The μP will be used in washers and dryers, refrigerators, dish washers and microwave ovens. An even greater number of discretes will be required. Since MPU-controlled electronic systems will replace mechanical clocks and cams to provide more effective control and flexibility, most major appliances will use four to eight thyristors and optocouplers.

At some point in the future, every new home will come equipped with a sophisticated MPU-controlled security system, requiring a great number of discretes to actuate alarms and indicators. Other emerging consumer markets include MPU-controlled video games, electronic TV tuning and home environmental control systems. In automotive applications, while optoelectronics will grow slightly, major growth will occur in zener diodes and small signal transistors.

These are just a few examples, but I think they illustrate the reason for our confidence in the increasing penetration of discretes in new markets. So, as I stated at the beginning, "Who says discretes are dead?" Perhaps these reliable workhorses of industry have less glamour and receive less publicity than more exotic LSI developments. But they provide a critical link between the feasibility of exotic ICs and their implementation.

# 11/70 USERS:

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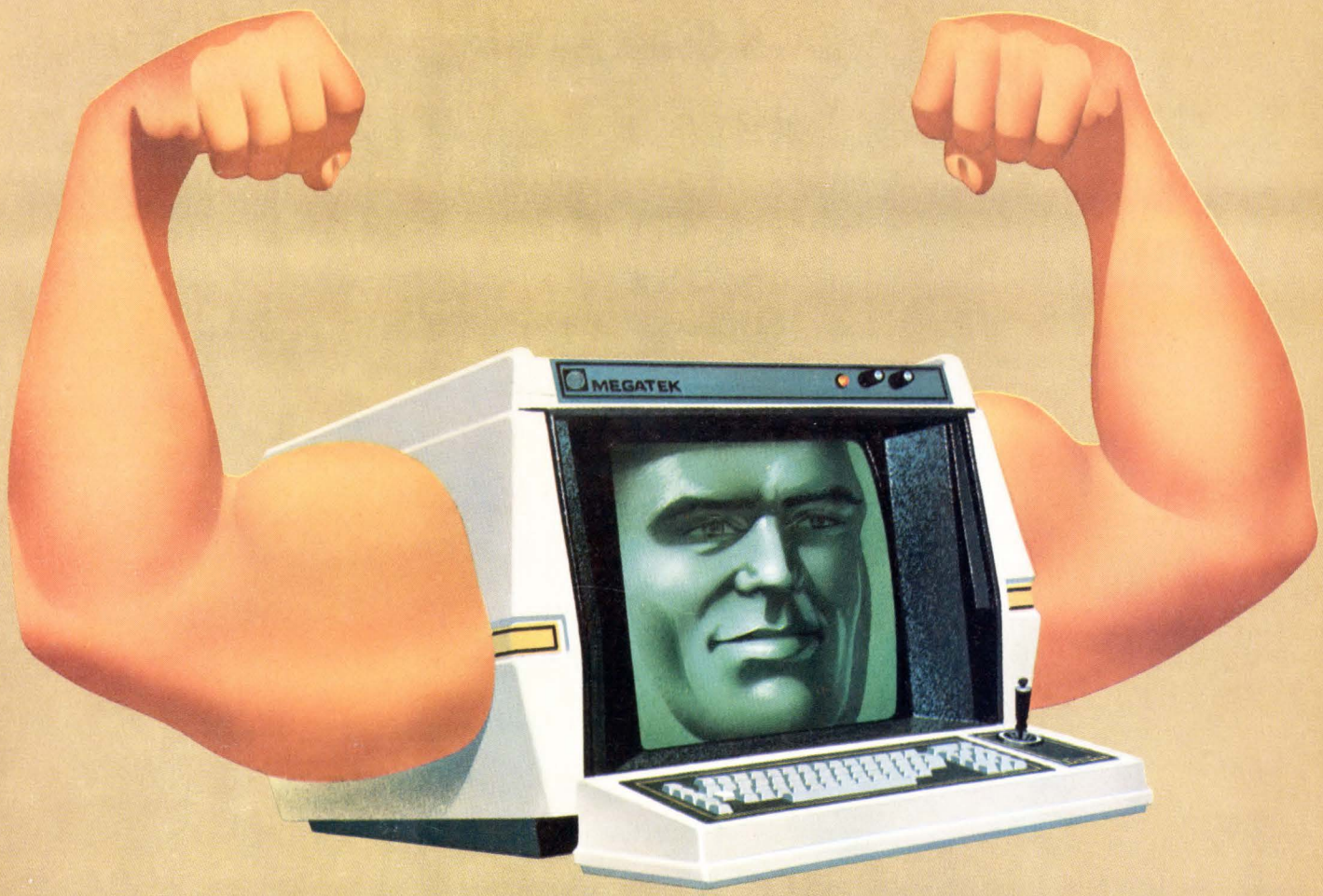
**Circle 2 on Reader Inquiry Card**




# All muscle and no fat.

Most refresh graphic systems are flabby. With lots of features you don't need. Without a few you do.

The MEGATEK 7000 is built lean. You get fast graphics throughput. A high resolution, real-time, interactive display. Complete system modularity. An unmatched refresh graphics system. At a price that makes sense.

A built-in 32-bit microcomputer with a 64K byte, 32-bit wide refresh memory, expandable to 128K. Lets you process graphics data fast. And, saves you host computer time. Add MEGATEK's advanced vector generator and you get unbeatable graphics throughput.

Vectors and characters are displayed instantly. With precision end point matching. And constant intensity. 12-bit resolution is standard. Vector quality that outclasses every other refresh system.

Easy-to-use real-time interactive graphics. Outstanding display

dynamics. Hardware translation, blink, dashed lines. Absolute and relative jump. All standard. And, hardware clip, rotate, scale, and zoom are available as well.

Plus, the MEGATEK 7000 is easy to look at. 16 levels of image intensity. 8 programmable character sizes. The screen is clear and readable, even in a brightly lit room. And, with selective erase, you don't have to blank the screen to change a vector or symbol.

Add a universal computer interface that connects to any host computer. Field-proven software that cuts system development cost. A full line of peripherals and accessories. Even color, if you need it. And, you have the most powerful refresh graphics terminal for your dollar on the market today.

But, don't take our word. Prove it to yourself. Call or write for a demonstration. And remember, the MEGATEK 7000 is backed by a national service network with fast, hot-line access.

For full details, write or call Peter J. Shaw, MEGATEK, 3931 Sorrento Valley Blvd., San Diego, CA 92121. (714) 455-5590. TWX: 910-337-1270. (European office: 14, rue de l'Ancien Port. 1201 Geneva, Switzerland. Phone: (022) 32.97.20 Telex: 23343.)

**The Visible Difference**

**MEGATEK CORPORATION**

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