VOLUME 10, NO. 10

OCTOBER 1980

Digital Design

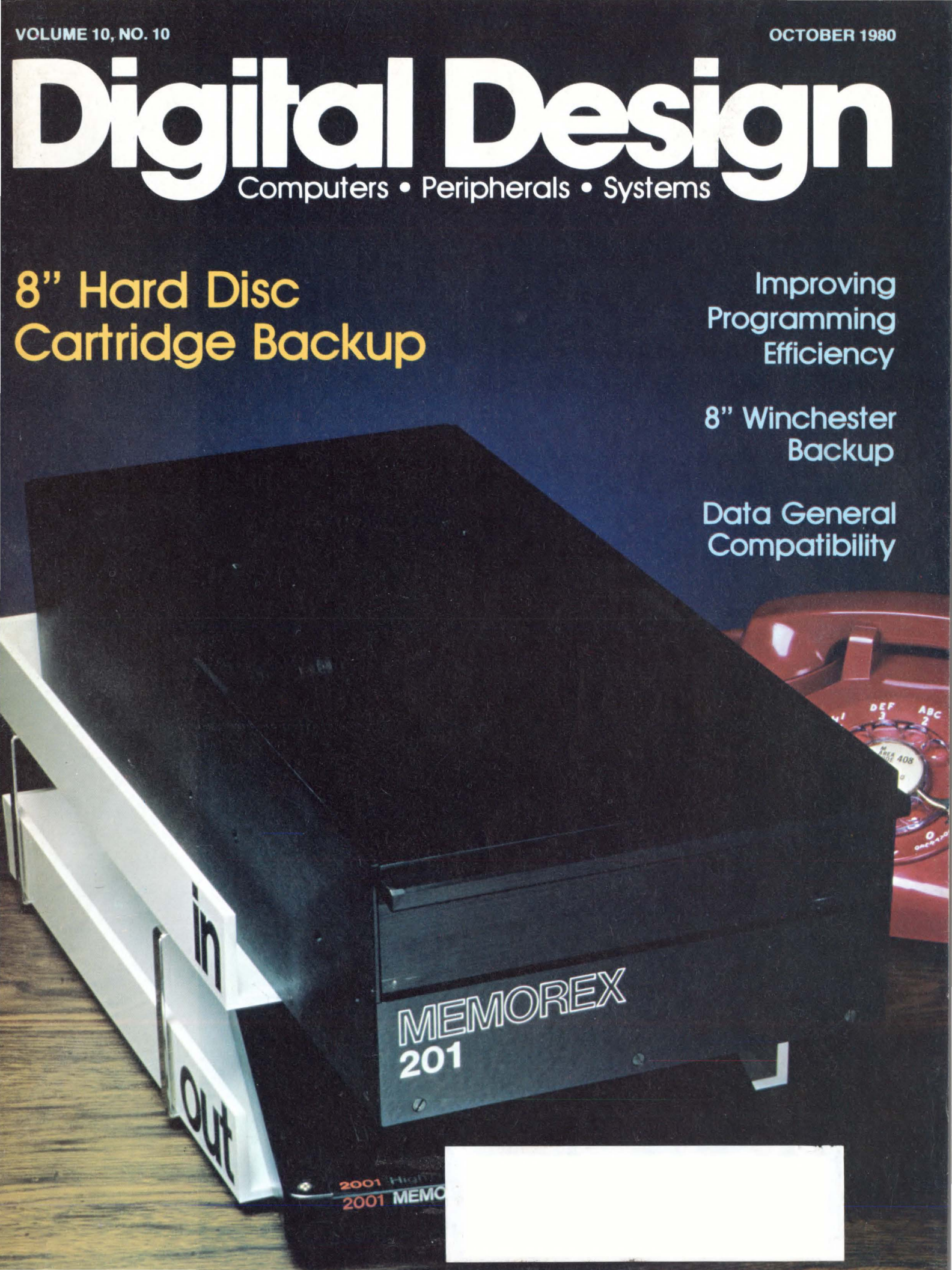
Computers • Peripherals • Systems

8" Hard Disc Cartridge Backup

Improving Programming Efficiency

8" Winchester Backup

Data General Compatibility



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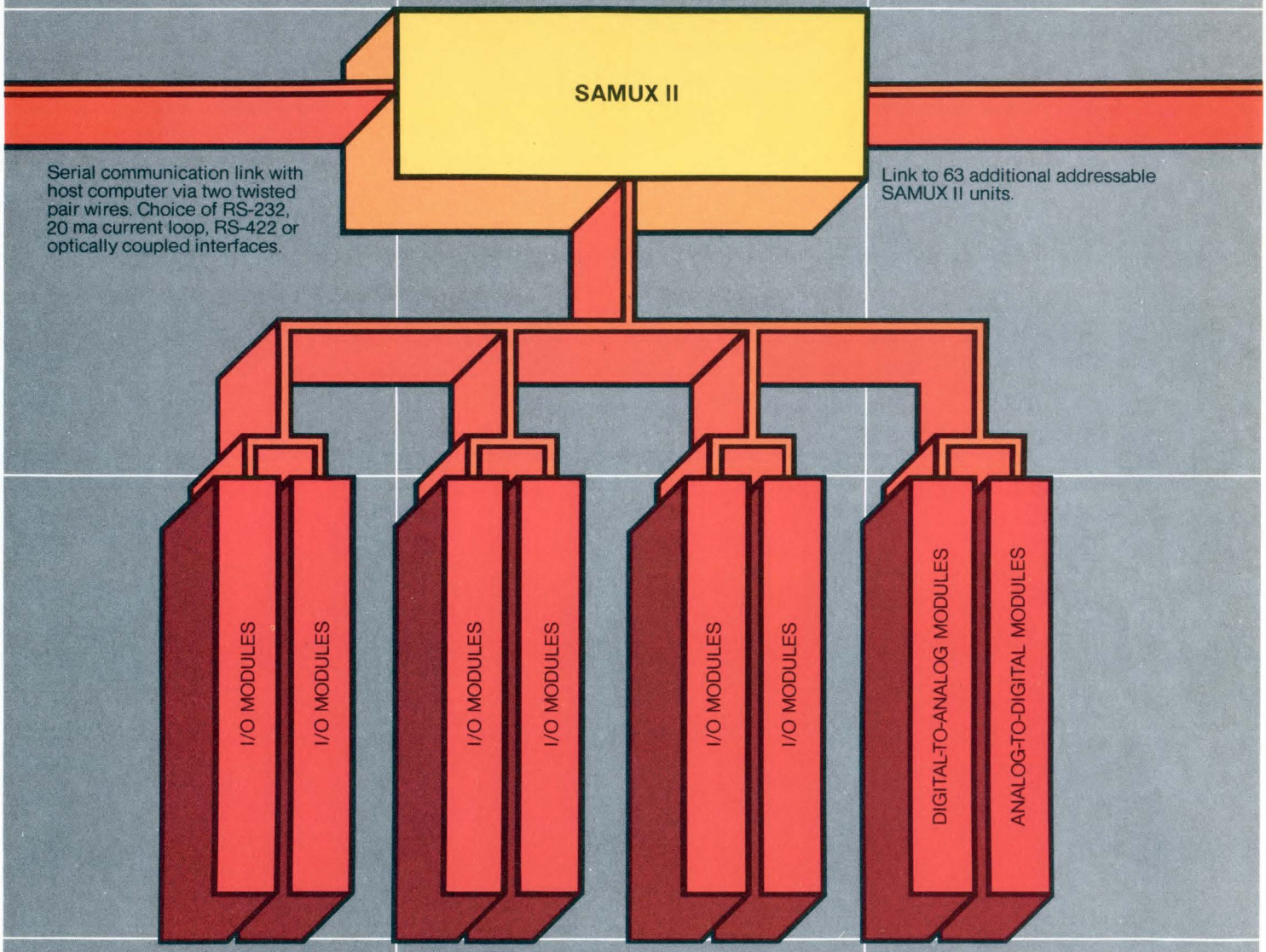

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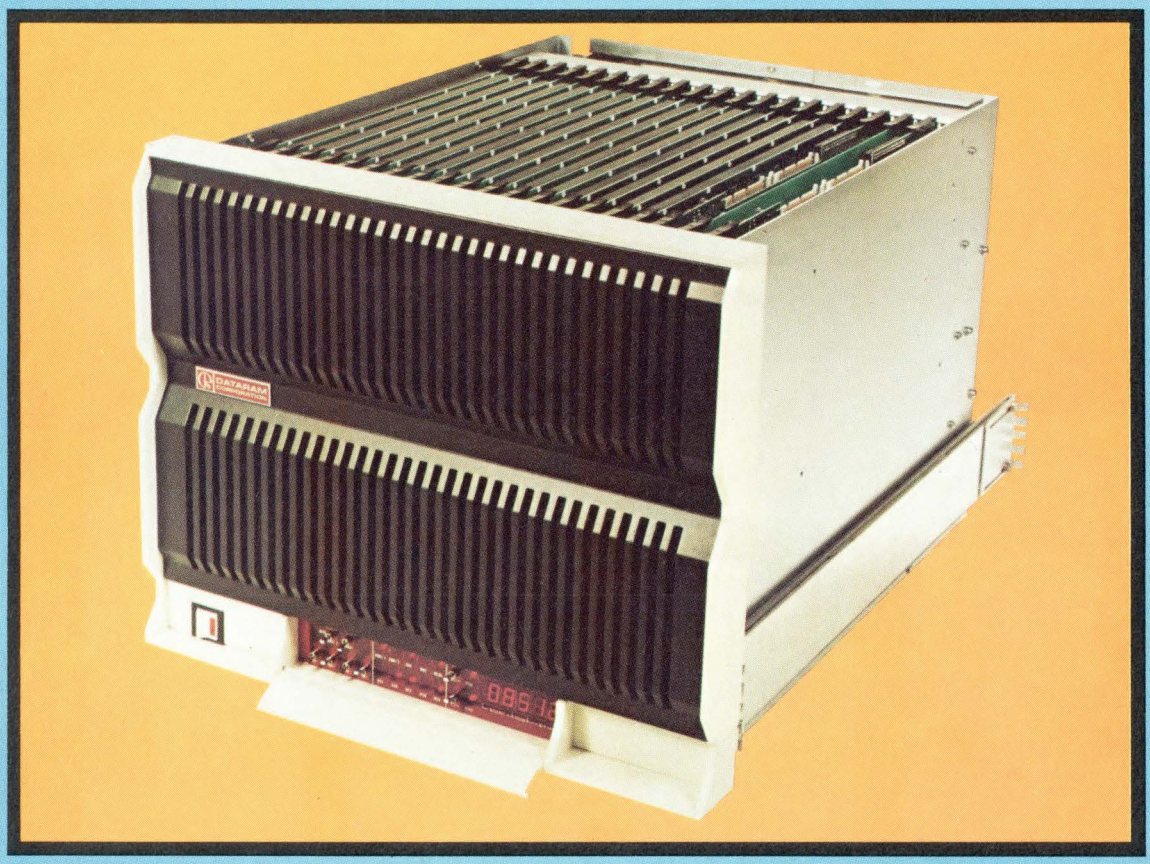
THE INDUSTRY STANDARD

BULK CORE BULK SEMI



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Circle 2 on Reader Inquiry Card

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

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

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

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

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

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

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

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

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

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

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Anaheim, CA 92806
Phone: (714) 632-7500

Century Data Systems
A Xerox Company

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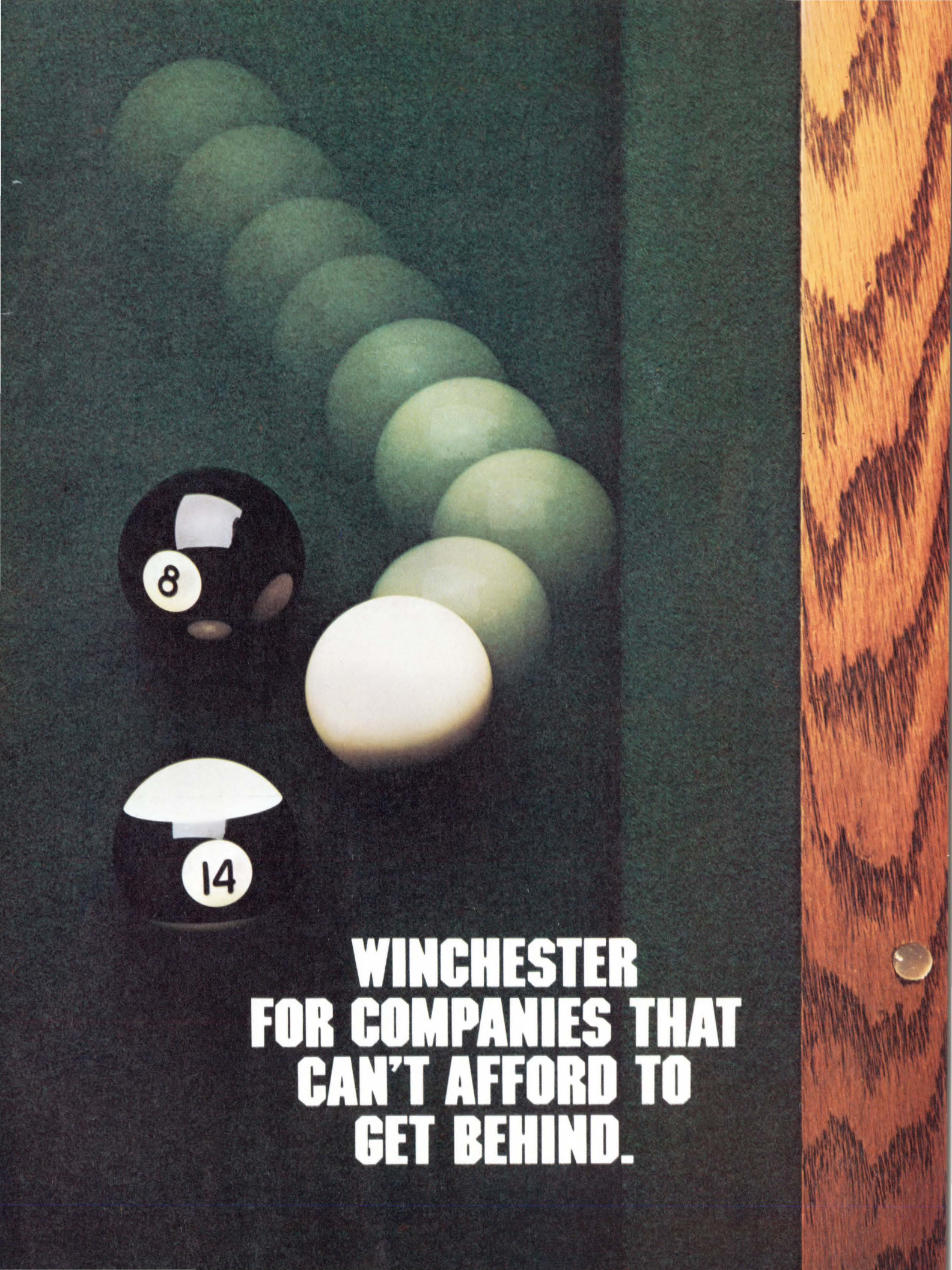

WINCHESTER FOR COMPANIES THAT CAN'T AFFORD TO GET BEHIND.

Complete systems for computer graphics and image processing.

And, we do mean complete! Grinnell systems can include computers, disc drives, terminals and software operating systems. Plus a FORTRAN software and driver package; high resolution TV monitor, camera, and hard copy color printer.

There are also other options to meet any special requirement you might have.

Of course, you may already have some of the necessary hardware. That's why Grinnell systems work with standard TV monitors and cameras, and why plug-compatible interfaces are available for most minicomputers.

We also give you a complete product line to choose from:

GMR 270 Series: 512 x 512 resolution frame buffers and full color pipeline image processing systems.

GMR 260 Series: 1024 x 1024 resolution frame buffers for grey scale, black and white, pseudo color and full color.

GMR 27 Series: High speed, modular graphic and image display systems.

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

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Digital Design

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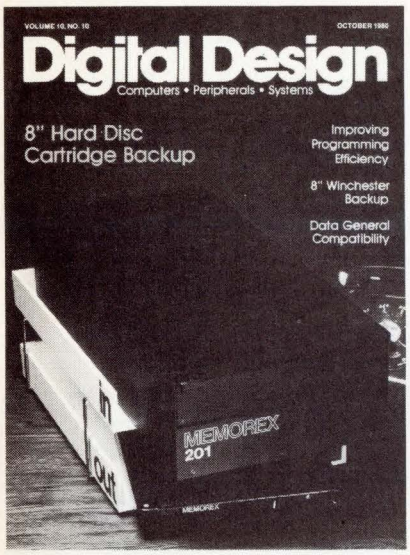

ON OUR COVER

The arrival of new removeable-cartridge-drive integral backup breaks the Eight-Inch Winchester drive backup bottleneck. *(Photo courtesy of Memorex.)*

Features

Departments

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- Totally software transparent runs DEC operating and diagnostic software.
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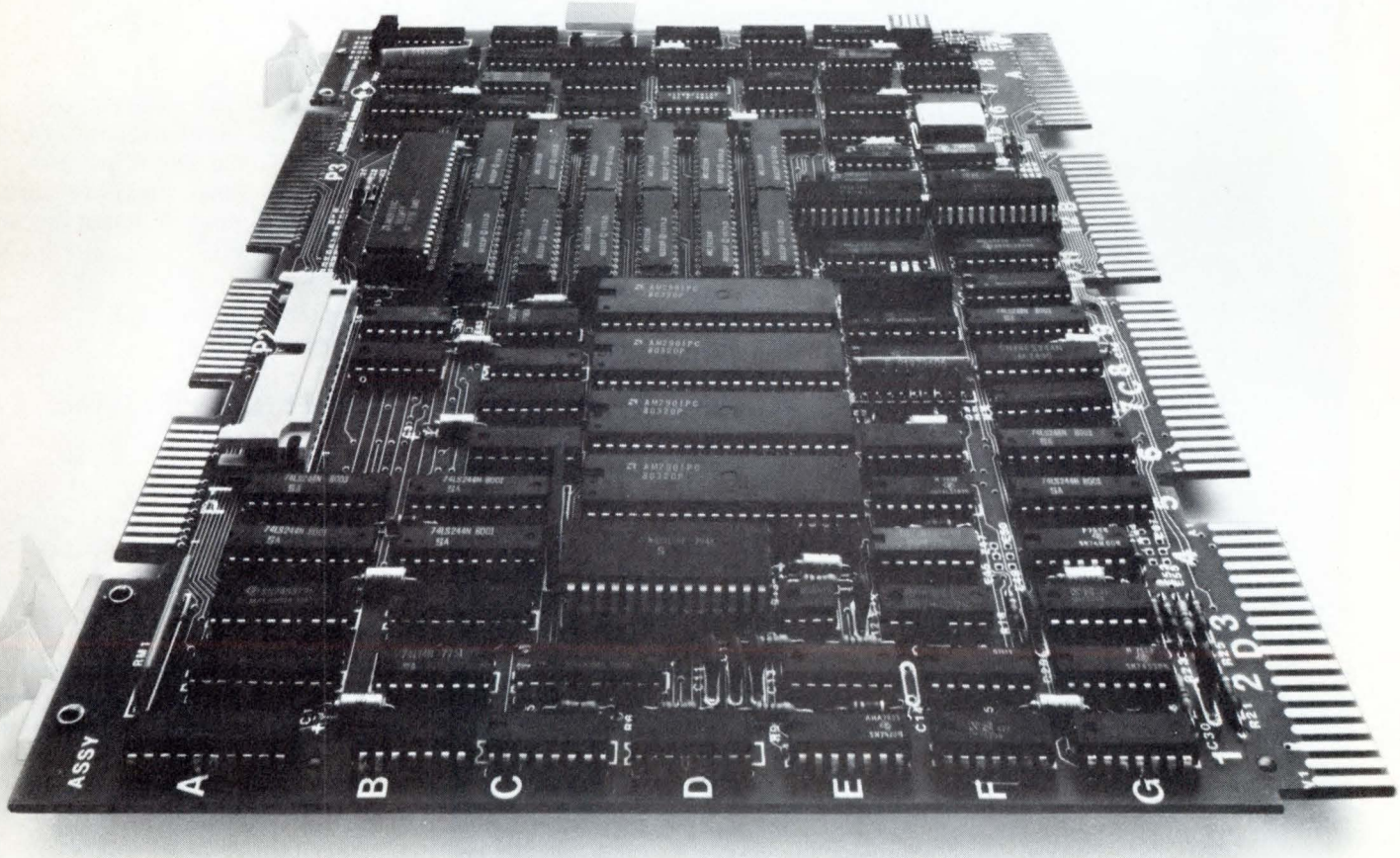


TC-151

†PE requires an additional half board
*Trade name of Digital Equipment Corporation

Number 1 in controllers.

Circle 6 on Reader Inquiry Card

Letters

Two-Way Street

Dear Editor:

I am writing regarding the Technology Trends article on the IEEE "giving away hard-earned U.S. technology to the PRC". Not so. IEEE publications are available to translators in any country. This is also true of *Digital Design*. If a company does not want to give away proprietary information, it may have to prevent some employees writing certain articles; but restricting IEEE activities with regard to the PRC is nonsense. This is a two-way street: the recent publication in the U.S. of the Soviet book, "Radar Anti-jamming Techniques", by Artech House will aid many U.S. radar designers. The Russians made no effort to stop this translation of a Soviet book from being published here. Please note that these views are my own.

C. L. Fruchter
Aerospace & Special Systems
CSC
Falls Church, VA

Video Discs

Dear Editor:

Digital Design has excellent coverage on one of my favorite topics – Digital graphics. I would like to see more on video discs, video digitizers, digital plotters (both product description and technical articles).

Gregg Parrott
Norton (Div. Sun Electric)
Sunnyvale, CA

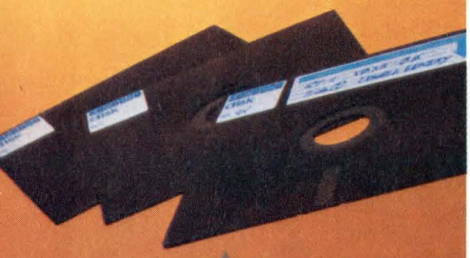
6250 BPI GCR Tape Drives

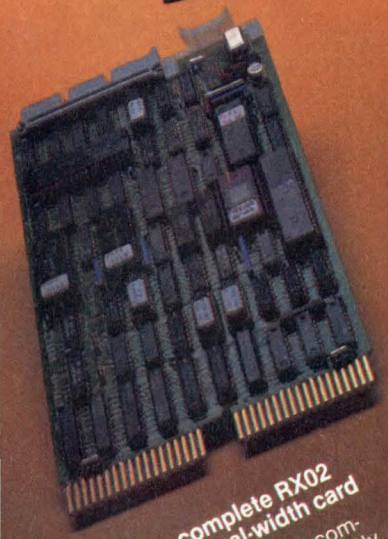
Dear Editor:

Daniel O'Neil's letter to you on the 6250 BPI GCR tape drives (April 1980) was informative. He was, however, inaccurate when he cited Telex Computer Products and Storage Technology as the "only two viable suppliers" of these drives. Pertec Computer Corp. is another viable supplier. In fact, despite its later entry into the market than the other two companies, Pertec is now shipping in substantial OEM quantities and, within several months, will be enjoying a major share of the market.

Bob Abraham
Tape Product Manager
Pertec Computer Corp.
Woodland Hills, CA

DEC COMPATIBILITY



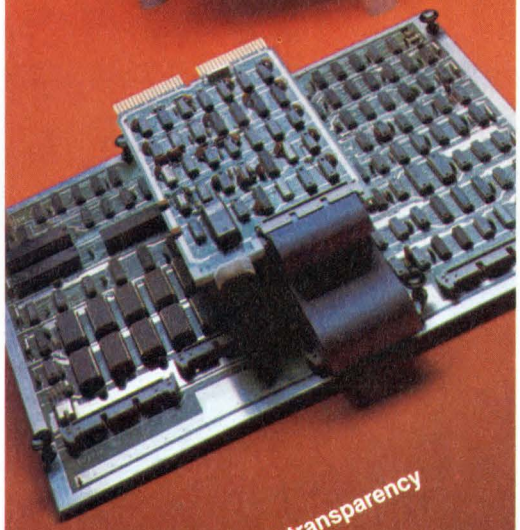


FLEX 02 offers complete RX02 emulation on one dual-width card

Media compatible and software compatible, the FLEX 02 card plugs directly into your LSI-11, 11/2 or 11/23. This low-priced controller has built-in bootstrap; handles single or dual-head floppy disk drives. Order now for 30-day delivery!

Circle 76

DEC COMPATIBILITY



WINC 01 offers RL01 transparency for Winchester-type drives

Software transparent to RL01 driver, WINC 01 maps the data of three RL01 cartridges (15.6 MBs) on one Winchester. Dual-width interface card plugs into LSI-11, 11/2 or 11/23; low-cost controller mounts onto Marksman drive. Call today, they're going fast!

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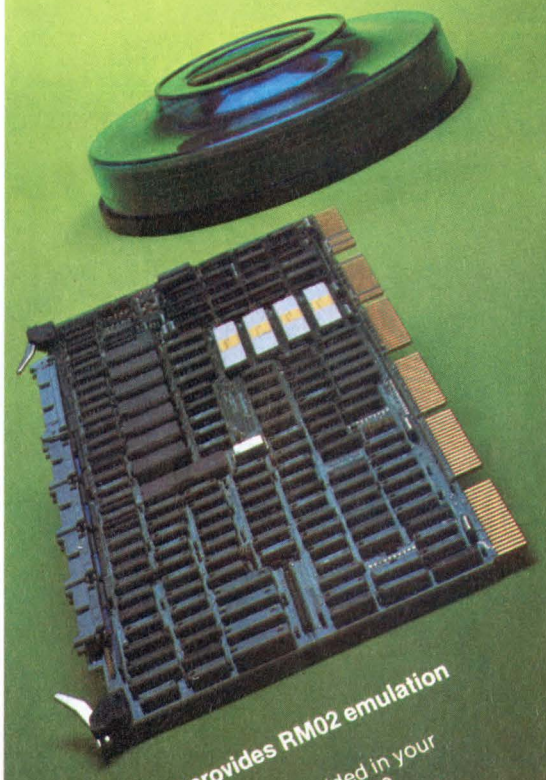
Circle 77

DEC COMPATIBILITY

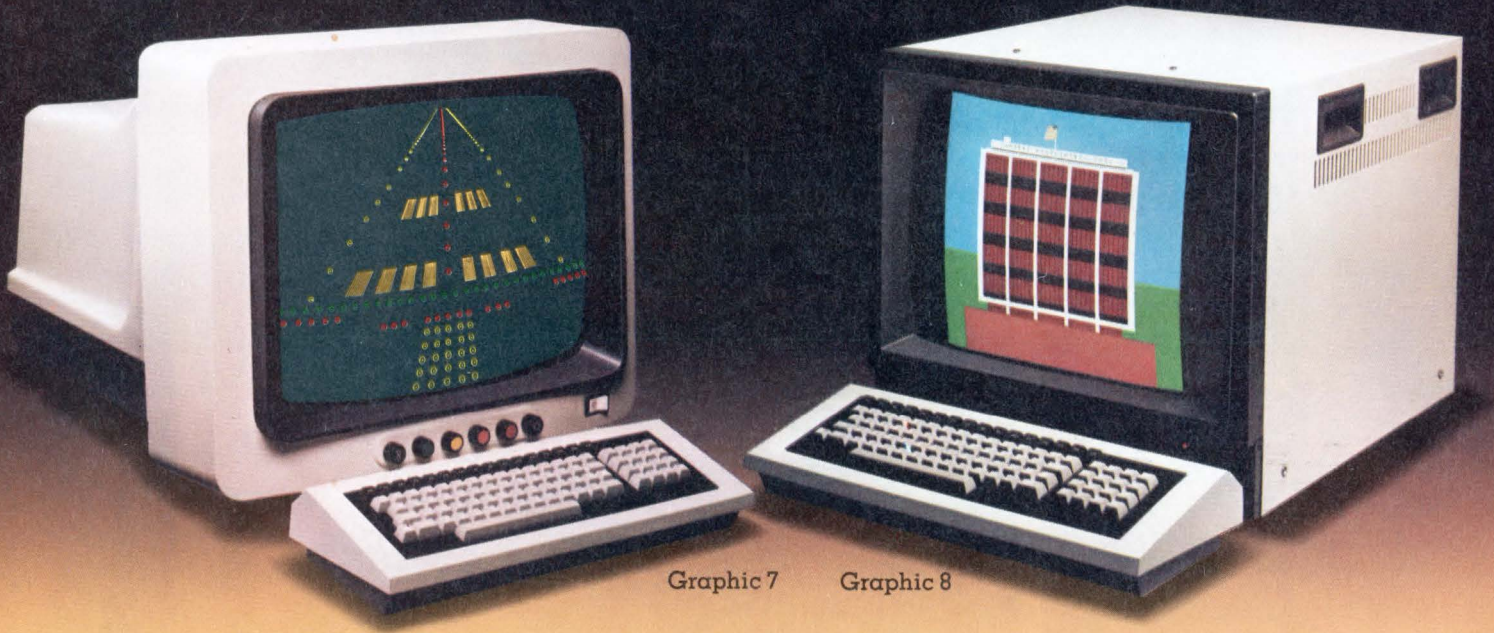


STORM 02 provides RM02 emulation for PDP-11 users

This single hex card, embedded in your PDP-11, runs under standard RM02 drivers. STORM 02 accommodates up to four 80 MB storage module drives and provides disk pack interchangeability with DEC. 30-day delivery and quantity discounts!

Circle 78

THE BEST OF BOTH WORLDS: STROKE AND RASTER.



Graphic 7 Graphic 8

Want high performance raster graphics?

Sanders Associates' new Graphic 8 offers you up to 256 simultaneous colors. High resolution. Dynamic operation with double-buffered refresh memory...

Plus upward-instruction compatibility with the Sanders stroke refresh Graphic 7 and its color and 3D options.

But there's more.

Both display systems – Graphic 7 and Graphic 8 – bring you built-in test, FORTRAN support, remote or local operation, interfaces to most computers, and other important user-oriented features.

Sanders' stroke refresh Graphic 7 and new raster Graphic 8 display systems: they put the best of both worlds at your fingertips. For more information, write or phone Sanders Associates, Inc., Information Products Division, Daniel Webster Highway South, Nashua, NH 03061. 603-885-5280.

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The Graphics People

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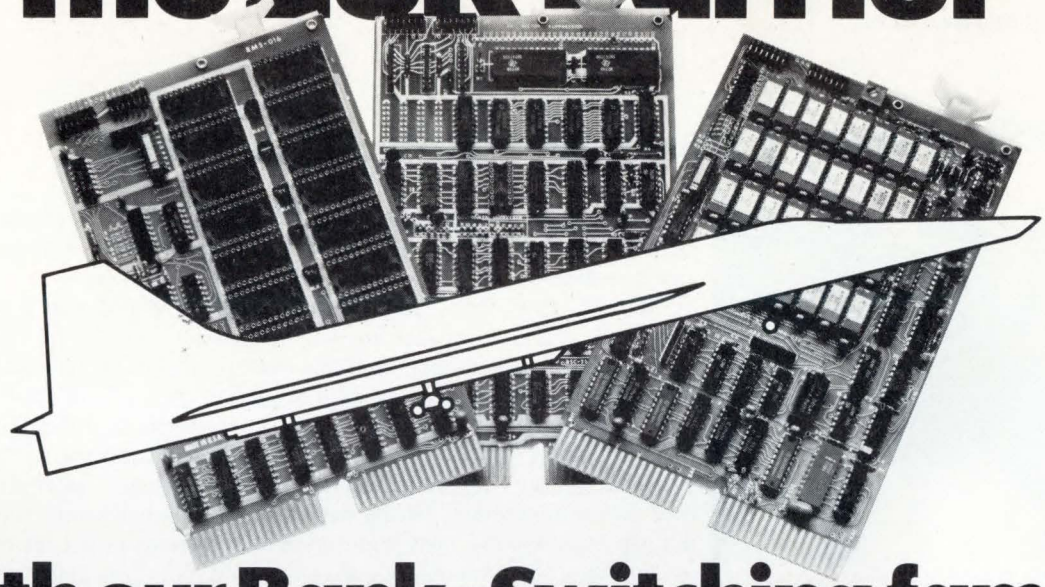

With our Bank-Switching family

In LOCAL mode our memory is functionally just like DEC memory. But when you run out of memory space you're not lost. Add an inexpensive Bank-Switch Controller (BSC-256) and you can go to **two megabytes.** Add another and go to **four megabytes.**

So don't get boxed in with other brands of LSI-11* memory. Break free. Join the family:

RMA-032	32K by 16 bit RAM. On-board refresh	$990 (Single qty.)
RMS-016	16K by 16 bit ROM. (Intel 2716)	$300 (Single qty.)
BSC-256	The Bank-Switch Controller	$300 (Single qty.)

Substantial quantity discounts are available. The RMA-032 is also available without memory chips for $450 (single quantity). For a free copy of our Bank-Switching manual, call or write on your company letterhead.

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DIGITAL PATHWAYS

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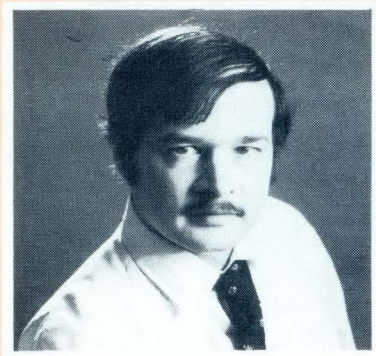
Speakout

Paul Snigier, *Editor*

Will Memory Capacity Slowdown Affect Systems?



One fatality of the 1970s was Moore's "Law." Despite opinions to the contrary, the slowdown in the memory capacity rate does not mean much anymore.

Moore's Law states that memory capacity per device quadruples every two years, or between any two periods in time: $C2 = C1 \cdot 2^{(t2-t1)}$. It was neat, it was simple. But, like most overly-simplistic explanations of reality, it proved only an approximation over a brief span of time now history. And it's not likely to be revived in modified form, i.e., quadrupling every three or four years – for several reasons.

Moore's Law cannot account for other effects: asymptotic approaches to theoretical density per unit of silicon real estate, the widening gap between any meaningful availability versus initial introduction or sampling, the preliminary spec game, and more fundamental effects.

Moore's Law failed to account for quantum jumps needed in fabrication. In going from 4-k to 16-k RAMs, in-place projection lithographic equipment was used for the 16-k RAMs. That was one thing and the transition was smooth. But, with 64-k RAMs, scaling reduced line widths from 5 to 3.5 μm or less, pushing the lithographic equipment. Then there was time lost solving alpha radiation woes. And, Moore's Law could not account for 64-k RAM delays due to the need to generate substrate bias internally (5V-only). Many semi makers took one giant leap backward, developing 5V, single-supply 16-k RAMs first as a learning experience. Worse, direct-writing EB, X-ray and other fabrication technologies will boost development costs through the ceiling.

Expect to see longer life cycles of present devices in the 1980s. It's not merely the skyrocketing development costs, but greater number of committed OEMs and wider application bases (not to mention sluggishness in getting memory chips into designers' boards) that will force this trend. Then, there's the question of the need for super-chips coming down the road; how many designers will really need or want such mind-boggling capacities? Moore's Law won't account for the asymptotic approach to silicon's limits, which will require *new memory architectures* (intelligent memories?). Other more mundane boinkles also surfaced in the late 1970s.

Is it available? Supply and demand is a very fundamental law that Moore's Law doesn't even acknowledge. If 256-k RAMs are available, but the demand/supply ratio is so high that no one can get them in any reasonable quantity until four years after initial deliveries, then can we really say that RAM capacity has quadrupled? For example, 64-k RAMs were sampled awhile back, yet we see RAM/ROM memory boards having 32 or more 4-k RAMs on board, which makes the boards far larger than necessary if the 16-k or 64-k RAMs were really available. It's the old "bird in the bush" proverb. It also goes for memory chips.

That the rate of capacity increase has fallen is no failing of the semiconductor makers, nor will its impact be as significant as other industry observers have prognosticated. System capability is not a linear function of total memory capacity: it's far greater. This "combinational explosion" means that quadrupling of memory capacity every three or more years rather than two does not represent a true slowing in progress. Although both have quadrupled, there's a bigger computational difference that results in a system when going from a 16-k to 64-k RAM (or 8-bit to 16-bit μP) than from a 1-k to 4-k RAM (or 4-bit to 8-bit μP). And, the n-fold increase in system power resulting in the first case is far greater than in the second. For this reason, any slowdown in memory capacity will be offset by combinational effects in overall system capability. Continued and rapid growth in system capacity lies ahead.

Paul Snigier

Plug in to CRDS for complete LSI-11® systems

LSI-11/23 systems 30 days! a.r.o.

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Your choice of:

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- **Controller Card with RL01 Instruction Set Compatibility**

When you plug in to Charles River Data Systems you plug in to innovative, practical solutions to your system design requirements. Solutions like our double-sided, double-density floppy disk systems—offering one megabyte of RX02 equivalent storage per drive. Or our Winchester drive with cartridge tape back-up for fail-safe reliability—in a single enclosure, with a common controller card.

You can purchase each of our compact, reliable components separately to expand or complete a system. Or combine them in your choice of configurations for powerful, multi-user, general purpose computers in a single, cost-effective package.

Equally at home as R & D systems or as the basis for business and process control systems, CRDS systems are based on the DEC LSI-11/2 or LSI-11/23, with from 32K to 128K words of MOS memory. Peripherals available include a 21 megabyte Winchester fixed disk system; single- or double-sided floppy disk drives; and a 3M cartridge tape back-up for the Winchester disk. Software systems available include RT-11, RSX-11, and U/V6 (UNIX*).

Whichever configuration you choose, you're assured of plugging in your system fast, because CRDS delivers most products in *30 days!*

For complete specifications, and to discuss the configuration or components that best meet your needs, call CRDS Marketing at (617) 655-1800. And plug in to CRDS *today.*

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Circle 10 on Reader Inquiry Card

Technology Trends

High-Efficiency Power Supply Augurs Industry Trends

Boschert enters the high-power switching power supply area for the first time with the HL 1500. This new supply has innovations that yield higher efficiency and power density than conventional designs, and that solve the problem of load balancing when supplies are configured in parallel.

HL 1500 product manager, Steve Flannery, forsees the unit's primary usage in superminis, small mainframes, test systems, industrial controls and memory systems – their tendency toward greater board population and ever higher performance levels increase their need for more power. Flannery points out that systems currently using multiple 750-W supplies can realize a significant cost savings by replacing them with fewer of the 1500-W units.

Besides cost savings, the HL 1500 provides greater power density. It develops 1500 W using two internal 750-W bridges phase-shifted 90° to one another. This phase shift cancels considerable ripple, reducing the output filter capacitor size. Other space-savers are a motherboard that eliminates 70% of top wiring and custom-designed heatsinks for maximum surface area. The heatsinks' offset-fin height arrangement maintains a 3.6 fin height/open space ratio.

The supply solves upgrade problems for systems limited by their current power consumption. Most mainframe and other large digital systems are now powered with 750-W and 1000-W supplies in the standard package, which fits into a 5″ by 8″ slot in the mainframe cabinet or system rack. Because the HL 1500 fits into a standard 5″ by 8″ slot, many computers can be upgraded without changes in system housing. For example, two 750-W supplies can be replaced with a single HL 1500, freeing a slot for further upgrading, and reducing cost/watt. To enhance ease-of-upgrade, HL 1500 uses the same mounting screw configuration as the 750-W units.

Boschert's design gets very fast transient response. The HL 1500 controls output voltage to 1% over a 25% change in load, recovering to "flat" output within 0.5 ms. In contrast, typical conventional designs experience a 3% voltage fluctuation during the same load transient, require about 0.5 ms to come back to 1%, and more time to become flat.

Transient response is aided by the faster response of Boschert's current source converter. Unlike the inherently slower response from typical pulse-width-controlled constant-voltage converters, the current source converter gives response to a change in the control voltage approaching one switch cycle.

Typical line regulation for the power supply is 0.2%; load regulation, 0.3%. A 30-ms holdup masks ac line-power interruptions and the unit power supply is 0.2%; load regulation, 0.3%. A 30-ms holdup masks ac line-power interruptions and the unit provides the widest brownout tolerance available.

HL 1500 also solves problems associated with paralleling power supplies; principally load sharing. Normally, when power supplies are operating in parallel, the load is not. Rather, each supply operates at current limit, sharing only that portion of the load that exceeds the current limit of the supply. This means that while one supply is operating at only a fraction of its capacity, one or more supplies are operating at current limit. This has a tendency to produce overall lower reliability than equal load sharing between power supplies.

HL 1500 avoids this problem. Its current source converter and single feedback circuit regulate the voltage

---

Midcon/80

Highlights Computers

All events for Midcon/80, November 4-6, will be held in the downtown Dallas Convention Center, with the Professional Program – over 30 sessions and 130 technical presentations – staged in meeting room adjacent to the exhibit hall.

There are three blocks of Professional Program sessions/day. Sessions are from 9:30 to 11:30 A.M., 1 to 3 P.M., and 4 to 6 P.M. each day.

Sessions cover fiber optics, memory, packaging, EMI, information systems, data security, communication, radar antennas, μC instruments, ICs, the single-chip μC, μPs in an "analog world", low-power data processors and 16-bit μPs.

Exhibits in the Dallas Convention Center will be in four color-coded groups. Categories include instruments/instrumentation and control systems; production, packaging and test equipment; components, microelectronics and fiber-optics; and mini and μCs and EDP peripherals. Exhibit hours are 9:30 A.M. to 6 P.M. Tues. and Wed; to 5:30 P.M. on Thurs.

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Recording density:
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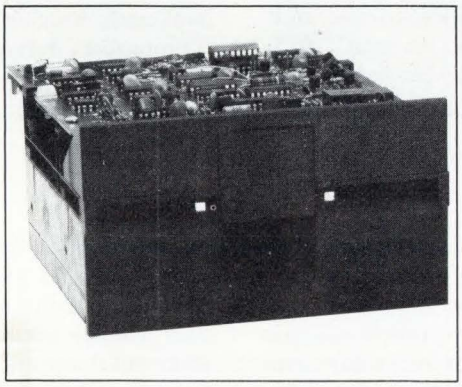
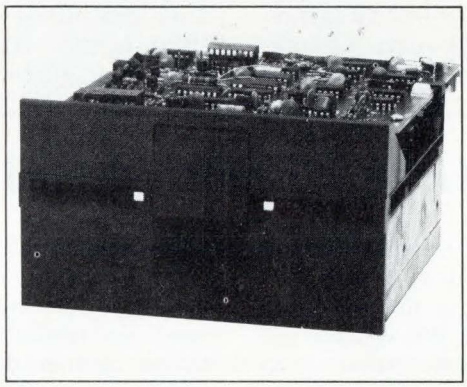
Access time:
• Track to track: 3ms
• Average: 90 ms





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of all parallel supplies. The output error signal is communicated across all paralleled supplies, allowing them to share the load nearly equally. The control on the 5-V model is designed so that up to four supplies will share up to 1,200 A automatically, giving a total power output of up to 6 kW. The supplies are simply linked with a control cable provided by Boschert.

Boschert achieves higher efficiency than conventional designs – 82% versus 70 to 75% – in part by using more output diodes to share the current output. By using eight diodes, instead of the more usual 4 to 6, output current dissipation is reduced. Efficiency is also boosted by special proprietary circuitry that keeps power transistors out of saturation and allows them to switch on and off quickly, lowering power dissipation of the power transformer network. Switch-on and switch-off times for the Boschert supply are about 150 ns.

Reliability is enhanced by the supply's low operating temperature. The supply is cool to the touch during operation, and air temperature rise from intake to exhaust is only 18°C. The supply can operate safely at full power at ambient temperatures to 50°C. This low temperature contributes to the system's high MTBF rating of 50,000 hours, calculated according to MIL-HDBK-217C.

Boschert achieves this low operating temperature through a design that uses two "wind tunnels" with components aligned to maximize heat transfer from components and heat sinks to the air. Heat rise in each tunnel is balanced, with hottest components distributed appropriately between each wind tunnel to minimize accumulation of heat rise of the air as it moves through the tunnel. The diode heat sink was allowed to carry 5V, eliminating insulating material and maximizing diodes-to-heat sink heat transfer. Also, the unit's 82% full load efficiency decreased heat dissipation, reducing heat sink size.

To speed maintenance, all critical components are plugging in modules: power bridge, diode assembly, control electronics, input and output capacitors. The cooling fan is also field-replaceable.

HL 1500 design includes all control features that may be required in large systems, plus all warning indicators such as power-fail detect and standard protective circuitry such as over-voltage, over-current and reverse-voltage protection. Remote features include remote sense, output voltage programming, remote on/off, and margin. An over-temperature indicator signals the computer if the supply's internal thermostat senses an over-temperature condition. The supply then delays 1 sec before shutdown, giving the computer an opportunity to perform necessary housekeeping for an orderly shutdown instead of suffering an uncontrolled system crash. Boschert Inc., 384 G Santa Trinita Ave., Sunnyvale, CA 94086.

–Loren Werner

Keyboard Growth Unprecedented

Fact 1: Computers require keyboards or keypads to communicate with. Fact 2: Computers – particularly small business computers, WP systems and home computer-based systems – all are growing at an unprecedented rate. Conclusion: the need for keyboards, whether of the complex type or of the simple keypad variety, could outstrip the manufacturing capability of keyboard/pad manufacturers in the 1980s. Longer lead times will affect system builders and integrators.

Will voice recognition KO keyboards?

One day voice recognition will take over from keyboards/pads – but not for another eight years. In the meantime, keyboards will remain the major means for people to communicate with machines. The increasing flood of keyboard-equipped games, terminals and word processors will spell a bonanza for keyboard makers. Shipments will exceed $100 million this year; by 1985, it will more than double.

Membranes winning

Membrane keyboards have several layers of specially-configured conducting/non-conducting sheets, and are growing fast. Membrane keyboards resist dirt and fluids in process control, household appliances, factory machines – and are mass-produced inexpensively. Membrane keyboards will enter new applications (keyboard-controlled ignition, door locks for automobiles) and will take market share away from capacitive, inductive and Hall-effect keyboards.

Will relatively inexpensive electromechanical (EM) keyboards die? No. New semiconductor devices which monitor keyswitch movements to eliminate "bounce" and other problems will resurrect them.

Price wars benefit OEMs

System builders and integrators should stay abreast of keyboards/pads, and in designing a system, should consider the replacement of keyboards/pads whenever expedient when upgrading or modifying an existing product or line.

As an example of this, some industry observers had prognosticated an ultimate continued decreased market share for electromechanical switches. But the resurgence of EM switching and membrane switchboard growth will challenge the more costly keyboards, affecting OEM decisions.

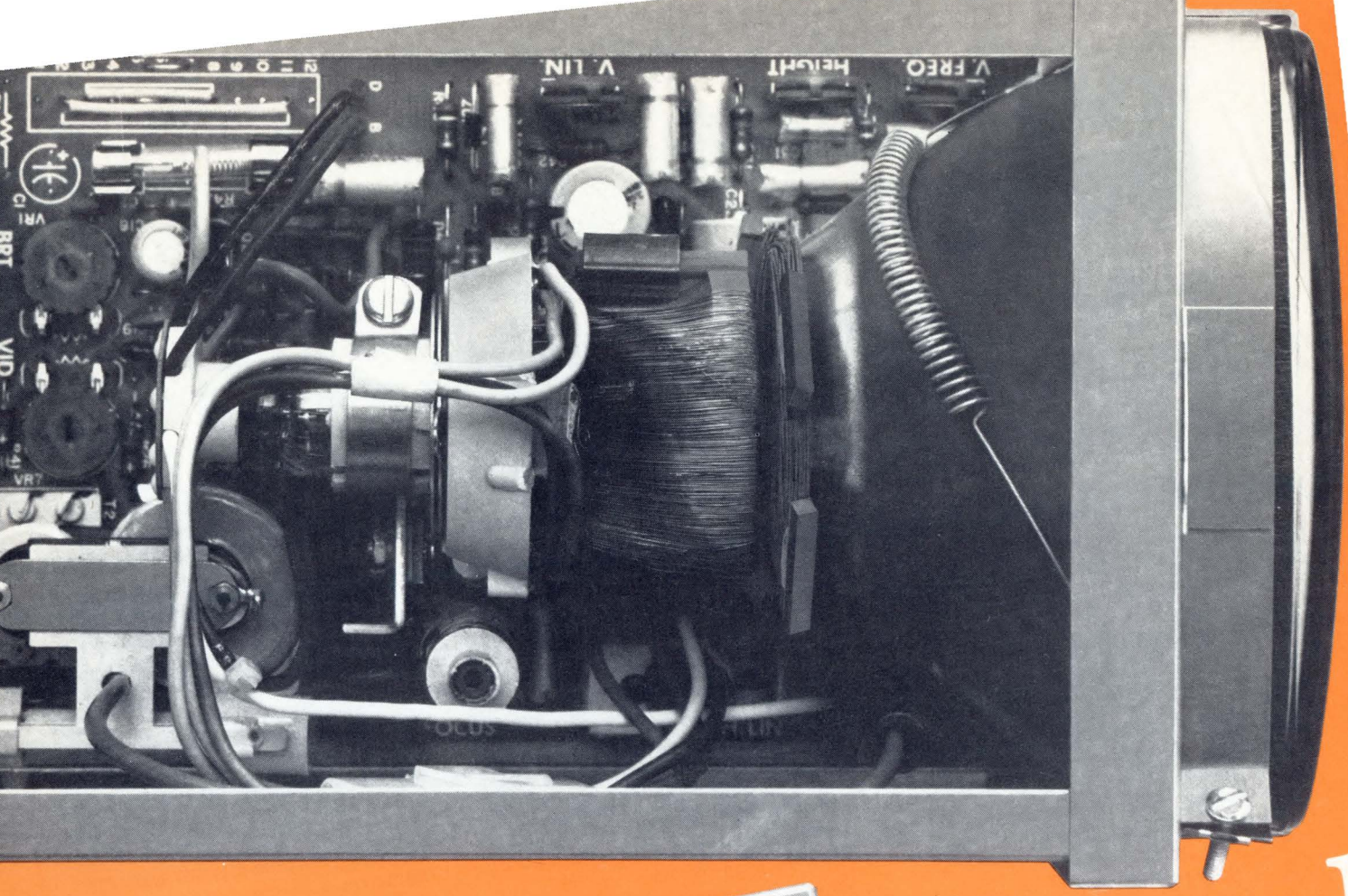
IRD (of 30 High St., Norwalk, CT) predicts that a shakeout will come by 1986 or 1987 for three reasons. First, as with all good markets, the entry of new firms and expansion of present ones will overshoot demand, and price wars and a declining supply-to-demand ratio will shake out the marginal manufacturers. Second, by the end of the decade, speech recognition will come on the scene as a serious contender to keyboard entry. Third, the woes of keyboard makers will also worsen as more business comes from the volatile fortunes of consumer markets. This destabilizing effect will worsen as less market share occurs in the more stable business machines, computer and industrial markets.

At this stage, over 90% of keyboards are used in telephones, games, appliances, test/measuring instruments, medical equipment, calculators, alarm/monitoring equipment, elevators, vending machines, typesetting, etc.

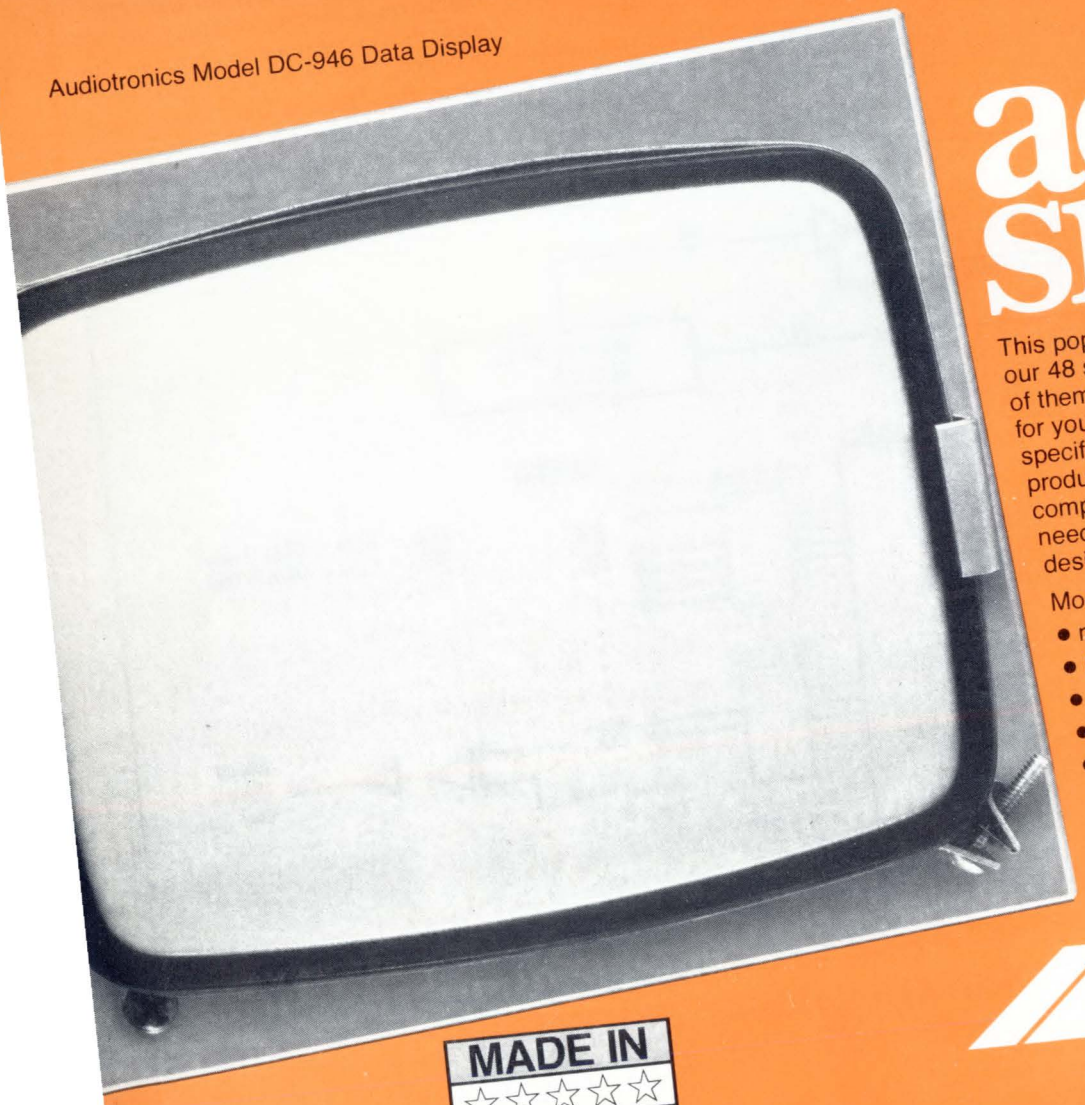
Recession proof?

Since keyboards/pads "track" computer-based products and systems, a major downturn in computer-based products would hurt the keyboards/pads market. Such a downturn has not hit computers. So long as we see no dropoff in 1981, the keyboard/pad industry will see unprecedented growth continue through the next eight years.

– Paul Snigier



Audiotronics Model DC-946 Data Display



actual size

This popular Audiotronics data display is one of our 48 standard models. We have sold thousands of them to giants in the industry. Maybe it's perfect for your requirements. If not, talk to us about your specifications. We're dedicated to innovative product design, quality production standards and complete customer satisfaction. Whatever you need, we have the experience and talent to design it, or improve it. Contact us today.

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  - Composite video (plug-in module)
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Innovative Design

S-100 Bus Gets Self-Correcting Memory

A newly available dynamic random access memory board for the S-100 bus can correct single-bit errors and detect double-bit errors. Called Supermem-3, this 64KB board from Piiceon (San Jose, CA) computes and stores the data parity as it is first written into memory, and then compares it with parity that is recomputed at memory read time.

The 9″ X 10″ memory board uses a modified error checking and correction Hamming code, named for inventor Richard W. Hamming. The memory system employs a number of extra Hamming (check) bits to monitor the contents of a memory location and to invoke correcting circuits should a single bit change its logic state.

Supermem-3, which can be used as a 64K X 8-bit or 32K X 16-bit device, supports the IEEE S-100 bus. (See the boxed item, "The IEEE S-100 Bus".) By operating on a 16-bit word, the ECC logic minimizes the number of extra bits required for the Hamming code. An 8-bit data word requires 4 Hamming bits for single-bit error detection, while a 16-bit word requires only 5 bits. An added sixth bit produces double-bit error detection.

To understand how Supermem-3 detects and corrects, look at the block diagram **(Fig 1)**. Six 74S280 parity-checking circuits monitor incoming data and generate six check bits. At data write time, check bits are initialized to zero, and then each monitoring device generates a parity bit for each of the six data subgroups. The parity bit is stored in the error checking ECC bits next to the data word. During a memory read cycle, the data sub-group and the stored parity bit are again sent through the parity generator. The system recalculates parity for each sub-group and compares the result with the stored parity bit. If the compared parity bit matches, the output, called the syndrome bit, is set to zero. Syndrome bits for the six subgroups are collected and decoded by a series of 74S138 chips, which then put out a 16-bit word, called the decoded data line, which contains the bit status. If all the syndrome bits are zeros, the 74S138 generates a NO ERR signal by setting all bits high in the decoded data line. If one or more syndrome bits are high (one), indicative of an error, the 74S138 sets the corresponding bits in the decoded data line low (zero). Each bit in the decoded data line is then exclusive-ORed with the corresponding data bit from memory, and the

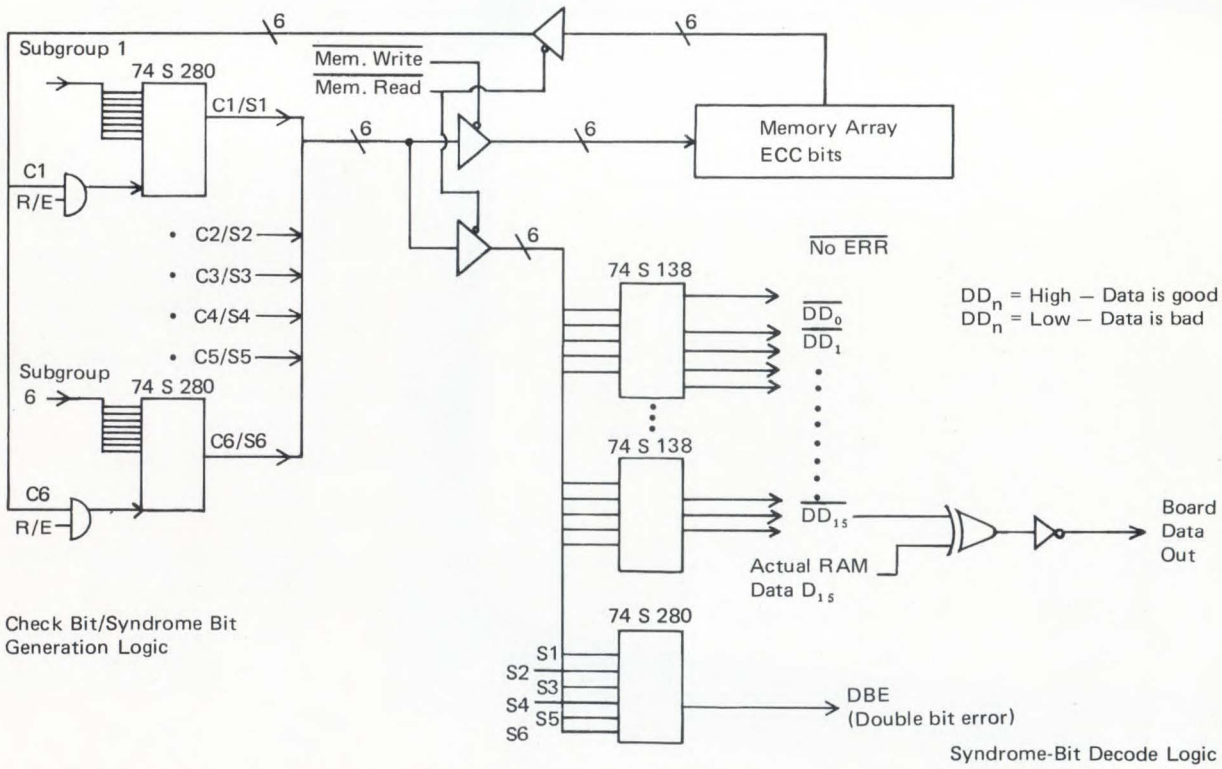

Fig 1 Block diagram of error detecting and correcting circuitry of the Supermem-3.

result is then inverted and sent out to the bus. It can be seen that this scheme results in correct data being sent to the bus for all possible combinations of bit values and error conditions.

The system can detect double-bit errors but cannot automatically correct them. Syndrome bits are sent to yet another S280 device and checked for parity. Even parity indicates a no-error condition; and the two-bits, an error condition. In either case, the system puts out a double-bit error (DBE) signal. The presence of a NO ERR signal generated by the 74S138s overrides the DBE; the lack of a NO ERR signal indicates that a double-bit error has occurred.—*Loren Werner*

The IEEE S-100 Bus

The recently-developed IEEE-696 S-100 bus updates the well-known S-100 bus. It accommodates more powerful processors with 24-bit addressing for a main memory space as large as 16MB. The data bus is 16 bits bidirectional or dual 8 bit unidirectional. Built-in arbitration can allocate up to 16 different bus masters.

To update the S-100 bus, IEEE-696 calls for removing the front panel control lines to free extra lines needed for extended addressing. These front panel lines are now connected to the CPU card via another card edge connector. It adds extra control lines for the bus arbitration logic and two extra groundlines for better noise immunity. Added status lines now can share 8- and 16-bit units on a single bus. (It is these lines that the Supermem-3 monitors to decide whether an 8- or 16-bit data transfer is requested.)

The standard now extends the normal 5″ × 10″ -size card to include a double height size of 9″ × 10″. This double-sized card allows more complex systems, such as 16-bit single-board computers and error checking and correcting memories on a single board.

Innovative Software

Software Speeds Real-Time Data Acquisition

In such real-time data acquisition applications as image processing, laboratory automation, measurement and industrial process control, the Forth language solves memory-bound processor problems. Escalating volumes of data are pushing some machines to their capacity limit and causing users to search for solutions that increase throughput. While the traditional solution — adding memory — is now more attractive due to reduced memory costs, it does nothing to reduce operating system overhead or to alleviate the long software development time associated with using the space-efficient assembly language typically chosen for these applications.

Some designers are solving these problems with Forth, which uses space efficiently enough to rival assembler, and which offers the code-development advantages of a high-level structured language. Sytech, a company involved in systems development for seismic data processing, has benefited by using Forth in a real-time shipboard high-resolution seismic data acquisition system. This 64K-byte LSI-11/02-based system surveys well sites for hazardous conditions, and samples 4,000 data points per second with 16-bit precision. Forth does away with RT-11 operating system overhead and switching between assembler and a high-level language, and decreases sampling time from 1 to 1/4ms.

Source-Level Debugger Promotes Efficiency

Interactive source-level debugging can greatly enhance programmer productivity and reduce software development costs. FBUG, a dynamic source-level debugger from Corporate Computer Systems, Aberdeen, NJ, helps programmers debug software efficiently.

FBUG's multiple breakpoint capability allows halting a program for examination at several different points. The n-pass feature is useful in finding bugs in loops by allowing the program to pass through a breakpoint *n* times and suspend the program only on the nth pass. Source-level items, referenced by name, can be printed and altered. Since the debug code can be made transparent during normal execution (for example, execution not initiated by the interactive debugger), production code can retain debug features. If bugs develop in the production code, you can use FBUG statements without recompilation by initiating execution from the debugger. FBUG also allows storing program debug commands in a file.

By using FBUG, the Boyce Thompson Institute at Cornell University got rid of a bug in its production code that eluded detection for 1½ weeks with conventional static debug procedures. The production code consists of a data base with twelve concurrently-running processes used to control 30 greenhouses and a number of environmental chambers. While the highly interactive nature of the system rendered static debug procedures ineffective, FBUG allowed programmers to find and fix the bug in one day.

In the following example, a simple FORTRAN program is followed by the FBUG listing used to check it out. The column on the left in the FBUG listing consists of FBUG statements and printed responses to FBUG commands. The column on the right contains annotation for the left-hand column. Note that most of the statements in the left-hand column are preceeded by the FBUG prompt.

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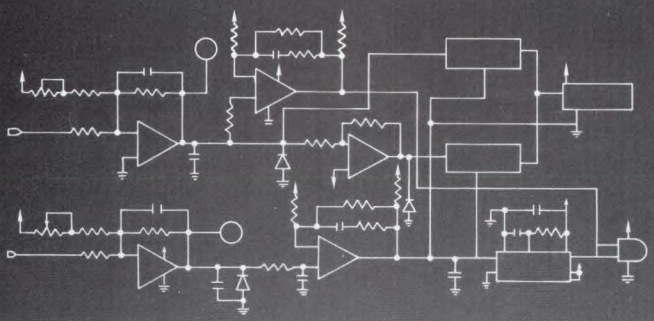

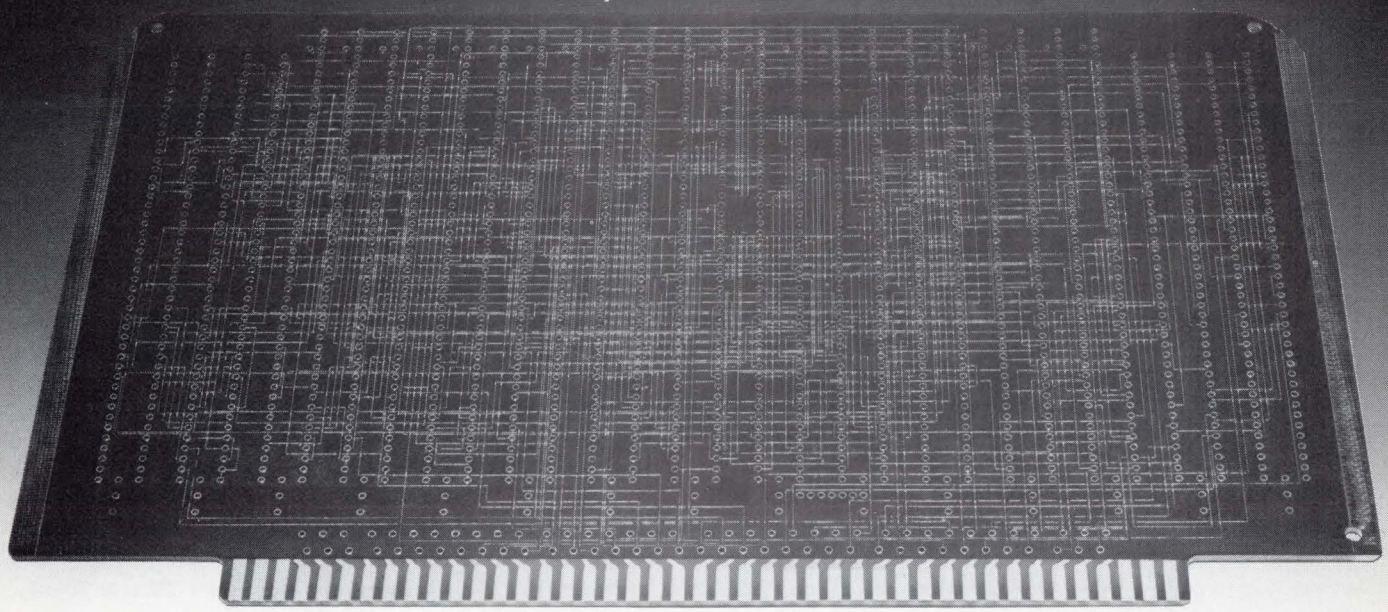

Licenses to design and manufacture Multiwire circuit boards are available from PCK Technology Division, Kollmorgen Corporation, 31 Sea Cliff Avenue, Glen Cove, NY 11542. Phone: (516) 448-1166.

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Innovative Software

FORTRAN source listing: Program source listing

```
0001 FTN,L
0002    PROGRAM DEBUG
0003    DIMENSION X(3)
0004    I = 0
0005    WRITE(1,10) I
0006 10FORMAT ("THE VALUE
       OF I IS ", 12)
0007    X(1) = 2.5
0008    END
```

```
$RU,DEBUG                 Normal run of program debug
THE VALUE OF I IS 0       Note output from line 5.
$RU,FB                    Run the interactive debug package
```

FBUG listing:

```
f>L LMAP                  Read in the module load map.
f>M @T                    Read in the source module map.
f>PN DEBUG                Program name to debug
f>B 5 0 DEBUG             Put break #0 at line #5
f>G                       Begin execution of program
break 0 at 5 in DEBUG     Hit the break point.
f>P I                     Print out source identifier "I"
   I = 0                  Value of I currently.
f>B 7                     Move break point to line #7
f>G                       Continue execution.
THE VALUE OF I IS 0       Output from the source program
break 0 at 7 in DEBUG     Hit break point
f>S I 5                   Set a value of 5 into "I"
f>G L5                    Go back and execute from line 5
THE VALUE OF I IS 5       Output again — note value change
break 0 at 7 in DEBUG     Hit break point again.
f>P X(1)                  Print out x(1)
   X(1) = 0.000000E 00    Note in floating point because x is a real
                             variable
f>S X(1) 2.5              Change the value of x(1)
f>P X(1)                  Verify change
   X(1) = 2.500000E00
f>G                       Continue execution.
link lost                 Test module termination.
f>EX                      Exit from debug module
FBUG end                  Termination message.
```

Microprocessor Development Systems News

Hewlett-Packard. A HP Pascal compiler for model 64000 logic development systems uses a two-pass compilation process that generates machine-independent, intermediate code on the first pass, and creates relocatable object code for the 8080 or 8085 μPs on the second pass. Source programs written in Pascal/64000 are portable between systems. As Pascal 64000 compilers become available for other processors, users will be able to select the best μPs for a given application without sacrificing previous program development work done for other μP systems. The 64000 emulator can debug code and allow Pascal source files to be edited, compiled, relinked and reloaded into emulation memory. Assembly language listings of object code can be called up and Pascal procedures can be linked with assembly modules. A special capability labels any source code statements that deviate from ANSI.

Tektronix. Designers who use standard single board computer circuit cards instead of implementing their own μP circuit cards now have two more software development tools available for the Tektronix 8002A μP development laboratory. Support includes assemblers for the 8086/8088 and Z8002 μPs and prototype debug packages for the Intel iSBC 86/12 and Zilog Z8000 development module single board computers.

Assemblers convert source code into executable object code by using a source file that has been created through the 8002A editing software. Address space for the assemblers is 0-64K bytes, and cannot be mapped. Macro capabilities that allow the expansion of in-line code include the ability to call macros through easily-identifiable name parameters, the acceptance of an indefinite number of arguments, string manipulation which includes the use of varying string lengths inside and outside of macros, and a group of commands which allow conditional assembly based on an IF/ELSE structure. The linker can combine multiple object files into a single load file.

The prototype debug package allows transferring absolute object code or a linked load file from the 8002A to the single-board computer and then executing it under control of the debug software. Execution can take place in real time with predetermined breakpoints, or in single instruction steps. The user can examine and modify computer memory contents and the processor registers during a debug session. Blocks of data can be moved from one set of memory locations to another, and the result of debugging can be saved by uploading the memory contents to the 8002A for file storage.

Intel. Model 810 software development module supports all five of Intel's iSBC 8080/8085 family of 8-bit single-board Multibus computers. It allows the user to develop and debug assembly language software within the target system. The 810 provides resident text entry, editing, assembly and debug facilities. You can remove the module from the target system to develop other products or ship it with the target system to serve as a resident programming subsystem and memory expansion unit.

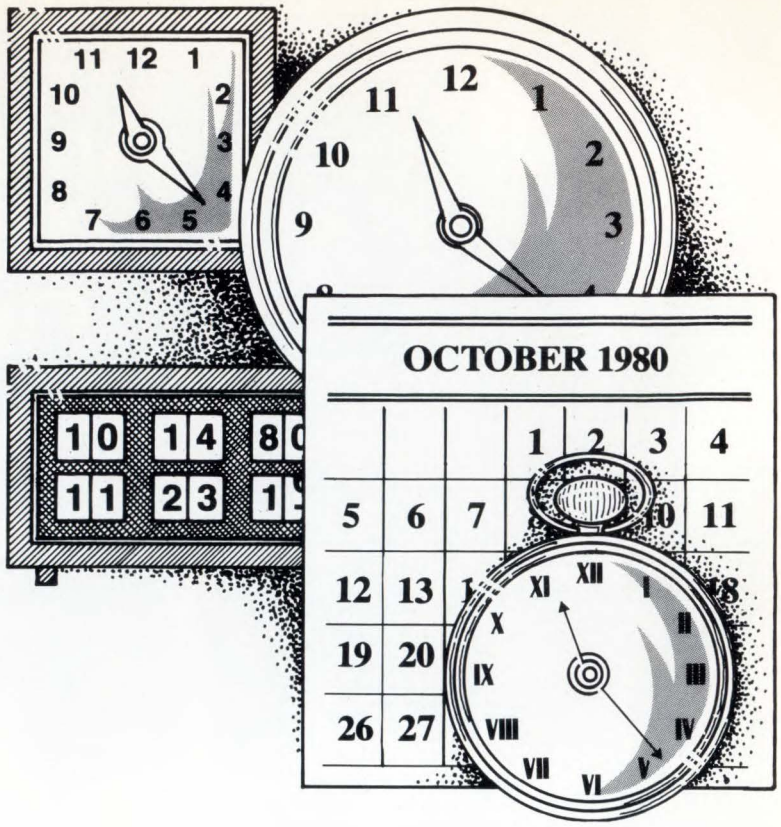
The 810 uses only single character commands to the text editor to reduce typing time. The symbolic assembler, a subset of Intel's full 8080/8085 assembler used in Intellec μC development systems, produces absolute code for immediate loading and execution; object code can be stored on paper tape or in RAM for intermediate testing.

The user sets breakpoints, examines and modifies dump registers and memory locations with the debug monitors. The monitors also control system input and output. The system interface supports a TTY keyboard, printer and paper tape reader/punch.

A mainframe link for distributed development, another development aid from Intel, connects one or more Intellec systems with existing computer mainframes. It makes the combined resources available as a fully-integrated configuration to large μC development projects. A large number of programmers assigned to a project can employ an existing in-house computer for effective source code management by making good use of the mainframe's fast disks, file management utilities and high speed printers. Finished source programs can be downloaded from the mainframe to Intellec systems, which can compile and test them. The Intellecs can also transmit binary files to the mainframe for storage.

– Loren Werner

Computer-Compatible Peripherals: Calendar Clocks Provide System Insurance



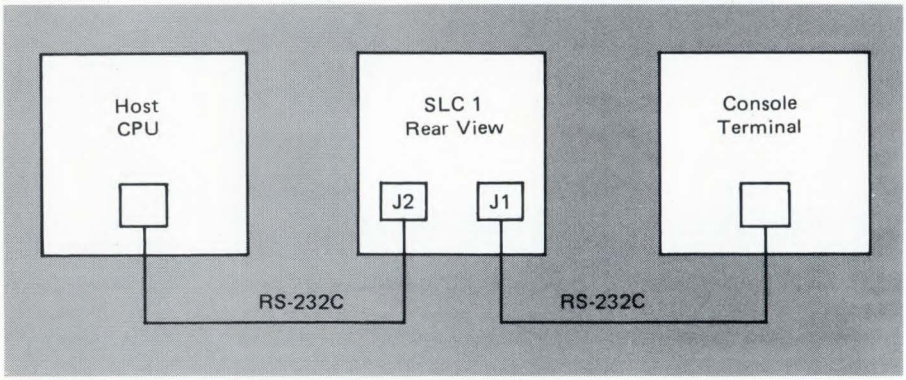
Leonard C. Birkwood
Digital Pathways, Inc., Mountain View, CA

For several years we produced battery-supported calendar clocks for various computers – including Data General computers. The most important feature of these clocks is the retention of date and time during power failure or power-down, and removing the possibility of incorrect date and time entry during the initial Boot. As a result of many inquiries, we decided to produce a clock that is compatible with any computer system using the RS-232C or 20-mA loop serial interface. The SLC-1, the Time Machine, met several user/OEM needs. First, it retained correct date and time after power-down. Second, it eliminated incorrect manual date and time entry. Third, it intercepted and automatically responded to messages from the computer. Fourth, it achieved the preceeding three without having to change the existing operating system.

Here are some of the SLC-1 features: • 6502-controlled • dual UARTS • 16 selectable baud rates • battery-supported calendar clock (year, month, day, hour, minute, sec., day-of-week, week-of-year • 256-bytes (battery supported) RAM • 2-Kbytes EPROM (expandable to 12 kbytes) • 384-bytes RAM (expandable to 12 kbytes) • optional 10-digit display (displays month, day, hour, min, and sec.).

The unit fits into existing RS-232C or current-loop serial link, connecting the user's console terminal to his host computer. There are two front panel switches: ON/OFF LINE and AUTO/MANUAL. In the on/line mode, the unit is invisible to the computer-terminal pair and does not affect the normal operation between them. When it is in the off/line mode, the unit appears to the terminal as a complete, independent, μP system. The host computer sees the off/line merely as an inactive terminal. Switching back and forth from on/line to off/line does not affect the host computer's operations. Thus, the user can move off/line (while the host computer is busy) and continue to work using the unit until the host processor has finished its task. In many respects, it can be used as "brains" to make a "dumb" terminal "smart."

It contains a battery-powered time-of-day, 24-hour clock and a 100-year self-correcting calendar. When on-line in the AUTOMATIC mode, it constantly monitors the host processor's output, which it passes, unchanged, to the terminal. When it sees a "key phase" it instantly responds by sending



Interconnection arrangement shows how the host CPU terminal and clock are interfaced, using the EIA RS-232-C standards.

Illustrated by Josh Randall

a "key response" to the host processor. The keys and responses are defined by the user via the terminal with the unit in its off/line mode of operation. These key-response pairs are maintained in the battery-powered memory, and, therefore, need be initialized only once.

It comes in a single-port configuration that requires only one serial link to operate and is for users who cannot break the link between their processor and console terminal or for those who would prefer to use it as a satellite device communicating with their host processor over a spare serial interface channel.

In the single-port configuration, the off/line characteristics are unchanged – except that communications are direct with the host processor instead of the console terminal. In the on/line mode, however, it no longer transmits information bi-directionally through its two serial interfaces. Rather, it simply monitors all input from the CPU and checks for matches against its "key phrases." If it finds a match, and the unit is in Automatic mode, the appropriate "keyed-response" is fired back to the host processor at the Baud Rate specified in the unit's configuration. Momentarily pressing the Enter switch sends "keyed response #0" to the host processor – whether or not "key phase # 0" was seen.

The figure shows the unit's installation configuration in an RS-232C system. The pre-IC EIA RS-232C (unlike the 20-mA current loop) standard, as is well-known, uses voltage levels: one is –3 to –9V (or less); zero, +3 to +9V (or more).

Here are a few comments and applications from SLC-1 users:

- IBM 1800 Process Control. "Great." Perkin Elmer 816E Grain export house. "Has fully automated our system."
- HP-1000/40 industrial application. "Automates an unattended system."
- Westinghouse W-2500 Process control and data acquisition. "Just can't rely on people entry."
- HP-1000 Bank transactions. "Great product. Paid for itself the first time we didn't have to correct the time and date."
- Perkin-Elmer Model 70 Factory information system. "Stand alone 24-hour operation. Attended by non-technical people at night."

Applications are limited only by user's imagination. Adding such units to your computer system improves efficiency and versatility.

Data General Compatible Products: Hiatus or Impending Growth?

Paul Snigier, *Editor*

The Data General Corporation (DGC) compatible market is about to dwindle, or about to take off – depending on who you talk to. Makers of DGC-compatible equipment felt it was about to grow; DGC, obviously, won't agree. Before we get into the pros and cons of the market and the issues involved, let's first examine the qualities that DGC-compatible products should ideally possess.

Service beats low prices

An ideal DGC-compatible product should represent a good, solid concept or product that can stand alone from the product line. It should fit in with that particular Data General-compatible maker's line. If, for example, it is outside that firm's line of expertise, will it be as good as that from a firm specializing in that product area? Perhaps, but it's not so likely. Service, of course, is a bear. Can the independent service your DGC-compatible products two years from now? Larger and reputable firms like Mostek will certainly be around, and will definitely be able to provide the service. In the case of Mostek, add-in/add-on semiconductor memory boards for Data General computers make sense in terms of Mostek's other product lines, since they are capable in manufacturing memory chips and making memory boards. The DGC-compatible product must fill a gap in terms of : (a) performance, size, configuration and related characteristics, (b) availability (for example, specialized or high-performance products that DGC cannot afford to be bothered with), and (c) undercut longer lead-times from that particular mini maker (a factor more serious with DEC than DGC). What I said in my January special report on Add-In/Add-On computer memories on judging customer support also applies to the DGC situation (and need not be reiterated).

Add-in/add-on memory

Data General system houses traditionally don't integrate that much foreign memory into their systems, unlike DEC system houses. In the case of DEC, long lead times force OEMers to seek outside boards or boxes. But DGC doesn't have this "problem", since more customers prefer DEC systems, aggravating shortages of DEC memories and stretching deliveries. Aggravating this further is DEC's conservative expansion policy (insurance against any downturn, which, it seems never materialized).

Data General, on the other hand, claims this isn't the real reason; it's because DGC offers good quality, low-cost memory (true). Also, service is a big factor. Data General system houses feel service to be important; and, since third-party maintenance could turn off some smaller, unsophisticated end users, some OEMers may prefer to stick with higher-cost DGC memories. DGC system houses that add non-DGC peripherals are less likely to go with non-DGC memory unless they have a strong in-house maintenance program. In such cases, the OEM is more independent from DGC. Other obstacles to system houses seeking lower-cost, non-DGC memory include DGC's arm-twisting tactics. It is well-known that DGC never really liked non-DGC memory and did a lot to hinder OEMers or end users from integrating foreign boards into DGC systems. DGC made it hard on system houses that tried to incorporate non-DG memory, and would prefer not to support such DGC computers. This made a lot of end users and OEM system houses think twice before considering plug-compatible equipment and add-in memories.

But, perhaps the scarcity of well-qualified third-party maintenance groups is what most scared off many system houses without a strong in-house maintenance group. DGC's field maintenance system is good, so for many system houses the lower-priced DGC-compatible memory isn't worth the gamble. Also, if those foreign boards were to cut off some customers from DGC's maintenance contract – DGC has been strict on its contracts and licensing agreements – then this risks alienating and even losing customers for that particular system house. It's also said that non-DGC memories are more susceptible to reliability variations than in DEC's case. If the memory amount is small, say 16 kB, then it's not worth it when all factors are considered. However, with larger systems, the story is different.

New memory markets?

The DGC-compatible memory market could grow due to the larger minis that DGC will introduce in the 1980s. MV/8000 – like DEC's VAX-11/780 and /580, and other 32-bit minis from SEL, TI, H-P, P-E – will require lots of add-in/add-on memory. Although the compatible add-in/add-on memory for DGC Novas, superNovas and Eclipses never took off in the way it did for the DEC-11 market, the MV/8000 market might provide a target for independents, particularly semiconductor makers with good service organizations.

Outside of a few firms, such as Mostek, many DGC-compatible add-in/add-on memory makers aren't pushing their DGC-compatible memory boards; some are even cutting back and taking a wait-and-see attitude on memories. For those, like Mostek, that are aggressive in marketing their DGC-compatible memories, the opportunities look good. These firms also have good maintenance departments, which helps sell their lower-priced memory boards. At the moment, however, DGC remains most susceptible to the plug-compatible makers' inroads in the tape- and disk-compatible areas.

If DGC keeps growing at a rapid rate (and there is every indication this will occur), then sooner or later DGC may encounter longer lead times. In such a case, if a computer can be shipped, say, with only a portion of memory ordered, and if filling the remaining memory orders takes four to ten months, then market pressures will make foreign memory more attractive. Industry shortages of 16-k RAMs haven't exactly aided DGC, which posted an unexpected last quarter loss last year and attributed it to a shortage of memory chips. With a resurgence of the economy expected next year, demand for computer-based systems will soar again, perhaps to unexpected heights, and memory IC lead

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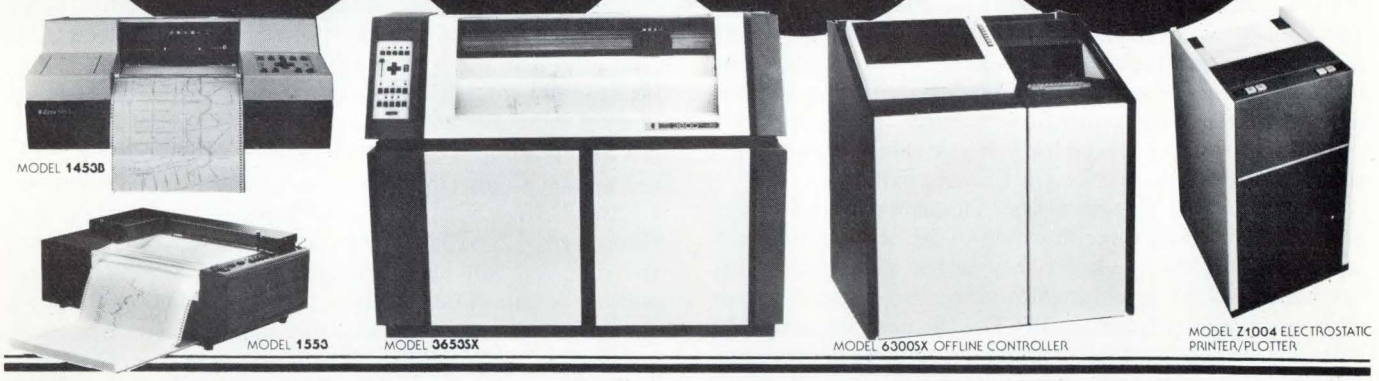

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times will once again stretch out. In face of such shortages, it would make sense for any mini maker to ship systems without the full memory and promise later delivery on the remaining memory, perhaps in three to five months later and offering the customer an option of taking later delivery on the memory or bow out (which most won't do, having waited for the computer system).

Antitrust lawsuit hits Data General

Are there *big* future profits in the Data General plug-compatible market? Not just yet. But some industry observers predict that this could occur by 1982. Although this is not all due to the loss of the Data General Sherman antitrust lawsuit in San Francisco last April, some say this should open the door for independents.

Unlike DEC, which had a patented Unibus defense (against the old National Semiconductor suit), Data General is said to have used different marketing tactics, contracts and licenses, trademark and trade secrets, and other practices to discourage plug-compatible manufactures (independents), according to former Attorney General and now Federal Judge William Orick. Plaintiffs (Fairchild, Ampex, Bytronix, Digidyne, Data Compass, SCI Systems) accused Data General of illegally restricting competition by using artificial product-tying arrangements, forcing customers buying an operating system to buy a CPU, or if buying a CPU, then forcing them to buy memory boards from Data General. Such anticompetitive tying arrangements are automatically illegal under antitrust legislation. In this historic court case, it's said that this is the first time a computer maker was hit for such violations. At issue, however, is not whether bundled or joint sales of two products are legal (it's illegal), but if Data General can refuse to sell each independently. The plaintiffs wanted plug-compatible manufacturer customers to lease or buy Data General operating systems for use on Nova or Eclipse emulators.

Data General's aggressive sales tactics were ruled in violation of law. Data General wouldn't sell its operating systems to a customer – unless they signed a program license agreement (PLA), promising not to use this software except on a specific Data General CPU. Data General demanded its software licensee purchase a minimum equipment configuration of memory and peripherals from Data General. If the CPU purchaser protested that he didn't want or even need the minimum boards, too bad. He got them anyway! Or, he paid a hefty license charge. This made tons of money for Data General, but didn't exactly help independents to sell Data General-compatible equipment. With these roadblocks in their path, many independents preferred to concentrate on the more lucrative DEC-11 compatible market. Besides, the DEC-11s had a greater installed base, and due to overdemand, DEC had its hands full meeting sales. Long DEC leadtimes, due to high demand, created a ready market for independents – with minimal risk.

The judge ruled that the CPU/software and CPU/-memory tie-in, indeed, existed, and that it was hurting the independent memory makers not just a little and that they had "suffered actual injury" due to the "material cause" of Data General's tie-in tactics. Judge Orick ruled that Data General had no legitimate business justification for either type of product tie-in.

It's up to the jury now to decide the economic issues. To win, Data General must (ironically) prove it is not a real economic force in the marketplace – a case not too easy to prove. In essence, it was necessary to show that DGC CPUs, operating systems and memories are not popular nor unique! When Judge Orick asked if Data General Equipment is good, Data General's attorney, Richard Goff, stated: "Some people say it's good; other people say it's not. And many customers say its obsolete and prefer to use other software." (This is hardly the case, of course.) In essence, DGC was in the contradictory position of having to prove it was not so competitive, and avoid saying anything good about its own CPUs, operating systems or memories. The repercussions from this case will affect certain other computer makers.

Data General enters S/VSBC market

How will Data General's distribution strategy affect the future market for OEM system houses and Data General plug-compatible manufacturers? No one can say at this moment for certain.

The first-time, small business computer customer – S/VSBC (small/very small business computer) user – will be the big meal ticket for computer makers in the 1980s. The traditional mini makers (DGC, DEC, TI, P-E, etc.) will vie for this market against traditional semiconductor houses and microcomputer makers (Intel) plus the cottage shops that survived the late 1970s (Apple, North Star, Commodore). IBM will be in there, for sure, but will move into communications, competing with ITT, the U.S. Post Office, AT & T and others for the data communications market.

Marketing research firms' estimates (all large) that we've seen all differ on the actual dollar volumes that they project for the 1980s in the commercial S/VSBC field. Most have proven incorrect in the past (usually too conservative). The exact value is irrelevant. Whichever estimate is correct, the handwriting is on the wall: the commercial, under-$15M/year sales firm will be the high-growth market of the 1980s. At this moment, it's a battle in its initial stages – a battle for market share. By late next year, of the potential 2.2 million S/VSBC customers, only 8% will have computers. By 1983, the market shares (total and sales of $7.3 billion) will be established, effectively locking out new entrants or established firms trying to expand their market share. And, by 1988, the industry will have matured, and the S/VSBC market will begin saturating. By then, certain middleweights won't survive as serious contenders, although the major heavies of today (DEC, DGC, H-P) will be bigger than ever. DGC marketing knows this.

Unlike DEC, IBM, Tandy, Apple and Xerox, DGC decided to go with independent retail marketing – and not with more profitable company-owned stores. The reason? As we saw, at this stage in the game, it's a race for market share – a race that will be won or lost by 1983. By signing up regional distributors (each with retail outlets), Data Genenral's retail distribution program ("Groundswell") can choose among 1200 established distributors in the U.S. Many, unable to carry other successful lines, are discovering things aren't going so well, and may be receptive to selling the DGC line. Projections (as of this writing) are for 160 or so stores by year's end to carry Data General's line of micro-Nova and Nova minis ($1.5-$20k) that were developed for the S/VSBC customer.

Data General's field service will provide maintenance; dealers will provide business applications software. Data General will provide improved software development tools in the future. Data General is supporting its dealers with training, advertising campaigns, inventory financing, a ten-month-old General Distribution Division, (with its own development group and product line).

Although hardware costs continue to plummet, the costs for sales, mainframes and software continue to escalate.

Plessey's 256 Kbyte Add-In MOS Memories for the PDP-11*

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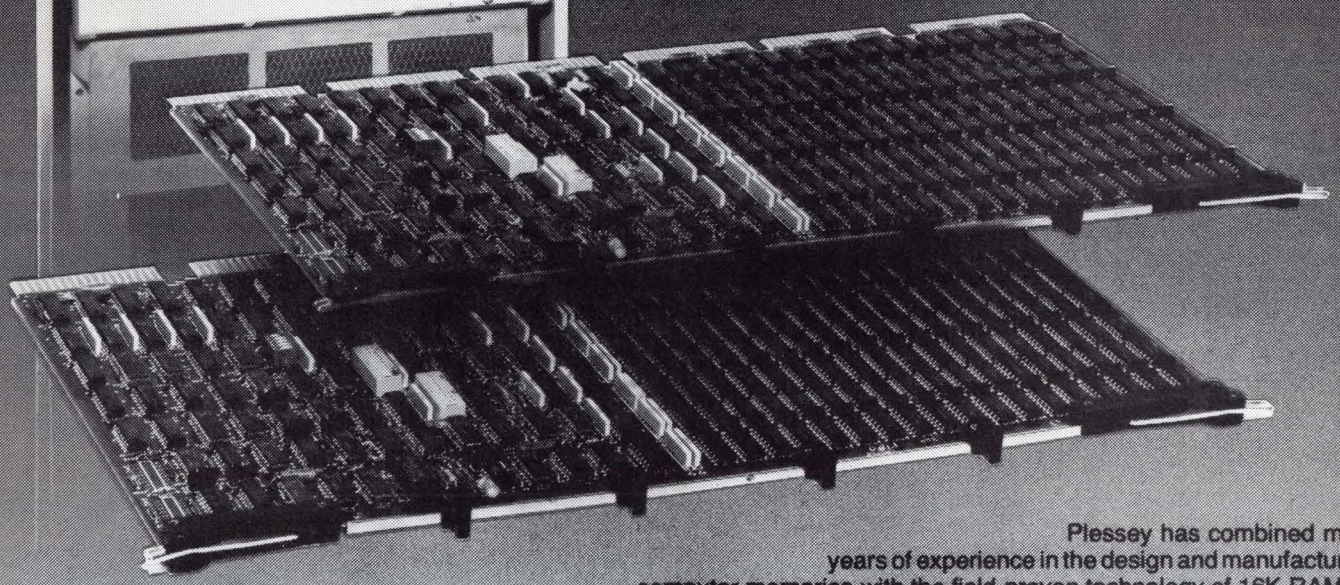

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With the dryup of the military as a source of field technicians and test/maintenance engineers, and with better field/test techs and engineers getting out of this field (generally moving into some design activity), DGC wisely turned to retail distribution as a superior and cost-effective distribution channel that could get off the ground quickly. Data General points to other advantages: independent dealers create more trust among customers, are closer to and understand customers' needs better, and can do "hand holding" that a big mini firm couldn't do effectively.

Data General recognizes the profit margins are lower with independents, but getting its market share by 1983 is critical in its marketing strategy. Is it a "love em' and leave em' tommorrow" deal? Once the independents achieve DGC's goals, would DGC decide to drop its retailers to get at the profits? DGC insists this isn't going to be the case, and doesn't mind its distributors and retailers "getting rich", as one Data General spokesman put it; and, as proof of this, said that Data General has gone all-out to back up its distributors and retailers. It is a long-term situation.

The Data General distributor, who is backed up solidly by DGC, offers its own retail stores reasonably extensive information-training and support, ads (prepared and tested carefully for effectiveness by DGC and provided to the distributors), will hold inventory, etc. Retail stores looking for DGC certification must pass strict qualification requirements, and must maintain a professional image. This involves keeping systems in good condition and a careful floor plan that isolates personal computers and hobbyist games in a separate section, since they may create an unprofessional image on businessmen.

With DGC's floor plan financing, retail stores need not tie up their cash in inventory; by contracting with the floor plan company, which purchases equipment from DGC for the retail store, the retailer can sell equipment (using his demo units) and then pay the floor plan company after the sale is made. The floor plan company makes its money on the interest it charges the retailer. This arrangement, used in the stereo and other markets, has proven itself effective.

As for applications, a potential roadblock that could slow DGC from achieving its market share, DGC is taking action. Of necessity, Data General will push software aids and tools to help OEMs; indeed, DGC must get heavily into applications software mark to survive. DGC sells its commercial applications software through suppliers – not directly to end users – since it doesn't have the business expertise to install or maintain them. Good suppliers will provide assistance that DGC couldn't, and could provide better software. DGC's marketing strategy, like DEC's has shifted to the end user, with sales divided between OEM and end user market areas. The impact of DGC (and other) minis on the machine tool control industries and manufacturing in the 1970s has been inestimable, and they largely accounted for the great productivity gains of the 1970s. The scientific market for minis/micros will not saturate in the 1980s, nor will the machine tool control market – either for the mini makers, system houses or for the plug-compatible makers – but it will be less significant proportionately and will take a back seat to the commercial computer system market, particularly for the small business computer.

What the future holds for DGC-compatible manufacturers is not certain, and the downturn forecast by some may only be a short-term trend. In either case, long-term trend for certain DGC-compatible manufacturers and Data General is excellent.

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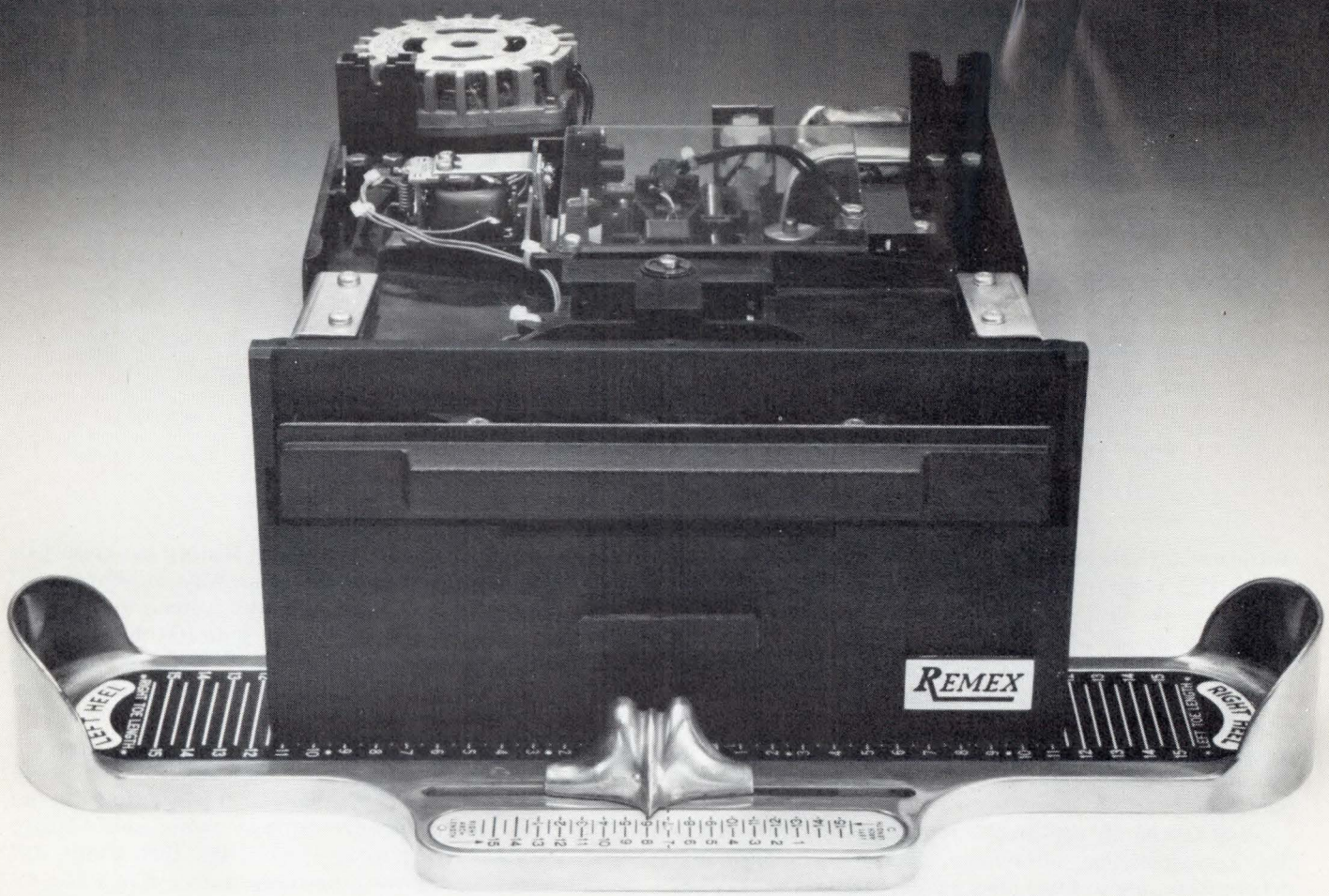

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DATA WAREHOUSE

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Programming Efficiency Can Be Improved

Here's How

Michael D. Maples
M & E Associates

Estimates for software development and maintenance costs in the U.S. range from fifteen to twenty-five billion dollars. Therefore, the time has come for industry to pay more attention to the cost of software development.

Long ago, industrial engineers began studying and analyzing the work habits of personnel. These studies have contributed to significantly reduced costs in manufacturing and production operations. Now we need to do the same sort of research into software production, most especially for microcomputer systems.

You can hardly read an electronic magazine without seeing a programming rate quoted. The numbers range anywhere from one to forty lines per day; 10 lines per day has become a favorite standard. Where do these numbers come from and why does such a large discrepancy between quoted rates exist? These rates are extremely critical for any company embarking upon the development of microcomputer or microprocessor-based machines or instruments. Errors due to incorrectly estimating software development costs could cause the financial collapse of the company.

Let us look at some of the aspects of software development that allow project managers to develop accurate software estimates. To create a proper estimate of programmer productivity, we must first examine the elements that make up the software development process.

Several factors influence programmer productivity which differs from organization to organization. Some of the productivity factors include the type of software to be developed, its level of complexity, the experience of the programmers, the attitude and involvement of these programmers, the type and level of hardware/software development tools available and even the overall expectation of the personnel and management regarding the software project undertaken.

Two steps

A manager should first break the software project down into specific tasks. He can designate them as software requirements analysis, preliminary design, coding and debugging, development testing, documentation and maintenance.

Next, he should assign a certain percentage of effort that should go into each of these tasks. History has given us a hint on how to make these estimates. Why not draw on the experience gained on larger computer systems for some of these percentages? Past experience indicates that software requirements analysis takes about 12% of a project, preliminary design about 15% and the detailed design about 13%. The actual coding and debugging only takes about 16% of the total project. Documentation can take up to 8%. Maintenance can go as high as 36% and, indeed, is quoted in some places as high as 80%. Validation and testing can run about 10%. Microcomputer projects with which I have been involved have typically needed less than about 10% maintenance time. These projects typically run less than 4K bytes of program memory.

Once the manager has decided the effort that he has apportioned to each task, he can next look at some of the problems involved in developing good estimates from his personnel. Again, historical experience gained from larger computer systems provides valuable information. For programs of less than 20,000 statements, a bottoms-up estimation method in conjunction with top-down and similarities and differences methods as verifiers are excellent techniques to use for making estimates. The bottom-up method refers to a technique that breaks the project down into small work units or packages. The breakdown continues until it becomes reasonably clear what steps and talents are involved in doing each task. The cost of each task is then estimated and pyramided to build a total project cost.

As you would expect, top-down estimating works in the other direction. Historical data from previous projects are used to estimate large portions of the new project. The similarities and differences estimating method breaks a project into detailed units that allow you to compare similarities and differences with previous projects. Consequently, the manager of a microcomputer-based project is often quite fortunate in that he may be able to use these various methods in over 90% of his projects.

Other obstacles

The manager must deal with other obstacles when developing a proper cost estimate of his software project. Factors

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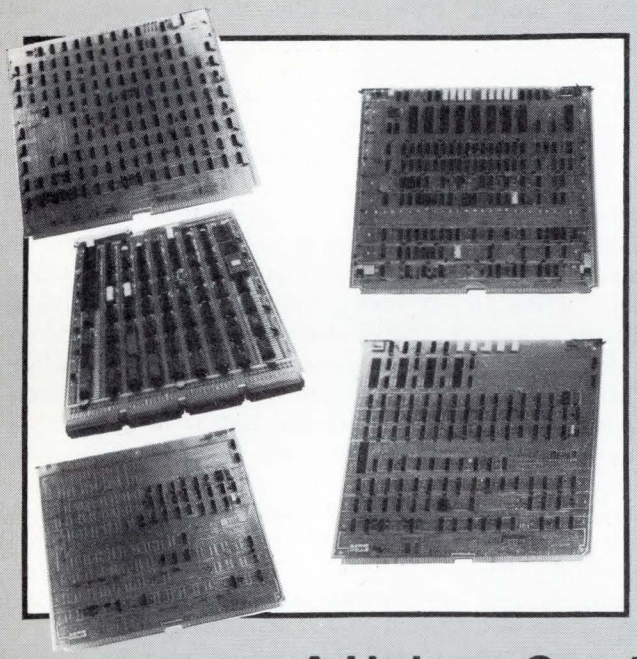

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that characterize microcomputer software include: assembly language, speed-critical routines, system control or logic hardware replacememt, program Stored in ROM or EPROM and program under 20,000 bytes (often smaller than 4000 bytes). He must become familiar with some of the characteristics that differentiate microprocessor from traditional software. First, he learns that its functionality is closely related to the control or replacement of a particular hardware system rather than with solving some algorithmic type of problem. Second, the software frequently operates in real time and that in certain sections of the code, timing is a crucial element. Third, the program is typically written in assembly language even though high-level language is beginning to be used more often. Fourth, the programs are stored in unalterable memory, whether it be ROMs or EPROMs, and the data in alterable memory RAMs. Fifth, a typical program consists of less than 4,000 bytes.

Project managers can use the five following techniques to derive close-to-real software estimates: (1) They can produce software documentation that meets an established programming standard, is accurate and, most importantly, fits the needs of the end-user. Management can use this technique as an instrument to control the project. (2) Management can conduct technical reviews to determine whether the software meets the predetermined acceptance criteria. (3) Management can control the software's physical media regardless whether it resides on tapes, disks, or even paper tape or punched cards. Packaging the software on a medium provides the use of a known configuration in testing, demonstration and certification. (4) Management can apply software configuration, management tools and procedures to assure that the required changes are implemented, tested and, most importantly, fully documented and understood. (5) Management can provide a data reporting repository and control system to assure that all problems, change proposals and software configuration data are analyzed, reported and available to all project personnel.

These tools and techniques can be extremely beneficial and helpful to the project. Apply them without bias; use them objectively to reveal problem areas in the project and recommend and propose solutions, and, most importantly, promote realism. Again we repeat that in developing and producing the estimate, management should promote good programming practices. These practices, the ones most commonly promoted at the present time, include top-down development, a chief for the programmer team, a development support librarian, modular breakdown structured design, structured programming and structured walk-through. These modern practices can increase programming productivity, because they help reduce the number of errors designed and incorporated into a code.

After the estimate phase

Now that the manager has laid the proper groundwork for making the estimates, he is ready to look at the most significant aspect of the programming project, the programmers themselves. Management and analysts must understand their programming staff, their capabilities, frailities and failings. First of all, who are the programmers? The U.S. Government says that over 200,000 people describe their occupation as programmers. Interestingly enough, these people are chemists, mathematicians, physicists, engineers – electrical, chemical, mechanical – psychologists, sociologists, etc. Not only do their backgrounds vary, but so does their training and education in software development and microcomputers.

People working in the design of microcomputer-based products typically suffer from some troublesome handicaps. They seldom have received training in using software development techniques, or they possess little experience in designing hardware, or they lack the necessary combined training and experience in hardware and software that is so critical for making good tradeoffs between the two. Trained computer scientists typically lack training in hardware design and therefore find it hard to make hardware decisions. On the other hand, hardware engineers lack software training and find it hard to make software trade-off decisions. As for many professional programmers, they can solve many of the large CPU-based application problems, but they lack experience with assembling hardware for real-time applications that is so important in microcomputer-controlled projects. Indeed, if you find someone who possesses both backgrounds, he or she is a recent college graduate and consequently lacks actual experience – which is so important. Noting these problems, the manager must examine his people closely to identify their capabilities.

It is also interesting and important to look at why these people have become programmers, because management will use them for producing software estimates. By asking what is the psychological makeup of the programmers and how it will affect the project, particularly in the early portions of the project, management can understand the attitude and determine the involvement of these programmers.

Programmers naturally prefer to, and often do, perform interesting work at the expense of dull work. For example, doing the job in a clever manner tends to be more important than getting it done adequately, on time, or even at a reasonable cost. Management must realize that programmers tend to be optimistic rather than realistic and their time estimates for task completion reflects this tendency. And as so often happens in technical work, software engineers, mathematicians and programmers have trouble communicating with each other and other members of the team.

As previously noted, programming rates for a varied work force can range from one line to 92 lines a day. Intimate knowledge of the experience and attitudes of typical groups of programmers can make you understand why such a large disparity in these productivity numbers exists.

Mistakes to avoid

Some of the key mistakes management can avoid will help improve programming productivity on each project. They will help produce more realistic estimates. They are: • Avoid vague hardware specifications, • Avoid changing hardware design, • Be careful to note the lack of experience your personnel may have in any particular application, • Carefully evaluate how much experience your personnel has had with the chosen microprocessor and • Monitor the quality of the available software aides.

A productive man-year typically breaks down into 37 weeks. (Of course, nobody can normally produce 8 to 10 hours of work every day.) Also, the normal man-year includes two weeks of vacation, two weeks or more of holidays, two weeks of sick leave, typically four weeks for administrative tasks, two weeks for miscellaneous tasks, and slack and wasted time can consume as much as three weeks. Nonproductive time is critically important when you're developing your overall estimate. You must also take them into account for determining deadlines and estimated costs.

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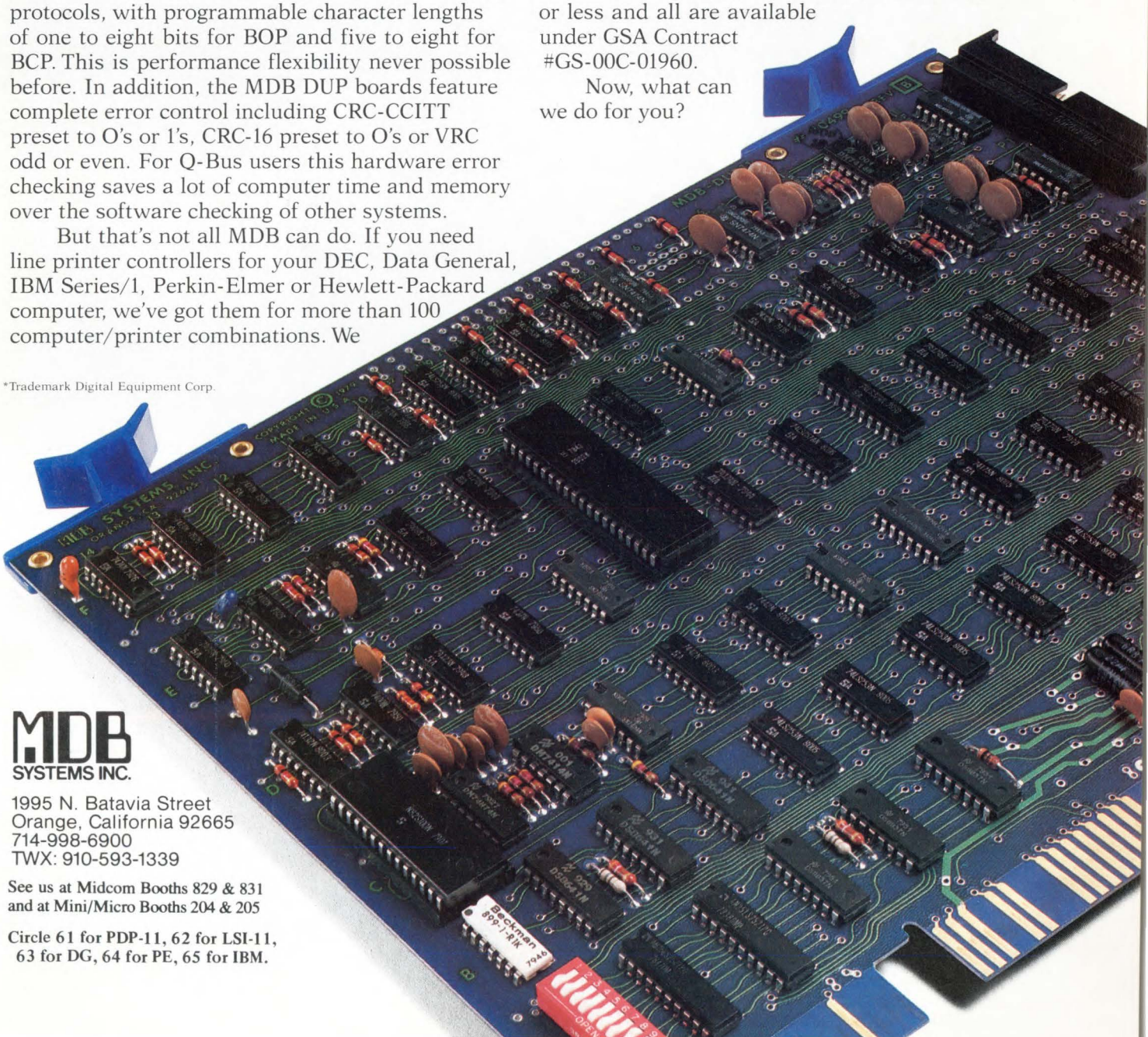

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Circle 61 for PDP-11, 62 for LSI-11, 63 for DG, 64 for PE, 65 for IBM.

lators, development systems, macro assemblers, compilers, interpreters, debuggers, utilities and subroutine libraries.

Although programmers know they can write neater, more efficient code, management must be aware that code production is more complicated and time consuming. Studies have shown that a programmer produces approximately the same number of lines of source code per day regardless of the programming language. This limitation can prevent the development of a project on time. The original cost estimate should note those routines which cannot be programmed in a high-level language. Some real-time routines may need programming in assembly language and the estimate should account for that fact. The type of language can influence the programming rate. A structured language such as PASCAL, PLM, PLUS or MPL can be written and debugged more efficiently than FORTRAN. Also, depending upon the experience and resource level that your work force possesses, an interpretive language, such as BASIC may be used to get the project out in reasonable time. Remember that the software cost very easily tops the cost of the hardware.

My experience has shown that interpreters increase programmer productivity significantly more than compilers do. Two factors help improve this productivity. First, you can use inexperienced personnel to develop significant portions of the program. Second, the interpreters provide on-line, immediate feedback of errors and allow immediate corrections.

A manager who has absorbed his lessons on programming productivity and cost estimating can develop reasonable goals, guide lines and cost estimates. He must remember to consider every project on its merits and demerits before he can develop estimating techniques, assign a programming staff, allocate resources and determine production rates.

Avoid rule-of-thumb analyses in making estimates, until you have completed the initial project analysis. For microcomputer-based systems, the bottom-up technique typically provides quite adequate cost estimates, particularly when you verify them by the top-down and differences and similarity methods.

Although good programming practices combined with good hardware and software development tools can increase programming productivity, the key to code production and cost is the programmer. Project management must maintain a realistic atmosphere during the cost estimate phase of the project, because the programmer usually underestimates the cost. Productive programming days, three to five hours long, producing from one to twenty lines a day of code may not excite management, but they easily fall within the realm of probabilities. All the factors concerning program complexity, programmer ability, experience and attitude heavily influence the productivity and must be accounted for in the estimate. Once you have developed these productivity rates, then you can derive reasonable software project estimates for monitoring effectively the entire software project.

Each software facility exhibits its own unique characteristics which are based on its personnel and the facilities available. The combination of these unique characteristics and the complexity of the program estimating process for a system that works in one facility is so significant, that you should not blindly adopt it in any other. Instead, opt for the just-discussed techniques that allow you to produce cost and schedule estimates, and to implement the software portion of microcomputer-based products. You should apply these techniques facility-by-facility.

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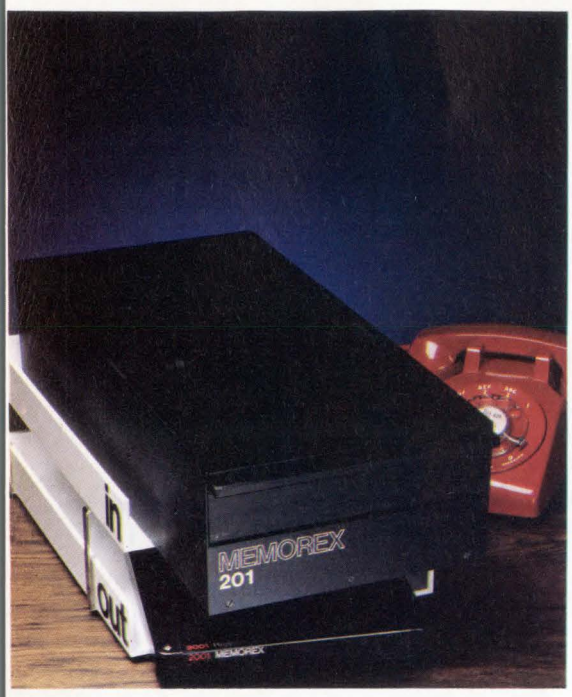


The 8" Fixed Disc Removeable Cartridge Drive Integral Backup For Small Systems

A. Keith Plant,
Memorex Corp. Santa Clara, CA

Rigid disc drive technology has taken another significant step forward with the introduction by a few manufacturers of the the 8-inch fixed disc/removable cartridge storage device. This new product derives its essential engineering from the computer industry's nearly ten years of experience with Winchester storage devices, and it is, therefore, an innovation with roots deeply embedded in a proven technology.

Since their introduction, Winchester drives have been used successfully in many different applications. Until recently, however, they have been used primarily in large computer systems because both their standard 14-inch media size and their large data capacities have not been well suited to the desktop-size and lower-capacity needs of the small systems user. This picture changed dramatically in 1979 with the coming of the 8-inch Winchester disc drive, which expanded the range of Winchester applications to small systems users – the largest and most rapidly growing sector of the storage device marketplace.

This important market segment was being served by flexible disc drives. Yet it generally is recognized that the widespread reliance on flexible drives in this area was due largely to the absence of a viable alternative. Small systems users were willing to use floppy devices, despite their small capacities and sometimes irregular reliability, because they were cheap and the media was removable. Removability meant they were well suited for archival storage, for protection of important data and for reuse. The reliablility problem especially plagued flexible drive makers in their efforts with the higher-capacity double-headed design.

The broad acceptance of the flexible disc devices, given their limitations, hampered the efforts of small systems designers in their pursuit of increased system performance, lower system cost in terms of dollars per megabyte of storage and further simplification of the user/system interface. On the other hand, one issue continued to impede the full acceptance of 8-inch rigid disc drives as alternatives to flexible disc drives – and that was the question of backup or, to put it another way, the availability of removable storage media.

The introduction earlier this year of the fixed disc/removable cartridge 8-inch drive provides an answer to this question. This new drive takes its place among a number of 8-inch Winchester drives with varying capacities and performance rates.

The technology associated with Winchester devices, both 14-inch and 8-inch, is well known. It provides a sealed environment for the magnetic media, heads and head actuators as protection from contamination by

	Capacity (Unformatted MBytes)	Transfer Rate (KBytes/Sec)	Track-Track Access Time (MSec)	$/MB
5-1/4" Single Sided Flex Disc	0.1-0.25	15-64	8-40	550-1800
5-1/4" Double Sided Flex Disc	0.25-0.4	15-64	5-25	550-1800
8" Single Sided Flex Disc	0.25-0.8	31-62	6-30	500-1120
8" Double Sided Flex Disc	0.5-1.6	31-125	3-23	312-800
5-1/4" Fixed Disc	6	625	3	145
8" Fixed Disc	5-75	542-1229	10-19	48-300
8" Fixed/Removable Disc	16-25	1209	10	100-169
14" Fixed/Removable (CMD)	16-96	1209	6	57-200

This chart compares the 8-inch fixed disc/removable cartridge drive to other disc drive types in capacity, performance and price.

dust or other particles which would cause the low-flying heads – they fly about 20 microinches above the disc surface – to crash. A crash causes damage to both the heads and the disc and consequently results in a loss of data.

The essential features of this technology are: low-mass, lightly-loaded heads; lubricated media; low flying heights of heads; and sealed head-disc assemblies (HDAs). Benefits stemming from these features include: large capacities, fast access and increased reliability and cost effectiveness in terms of dollars per megabyte.

This familiar, proven technology has transferred easily from the 14-inch disc size to the new 8-inch drives, and it is expected that, while the 14-inch disc drive will continue to be used widely in OEM and large system applications, the 8-inch drive will capture an ever-increasing share of the small systems market.

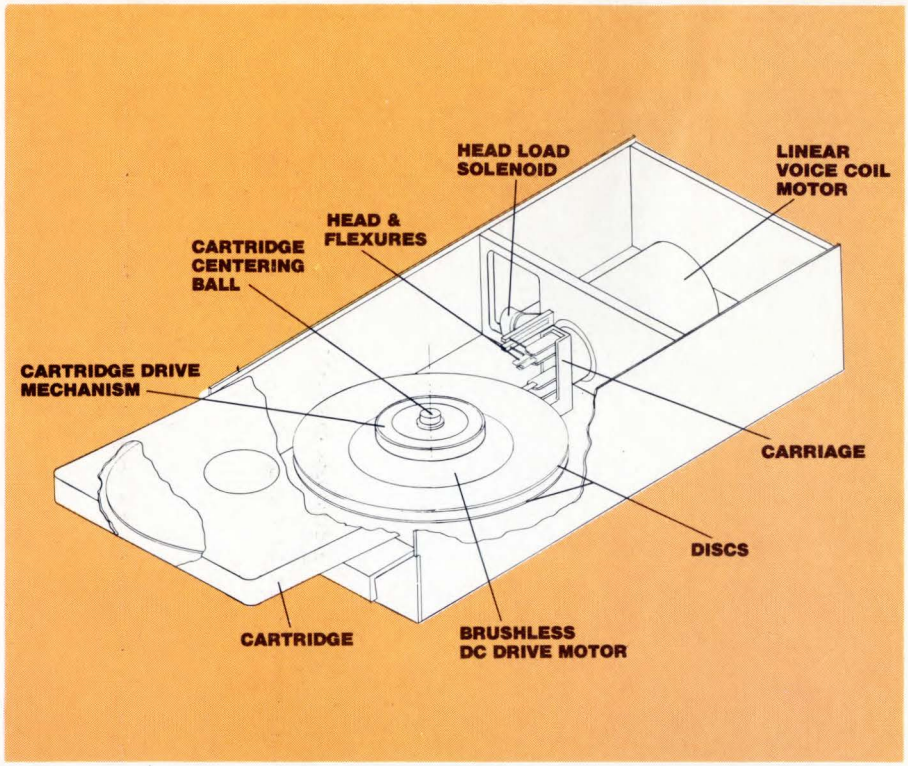
Also, imminent refinements to Winchester technology will have as immediate an effect on 8-inch drives as on their 14-inch counterparts. Even before the use of thin-film heads and media, it can be expected that performance will increase within the bounds of present technology. For example, some engineers predict that capacity will be multiplied five or six times by increases in aerial density still possible within the ferrite head/oxide media context.

However, with the coming of thin-film heads and thin-film media, the capacity of Winchester units, 14-inch and 8-inch, will be increased even further. Higher reliability also can be expected as sophisticated servo systems and head-positioning devices are introduced. Such impending technological advances will improve system cost effectiveness as well.

Range of 8″ offerings

The 8-inch disc drive products now being offered by a variety of manufacturers range across a broad spectrum of price, performance, capacity and system compatibility parameters. This array can be grouped by price and performance into two, medium and high categories. The drives also can be grouped according to their use of fixed or moving heads and fixed or removable media.

Some manufacturers have chosen to compete only at one end or the other of these scales – some producing low-capacity drives, some producing very high-capacity devices. Other drive makers, such as Memorex or Control Data Corporation, will compete initially in the low and medium ranges, with future products at the high-cost, high-capacity levels. Memorex, for instance, has introduced its Model 101, with 11.7 megabytes of storage and with an average access time of 70 milliseconds, and it also will be making a drive with twice this capacity, 23.4 megabytes, as a multiple-user flexible disc drive replacement.



This drawing shows the various parts of an 8-inch fixed/removable drive.

Types of head and media technology provide further means of categorizing 8-inch drives. *Fixed head/fixed media drives,* usually with less than five megabytes of storage, have low access times and compete directly with flexible disc units.

Moving head/fixed media drives, such as the Memorex 101 and Shugart 1002, have higher capacities (between five and 25 megabytes) and access times of 70 milliseconds, and they employ band-actuated stepper motors. Other drives of this type use voice-coil actuators. They offer access times between 30-50 milliseconds and capacities up to 75 megabytes, putting them into the medium capacity/performance/price range. Still other drives of this type, such as the IBM 3310, are aimed at replacing the 14-inch drives in high-cost systems, and they offer capacities which begin at, and go beyond, the 65 megabyte range.

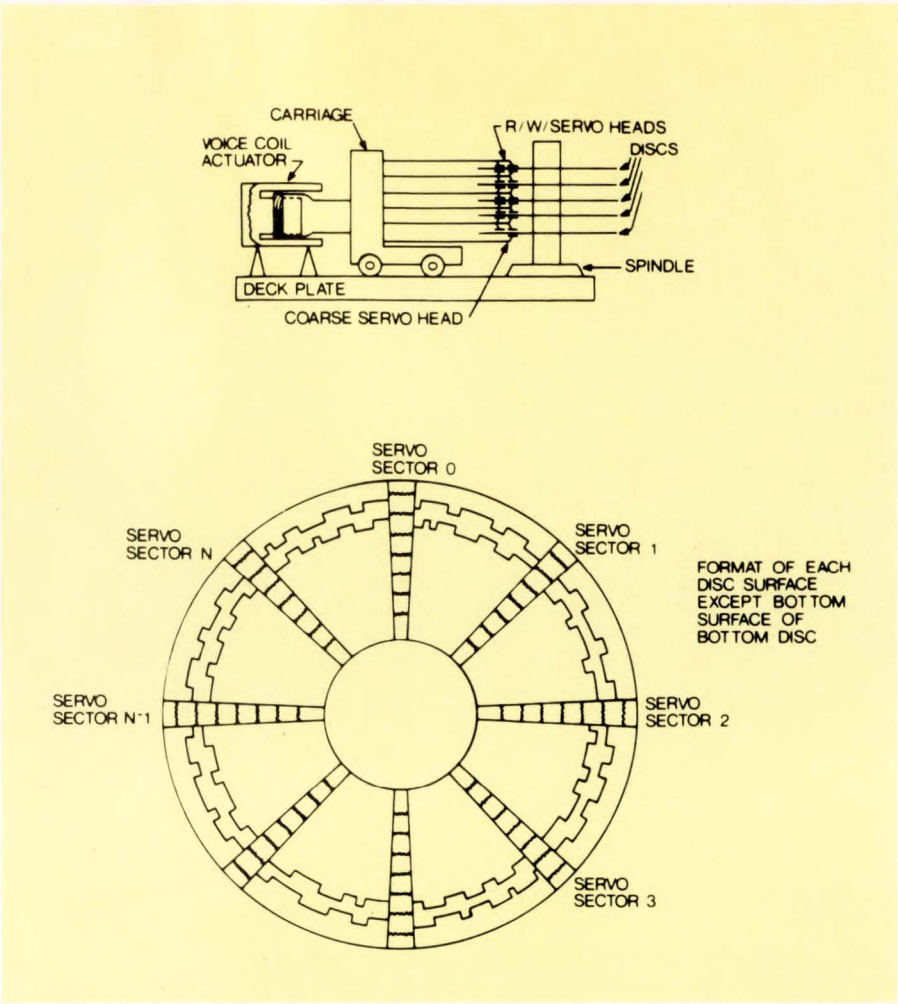
Finally, the *moving head/fixed and removable media drives,* such as Memorex's Model 201 and the CDC "Lark," will be aimed at multiple-user, multiple-tasking systems demanding relatively fast access (30-50 milliseconds). The storage capacity for the entire system usually will be under 100 megabytes. These devices also will compete with cartridge or storage module devices in relatively large systems.

Drives in this category, with both fixed discs and removable cartridge media, obviously confront head-on the question of 8-inch disc drive backup, and they solve that problem by providing integral removable storage. Backup, as mentioned earlier, is still a key issue affecting the acceptance of 8-inch fixed disc storage devices. Thus, the removable cartridge feature of the new drives should facilitate their acceptance by flexible disc users.

Backup alternatives

To protect data stored on a magnetic disc in case of a power outage or simply to provide for archival storage, requires the transfer of the data from the 8-inch disc to a removable form of storage media.

At present, except for the new fixed/removable disc drives, backup alternatives are limited to flexible discs or various magnetic tape products, including the new streaming-tape devices. Tape alternatives include quarter-inch, half-inch, cartridge and cassette formats. In general, the half-inch streaming-tape backup alternative is not suit-



The above drawings are a generic representation of an embedded or sample data servo system.

able for low-capacity 8-inch drives because the streaming tape's high capacity means large unit size and higher costs. Such alternatives might better be matched with high-capacity 8-inch drives, above 25 megabytes. Tape drives using the quarter-inch format are smaller and cheaper, to be sure, but they also generally have lower capacities and slower transfer rates, making them more compatible with lower-capacity 8-inch drives.

Flexible disc storage units also can be used for 8-inch rigid disc backup. However, the floppies' low capacities, high error rates and low data transfer rates limit their backup use to low-capacity 8-inch drives even though they are cheap, easy to use and standardized for compatibility.

The question of 8-inch rigid disc backup is not yet completely solved. A recent report on the 8-inch market concludes, "Those who wait for the perfect backup will wait a long time" (There also are some interfacing and software roadblocks standing in the way of simple and compatible utilization of 8-inch drives in OEM systems). But the 8-inch fixed/removable media drive suits a number of applications and meets the need for integral backup within certain capacity, performance, price and size parameters.

Anatomy of a drive

Although the following description of an 8-inch fixed/removable rigid disc drive is based on the specifications of the Memorex Model 201, it generally fits the specifications of fixed/removable products from other manufacturers as well.

These drives are medium-priced (approximately $3,000 a unit in OEM quantities), medium-capacity (16-50 megabytes), medium/high performance (30-50 milliseconds access time) products, serving as disc cartridge or storage module replacements.

Utilizing Winchester technology, they feature a sealed head, head actuator and media environment to protect them from contamination, combined with a removable rigid disc cartridge, typically front-loaded. Cartridge sizes are not standardized and vary from one manufacturer to another. The Model 201 cartridge measures 8.3″ × 8.4″ × 1″. When inserted above the fixed discs, the cartridge engages with the drive motor spindle and the head actuator assembly.

In the Memorex Model 201, actuators are of the linear voice-coil motor type, mounted on a six-bearing carriage. Heads are the low-mass Winchester type, made of a magnesium-zinc ferrite material.

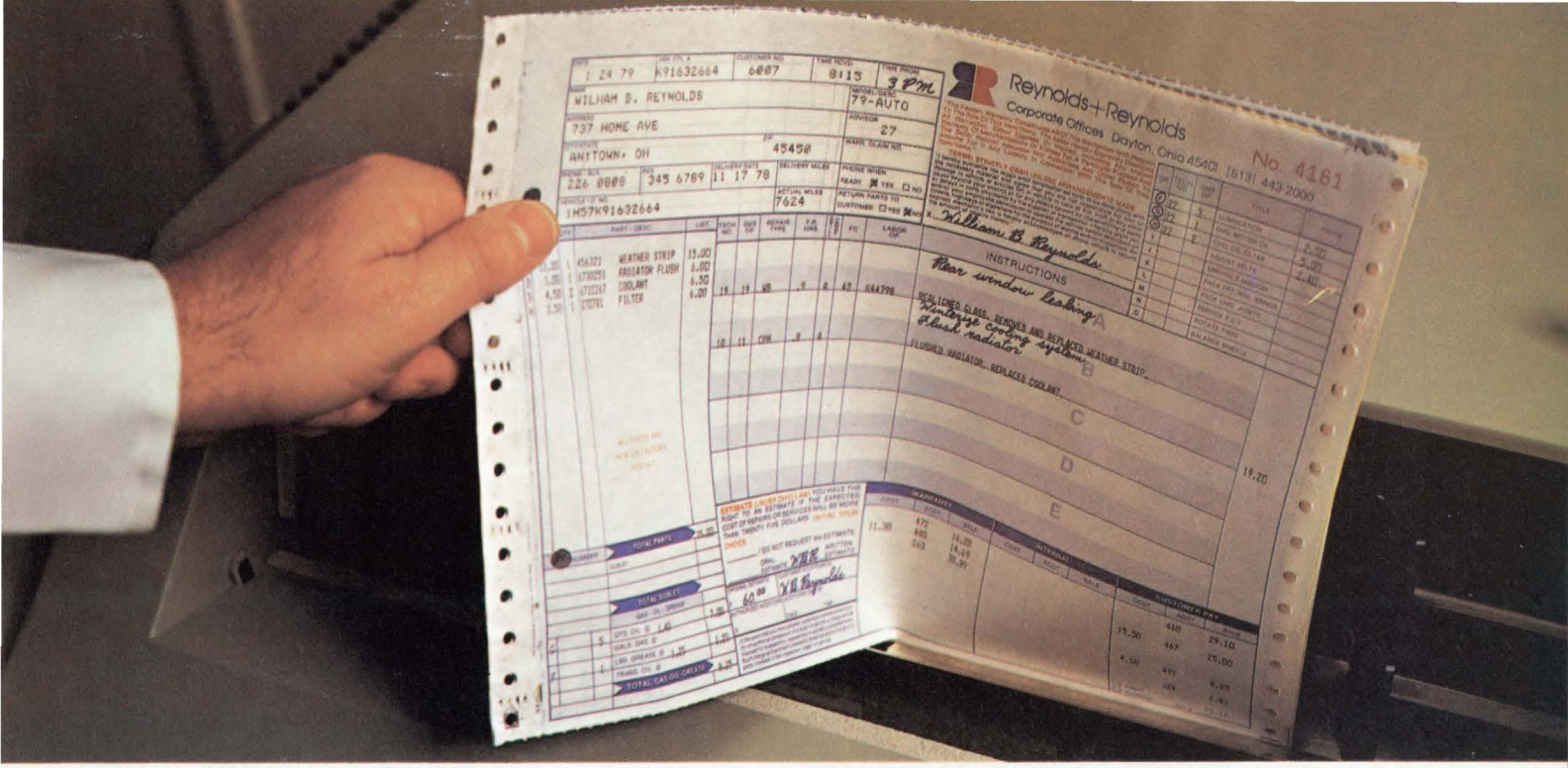
The 201's two fixed discs are fully sealed. They are driven by a DC brushless motor with an integral spindle. This eliminates the need for belts, pulleys or gears, thereby reducing noise, vibration, thermal effects and production costs. This design simplicity also increases reliability.

In the 16-50-megabyte capacity range generally associated with these products, the Memorex Model 201 has a capacity of 25 megabytes – the two fixed discs provide 12.5 megabytes and the removable cartridge another 12.5 megabytes. The fixed discs include one disc with one surface of dedicated servo information and another with two data surfaces and embedded servo information. The removable cartridge provides one disc, using two data surfaces with embedded servo in each track.

The factory-embedded servo gives the device very fast access times and very accurate tracking. For instance, in the Model 201, the dedicated servo information provides accurate positioning and fast access to within one-half track of the sought-for data. At that point the embedded servo takes over for the last half-track search. This technology enables the Model 201 to access data at an average speed of only 30 milliseconds, or 20 milliseconds faster than the CDC "Lark".

The two fixed and one removable discs are all identical in size and composition, and in the Model 201 they feature a proprietary oxide coating formulation as well as an extra lubrication layer, wiped across the disc and then buffed to a thickness of a few molecules. These discs are sized at 200 millimeters outside diameter and 100 mm inside diameter, a size which conforms to a "principle of similitude," which maintains that the OD/ID ratio should be similar to that for the standard 14-inch disc. By use of this principle, experience with 14-inch technology can be applied to 8-inch discs, thereby taking some of the guesswork out of solving modal vibration or mechanical resonance problems.

There are several permutations of the generic 8-inch disc size media now on the market – ranging from 63.5-mm ID/200-mm OD through 100 milli-



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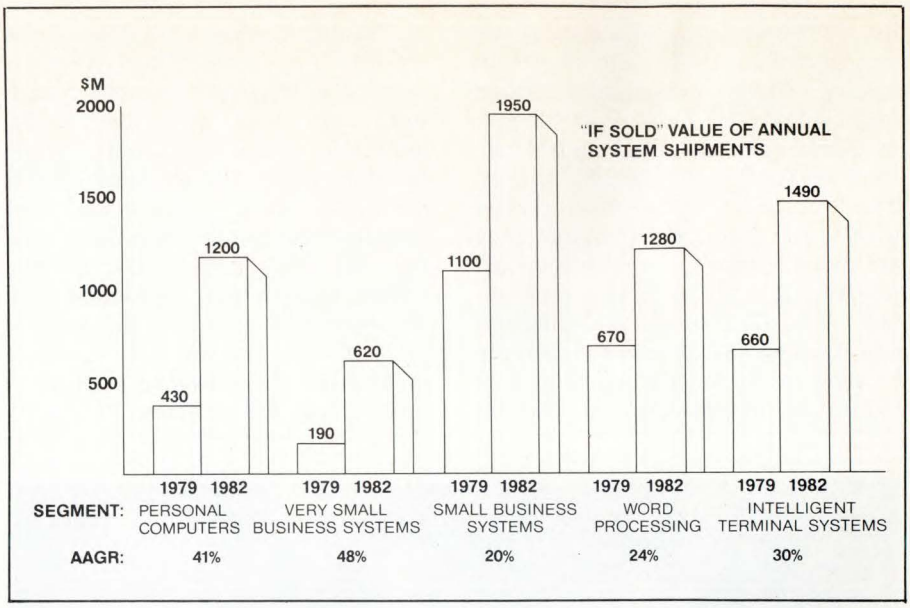
meters ID/195-mm OD to 100 millimeters ID/210-mm OD. Any reduction in outside diameter below 200 millimeters, however, results in less than the optimal capacity which can be stored on a disc that fits a floppy drive envelope. A very small inside diameter, on the other hand, will increase the moment of inertia, requiring more energy to maintain angular rotation speeds.

In some fixed/removable cartridge drives, such as CDC's "Lark," the cartridges are "ramp-loaded," because they use modified 3330 heads. On the other hand, the Memorex 201 employs an "active-loading" system, using a rotary solenoid to expand a simple mechanism which loads or lifts off the Winchester heads upon insertion or withdrawal of the cartridge. The cartridge doors fully seal when the cartridge is withdrawn and require door-actuating mechanisms for loading. A write-protect feature needs to be located on the cartridge; in the case of the Model 201, this feature is a simple removable foolproof button, while in some competitive units a switch is used.

The dual air system of the fixed/removable disc drive is a recirculating, absolute-filtered system which flushes the fixed disc and cartridge areas, provides contamination protection and reduces heat. It is positively pressurized to ensure that any contamination is forced out of the drive during loading or withdrawal of the cartridge. Because the 201's cartridge loading door can be opened only when the power is on, this positive pressurization is always present when the door is open.

The overall size of the fixed/removable storage device (the Model 201 is 4.38″ high, 8.55″ wide and 18″ deep) makes it exchangeable with the flexible disc units it is designed to replace. The first fixed/removable products on the market employ a conservative design approach which requires a "two-box" system, with heads, media and associated mechanical and electrical assemblies in one flexible drive-size package and the electronics in another similar-sized package. In other words, designers of the early products have chosen an MSI approach, rather than an LSI circuit design approach. We and others will soon take the LSI step, however, using a single board to be inserted into the head/disc unit without changing the overall dimensions of the drive. This can be accomplished in the field, and the second or electronics box can then be replaced by an additional drive in the same space. The only electronics



The graph indicates projected growth in small systems markets, targets for new 8″-Winchester drives. (AAGR = Average Annual Growth Rate).

in the drive unit are in the R/W chip that controls the head actuators.

The disc drive interface for the 8-inch fixed/removable device made by Memorex is designed to be compatible with SMD-type controllers, although a higher-level parallel-type interface also will be introduced.

Data retrieval times are an important measure of disc drive function. Again within the general parameters of available fixed/removable devices, the Model 201 features a track-to-track access time of ten milliseconds, with an average access time of 30 mm and a transfer rate of 1.20 megabytes/second. The discs spin at 3510 RPM. Tracks per inch on the 8-inch discs are 480, with 8,450 bpi. In some ways, it is easier to increase TPI on 8-inch rigid discs than on the 14-inch discs because there is less vibration and wobble and because the smaller discs require less power to spin less mass. These factors facilitate more accurate head positioning, for example.

Most manufacturers of 8-inch fixed/removable disc storage units are expected to match fairly closely the general specifications outlined above. The devices are, after all, aimed at essentially the same users. These are users with computer systems with multiple-user, multiple-tasking configurations who require relatively large capacity, faster access, increased data transfer and at least equal cost-efficiency when compared to 8-inch drives without integral backup or to flexible disc drives now in use in many small systems. The OEM's choice of vendor then will be based on overall vendor capabilities, production capacity, design efficiency and sophistication and future upgradeability of the product, rather than simply on listed specifications. Buildability, deliverability, reliability and evolvability are the catchwords by which the OEM and end-user will judge the market offerings.

Thin-film heads and media

The question of evolvability is a crucial one for OEMs considering the use of the new 8-inch drives, especially in light of the attention being paid to advances in thin-film head and thin-film media technology. Memorex's applied research centers, particularly its Recording Technology Center, along with the research establishments of other manufacturers, have been studying thin-film heads and thin-film media for years.

Thin-film recording utilizes technology which the semiconductor industry has developed over the past 25 years. This technology includes photolithography and a highly accurate masking technique which makes possible the batch processing of thousands of heads at one time. Thin-film recording heads are produced by sputtering, vacuum deposition and plating – all semiconductor production processes.

Testing procedures developed by the semiconductor industry also can be applied to the manufacture of thin-film heads. As a result of the application of these manufacturing and testing techniques, thin-film heads have some major advantages over ferrite heads. The improved performance characteristics of the materials used in the thin-film process are one advantage –

thin-film head permalloys can operate at higher frequencies, and they have greater overall permeability. Other major advantages result from the geometrical and dimensional control provided by the photolithographic process. The heads produced are much smaller than ferrite heads, and, therefore, they are more efficient in transmitting and receiving flux from the recording surface. Also, much smaller recording gaps and track widths are achieved than can be achieved by the machine-shop techniques used in ferrite head production.

The development of thin-film heads heads has been accompanied by similar work with thin-film recording media. For many years, particulate oxides have been used as the primary coating for disc media. The thickness of this particulate oxide coating has been steadily reduced over time. Now coating uniformity defects have become critical because mass production coating thickness has reached the order of 35 millionths of an inch. Under a microscope, the individual particles of oxide look like a forest of Fe_2O_3 slivers, whereas a media sample produced by the thin-film process appears as a continuous film of coating, resulting in a continuum of much smaller magnetic domains. In addition, signal-to-noise ratio measurements show that thin-film magnetic recording media outperform particulate oxide coatings by a factor of nearly ten.

Industry technologists predict the combined use of thin-film heads and thin-film media will result in an increase in aerial density from the present 3 to 8 million bits per square inch to 50 million bits per square inch by the mid-1980s. Thin-film heads will influence bits per inch by their electrical and magnetic performance, as well as influencing tracks per inch by the geometrical control of the recording transducer. Recording at 25,000 bpi will be achieved in standard longitudinal recording at a track density of 2,000 tracks per inch. With further advances in magnetic recording techniques based on thin-film heads and thin-film media, which open the door to "perpendicular" or "vertical" recording, the promise of 100 Mbits/in^2 becomes more and more likely. Increased aerial density means greater capacity at lower costs. This can be examined in terms of rapidly declining costs per megabyte or in terms of relatively constant costs per disc spindle. These advances, now on the horizon, will of course affect the 8-inch rigid disc drives as well as the larger 14-inch drives because the basic technology contains no important barries to the use of a reduced disc.

Increased subsystems performance by the use of LSI circuit design also is available and readily transferrable to the 8-inch rigid disc drive. The evolvability of the 8-inch drives, including the fixed/removable units, is assured, and users will find they can continue to upgrade storage components without radical departures in size and other physical standards. The steady evolution of the Winchester rigid disc drive from the first 14-inch products toward the advanced thin-film 8-inch products is a prime example of the advantages of continuing to exploit a proven technology.

The marketplace

It was said earlier that the 8-inch rigid disc drive is designed to provide higher capacity and faster performance for small systems users – the largest and most rapidly-expanding sector in the computer peripheral marketplace. Just how large is that sector? The number

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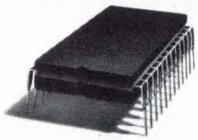
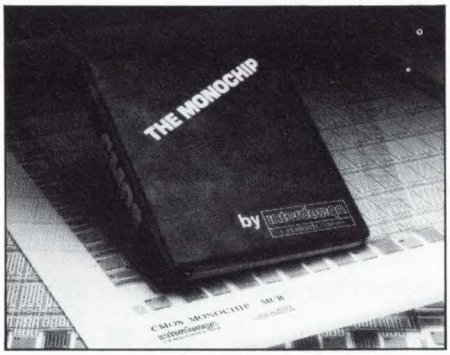


Monochip:™
the semi-custom IC.



Our $59 Monochip Design Kit has everything you need to develop your own CMOS IC. You choose the size—from 100 to 400 gates.

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Circle 16 on Reader Inquiry Card

of present and potential users is enormous.

In round figures, there are approximately four million businesses of all kinds in the Unites States alone. The very large businesses, the "Fortune 1000" businesses and some others, are already using sophisticated electronic data processing equipment – primarily large mainframe systems and multiterminal distributed data processing configurations.

Below this fairly exclusive group of major businesses is another larger group of perhaps 1.5 million businesses, some employing no more than 50 persons or even fewer. It is this marketplace which is targeted as the primary market for small business systems needing the storage support provided by the 8-inch disc drive, in different formats and with different capacities. This market, if not employing electronic data processing on a large scale, is already somewhat experienced with computer-based business and scientific support systems for use in the office, laboratory, warehouse and manufacturing plant.

Here the desktop computer or small business system has been used for manipulation of business information of all kinds. Applications include word processing, intelligent and graphics terminal support, protocomposition and inventory and process control. In many cases, very small business systems and "personal" computers will also demand support from 8-inch disc drive devices.

The remaining 2.5 million or so businesses in the United States, with sales of only a few million dollars or less each year, employing from one to 25 persons, rely for the present on such electronic devices as desk and hand calculators to process data. Yet this market, too, will soon be ripe for penetration by the small business computer manufacturer and will require compatible storage devices such as the 8-inch disc drive.

Indeed, there is hardly a business-known that is not potentially available to the vendor of small systems, and all of them will need and want integral backup 8-inch storage. As programs grow in length, as high level languages take up more memory space, and as the storage requirements continue to grow for 16-bit and the coming 32-bit μPs, the capacity, access time, size and cost of the 8-inch disc drive make it an ideal choice. (See chart #6).

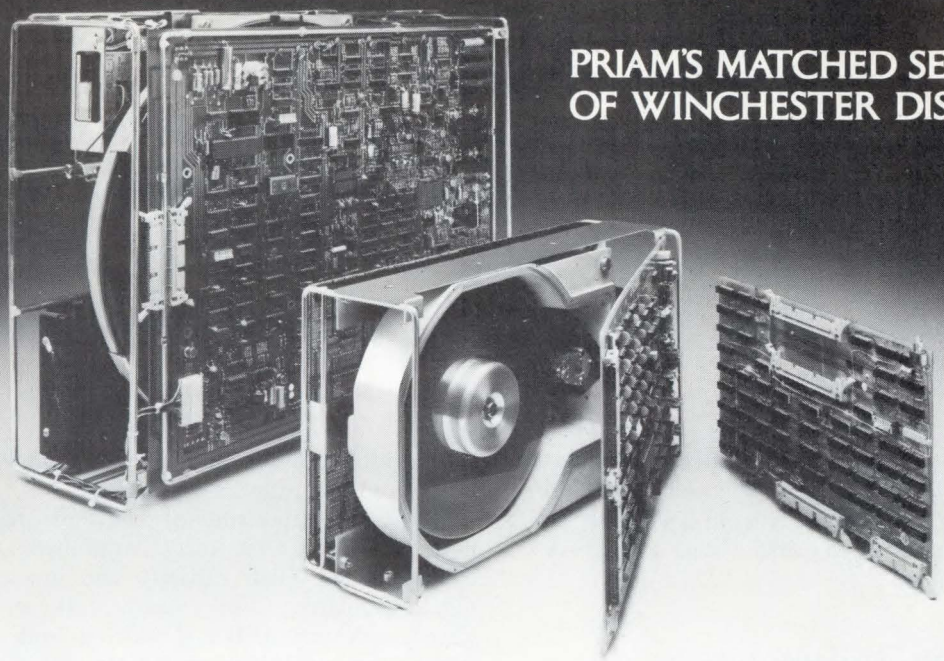
The fixed/removable choice

The selection of an 8-inch fixed/removable media disc drive is not yet a bewildering matter; only a few manufacturers have introduced such products to date, although more such storage devices will appear soon.

Also, since 8-inch drives are similar in specs, size and cost, it at first seems that the choice is easy or not important. This is not true. Although the choice of an 8-inch fixed/removable disc drive would not be based entirely on raw spec data, it's important that the OEM (or the end-user configuring his own system) look carefully at some broad selection criteria.

Competitive advantages in this still-narrow field will largely be based on the ability to produce 8-inch fixed/removable media drives efficiently, reliably and at high production levels. Only manufacturers committing major resources to ensure buildability, reliability, deliverability and evolvabililty – including capability of manufacturing essential components, such as heads and media in-house – will have viable options.

FAST COMPANY!



PRIAM'S MATCHED SET OF WINCHESTER DISC DRIVES

PRIAM's high-performance, low-cost Winchester disc drives speed up throughput and expand data storage from 10.8 megabytes to 158 megabytes. And a single controller can be used to operate 14-inch-disc drives with capacities of 34, 68 or 158 megabytes or floppy-disc-size drives holding 10.8, 21 and 35 megabytes. So it's easy to move up in capacity, or reduce package size, without changing important system elements or performance.

High Performance and Capacity at Low Cost

Fast, linear voice coil positioning gives you high system throughput, without traditional high cost. Track-to-track positioning time is 8 milliseconds, and average positioning takes just 45 milliseconds for all voice-coil models. PRIAM's use of IBM 3350-level Winchester disc technology gives you high capacity at amazingly low cost.

Simple, efficient design makes all PRIAM drives reliable and economical. Brushless DC motors eliminate belts, pulleys and mechanical brakes. They also save you money and let any PRIAM drive operate anywhere in the world.

Compact Sizes, Light Weight

Small size and light weight make PRIAM drives a cinch to fit into your systems. The space-saving DISKOS 3350, 6650, and 15450 weigh a mere 33 pounds. The DISKOS 1070, 2050 and 3450 have exactly floppy-disc-drive dimensions and weigh only 20 pounds. Compact, light steel rod frames permit easy flow of air in the system, improving system reliability. In the 14-inch drives, the optional power supply can be fully enclosed within the disc drive assembly.

High Reliability

PRIAM's proprietary head-disc assembly air system assures long-term reliability by maintaining positive pressure at the spindle-bearing seals. In voice-coil models, data reliability is guaranteed by full servoed head positioning; dedicated servo tracks eliminate the positioning errors to which other low-cost drives are vulnerable. Microprocessor control reduces component count and cost and improves reliability and flexibility.

SMART Interfacing

PRIAM's low-cost SMART Interface is the same for both 8 inch and 14 inch drives, and all PRIAM drives include data separation. To make interfacing easier , PRIAM's optional SMART Interface provides functions that permit interfacing directly to the I/O bus at the byte level. It controls up to four drives, and provides serialization and deserialization of data, disc formatting, sector buffer, polled or interrupt operation, defect mapping, overlapped commands, implied seek, selectable sector sizes, and resident microdiagnostics. A simple interface adapter to the CPU is all that's needed, eliminating tedious and expensive controller development.

SMD Interface

If you have an SMD controller in your system, you can move quickly to Winchester technology performance, reliability and economy by using PRIAM's optional SMD Interface. It matches up conveniently with existing Storage Module interfaces and it is available with all of the following PRIAM models.

THE PRIAM LINEUP

Model/Disc Size	Capacity	Transfer Rate	Size
DISKOS 3350 (14")	34 Mbytes	1.04 Mbytes/Sec	7" x 17" x 20"
DISKOS 6650 (14")	68 Mbytes	1.04 Mbytes/Sec	7" x 17" x 20"
DISKOS 15450 (14")	158 Mbytes	1.04 Mbytes/Sec	7" x 17" x 20"
DISKOS 1070 (8")	10.8 Mbytes	0.8 Mbytes/Sec	4.62" x 8.55" x 14.25"
DISKOS 2050 (8")	21 Mbytes	0.8 Mbytes/Sec	4.62" x 8.55" x 14.25"
DISKOS 3450 (8")	35 Mbytes	0.8 Mbytes/Sec	4.62" x 8.55" x 14.25"

Take a closer look at future database requirements. Then get complete details about PRIAM Winchester disc drives by writing or calling:

PRIAM

Ask for "Who's Selling Rifles to the Indians?", PRIAM's FREE Winchester Technology Primer.

3096 Orchard Drive San Jose, CA 95134
Telephone (408) 946-4600 TWX 910-338-0293

Circle 28 on Reader Inquiry Card

Backup For Your 8" Winchester

Bob Hirshon, Assistant Editor

When it comes to backup, 8" Winchesters are victims of their own success: finding a compatible backup partner for compact, high-capacity mini-Winnies is no small task. Yet backup is essential for any fixed media system – what are a system designer's choices?

Tape or disk?

Backup systems fall into two main categories: tape or removable disk. Most tape backup systems are either 1/2" reel or 1/4" cartridge; either of these may be streaming or start/stop. Removable disks may be floppies or the recently-introduced removable 8" hard disks.

Tape. The granddaddy of removable storage media, magnetic tape still thrives today as the media of choice for archival storage. High capacity and low cost account for tape's popularity. Until recently, however, reel tape drives were simply too costly and bulky to back up mini-Winchesters; no one wanted to spend more on backup than on main memory. Then streaming tape drives came out. Designed specifically for backup applications, streamers do without

Suppliers of Back-Up Media

ARCHIVE CORP. (QT)
3540 Cadillac Ave.
Costa Mesa, CA 92626
(714) 641-0279

BASF AG (VT)
6700 Ludwigshafen
West Germany
(06 21) 60 9 25 36

BRAEMAR COMPUTER DEVICES, INC. (CT)
11950 Twelfth Ave, S.
Burnsville, MN 55337
(612) 890-5135

BURROUGHS CORP.
One Burroughs Place
Detroit, MI 48232
(313) 972-7000

CIPHER DATA PRODUCTS, INC. (HT)
10225 Willow Creek Rd.
San Diego, CA 92131
(714) 578-9100

CONTROL DATA CORP. (HT, QT, HD)
8100 34th Ave, S.
Minneapolis, MN 55420
(612) 853-8100

DATA ELECTRONICS, INC. (QT)
10150 Sorrento Valley Rd.
San Diego, CA 92121
(714) 452-7840

DATA PERIPHERALS CORP. (HD)
3310 Montgomery Dr.
Santa Clara, CA 95051
(408) 496-0916

DATAPOINT CORP. (QT)
Peripheral Operations Div.
510 North Pastoria Ave.
Sunnyvale, CA 94086
(408) 732-7330

ELECTRONIC PROCESSORS, INC. (QT)
1265 West Dartmouth Ave.
Englewood, CO 80110
(303) 761-8540

EMI (SE LABS, LTD.)
Data Products Div.
Spur Rd.
Feltham, Middlesex,
TW 14-OTD
England
Telephone (01) 890 1477

EVKIN (QT)
2630 Walnut Ave.
Tustin, CA 92680
Telephone (714) 838-7636

HITACHI, LTD. (HD)
6-2, Otemachi 2-chome
Chiyoda-ku, Tokyo 100
(03) 270-2111

INNOVATIVE DATA TECHNOLOGY (QT)
4060 Morena Blvd.
San Diego, CA 92117
(714) 279-3990

INTERDYNE (UT)
14761 Califa St.
Van Nuys, CA 91411
(213) 787-6800

IOMEGA (FD)
(temp. address)
3801 N. Oracle Rd.
Tucson, AZ 85705
(602) 293-4890

IBM (QT, HT, FD)
Route 22
Armonk, NY 10504
(914) 765-1900

expensive start/stop components (like vacuum column drives) for precise data manipulation, thereby significantly reducing unit size and cost. Suddenly, tape drives became viable candidates for 8" Winchester backup.

Competition between 1/2" and 1/4" tape manufacturers is stiff. A release from Cipher Products, manufacturers of 1/2" streamers, quotes specifications claiming that 1/4" tape is 100 times less reliable than 1/2" tape. Nels Johnson, a spokesman for 3M, replies, somewhat annoyedly, that his company's 1/4" tape unit, with on-board error detection and correction, equals 1/2" drives' specs.

In general, 1/2" drives are effective backup for systems greater than 30 MB, becoming especially attractive above 60 MB. Compact 1/4" cartridge drives usually back up mid-size systems in the 10- to 60-MB range. Both types vie head on for the 30 to 60-MB market; as systems approach 60 MB, the costlier, bulkier 1/2" tape drives earn their keep with faster dump times.

Disk. The floppy disk has become like a well-worn easy chair which most users are exceedingly reluctant to leave. Handy and familiar, floppies were obvious backup candidates, and took the lion's share of the early small system backup market. The problem with floppies, however, is low capacity: eight of them are needed to back up 10 MB. No matter how comfortable a user is with floppies, he'll find that the relationship is strained in systems much larger than this.

Removable 8" hard disks have recently become a reality; at least two manufacturers (Control Data and Memorex) produce them, and a number of other companies will be releasing them shortly. The first two entries consist of a fixed disk drive with integral removable disk drive backup. These removable disks offer the random access of floppies along with higher capacity (10-15 MB). Removable 8" disks have a one-to-one data dump ratio with the fixed disks they back up, thus ending multiple-disk handling problems. On the negative side, 8" removables are new, and substantive reliability figures have yet to be provided – by the pioneers who opt for the units now.

Other alternatives

A number of other choices exist, outside of the mainstream backup alternatives. These include cassettes (not to be confused with 1/4" cartridges), unireels, and videotape cassettes.

Cassettes, similar to those used in stereo systems, may be used for small system backup. Although their error rate tends to be high and their data rate is slower than that of floppies, their capacity is higher (up to 4 MB).

Unireels are manufactured by Interdyne, offering 56-MB capacity with a dump time of 22 minutes; being a non-standard medium with no second source is the chief drawback of the system.

Videotape cassette drives, by Pixel and BASF, store a hefty amount of data, with high dump times; these units should be effective in high-capacity (over 60 MB) applications.

Each of these may do well in its own niche, but none should take a significant portion of the overall market. Ray Freeman, of Freeman Associates, the Santa Barbara consulting firm, puts it: "Video cassette might be picked up by a businessman who wants to buy a video deck anyway, and use it as a business expense, but videotape, like the other unique technologies, won't be a significant market penetrator."

KENNEDY CO. (HT, QT)
1600 S. Shamrock Ave.
Monrovia, CA 91016
(213) 357-8831

MEMOREX CORP. (HD)
San Tomas at Central Expwy.
Santa Clara, CA 95052
(408) 987-1000

MFE (CT, FD)
Keewaydin Dr.
Salem, NH 03079
(603) 893-1921

PEREX LTD. (QT)
Arkwright Rd.
Reading, Berks RG2 OLS
England
(0734) 85464

PERKIN-ELMER (HT, HD)
Memory Products Div.
7301 Orangewood Ave.
Garden Grove, CA 92641
(714) 891-3711

PERSCI, INC. (FD)
12210 Nebraska Ave.
West Los Angeles, CA 90025
(213) 820-7621

PERTEC COMPUTER CORP. (HT)
Peripherals Div.
9600 Irondale Ave.
Chatsworth, CA 91311
(213) 882-0030

PIXEL CORP. (VT)
229 White Ave.
Belmont, MA 02178
(617) 489-3024

QUANTEX DIV. (QT)
North Atlantic Industries
60 Plant Ave.
Hauppauge, NY 11797
(516) 582-6060

RAYMOND ENGINEERING, INC. (QT, CT)
Raycorder Products Div.
217 Smith St.
Middletown, CT 06457
(203) 632-1000

SAYLOR ELECTRONICS INT'L (CT)
1436 East Katella Ave.
Anaheim, CA 92805
(714) 634-4755

SHUGART ASSOC.(FD)
415 Oakmead Pkwy.
Sunnyvale, CA 92805
(408) 733-0100

SINTROM ELECTRONICS, INC. (QT)
1798 Technology Dr.
San Jose, CA 95110
(408) 280-7566

STORAGE TECHNOLOGY CORP. (HT)
2270 S. 88th St.
Louisville, CO 80027
(303) 673-5151

3M CORP. (QT)
Data Products Div.
223-5E 3M Center
St. Paul, MN 55101
(612) 733-8892

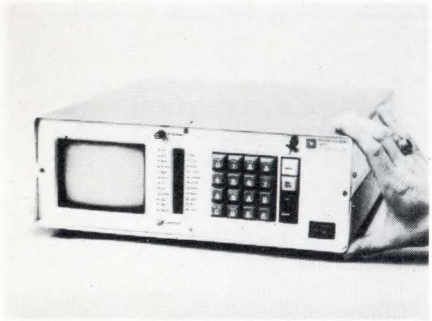
KEY:
QT – ¼" cartridge tape
HT – ½" reel tape
VT – videotape
CT – cassette tape
UT – unireel tape

FD – floppy disk
HD – 8" removable hard disk

Compiled with cooperation of Freeman Associates, 211 E. Carrillo St, Santa, Barbara, CA 93101

New Products

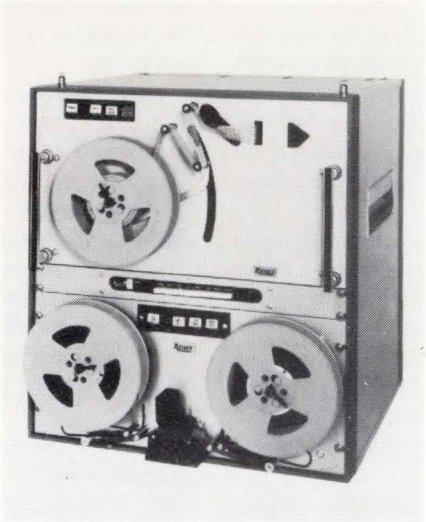
DATA COMMUNICATIONS TEST SET is designed to monitor and communicate with data appearing at the EIA RS-232 interface. This μP-based Hawk 4010 datatrap locates and isolates problems in the hardware and software by simultaneously displaying both transmit and receive data on the 5", 512 character CRT display. It can trap and store 4096 characters and recall this data for further detailed visual analysis. Has synchronous data rates up to 19,200 bps in both half and full-duplex modes. Asynchronous operation is provided by 16 clock speeds from 50 to 19,200 bps. Data characters can contain 5, 6, 7 or 8 bits, with 1 or 2 sync characters, plus parity. Model 4010 is $7500. Also available for use with this system or as a stand-alone unit, is the Model 7000 datatape, a μP-based recording device that provides a non-volatile mass storage for digital data associated with the EIA RS-232C and CCITT V.24 communications interfaces. Data can be recorded and later replayed at any one of 16 data rates. ($5500 - delivery 90 days ARO). Model 8538-D EIA Bypass Switch is also available from IDS. A



two-position switch allows a chained terminal to be on-line or bypassed, and the entire EIA 25-pin interface is switched. ($320). **International Data Sciences, Inc,** 7 Wellington Rd, Lincoln, RI 02865 **Circle 158**

PROGRAM GENERATION STATION With this enclosure kit, a user can integrate a high-speed Remex reader/spooler, a high speed punch, and an RS232C interface or a duplicator interface in a single package. It can be mounted as a rolling station and has a hinged top cover for easy loading of tape in the perforator. An internal AC power strip has a master on/off switch, pilot light, 15 AMP circuit breaker and 15 foot power cord.

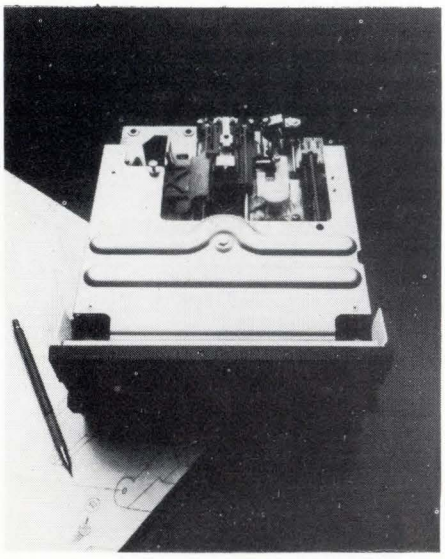
The RMA0026 Enclosure can accept a reader from the Remex 6000 or 7000 Series. The 6000 Series has speeds up to 300 cps asynchronous and 500 cps synchronous bidirectional. The 7000 Series has 200 cps read speeds with a 400 cps rewind speed. Both series are available with 7 1/2" reels.



Perforators for the programming station are available in 120 cps and 75 cps models. The units will punch 5 and 8 level paper or mylar tape.

The RMA0026 is $595/unit, 30 days ARO. **Ex-cell-o Corp,** Remex Div, Box C-19533, 1733 Alton St, Irvine, CA 92713 **Circle 148**

DC MOTOR for MFEs series 550 and 750 8" flexible disc drives cuts total power consumption by 55% using only 300 mA of 24-volt DC for a total consumption of 30 watts. Series 550 and



750 weigh 11% less than other MFE 8" disc drives. Along with the advantages of DC power, the 550 and 750 provide MFEs Heliband head positioning system, a guaranteed 3 ms access time, longer media wear with IBM-compatible head design, a diskette anti-crunch system and compact dimensions. **MFE Corp,** Keewaydin Dr, Salem, NH 03079 **Circle 173**

GRAPHICS PCB FOR DEC VT-100/103 provides a 1220 x 240 dot resolution on the 8" x 4.5" screen, and a separate display memory with text and graph labelling. The text includes 4 character sets, 3 text rotations for labelling, and 3 type fonts.

Board includes a built-in vector generator. Users need only specify line endpoints in the 64K by 64K addressable areas. Graphics-100 then computes the

line, and displays that section which lies within the designated viewing window, which may be moved anywhere within the addressable space. Vectors may also be magnified by creating a software controlled "zoom" effect. $1,195 delivery 6 weeks. **Selanar,** 2403 De La Cruz Blvd, Santa Clara, CA 95050.

Circle 156

NEW UNIVERSAL COUNTER/TIMER the DC 503A, a TM 500 plug-in, replaces the DC 503. This instrument features 11 measurement functions.

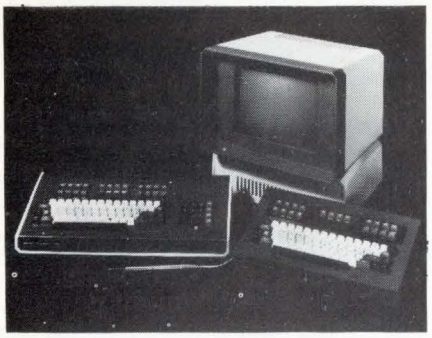
Measurements can be averaged from 1 to 10^8 times, allowing 10 ps resolution in Time A → B and Width modes. Single-shot resolution is 100 ns.

The DC 503A has two input channels, A & B, each with a full 0 to 125 MHz frequency range, 20 mV rms sensitivity, and separate controls for triggering level, triggering slope, attenuation, and coupling.

It can be equipped with an optional high-stability (±0.2 PPM), oven-controlled, 10 MHz crystal oscillator time base. Both the optional oscillator and the standard 10 MHz crystal oscillator provide 100 ns resolution of single-shot time intervals. The DC 503A is $900. The high-stability time base option is $275. **Tektronix, Inc,** PO Box 1700, Beaverton, OR 97075. **Circle 157**

TWO NEW SMART OWL TERMINALS Model 1251 Super Owl is for sophisticated timesharing end users and OEMs. Its complete configuration may either be keyboard-entered in response to an English menu in ROM or down-line loaded from the host.

The 1251's EAROM memory provides 400 bytes of non-volatile storage to enter frequently-needed character



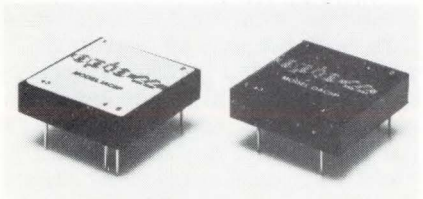
strings, words, or codes with the depression of a single key. It also offers a standard printer port which can copy the screen, print host data with or without displaying it, and skip the headings on preprinted forms when interfaced with most RS232 serial printers.

Model 1245 OEM Owl for the OEM and system house, offers modular construction, small footprint, optional printer port and light pen, and no operator access to settings and controls. Its configuration settings are either derived from an optional EPROM or down-line loaded from the host.

Both models have all their logic and memory on a single board. Both can also execute diagnostic programs down-line loaded into screen memory.

Model 1251 is $1895, model 1245 is $1695, 30-60 days ARO. **Perkin-Elmer,** Terminals Div, 360 Rte 206S, Flanders, NJ 07836. **Circle 170**

μP INTERFACE MODULES This series of μP input modules for industrial control systems is available for both AC and DC inputs, for 5 volt logic system. Packaged in a case 3/8" high, designers can utilize PC boards with 1/2" spacing. The AC version is available for 120 or 240 volt AC input, and DC version for 10 –



32 VDC inputs. They can either be solder mounted or plugged into sockets on the PC board. Output modules for the same dimensions are available for 120 VAC, 240 VAC, 60 VDC, and 200 VDC. Delivery from stock. **Opto 22,** 15461 Springdale St, Huntington Beach, CA 92649. **Circle 166**

PRINTER STAND accommodates any size printer (stand measures 24" x 36" x 26"). It has a paper-feed opening (6" x 17") for bottom-feeding character printers, and can handle 132-column printout paper. A basket catches and refolds the paper. $165 (with basket); $135 (without basket). A catalog describing Inmac's series of CRT stands is also available. **Inmac,** Dept 1017, 2465 Augustine Dr, Santa Clara, CA 95051 **Circle 175**

WINCHESTER DISK BACKUP A new version of the Microsteamer streaming tape drive offers a 3200 bpi packing density that doubles the amount of data that can be stored on a standard reel of half-inch magnetic tape.

The Microstreamer 2 combines the 3200 bpi packing density with a third operating speed of 50 ips. The current speeds of 25 and 100 ips are retained for operation with the 1600 bpi packing density. By halving the streaming mode speed from 100 to 50 ips the drive can record data at the 3200 bpi density at a transfer rate of 160 kB/sec. and 92 MB of unformatted data storage on a 10 1/2" reel of tape. Microstreamer 2 is $2,350 each in OEM quantities, shipments begin in December 1980. **Cipher Data Products, Inc.,** 10225 Willow Creek Rd., San Diego, CA 92131. **Circle 129**

NEW DIGITIZER This low cost μP based Supergrid utilizes a new technology, the "Direct Magnetostrictive" principle. It combines high accuracy (± .005"/.125mm) and high resolution (.001"/.025mm) with other features: it eliminates the need for a biasing magnet; it is translucent, allowing for tracing; its surface is completely flat, making it useable for large drawings; it supports both a stylus and a cursor; and it permits simultaneous use of 2 digitizer tablets with the same driving electronics.

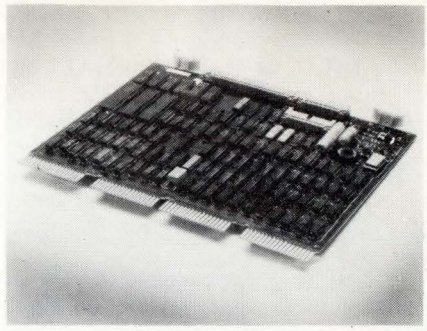
Summagrid supports RS-232C, IEEE, 8-Bit Parallel, and 16-Bit Parallel interfaces. Production begins in Fall 1980, 90 days delivery. **Summagraphics Corp.,** 35 Brentwood Avenue, Box 781, Fairfield, CT 06430.

Circle 130

SHEET FEEDER is integrated into the word-processing software specifically offered with Vector Graphic business systems.

The sheet feeder is only for use with Vector's Memorite word processing software and the Qume Sprint 3 or Sprint 5 printers. It can be snapped on and off as needed, and can be retrofitted to existing systems using the Sprint 3 or Sprint 5 printers. Purchase includes the latest version of Memorite software. **Vector Graphic, Inc,** 31364 Via Colinas, Westlake Village, CA 91362 **Circle 147**

LSI-11 DISK CONTROLLER. This LSI-11 compatible controller interfaces any two 8" or 14" Winchester drives with one quad size PC card, boasting cost/space/power savings of 50%. Controller utilizes proprietary μP firmware

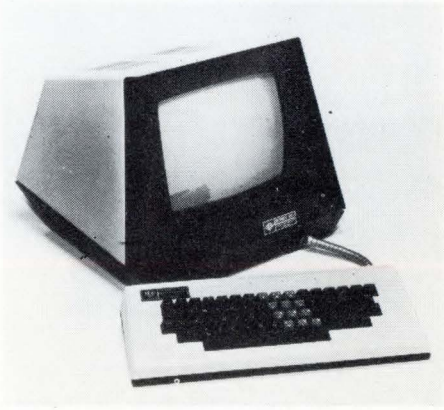


architecture and interfaces through an SMD cable set to popular industry standard disks without external circuitry, power or chassis. Unit runs standard DEC driver software and RT-11, RSX-11 and RSTS operating systems. On-board bootstrap loader has 128 bytes of spare area; full sector buffer eliminates CPU I/O bus throughput and data late problems. DQ202, $1592 (50). Delivery, stock to 60 days ARO. **DILOG,** 12800-G Garden Grove Blvd, Garden Grove, CA 92643. **Circle 168**

CRT WITH DETACHABLE KEYBOARD Conversational and buffered data communications capabilities at 100-9600 baud permit expansion from a teletypewriter mode to a batch processing operation.

Standard features include upper and lower case characters, protected data fields, forward and back tab, X-Y cursor positioning, cursor sensing, page mode or roll-up mode, and self-test, with selection switches for baud rate and parity, and controls for brightness.

The Series 610 Data-Screen terminals also offer 15-key numeric pad; auxiliary output; current loop interface; end of line bell; 230 V AC operation; 50 Hz



CRT refresh rate with line lock, international character sets. System measures 16" x 13 1/2" x 15 1/2" with a 12" display. $1090/unit, immediate delivery. **TEC, Inc,** 2727 N. Fairview Ave, Tucson, AZ 85705. **Circle 171**

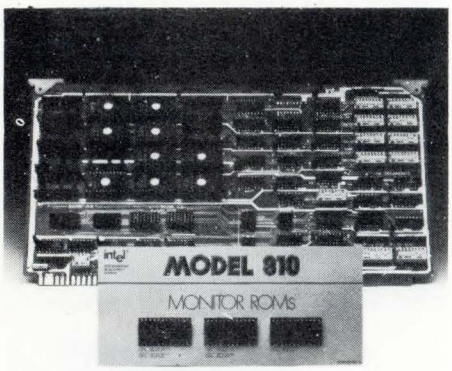
New Products

TWO NEW CONTROLLERS The HD46504/MC6844 DMA Controller can support 4 DMA channels. High speed data transfer occurs at a 1 MB/sec. In a 6800 system, control is transferred to the DMAC using the MPU HALT and TSC functions. DMA termination is controlled by both IRQ and DEND. $11.85/100.

The HD46505/MC6845 CRT Controller provides the interface between a μP system and a conventional raster scan CRT display.

It is fully programmable via the μP bus structure, and capable of alphanumeric, semi-graphic, and full-graphic operation. Operating from a single +5 volt supply, the device provides hardware scroll, programmed curser control, light pen capability, and programmable interlace or non-interlace scan. The CRT Controller also provides video timing and refresh memory addressing. **Hitachi America, Ltd,** Electronic Devices Sales and Service Div, 707 W. Algonquin Rd, Arlington Heights, IL 60005. **Circle 160**

NEW FROM INTEL A software development module that supports the iSBC 8080/8085 family, allows software written in 8080/8085 assembly language to be developed and debugged completely in the target system. The module is supplied with text editor, 8080/8085 symbolic assembler on a standard memory expansion board and 3 debug monitors, all stored in ROMs. The Model 810 is $1,500. Also available is a Mainframe Link which allows Intellec system users to link one or more Intellec microcomputer development systems with existing computer mainframes. A file management utility can be used to write-protect a current master program, or allow access to routines shared by programmers. The



Mainframe Link (MDS-384 Kit) consists of diskette-based software, a modem cable, a loopback connector (for diagnostics) and user manual. $2,000 delivery 4 to 6 weeks ARO. **Intel Corp,** 3065 Bowers Ave, Santa Clara, CA 95051.
Circle 183

NEW DISK AND CARTRIDGE SYSTEM. The 300MB disk has a 45% increase in storage capacity over the RP06. It is available either as a subsystem, consisting of disk drive and controller, or as an add-on drive. It is compatible with existing MASSBUS disks, enabling direct add-on to Digital systems, and is currently supported on both PDP-11/70 and VAX-11/780 computer systems. The new RM05 has an access time of 38.3 ms, and peak transfer rate of 1.2MB/sec. It employs a 12-disk pack with 19 R/W surfaces and one read-only servo surface. It has a recording density of 384 tpi and 6,038 bpi. Up to 8 drives can be connected to each controller. The RM05 subsystem (drive and controller) is $44,000, add-on RM05s are $34,000. The new cartridge tape system is available as a rack-mountable or tabletop version of the TU58 DECtape II cartridge drive. It has a quarter-MB capacity per cartridge, or a half-MB capacity per system. It can be used as an entry-level storage device or as a backup storage unit on a tape- or disk-based system. The data transfer rate for the TU58 is adjustable, via jumper selection, from 150 to 34,800 baud. Its high-speed search mode provides a 9 sec average access time and a 30 sec maximum access time. From $1750. **Digital Equipment Corp,** Maynard, MA 01754 **Circle 149**

DISK CONTROLLER The unit allows users of Data General NOVA and ECLIPSE compatible computers to attach SMD disk drives without modification to the RDOS, AOS, IRIS or BLIS/COBOL operating systems.

Different versions provide emulation of the Data General 6067 disk subsystem:

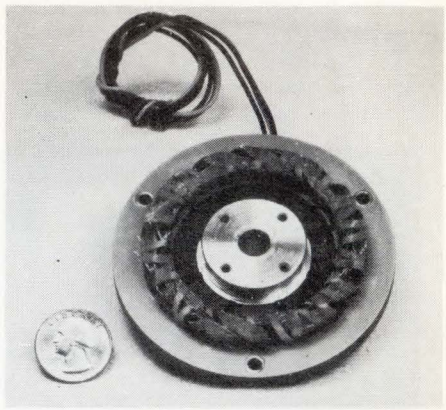
SPECTRA 10/A provides RDOS/AOS operating system and diagnostic software transparency when using 80MB SMD compatible disk drives in standard Data General disk format (24 sectors per track).

SPECTRA 10/B provides increased formatted capacity to 67.4MB on the 80MB SMD through expanded emulation, using a software parameter change to allow use of a full 32 sector format.

Features include 2048 byte (4 sector) RAM buffering; 32 bit ECC, correcting error bursts of up to 11 bits; automatic position verification; and dual on-board LED error status displays. ($3000) **Spectra Logic Corp,** 2316 Walsh Ave, Santa Clara, CA 95051.
Circle 178

D.C. MOTOR This low-cost brushless DC motor is designed for Winchester memory disk technology. It will direct-drive a disk load from standstill to 3600 rpm in 25 ms and develop up to 30 oz-in of reserve torque for rock steady synchronism.

The DB-3500 motor uses 8 ceramic magnet poles and a 3 phase, fractional-slot armature winding for improved efficiency, reduced size and ripple-free torque.



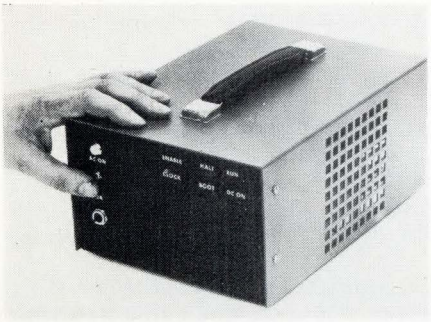
Motors can be furnished as basic rotor/stator sets, or with optional commutation encoders and as complete ready-to-run drives. **Clifton Precision,** Litton Systems, Inc., Marple at Broadway, Clifton Heights, PA 19018.
Circle 134

WIRE WRAPPABLE BOARDS This new board (4-6800) is fully compatible with Motorola's EXORcisor and Micro Module Family Bus Structure. The 4-format style is selectively loaded with screw machined socket pins, thus requiring no DIP sockets. This now completes the Motorola compatible line of Hybricon's wire wrappable boards to include the 2-format (2-6800), prepinned in the Vcc, Ground and I/O locations, ($70.50); the 4-format (4-6800) prepinned with screw machined socket pins in selected rows for the highest density for insertion of integrated circuits and discrete components, ($191.40); and Extender card (6800ET) with test points installed for convenience in attaching test probes while the board is in use, ($96.50). **Hybricon Corp,** 410 Great Rd, Littleton, MA 01460. **Circle 154**

50 Mbps STATISTICAL MULTIPLEXER Model 781 provides everything required to multiplex and demultiplex up to 4 lines of serial synchronous data, each at any bit rate from 100 Kbps to 48 Mbps, when connected to a full duplex 50 Mbps satellite communication channel. The multiplexer output can operate slaved to an external primary standard or the communication channel modem's 50 Mbps clock. In a free-running mode, the unit outputs data under control of its internal 50 Mbps clock, accurate to within 1 part in 10^7. The multiplexer provides a second 50 Mbps data and clock port for use by a backup recorder. **Aydin Monitor Systems,** 401 Commerce Dr, Ft. Washington, PA 19034. **Circle 153**

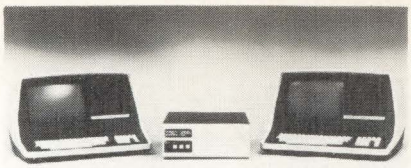
New Products

SMART BOX COMPUTER converts dumb terminals into intelligent terminals. It is a compact 16-bit computer based on DECs LSI-11/2 processor. Its self-contained enclosure includes all power supplies, cooling fans, interfaces, and memory necessary for stand-alone operation. Besides the LSI-11/2 processor board, other logic cards include two independent RS-232C interfaces, 8 kB of RAM (expandable to 32 kB), space for 8 kB of ROM, a 60 Hz crystal clock, and two vacant Q-bus compatible card slots to accommodate more



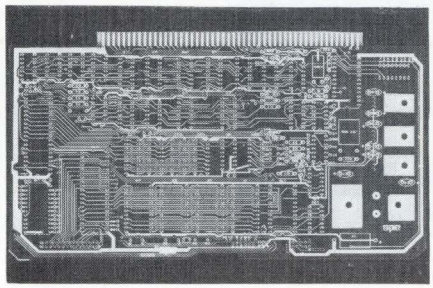
specialized cards. The Smarts Box has an integral control panel featuring DC ON/BOOT, RUN/HALT, and CLOCK ENABLE controls, as well as AC-ON and DC-ON switches and indicator lights. The unit weighs 8 lbs, can be permanently fixed or moved from job-to-job for data entry/access overloads. It can be used to link remote terminal clusters to a host computer, as well as upgrading terminal performance. ($2560/unit). **North Atlantic Industries, Inc**, 60 Plant Ave, Hauppauge, NY 11787. **Circle 223**

MULTI-USER MICROCOMPUTER SYSTEM The system consists of a network of video display terminasl which employ their own internal μP and dynamic RAM. The system architecture is based around one of three Disk Storage Systems consisting of a hard disk device, complete with power supply, and special disk controller and multiplexor circuitry to tie user stations into a common disk system. Four types of Video Processing Units (VPUs) can be connected into a disk storage system via an 8 bit parallel interface thus allowing a data transfer rate of 1.6 million bps between the disk storage system and the terminals. The VPUs are connected in a daisy-chain fashion. Up to 255 VPUs can be connected into a single network. Each terminal also has twin RS-232 serial ports for connecting an auxiliary printer and/or modem device. Models 20, 30 and 40 VPUs can all be used as stand-alone microcomputer systems and later daisy-chained into a CompuStar multi-user



network thus offering flexibility in system configuration. A brochure, "This is CompuStar," is available. **Intertec Data Systems**, 2300 Broad River Rd, Columbia, SC 29210. **Circle 221**

6809 SBC/IEEE S-100. ADS has interfaced the MC6809 processor to the proposed IEEE S-100 Bus Standard. Now the same board used to develop applications software can become the basis for applications hardware. The MC6809's architecture allows position independent code to be written which allows software written for one hard-



ware configuration to apply to many others without reassembly. The SBC features: 2K RAM, 4K/8K/16K ROM, 20 parallel I/O lines, RS-232 interface and 256 I/O ports. A complete manual is provided with the board and a monitor and software are also available. **Ackerman Digital Systems, Inc**, 110 N. York Rd, #208, Elmhurst, IL 60126. **Circle 217**

ENHANCED TERMINAL This display system has a 3440-character screen capacity and support for 9600 bps. data rate communications. It operates within data communications networks as IBM 3270-type terminals, under both binary synchronous and synchronous data link control protocol. The 3440-character display is configured as 43 lines of 80 characters each on a 15" video display monitor. Additional modules within the PTS-2000 family include capacities of 960, 1920, and 2560 characters which are operator selectable through the keyboard. Any combination of the 4 screen capacities can be mixed within a single PTS-2000 system, including support of up to 8 operator displays and printers. With the 9600 bps data rate, PTS-2000 systems can operate at the most commonly used transmission speeds including 2400, 4800, 7200 and 9600. **Raytheon Data Systems Co,** 1415 Boston-Providence Tpke, Norwood, MA 02062 **Circle 230**

NEW 8 PORT SERIAL I/O BOARD connects line printers, modems, CRTs, and all type of RS232 or current loop terminals to S-100 Bus based microcomputers and can interconnect computers in networking systems. OCTOPORT, with 7 lines plus ground per port, can be used for modem control. It has a real time clock with selectable rates at 12½, 25, 50, and 100 ms, and support for vectored interrupts in both 8080 mode and Z80 mode 2. ($595/two, quantity discounts available). **Konan Corp,** 1448 N 27th Ave, Phoenix, AZ 85009 **Circle 235**

8-SLOT MULTIBUS CHASSIS is a direct replacement for the Intel SBC-660. It features a Quad supply with 30 AMPS available on the +5 source and NSC BLC-604/614 cardcase-backplanes. Cooling is provided by 4 fans. The cardcase and power supply may be reversed so the cards can be drawn through the front panel. The top and back panels are also removable. The ZX-660 is $1929 (1-9). **Zendex Corp,** 6398 Dougherty Rd, MS 32, Dublin, CA 94566 **Circle 232**

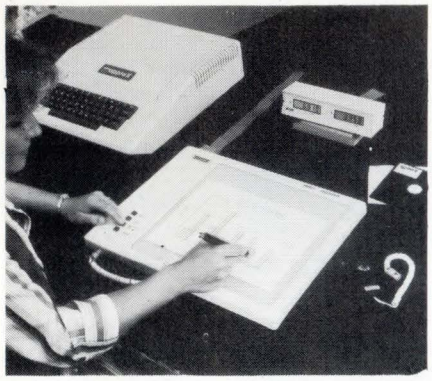
LOW COST 180 CPS PRINTER The unit utilizes logic-seeking bidirectional printing at 180 cps. The standard 1000 character buffer (optional 2000) and a choice of 2 handshaking protocols ensures optimum throughput. The 94 ASCII character set is printed in a 9 X 7 dot matrix. It can accommodate 6 part forms and fanfold perforated forms from 3 to 15". The DS180 comes standard with 3 interfaces: RS-232, current loop and an 8-bit parallel Centronics compatible. The 38 programmable features may be configured from the control panel on the printer or via the communications line. A non-volatile memory retains the settings when power is turned off. An optional terminal multiplexer allows up to 4 CRTs to share one printer. ($1395/unit, delivery 60-90 days) **Pacific Mountain States Corp,** 6319-B DeSoto Ave, Woodland Hills, CA 91367 **Circle 233**

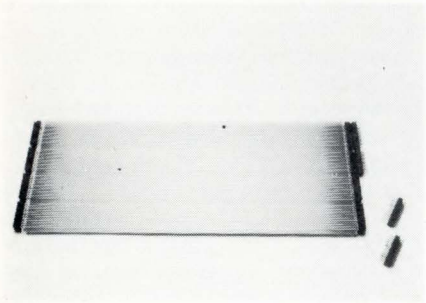
ENHANCED RANDAL SYSTEM Upgrade existing computer systems manufactured by Randal Data Systems by replacing the Randal processor and memory boards with a single Point 4 CPU board. This increases system throughput and can accommodate up to 128 KB of memory on the same pc board, and increases the number of slots available for peripheral devices. Features of the Point 4 processor include a 400 ns instruction execution time and advanced system architecture. $4400 for 64K, $6100 for 128K, 15 days ARO. **Microtech Business Systems,** 3176 Pullman St, Suite 108, Costa Mesa, CA 92626 **Circle 234**

New Products

NEW DIGITIZER FOR APPLE II is hardware and software supported. New DT–11A version of the HI PAD digitizer provides a slot interface card for the Apple II, a floppy based software package, menu overlay, and stylus. Functions supported by the software include draw, line, area, background, pen color, separate, catalog, save, load, shape, etc. A plastic overlay that serves as a menu allows the user a selection of these functions. It also offers slot independence, BASIC and PASCAL compatibility, assembler driver code, user controls, and optional cursor. The DT–11A/Apple II system requires a 48K system and the Applesoft Firmware Card. No magnetic biasing is required.

The package, including HI PAD digitizer, interface, software, overlay, and stylus is $795. **Houston Instrument,** One Houston Sq., Austin, TX 78753. **Circle 131**





EXTENDER BOARD FOR IBM SERIES/1 This 18" extender board allows users to debug their own circuitry as well as any IBM module. It includes 4 plug-in socket adapters that are easily replaced in the event of pin damage.

The board is an enhancement to MDB's line of products for Series/1 which includes line printer controllers and TTY/RS232 adapters as well as wire wrap modules. $395 in single units, delivery is 30 days ARO. **MDB Systems,** 1995 N. Batavia St, Orange, CA 92665. **Circle 145**

COLOR MONITORS The new 25" monitor uses a color shadow mask CRT with 0.367 mm pitch (vertical). It expands the GM 850 series and provides a large screen direct view presentation for small group viewing. The GM 865C also complements the GM 870 series monochrome monitors. $12,400.

The GM 714 series of monitors complements the GM 713/719 series. It utilizes the CRT using the ultra-fine pitch shadow mask with in-line gun structure.

The 714 series displays up to 640 x 512 pixel resolution with a horizontal line frequency of 15.5 to 19 KHz (516 thru 633 total lines at 2:1 interlace, 30/60 HZ). Available in rackmount or cabinet version with standard or long persistence phosphors.

Ramtek Corp, 2211 Lawson Ln, Santa Clara, CA 95050. **Circle 150**

THREE NEW SBCs are additions to Data General's microNOVA board computer family. The MBC/2 and 3 provide a central processor, 3 types of memory, and serial and parallel I/O. Both are based on the microNOVA MN602 central processor unit, which provides a full NOVA architecture, hardware stack and frame pointer, 16-bit hardware multiply and divide, real-time clock, and 16-level priority interrupts. The MBC/2 has 8 kB RAM, the MBC/3 has 32 kB RAM. Both have sockets for up to 1 kB of PROM and 32 kB of EPROM. They have 2 independent, programmable asynchronous/synchronous communication interfaces, 16 lines of digital I/O. The MBC/SDX is a debugging aid as well as an I/O expansion interface, and offers all the I/O features of the MBC/2. Runtime support for the MBC/2 and MBC/3 is provided by the MP/OS operating system. All 3 SBCs can be configured in a 4-slot card frame or an 8-slot MP/100 or MP/200 chassis. **Data General,** Rt. 9, Westboro, MA 01581. **Circle 218**

EXPANSION OF PAL FAMILY These new medium programmable array logic devices allow a system designer to replace up to 90% of the TTL circuitry in his designs and reduce chip count 4 to 12 fold.

They include programmable I/O, 3 state outputs, and registered data outputs with register feedback.

The PAL16L8 is an octal 16 input AND-OR-INVERT gate array, the PAL16R6 a hex 16 input registered AND-OR gate array, and the PAL16R4 a quad 16 input registered AND-OR gate array.

They feature typical propagation delays of about 25 ns. Available in 100 quantities, $30/unit. **Monolithic Memories,** 1165 East Arques Ave, Sunnyvale, CA 94086. **Circle 162**

CHANGES FOR 525 MINIDISKS Two design changes for the 5 1/4" minidisks have been made to eliminate potential disk hub damage and centering problems when a disk is inserted into the drive and R/W head contacts the disk. First, the thickness of the jacket PVC material has been increased from 7.5 to 8 mils. Second, the lamination pattern, which secures the lining to the jacket material, has been redesigned to eliminate potential "pillowing" problems which can interfere with the sideways movement of the disk. These minidisks are available in both single- and double-sided versions, with 35, 40, or 77 tps. All are double-density. **Verbatim Corp,** 323 Soquel Way, Sunnyvale, CA 94025. **Circle 165**

NEW INTERFACE provides signal compatability and data buffering between a Univac 1100 series computer and any of the standard electrostatic plotters manufactured by Benson Varian, Gould/Calcomp, and Versatec. Model 1100 operates on the Univac I/O controller in ISI mode; the location and extent of data buffers to be transferred to the printer/plotter are stored internally and referenced by the I/O controller. Has maximum word transfer rate of 444K wps. It also supports transfer of printer/plotter status to the Univac I/O controller. **KMW Systems Corp,** 8307 Hwy 71 W, Austin, Texas 78735. **Circle 222**

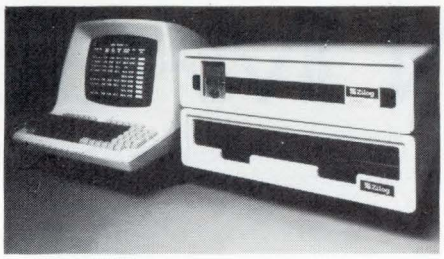
FAIL-SAFE MULTIPLEXER An addition to the Series II Microplexer family, the Traffic Balance multiplexers incorporate two built-in data links, each connected to a similar unit at the same or remote site. The new models automatically assign channels to each of their data links, and dynamically reassign them depending on traffic volume and link efficiency. THe M2407 is $3950. The M2427 Microplexer with a Supervisory Port to permit the network manager to obtain operating statistics and monitor the system is $4200. The Series II is a family of μP-controlled statistical multiplexers that transmit and receive data from up to 24 asynchronous and/or bisynchronous data sources. Operating features include flexible programming, a network management capability, programmable traffic control, dual data links and adaptive autospeed. **Timeplex, Inc,** One Communications Plaza, Rochelle Park, NJ 07662. **Circle 224**

DIGITAL ALIGNMENT METAL CASSETTE for use in calibrating digital and word processing equipment, is prerecorded at 1600 flux changes per inch on an optical alignment recorder which employs precision magnetic heads. The magnetic tape used is made for the digital reference tape application. Cassettes are available in several configurations which allow them to be compatible to most OEM decks presently employed. **Magnetic Information Systems, Inc.,** 415 Howe Ave., Shelton, CT 06484.

Circle 132

INTEGRATED DATA DICTIONARY This enhanced IDD is available in two versions: Basic (an integral part of SYSTEM 2000/80 DBMS and responsible primarily for data definition, security, and control functions for the data bases) and Extended (which provides added functionality to manage non-data base information resources. Intel's IDD provides control, documentation and communication functions, which give data administration staffs the means to develop and document a complete information processing environment. IDD supports a system's full life cycle from design into development and throughout production. **Intel Commercial Systems, Div.,** 12675 Research Blvd., Box 9968, Austin, TX 78766 **Circle 140**

SINGLE-STATION μC SYSTEMS. Based on the 4 MHz Z80A μP, the MCZ-2 μC systems include 64 KB of memory and are designed for business/accounting, information processing, software development and other specialized applications. Three models are available: MCZ-2/20 is a tabletop system offered in building-block increments; basic system, without peripherals, disk storage or software is $5990; with 2.4 MB floppy disk storage, $10,250. MCZ-2/25 is a rack-mountable system identical to the 2/20 in features and pricing. MCZ-2/50 is a complete ready-to-run system for business/accounting applications, including the MCZ-2/20 plus 2.4 MB floppy disk storage, 1920 character CRT, RIO/CP multitasking operating system, and single- or multiterminal COBOL run-time support, all for $12,175. **Zilog,** 10340 Bubb Rd, Cupertino, CA 95014. **Circle 142**



THREE NEW MINICOMPUTER INTERFACES. The interfaces connect directly to minicomputer buses and control lines, and can be used with Model 10277A/B/C/D General Purpose Probe Interface. The HP 1000 L-Series Interface (Model 10285A) plugs directly into an I/O slot ($350). Model 10279A Interface plugs directly into the NOVA 3 backplane ($500). Model 10280A Interface is used with only the MP 100 mainframe of the microNOVA minicomputer ($500). Active circuits on the interface boards assure that bus loading specifications are not exceeded. Switches qualify bus activity so that reads, writes, I/O, instruction fetches, or DMA transactions can be captured selectively for detailed analysis. **Hewlett-Packard Co,** 1507 Page Mill Rd, Palo Alto, CA 94304. **Circle 144**

MAN... HE MAKES HOPE IN HIS OWN IMAGE.

Evolution. The ongoing drama of the growth and development of man. His destiny. His greatest hope. Now the focus of the extraordinary OMNI Special Second Anniversary Issue.

Since the beginning of time, evolution has been occurring because of forces beyond our control or comprehension. Until now. Ours is the dawn of a new era. Man has begun to master the creation of life itself.

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OMNI, The Magazine of Tomorrow, has assembled a stellar group of distinguished authors, scientists, and philosophers for this landmark look into "The Evolution of Man." This special issue is a celebration of man, the future, and the second anniversary of the magazine devoted to man's future, OMNI.

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OM2DD

Photograph by Robert Dibue

New Products

THREE NEW TRS-80s Model III desktop computer has a 65-key keyboard, 12" monitor, power supply, integral housing for 2 (optional) disk drives, built-in interface and commands for optional printers, and BASIC language compatible with most Model I software. The 4K Level I system is $699. The 16K system with Model III BASIC is $999 including upper and lower case and real-time clock. The 32K Business System is $2495 including 2 double-density 40-track disk drives with a 315K data storage capacity and a built-in RS-232C. Expandable to 48K and 4 drives. The TRS-80 Pocket Computer is fully programmable in BASIC with a 1.9K RAM permanent memory. It is less than 7" long, has a 300-hour life, 5mm dot-matrix LCD readout, 4 1/4" display area which can read 24 characters. It has an optional Cassette Interface to enter or store programs and data ($49). The Pocket Computer has 15 arithmetic functions, 24 commands, and editing ($249). The third new TRS-80 is the Color Computer. It includes 53-key keyboard, 4K RAM memory, 8K ROM color BASIC, RS232C expansion port, and built-in connection to any TV set. It is internally expandable to 16K RAM, 16K ROM extended color BASIC, and allows for optional telephone modem, printer, joystick and cassette recorder. Plug-in instant load Program Paks are available ($399). **Radio Shack**, Div of Tandy Corp., 1800 One Tandy Center, Ft Worth, TX 76102.

Circle 136

DATA ACQUISITION SYSTEM This unit allows any one of 16 single-ended channels of analog information to be selected and digitized to 8 binary bits of resolution at a system throughput rate of up to 17.5 KHz. It is fabricated on a single chip and contained in a compact 40 pin plastic DIP, requiring only an external reference, clock and connection to power supply (+5V @ 1 mA max.). Total unadjusted error for the system is ±1/2 LSB max. The input multiplexer allows direct access to any of 16 single-ended analog input and provides necessary logic to permit additional channel expansion. Full scale range for the DAS-952R is determined by the voltage of the external reference source, selected from .512V to 5.25V, allowing selection of LSB size (resolution) from 2mV to 20.5 mV. Latched and decoded channel address inputs, latched 3-state TTL data outputs and μP compatible control logic permit easy interfacing to μPs. $37.50. **Datel Intersil,** 11 Cabot Blvd., Mansfield, MA 02048. **Circle 135**

COMMUNICATIONS SOFTWARE The Sperry Univac Distributed Communications Architecture (DCA) communication system now offers multiple line connections to each processor in the V77-600 and V77-800 series. This permits simultaneous connection to several hosts and provides the means for establishing a V77 network. ($3000). The Global Resource Access Manager (GRAM), is a high level interface to the DCA termination system. It can be used without the termination system to give terminal-to-program, program-to-program and Host Access Module-to-program interface. It also provides a sizeable memory requirement reduction. ($1000). The 1004 LPH is for use in remote batch mode of V77-600 or V77-800 to a S/90 or S/1100. The user can now implement Remote Batch Entry and Remote Job Entry using its own protocol in a non-DCA environment. ($3000). Also available is the Virtual Accelerator Module (VAM) for series 90/80-3 and 90/80-4 systems. A cost-effective means for improving processor performance by microcoding selected portions of VS/9 Executive Software. (Rental, $1095; purchase, $41,200). **Sperry Univac,** Box 500, Blue Bell, PA 19424. **Circle 138**

New Products

LSI-11/23 VISUALS SYSTEM performs graphic and true color, monochrome or pseudo color image processing twice as fast as previous systems. It supports up to 4 terminals, up to 512KB image memory, independent zoom and scroll on image or graphic overlay, 4 independent graphic overlay channels, up to 4 alphanumeric character generators, 4 intensity transformation units, and 4 independent cursor overlays. Available with RSX11M or RT11 Operating System Software, VISACOM/23 can also be used for process control, military activities, LANDSAT analysis and other command and control applications. Options include an alphanumeric overlay generator; cursor generator; joystick, trackball and light pen; high speed port; and external synchronization source. Cost, including color monitor, dual floppy disk, terminal and interactive joystick is $39,000. **DeAnza Systems,** 118 Charcot Ave, San Jose, CA 95131

Circle 146

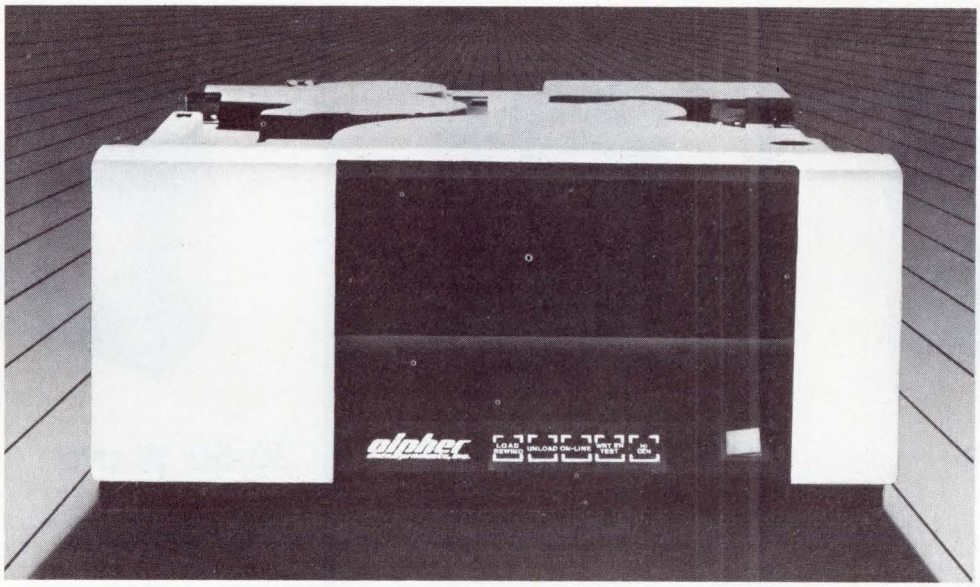
SINGLE BOARD TAPE CONTROLLER combines both Phase Encoded and NRZ formats on a single circuit board for use with DECs PDP-11 series computers. It can mix 9-track NRZ, PE, or dual-density tape units in any combination using up to 8 units. All filtering is switch-selectable, and a self-test LED built into the TC-131 indicates when an error is present. Other features include a 33-word buffer and automatic non-stop operation when doing consecutive R/W operations.

The TC-131P is $3300, with the TC-131N NRZI only unit at a lower price. Quantity discounts available to OEM'S. Delivery is 60 days. **Western Peripherals** Div of Wespercorp, 14321 Myford Rd., Tustin, CA 92680.

Circle 127

The Tape technology of the future is here...

...and it costs less than what you're paying for standard 1/2 tape drives.



It's the Microstreamer™ from Cipher Data Products and it's designed with advanced tape motion techniques for applications such as data acquisition, computer output microfilm, computer graphics, mass storage for sequential files. And more.

Performs like a conventional IBM compatible tape drive but has unique new features... and still costs less.

For most of these applications, the Microstreamer is a perfect replacement for standard start/stop drives and you get auto load, internal diagnostics, advanced packaging, dual speed, plus 100 ips for high speed **disk backup—FREE.**

And anyone can use it, NOW.

Controllers are available for interfacing the Microstreamer to just about anyone's minicomputer or microcomputer. From PDP-11's, LSI-11's and Novas to CPU's that use Multibus, S100 or IEEE-488 interfacing. The kind of system you configure is limited only by your imagination. And using dual purpose Microstreamers can simplify your system design.

Want to know "HOW CAN THAT BE?" Give us a call.
Ask for Ralph. (714) 578-9100

cipher data products, inc.

10225 Willow Creek Road, San Diego, CA 92131

Circle 38 on Reader Inquiry Card

SINGLE OUTPUT IC REGULATED OEM SERIES EAPS U

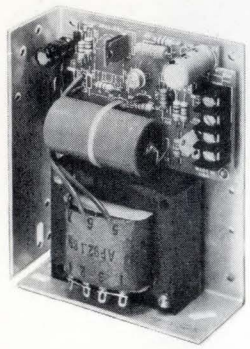
MEETS U L AND C S A REQUIREMENTS

Not available through distributors contact the engineering sales office near you. Minimum sales order 50 units.

FEATURES

- 3 way barrier block output terminals screw, solder connection or fast on tabs
- Higher efficiency cooler operation 45% efficiency at 5VDC, 60% at 15VDC
- Better noise immunity dual input electrostatically shielded transformer
- High reliability over 100,000 hr MTBF (5V 6A per MIL-HDBK-217B at 40°C ambient, full load, nominal line)
- Metal Cased Hermetically Sealed Pass Transistors used on all units over 25 watts
- 85°C 10 yr life computer Grade capacitors
- Meets UL and CSA requirements
- Full 5 yr warranty
- Metal Cased Hermetically Sealed IC regulator
- Fully enclosed, dustproof, insulated Potentiometers
- Wider input line voltage range 103-130V/206-260V 47-63Hz
- Thinner profile 3 plane mounting

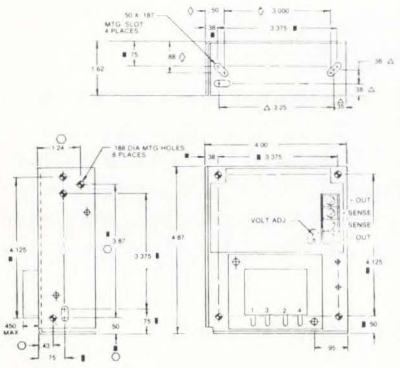
$22.25



10-15 Watts

HB Case Series
Meets U.L. and C.S.A. Requirements
5 Vdc @ 1.2 Amps to 24 Vdc @ 0.6 Amps
Optional OVP available for 5V to 24V units

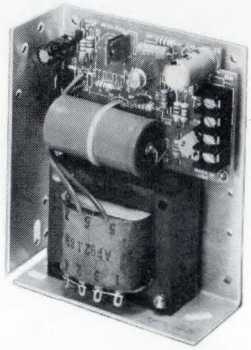
MODEL NUMBER	RATING		REGULATION		RIPPLE
	Vdc	Amps	Line	Load	(Pk/Pk)
EAPS 5-1.2U	5	1.2	±0.05%	±0.10%	3mV
EAPS 12-0.5U	12	0.5	±0.05%	±0.10%	3mV
EAPS 15-0.5U	15	0.5	±0.05%	±0.10%	3mV
EAPS 24-0.6U	24	0.6	±0.05%	±0.10%	5mV



Weight: 2 lbs

115V INPUT 1-4 JUMPER 1-3 & 2-4
230V INPUT 1-4 JUMPER 3-2 ONLY
NOTE UNLESS OTHERWISE SPECIFIED

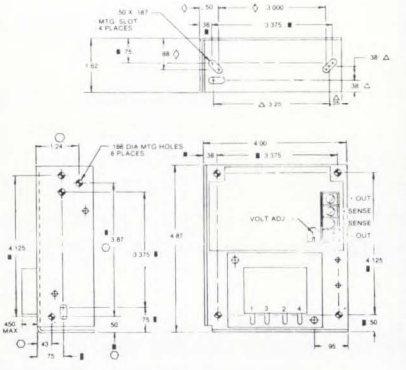
$23.25



15-24 Watts

HB Case Series
Meets UL and CSA Requirements
5VDC @ 3 Amps to 24VDC @ 1.0 Amps
Optional OVP available for 5V to 24V units.

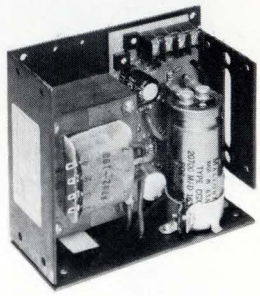
MODEL NUMBER	RATING		REGULATION		RIPPLE
	Vdc	Amps	Line	Load	(Pk/Pk)
EAPS 5-3.0U	5	3.0	±0.05%	±0.10%	5mV
EAPS 12-1.6U	12	1.6	±0.05%	±0.10%	5mV
EAPS 15-1.5U	15	1.5	±0.05%	±0.10%	5mV
EAPS 24-1.0U	24	1.0	±0.05%	±0.10%	5mV



Weight: 2 lbs

115V INPUT 1-4 JUMPER 1-3 & 2-4
230V INPUT 1-4 JUMPER 3-2 ONLY
NOTE UNLESS OTHERWISE SPECIFIED

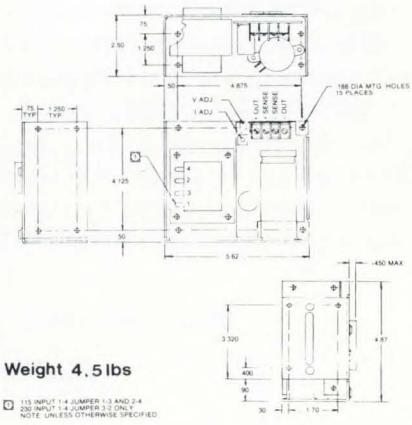
$44.95



30-50 Watts

HC Case Series
Meets UL and CSA requirements
5VDC @ 6 Amps to 24VDC @2.4 Amps
Optional OVP Available for 5V to 24V units

MODEL NUMBER	RATING		REGULATION		RIPPLE
	Vdc	Amps	Line	Load	(Pk/Pk)
EAPS 5-6.0U	5	6.0	±0.05%	±0.10%	5mV
EAPS 12-3.4U	12	3.4	±0.05%	±0.10%	5mV
EAPS 15-3.0U	15	3.0	±0.05%	±0.10%	5mV
EAPS 24-2.4U	24	2.4	±0.05%	±0.10%	5mV



Weight 4.5 lbs

115 INPUT 1-4 JUMPER 1-3 AND 2-4
230 INPUT 1-4 JUMPER 3-2 ONLY
NOTE UNLESS OTHERWISE SPECIFIED

NOW! Call Toll Free (800) 854-8288)

See Page 65 for List of Local ADTECH Field Offices . . .

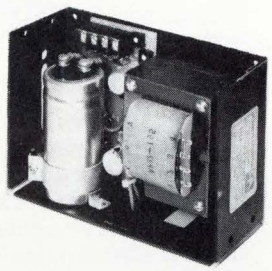
Specifications:

AC Input: 103-130V/206-260V AC 47/63Hz
Derate 10% at 50Hz
DC Output: See tabulation of models
Line Regulation: ±0.05% for ±10% line change
Load Regulation: ±0.1% for ±50% load change
Ripple: Less than 5Mv peak to peak
Transient Response: Less than 50 microseconds
Short Circuit and
Overload Protection: Automatic recovery foldback current limiting
Reverse Polarity Protection: Standard
Remote Sensing: Standard with open sense lead protection
Output Adjustment: ±5% minimum

Operating Temperature Range: 0°C to +50°C at full power rating. Derate linearly to 40% at 70°C or -20°C
Storage Temperature: -30°C to +85°C
Stability: ±0.1% for 24 hours after warm up
Temperature Coefficient: ±0.01% typical ±0.03% maximum
Vibration: Per MIL-STD-810B method 514, procedure 1, curve AB (to 50Hz)
Shock: Per MIL-STD-810B method 516 procedure
Overvoltage Protection: Optional
Efficiency: 5V units 45%; 12V units 55%; 15V units 60%; 24V units 62%
Line Noise Suppression: Electrostatically shielded transformer

ALL MODELS WARRANTED FOR 5 YEARS

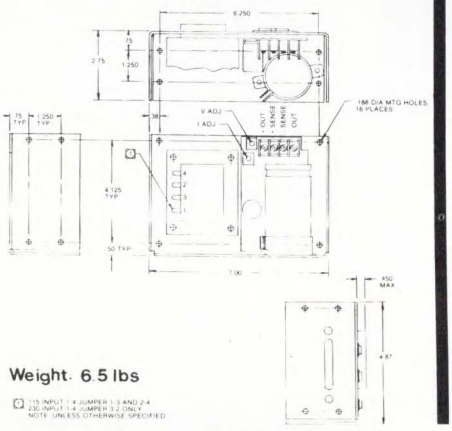
$59.45



50-84 Watts

HN Case Series
Meets UL and CSA Requirements
5 Vdc @ 9 Amps to 24 Vdc @ 3.6 Amps
Optional OVP available for 5V to 24V units

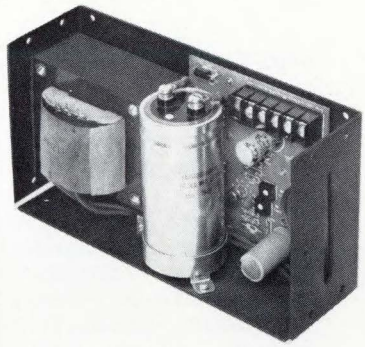
MODEL NUMBER	RATING		REGULATION		RIPPLE
	Vdc	Amps	Line	Load	(Pk/Pk)
EAPS 5-9.0U	5	9.0	±0.05%	±0.10%	5mV
EAPS 12-5.0U	12	5.0	±0.05%	±0.10%	5mV
EAPS 15-4.5U	15	4.5	±0.05%	±0.10%	5mV
EAPS 24-3.6U	24	3.6	±0.05%	±0.10%	5mV



Weight: 6.5 lbs

115 INPUT: 1-4 JUMPER 1-3 AND 2-4
230 INPUT: 1-4 JUMPER 3-2 ONLY
NOTE: UNLESS OTHERWISE SPECIFIED

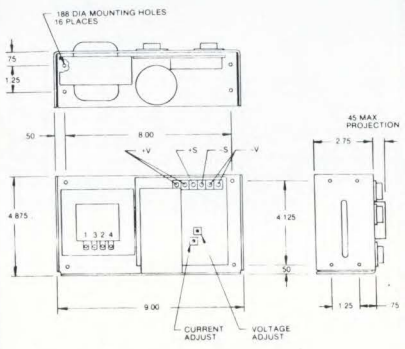
$71.05



60-100 Watts

HD Case Series
Meets UL and CSA Requirements
5 Vdc @ 12 Amps to 24 Vdc @ 4.5 Amps
Optional OVP available for 5V to 24V units

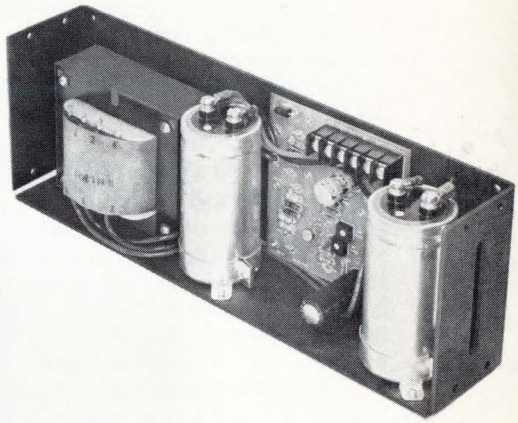
MODEL NUMBER	RATING		REGULATION		RIPPLE
	Vdc	Amps	Line	Load	(Pk/Pk)
EAPS 5-12.0U	5	12.0	±0.05%	±0.10%	5mV
EAPS 12-6.8U	12	6.8	±0.05%	±0.10%	5mV
EAPS 15-6.0U	15	6.0	±0.05%	±0.10%	5mV
EAPS 24-4.5U	24	4.5	±0.05%	±0.10%	5mV



Weight: 7 lbs

115 V INPUT: 1-4 JUMPER 1-3 & 2-4
230 V INPUT: 1-4 JUMPER 3-2 ONLY

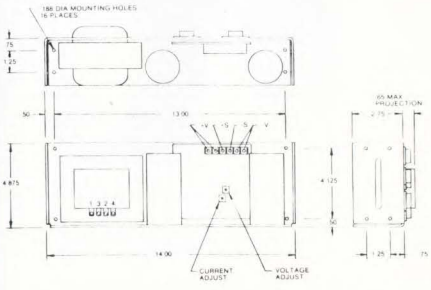
$98.85



90-168 Watts

HE Case Series
Meets UL and CSA Requirements
5 Vdc @ 18 Amps to 24 Vdc @ 7.0 Amps
Optional OVP available for 5V to 24V units

MODEL NUMBER	RATING		REGULATION		RIPPLE
	Vdc	Amps	Line	Load	(Pk/Pk)
EAPS 5-18.0U	5	18.0	±0.05%	±0.10%	5mV
EAPS 12-10.0U	12	10.0	±0.05%	±0.10%	5mV
EAPS 15-9.0U	15	9.0	±0.05%	±0.10%	5mV
EAPS 24-7.0U	24	7.0	±0.05%	±0.10%	5mV



Weight: 9.5 lbs

115 V INPUT: 1-4 JUMPER 1-3 & 2-4
230 V INPUT: 1-4 JUMPER 3-2 ONLY

ADTECH POWER SUPPLIES

ADTECH POWER

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Circle 39 on Reader Inquiry Card

New Products

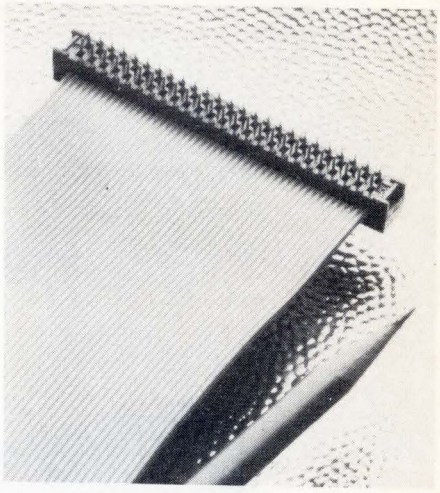
TWO NEW THERMAL PRINTHEADS The KH102 has an 8.3" wide, one-piece heating element to create numerals, characters, lines and solids of the desired size, width and density. Dot Density is 152 dots/inch. The KH106 has an 8.5" wide heating element with 203 dots/inch. Dot size is 0.0041" x 0.0137" with maximum print speed of 4 mSec/line for both. All enabling electronics, including drive circuits, shift registers and diode arrays, are mounted in compact, 40-terminal IC flatpacks. Life is specified at 30 million pulses or 20 miles of paper length. Operating temperature is -5°C to +45°C, with storage temperature from -25°C to +70°C. **R-ohm Corp,** Box 19515, Irvine, CA 92713. **Circle 139**

APPLE FORTRAN AND DISK OPERATING SYSTEM A programming language is now available that allows users to develop and run Fortran programs on their Apple personal computers. The language system lets the user create and integrate Fortran, Pascal and assembler routines into a single program. Apple Fortran is the ANSI standard subset of Fortran 77. It will run on an Apple II or Apple II Plus with a minimum of 48K of memory and the Apple Language System. Also required are a video monitor or standard television, and at least one Apple II disk drive with controller (2 drives recommended). $200. Also available is an improved disk operating system for Apple Disk II drives. DOS 3.3 is a "housekeeping" program that more efficiently stores, catalogs and retrieves diskette programs and data files. It uses a 16-sector storage format that increases the capacity of a diskette by 20%, from 116kB to 143 kB. $60. A DOS Toolkit contains an integrated assembler and source editor that lets Apple users and OEMs create and edit their own source code in 6502 assembly language. $75. **Apple Computer Inc.,** 10260 Bandley Dr., Cupertino, CA 94301. **Circle 137**

6502 FORTH A version of the FORTH programming system is now available for the 6502 based KIM-1, SYM-1, and AIM 65 microcomputer systems. A version for the APPLE II will be forthcoming.

It contains a built-in 6502 assembler, a text editor, and a cassette file management system. Information on interfacing FORTH to a floppy disk is provided as well as several extensions to the language. $90.00 including a user manual, a source listing, and an object code cassette. Eric C. Rehnke, **Tech Services,** 1067 Jadestone Lane, Corona, CA 91720. **Circle 179**

FLAT CABLE CONNECTORS These miniature D.I.P. series flat cable connectors are designed to connect flat cable to PC boards permanently by dip-soldering. No wire stripping is required.



The 750 series replaces headers without having to redesign the PC board. They can be used to replace the headers and sockets where the need for matability has been eliminated. The series provides mass termination for AWG #28 stranded as well as #30 solid flat cable. **Fujitsu America, Inc,** Component Sales Div, 910 Sherwood DR-23, Lake Bluff, IL 60044 **Circle 184**

54" DIGITAL DRUM PLOTTER with high speed (35 IPS), rapid acceleration (4G), fine resolution (0.0125MM) and continuous feed paper (240 foot roll).

It uses a servo-motor drive system and two 16-bit μPs.

The user can define a window, so only that portion of a plot is plotted. Negative windowing allows a portion of a plot to be blanked out.

Plot time is indicated on a LCD display, also used to report the results of an automatic self-diagnosis sequence initiated on power-up.

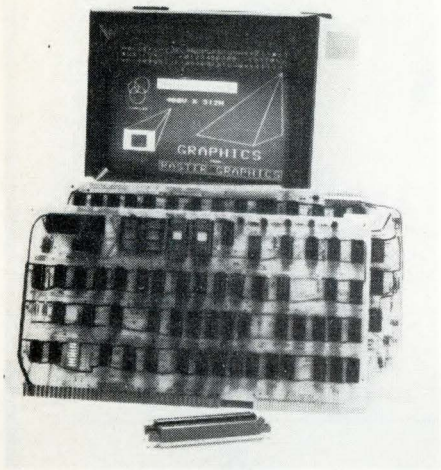
An RS-232 interface provides for both local and remote operation with terminal/modem.

Data rates are switch selectable from 110 to 9600 baud asynchronous.

Model 5400 is $33,900. With the optional, integral controller the price is $35,900. **Nicolet Zeta Corp**, 2300 Stanwell Dr, Concord, CA 94520. **Circle 159**

VECTOR GENERATOR BOARD It accepts high level instructions from the Multibus processor to generate ASCII characters, and other graphic shapes. Point to point draw is provided, allowing the user to specify a list of coordinates which define a shape to be drawn.

The RG-SBC-VG3 for use with an RG-SBC-M1 Refresh Memory board,



forms a complete graphics generator with 512H x 240V or 512H x 480V resolution for 525 line or 625 line TV applications.

Up to 8 RG-SBC Refresh Memory boards may be used with one RG-SBC-VG3 for black and white, RGB color, shades of gray, or multiple memory plane applications. Available from stock at $495. **Raster Graphics** Box 23334, Tigard, OR 97223. **Circle 181**

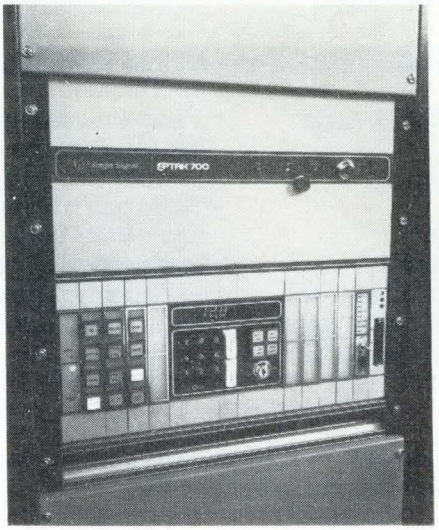
BUBBLE MEMORY AND MICROCOMPUTER BOARDS. The RBM411 one-megabit and the RBM256 quarter-megabit bubble memory device, along with the new RMS family of single board systems, containing one or two 256K bit or megabit devices, were shown at Wescon by Rockwell. Also shown were: the Microflex 65 board family which includes an SBC, 8K static and 32K dynamic RAM, 16K PROM/ROM, parallel and serial I/O, ACIA boards, 4 and 16 card motherboards, extender and prototyping boards; the PPS 4/1 family of 4-bit single-ship microcomputers; the R6500 family of 8-bit devices; the R24 modular modem with a synchronous 2400 bps set that enables the designer to integrate the modem into his equipment; and the AIM 65 microcomputer and expansion slots for additional memory and languages. **Rockwell International,** Electronic Devices Div, Box 3669 RC55, Anaheim, CA 92803 **Circle 177**

PDP-11/LSI-11 WORD PROCESSING With this system, formatting commands determine spacing, margins, page length, tabulation, indentation, justification, hyphenation, etc. Formatting of the copy can be changed either as copy is being entered or after entry in completed.

The PWS-1 word processing/list processing software is written in MACRO-11 assembler language and is used in conjuntion with the RT-11 operating system, with or without TSX timeshare facilities.

All insertions and deletions are cursor addressed and 21 lines of text are displayed at all times. ASC11 source files are used for easy interface with existing applications and for support by DEC-supplied utilities, including file merging. $2,300. OEM discounts available. **Plessey Peripheral Systems,** 17466 Daimler Ave, Irvine, CA **Circle 172**

POWERFUL μP CONTROLLER to be unveiled at the Houston ISA show in October, the EPTAK 700 controller includes a new executive user software, with increased computational capability, analog control enhancements, improved monitoring and simplified programming; new programming language, to utilize advanced analog capabilities of the system and provide improved operator control; improved analog accuracy and resolution – new I/O modules make the EPTAK 700 a 12-bit system, with increased resolution and tighter control



of analog loops, and compatible with more external devices; improved operator interface, with data conversion and display provided in standard engineering units; and higher density memory modules with 16K capacity each, compared to 4K of memory per module in the earlier EPTAK system, permitting 48K memory capability in only 3 modules. This frees several chassis slots for other self-diagnostic or operator interface modules, allowing a full capability EPTAK 700 system to be housed in a single chassis thereby saving space. Available in early 1981. **Eagle Signal Industrial Systems,** 736 Federal St, Davenport, IA 52803. **Circle 152**

THIRD ANNUAL

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MARCH
17-18, 1981

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- Theoretical and empirical bases of measurement techniques
- Operation and programming of measurement tools
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Technical papers and workshops offer state-of-the-art information on such topics as:

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- VLSI photomasking measurements
- Photoresist measurements and control
- Measurement and control in projection aligners
- Linewidth measurement: equipment; techniques; edge recognition; focus sensitivity; "standards"
- Laser annealing measurement and control
- Techniques to measure and control interface and insulator charge states
- Dry processing and plasma end-point measurements
- Toxic gas monitoring: chemical trace level/particle counter for VLSI/bubble memory production
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- On line measurement systems for Si/Al, P/silox, Ni/Fe
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New Products

SEMINAR ON MICRO/PERSONAL COMPUTERS equips information processing professionals with a practical working knowledge of μCs and an understanding of their capabilities and limitations. The program also presents the information and skills information processing professionals will need to apply μCs and/or personal computers to their advantage. **Datapro Research Corp,** 1805 Underwood Blvd, Delran, NJ 08075. **Circle 202**

NEW EPROM PROGRAMMER. This addition to the line of the JE608 Eprom Programmer is designed for programming 2704 or 2708 EPROMs. Programming is accomplished by the instrument's internal RAMs and on-board hex keyboard or by copying the program of a previously programmed 2704/2708 or pin compatible ROM. Three separate display registers are included: 8 LEDs for hex key entries, 10 LEDs (2^0 – 2^9) for Address Register, and 8 LEDs for Data Memory Register, which displays the content of the RAMs from the EPROM chip, $400 in kit form and $500 completely wired, assembled and tested. **Jameco Electronics,** 1355 Shoreway Rd, Belmont, CA 94002 **Circle 203**

10 BIT D/A CONVERTER. The unit has a high speed, μP compatible input register, designed for interfacing with even the fastest μPs. It guarantees monotonicity and $\pm 1/2$ LSB linearity over the 0°C to +70°C or −55°C to +125°C operating temperature range.

Most available monolithic 10 bit D/A's have slow CMOS latches and are incomplete, requiring external references and external output op amps for normal operation. The MN3040 has a fast TTL latch with internal reference and output on amp. $65/100, 4 weeks ARO. **Micro Networks Co,** 324 Clark St, Worcester, MA 01606. **Circle 204**

M6809 BASIC-M INTERACTIVE COMPILER. BASIC-M is a high level programming language used to solve a wide variety of problems with emphasis on real-time process control and business-related applications. It can reduce the time and cost associated with μP software development and maintenance. It produces position independent object programs, has real-time interrupt and condition monitoring, and several matrix operations. Min. configuration for BASIC-M compilation is an M6809 EXORciser/EXORterm with EXORdisk II/III, EXORciser-compatible terminal and M6809 MDOS; An EXORset with XDOS; and 48K Bytes of RAM. $1500 with run-time package on MDOS diskette and users guide. **Motorola Semiconductor, Inc.,** Box 20912, Phoenix, AZ 85035. **Circle 211**

DISC STORAGE SYSTEMS. A bulletin describing the DD Series Disc Storage Systems for Perkin-Elmer/Interdata 32-Bit Computers is available from Diva. These systems provide large capacity, high performance, cost effective disc storage. The basic sub-system provides 80-600 million bytes of disc data storage on fixed or removable media with expansion capability to 5.2 billion bytes. **DIVA, Inc.,** 607 Industrial Way West, Eatontown, NJ 07724. **Circle 206**

ENLARGED DEVELOPMENT CAPABILITIES. AMIX is a single-user disk-based software executive program designed to enlarge the development capabilities of the TI, Intel, Motorola and Tektronix systems to include μPs they cannot currently support. AMI supplies optional assemblers, using a single editor, to support the entire AMI S2000 and S2200 μC families, the complete S6800 family and the S9900 family. In addition, it supplies assemblers for the 8080A, 8085, Z80, 6502 and 2650 μPs. $550. **American Microsystems, Inc.,** 3800 Homestead Rd, Santa Clara, CA 95051. **Circle 208**

Product Index

To obtain detailed information on ads appearing in this issue use the Reader Inquiry Card. Circle appropriate numbers (as many as you desire), detach the card from binding and mail to *Digital Design*.

This index is provided as an additional service: the publisher assumes no liability for errors or omissions.

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A multitude of modules

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

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- **High Speed Arithmetic Unit**
- **Power Supplies**

System packaging

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

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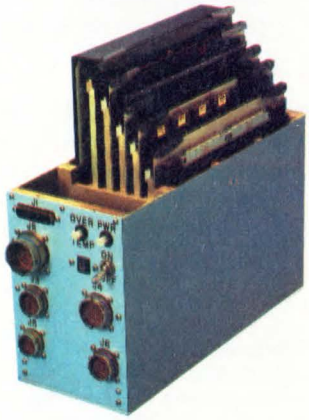
We've got core and semiconductor memories for military and commercial use, a Digital Data Acquisition System for the 1553 bus, and a compact Digital Tape System with 23 megabit capacity.

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



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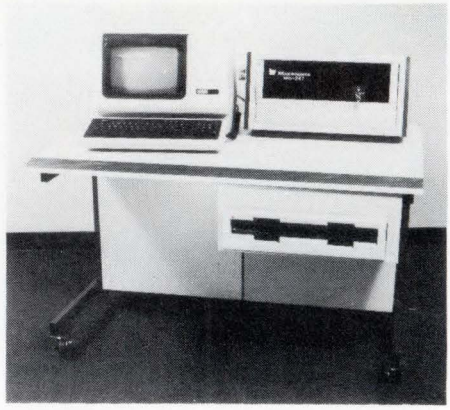
Circle 43 on Reader Inquiry Card

New Products

NEW PROGRAMMING STATION permits off-line program development. The system includes the Macrodata TEst COntrol Language (TECOL) executive, a TECOL editor, the DEC RT-11 operating system and handles DEC software; including FORTRAN, BASIC, FOCAL and ALGOL.



The programming station consists of the DEC LSI microcomputer with 32K words of memory, dual floppy disks each with 512KB of memory and a VT-100 video terminal. Options include dual MFE250C dual cassette tape transports and a TI Model 810 (150 cps) impact printer.

The MD-247 is $29,700, with the Automatic Program Generator at $10,000. Delivery is 60 to 90 days ARO. **Eaton Macrodata,** 21135 Erwin St, Woodland Hills, CA 91365 **Circle 185**

FLOPPY DISK CONTROLLER for S-100 systems supports both 5 1/4" and 8" single- or double-sided drives in any combination of up to 4 drives. It supports both IBM 3740 single-density and IBM System 34 double-density soft-sectored diskette formats.

An on-board 2K EPROM, supplies the Model 2422 with monitor firmware and a bootstrap loader for loading CP/M from disk. The bootstrap loader and monitor are disabled when CP/M is loaded, and LED indicates whether they are enabled or disabled. When the EPROM is selected, the 2422 generates a PHANTOM signal for memory overlay.

It can be assigned to one of 8 banks and can be set to come up enabled on system power-on and reset. $400 including copy of CP/M 2.2 on disk. **California Computer Systems,** 250 Caribbean Dr, Sunnyvale, CA 94086 **Circle 155**

ERROR-FREE MODEM is also a high-speed modem series for use with minicomputers and asynchronous 'dumb' terminals. It allows asynchronous terminals to operate at 2400, 4800 or 9600 bps on standard, unconditioned leased telephone lines without any changes to existing hardware or software. The modem eliminates the risk of undetected transmission errors by providing automatic retransmission-on-error. Its small size and light weight minimize logistics problems and simplify installation and replacement. The Micro5000 is $5500 (9600 bps) to $1500 (2400 bps). Quantity and OEM discounts available, delivery is 60 days ARO. **Micom Systems, Inc.,** 9551 Irondale Ave, Chatsworth, CA 91311. **Circle 151**

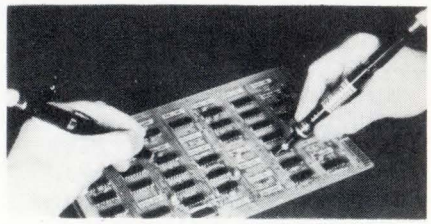
NEW SONIC DIGITIZERS in the Graf/Pen GP-6 family: GP-6-25 with integral RS-232 interface, and GP-6-26 with integral IEEE-488 interface. Each unit provides digital coordinates for any point on the plane with built-in environmental temperature compensation and parallel 14-bit binary output standard.

All OEM GP-6 sonic digitizers are designed to eliminate data tablets, and convert positional information in 1, 2 or 3 dimensions. They produce digital values in a form suitable for display, data processing, storage, or transmission. **Science Accessories Corp,** 970 Kings Hwy W, Southport, CT 06490

Circle 180

PAPER TAPE READER is RS232 compatible. Has enlarged capacity, can read 5- to 8- level tape and transmit 7- to 11-frames per character at 50 to 9600 baud. Features include starting and stopping on character at all speeds, choice of manual control or X-on, X-off, 90 to 260 volt, 50 to 60 Hz power and even, odd or no parity, with a choice of desk top or rack mounting. $656-$779/unit, 1-3 days ARO for the TTY loop or RS232 reader/transmitter. **Addmaster Corp,** 416 Junipero Serra Dr, San Gabriel, CA 91776 **Circle 167**

LOGIC PULSER There is no need to unsolder pins or cut printed-circuit traces even when a node is being clamped by digital outputs. PLS-1 is a multi-mode, high current pulse generator in a hand-held size. It can source or sink sufficient current to force saturated output transistors in digital circuits into the opposite logic state. A single high-going or low-going pulse of 2 u sec wide is delivered to the circuit node under test.



Pulse polarity is automatic: high nodes are pulsed low and low nodes are pulsed high. It delivers a series of pulses at 20 pps to the circuit under test. $48.95. **O.K. Machine and Tool Corp,** 3455 Conner St, Bronx, NY 10475 **Circle 176**

Our dumb terminals are smarter than you'd think. And, more and more OEMs and distributors are recognizing that our IQ120 and IQ140 video display terminals offer more features at a dumb terminal price. What others may offer as options, we give you as standard features. Like, preformatted screen, numeric pads, detached keyboard, complete cursor control, editing commands and switch selectable data transmission rates. In a smart-looking terminal designed for operator comfort, convenience and efficiency.

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Circle 47 on Reader Inquiry Card

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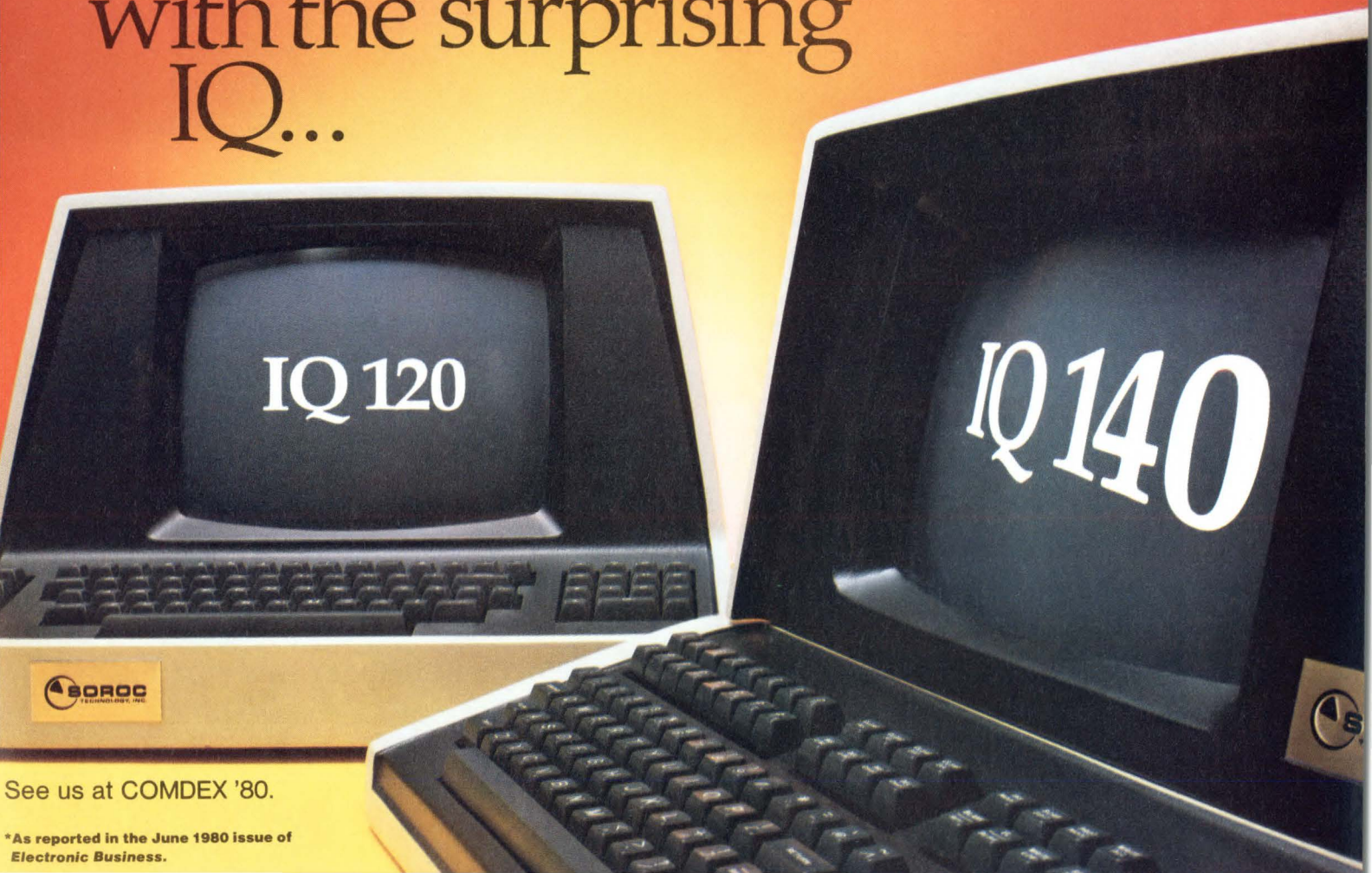

SOROC TECHNOLOGY, INC.

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*As reported in the June 1980 issue of *Electronic Business*.

NEVER BEFORE HAS A BACK-UP SYSTEM BEEN AS INTELLIGENT AS THE SYSTEM IT'S BACKING UP.

This is 3M's HCD-75 High Capacity Data Cartridge Drive. And the reason it's as intelligent as a computer is because it thinks like one.

You see, unlike other back-up systems, the HCD-75 is interfaced directly with the primary system by means of sophisticated, microprocessor electronics. When the host computer has data to feed, the HCD-75 starts automatically. When the host computer stops, it does too. And since the HCD-75 also positions to any location, it not only saves tape cost, but retrieval time as well.

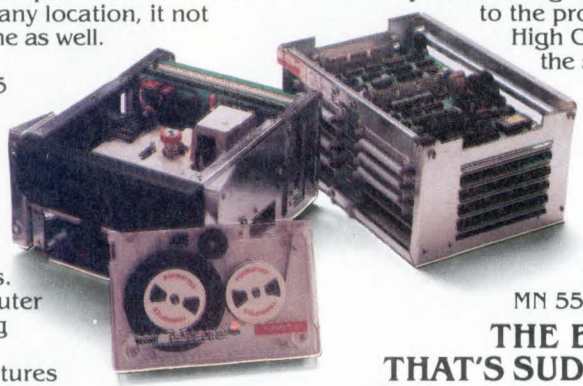
Of course, the use of microprocessors allows the HCD-75 to perform a number of other time-saving functions, too. Like block replacement, so you can easily correct errors or change files which need updating. And fast random access, which makes it useful both as an I-O device or as a storage unit for low-usage files. All of which relieves the host computer from difficult timing and formatting problems.

What's more, the HCD-75 features state-of-the-art error detection and correction capabilities. Even when the system is off-line, self-test diagnostic routines monitor its performance. And, combined with each of its $32.50 high-capacity cartridges, the HCD-75 provides a full 67 megabytes of formatted user information (144 mbytes unformatted). So costly operator interventions are sharply reduced.

If you're looking for a reliable, cost-effective solution to the problem of disk back-up, the HCD-75 High Capacity Data Cartridge Drive is the system you should be thinking about.

Not only has a lot of thinking gone into it. But a lot of thinking comes out of it, too.

For more information, check the listing on the next page for the representative nearest you. Or write: Data Products Division/3M, Bldg. 223-5E/3M Center, St. Paul, MN 55144.



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

Circle 44 on Reader Inquiry Card

New Products

PDP-11 PRINTERS/CONTROLLERS. A new line of plug-compatible controllers and line printers provide high-print capacity for DEC PDP-11/04 through VAX-11/780 minicomputers. Model LPC-11 provides 300 to 1200 lpm. For higher throughput the LPC-11 supports 1500 and 1800 lpm printers. The controllers are fully compatible with the DEC Unibus and occupies only one "quad" slot in the system backplane. They are completely transparent to RSX-11, IAS, RSTS, DSM-11 and RT-11 operating systems; no reprogramming is required. Parallel character data-transfer rate is 66.8 KHz. $6250 to $30,000 each, depending upon options and printer speed. Delivery is stock to 30 days. **BDS Computer Corp,** 1120 Crane St., Menlo Park, CA 94025. **Circle 210**

DUAL HEIGHT EXPANDER CARDS feature full hardware and software compatibility with the DEC LSI-11 dual height Q-Bus backplane. The Model DT2772 dual height single-board expander extends the DT2762 dual height, high-level input, analog interface board from 16 single-ended (SE) or 8 differential-input (DI) channels to factory-configured 64 SE or 32 DI analog input channels. Seven such expander boards provide 60DI channels, each capable of resolving 10mV to 10V full scale input signals in the presence of ±250V of common mode voltage. In 1-9 quantities, the DT2772 is $225 for 32 SE or 16 DI channels, $350 for 64 SE or 32 DI channels. DT2774 with 64 SE or 32 DI channels is $350. DT2775 is $445 for 8 isolated DI channels. 5 days ARO. **Data Translation,** 4 Strathmore Rd, Natick, MA 01760. **Circle 205**

DISK DRIVE STORES 160 MB. This self-contained random access mass storage unit stores in excess of 160 MB on a removable disk pack. Five R/W surfaces, each carrying 1645 tracks, store a total of 164.2×10^6 bytes. Each track carries 20,160 bytes or 161,280 bits (including header and gaps). Track density is 768 tracks per inch. Recording method is MFM, bit serial. Maximum access time averages 30 ms, between two adjacent tracks, 5 ms, and across maximum tracks (0 to 1645), 55 ms. Latency time is 16.7 ms. Data transfer rate is 9.68×10^6 bps at a standard rotational speed of 3600 RPM. Start and stop times are 20 seconds. Only 10.5″ high, the BD-160 can double or triple storage capacity without requiring changes in system configuration. Capacity has been increased through improving data density rather than adding more disks. This reduces mass, power requirements, drive motor size, and number of actuators and heads. $11,000, 90 days ARO. **Ball Computer Products,** 860 East Arques Ave., Sunnyvale, CA 94086. **Circle 207**

MAGNETIC TAPE SUBSYSTEMS accommodate GCR; PE and NRZ-I recording methods. With tape speeds from 50 to 125 IPS the units record 1600/800 BPI or 6250/1600 BPI. From MT-101 through MT-106 they provide transfer rates of 80/40, 312/80, 128/64, 500/128, 200/100 and 781/200 KB/S respectively. Rewind speeds from 250 to 375 IPS.

The MT-100 family features front end mounting of controls for ease of operation. Load rewind, start, unload, reset and power are controlled by front mounted switches, and LEDs are used for power on, ready, protect, load check and alarm indication. **Hitachi America, Ltd,** 100 California St, San Francisco, CA 94111. **Circle 209**

SOFTWARE. "Microprocessor Software." Editor Martin Whitbread is Senior Lecturer at the School of Electrical Engineering, Leeds Polytechnic. From his library on computer science he has extracted some outstanding articles on software and bound them in this single volume. "This collection," he says in his preface, "should provide a valuable introduction to the subject of microcomputer software and serve as a guide to the information currently available from magazines and journals." 150 ppg. 8″ × 12″. Price £9.50. Add £1.75 per copy for postage to the US. Checks in pounds sterling only. **Castle House Publications, Ltd.,** 27 London Rd., Tunbridge Wells, Kent. TN1 1BX. UK. **Circle 212**

DOT MATRIX PRINTER This 80 column printer features full dot graphics and complete μP control. Includes tractor feed, a 2K character buffer, hardware UART, and can store a complete screen display from a standard video terminal. Contains up to 8K of EPROM program and 4K of RAM to control all hardware functions, multiple character sets and graphics. Unit accepts paper widths from 1.5" to 10" and will print up to 5 part forms. Switch and software selectable option bits control the baud rate and forms length. The interface is RS-232C and 20 MA. current loop, using a standard D connector. Baud rate is programmable from 110 to 9600. The DE-800SG is mounted on a 16" x 8" x 15" enclosure powered by either 115 or 230 VAC 50-400 Hz. $995, OEM discounts available. **Data Electronic Devices, Inc,** 18 Bridge St, Salem, NH 03079 **Circle 163**

New Products

PLOTTING WORK STATION Working directly from unsorted CalComp 921/925 magnetic tapes, the unit sorts, rasterizes and controls electrostatic plotting. The system offers CRT-displayed menus to simplify the creation of canned sequences and graphics manipulation, such as scaling, expansion or reduction, windowing, rotation in one-degree increments, and modification of multiple line widths and line masks. It can generate multiple copies, select either of 2 electrostatic plotters, and select files from disk or tape.

System components include a μP with 64 kB of memory, Winchester disk with a capacity of 24.8 MB (formatted), CRT display, dual density magnetic tape drive with imbedded formatter (9-track 800 or 800/1600 bpi), and a bipolar algorithmic processor for sorting and vector to raster conversion. The system drives 2 Versatec plotters in plotting widths of 11, 20, 22, 24, 36, 42 or 72 inches. The two plotters need not be the same width. Deliveries begin in first quarter, 1981. Price for Model 430 with dual density 800/1600 bpi is $48,500. **Versatec**, a Xerox Company, 2805 Bowers Avenue, Santa Clara, CA 95051.

Circle 126

NEW FROM 3M. The 8200-R Static Control Floor Runner and the 8210-R Table Runner provide a single continuous conductive surface designed to dissipate harmful static electricity during assembly of electronic components. Also available is Scotch #247 crepe masking tape used to hold components during automatic component processing and prevent wire shifting. The tape also maintains precise spacing of lead intervals (pitch) for processing reliability when reels are placed in component sequencing and insertion machines. A low halogen adhesive inhibits wire corrosion. **3M**, Box 33600, St. Paul, MN 55133. **Circle 141**

NEW VERSION OF COBOL-80. Version 4.0 of the COBOL-80 compiler for 8080, 8085, and Z80 based μCs features: full-screen interactive ACCEPT/DISPLAY and SCREEN SECTION compatible with Data General Interactive COBOL; CHAIN with argument passing; and segmentation to ANSI standard Level 1. Version 4.0 supports all existing versions of CP/M, including 1.3, 1.4, and 2.X for files up to 8MB. COBOL-80 version 4.0 runs under CP/M, ISIS-II, IMDOS, CDOS, TEI'S TDOS and MODEL II TRSDOS operating systems. Single-copy price is $750; documentation available separately for $20. **Microsoft,** 10800 NE Eighth, Suite 819, Bellevue, WA 98004.

Circle 143

512KB SEMI ADD-IN for main memory expansion of DECs VAC-11/780 computer system.

This unit uses 16K dynamic RAMs and is internally organized as 64K x 72 to provide 512KB of storage. The 72 bit word consists of two 32 bit words plus 8 bits of error correcting code (ECC). Timing is governed by the M8213 memory controller in the host VAX-11/780. Access and cycle times in a read mode are 250 nsec and 530 nsec.

The DR-178S operates from the host systems +5 VDC, −5 VDC, and +12 VDC power supplies. Maximum current drains, when using the 512KB version, are .58 amp, .02 amp, and 1.45 amps. A DIP switch allows it to be isolated from the bus during troubleshooting. Operating temperatures are from 0°C to 55°C.

The 512KB DR-178S is $5,660. A 256KB version is $3,145. Delivery is 30 days ARO. **Dataram Corp.,** Princeton-Hightstown Rd., Cranbury, NJ 08512.

Circle 128

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

SINGLE-CARD VAX-COMPATIBLE MEMORY. This high-speed, high-density memory board packs 512KB on a single hex-wide card and is compatible with VAX-11/780. Partitioned power plane minimizes drain by powering only memory elements and refresh circuitry in battery backup applications. An on-line/off-line switch aids reconfiguring and trouble-shooting by allowing memory to be electrically removed from system without physically removing the card from the backplans. Memory is tested at 225 ns access/425 ns cycle time during 72-hour period at 70 C. Model NS780, $6995 (unit qty); OEM discounts. **National Semiconductor Corp,** 2900 Semiconductor Dr, Santa Clara, CA 95051.

Circle 169

NEW HP-2100 SERIES INTERFACE The TDC-3011 interface occupies one card slot in the HP-2100 Series computers and connects to the cartridge drive via a 40-wire flat ribbon cable. The interface services one ANSI/ECMA formatter, which in turn can drive up to 4 TDC-3000 digital cartridge drives. Using ANSI x3.56 each DC-300XL cartridge can store 4.32 MB of unformatted data, or 3.75 MB formatted using 2048 byte-blocks. The sub-system can operate either in programmed-channel (skip-on-flag) or in DMA mode. Software driver for SIO, RTE, BCS and DOS operating systems are available. **Innovative Data Technology,** 4060 Morena Blvd, San Diego, CA 92117. **Circle 220**

CARTRIDGE TAPE CONTROLLER Model 570 supports up to 68 MB of tape storage on the DEC Q-bus. The 570 is completely resident on one quad-sized board which utilizes bit slice technology and Xylogics' "micro-module" controller.

The 570, an emulating controller, provides software compatibility with OSs having TM11/TU10 support. It supports most popular 6400 BPI cartridge tape drives, such as the Data Electronics cartridge tape drive. It has Data Integrity Verification, mixed tape-drive capacity capability, with future expansion to handle 7200 BPI drives $1,125 (OEM qty). **Xylogics, Inc,** 42 Third Ave, Burlington, MA 01803.

Circle 161

MORE POWERFUL ZMS-70. Useful in stand-alone and DDP environments, the ZMS-70 is a powerful CRT work station consisting of a compact desktop enclosure with 15" CRT, 2 integral double density diskette drives and a detachable keyboard. Internally it features a μP, up to 12 KB of firmware and 64KB of RAM, video controller and synchronous/asynchronous communications port. Additional I/O controllers and other options may be installed. By incorporating the dual 100 TPI floppy disk drives within the CRT housing, it has increased storage capacity to over 500 KB. The disk controller will support 4 floppy disk drives, single or double-sided. An integral data modem allows synchronous communication over telephone lines. **Zentec Corp.**, 2400 Walsh Ave., Santa Clara, CA 95050.

Circle 133

CARD CAGES hold 21 S-100 bus cards on 3/4" centers for packaging microcomputer systems. The cage has adjustable struts for mounting card-edge connectors or the Vector Model 8803 S-100 bus motherboard without hole drilling or special hardware.

The cage measures 19" x 12.2" x 8.9". The adjustable cross members accommodate circuit boards ranging from 4.0" to 8.0" long and from 10.0" to 11.5" wide. Snap-in plastic card guides support .0625" thick cards. With the guides placed on 0.50 centers 31 cards could be accommodated.

The CCK100 card cage with 21 pairs of card guides is $49.80 each, unassembled. **Vector Electronic Co,** 12460 Gladstone Ave, Sylmar, CA 91342. **Circle 164**

Designers' Notebook

Constant RMS Controller Uses uP

Here is a simple constant RMS controller using a μP. RMS controller circuits for systems are usually expensive and use many discrete components which require a significant increase in PC board size and cost.

The majority of systems now produced are using μPs for controlling timing and other functions in system.

The circuit in **Fig 1** is a simple RMS controller circuit which will reduce discrete components counts and cost while only dedicating three I/O's to the μP for collecting data.

This particular circuit correlates with a 24-VAC isolated line (no load). However, with modifications this circuit could work directly off the AC line.

The 24-VAC signal enters D1, which allows only the positive half-cycle of the signal to pass through; R1 is used for current control. The signal will not affect Pin 5 of the NE555 until the breakdown voltage of the Zener diode D2 is surpassed. At this time R2, R3, and C1 will set up a DL bias which will introduce a change in frequency on the output (Pin 3) of the NE555 (IC1). A resistor pot in series with R3 can be used for a constant reference on the output for production circuits.

The NE555 is configured in a free-running STATE MODE where the output is approx. 10.8 with no modulation input. R4, R5, R3 and C2 generates this frequency.

The micro system monitors a zero voltage detect circuit (IC2) which is optically isolated (IC3) from the AC power line. When a negative going transition is at PA0, the μP initiates counting transitions at the PA1 input over a 16.6-msec time period (60 Hz). The number of counts during this time indicates the true RMS voltage of the line.

For example, if the 24 VAC isolated line varies to 25 VAC during the time period sample, the μP would have a count of approx. 140 ±1 (**Fig 2** illustrates the RMS voltage vs. counts per 60 Hz in a curve format.) The count is compared to a look-up table, stored in the μP and a correction is made if necessary for the phase-fire circuit.

Using this circuit will definitely take advantage of the μP bacause of low I/O count and software required to have a constant RMS controller circuit.

William J. Linkowski, Pitney Bowes Copier System, Danbury, CT 06810.

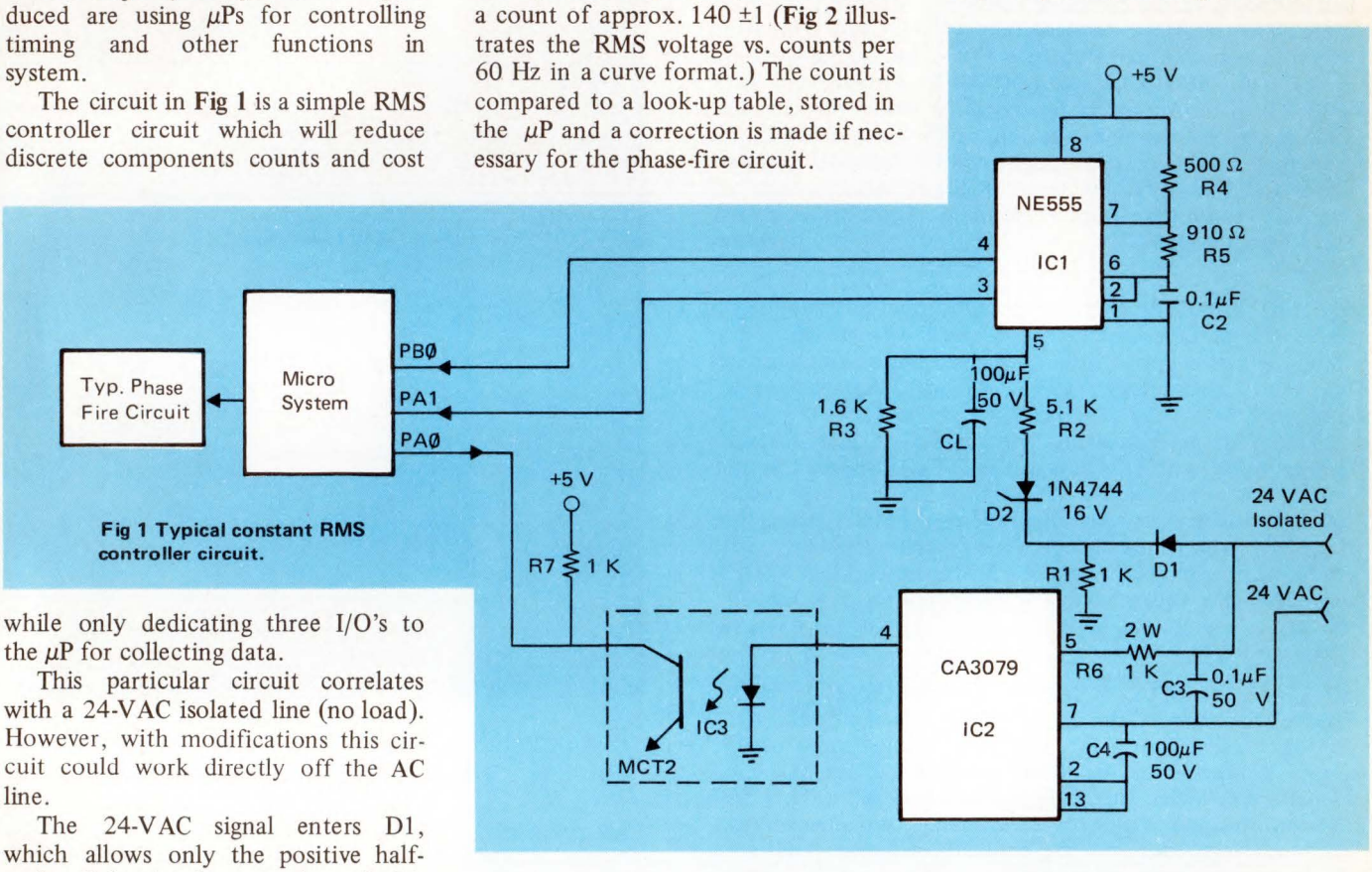


Fig 1 Typical constant RMS controller circuit.

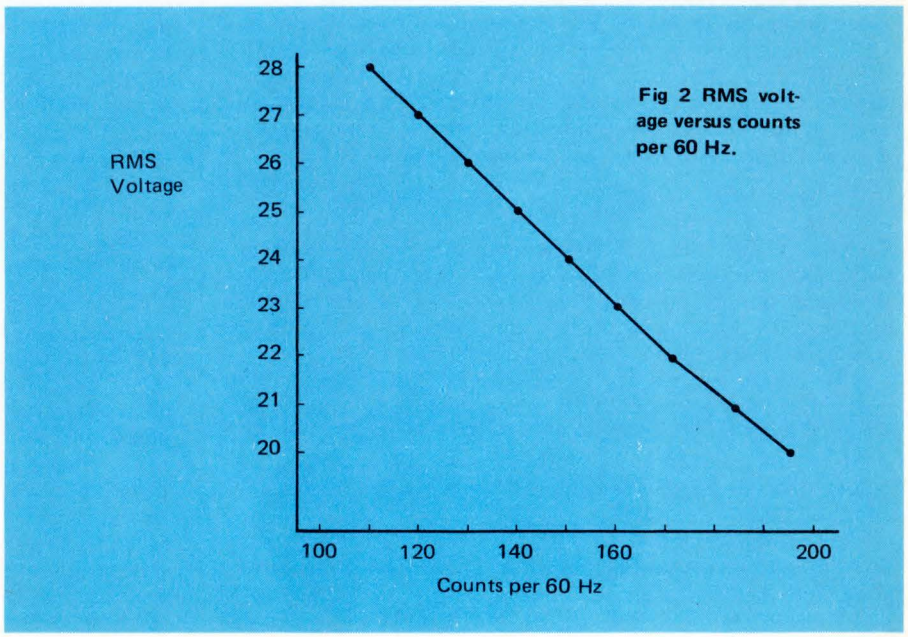


Fig 2 RMS voltage versus counts per 60 Hz.

8748/Keyboard Interface Time-Shares Data Bus

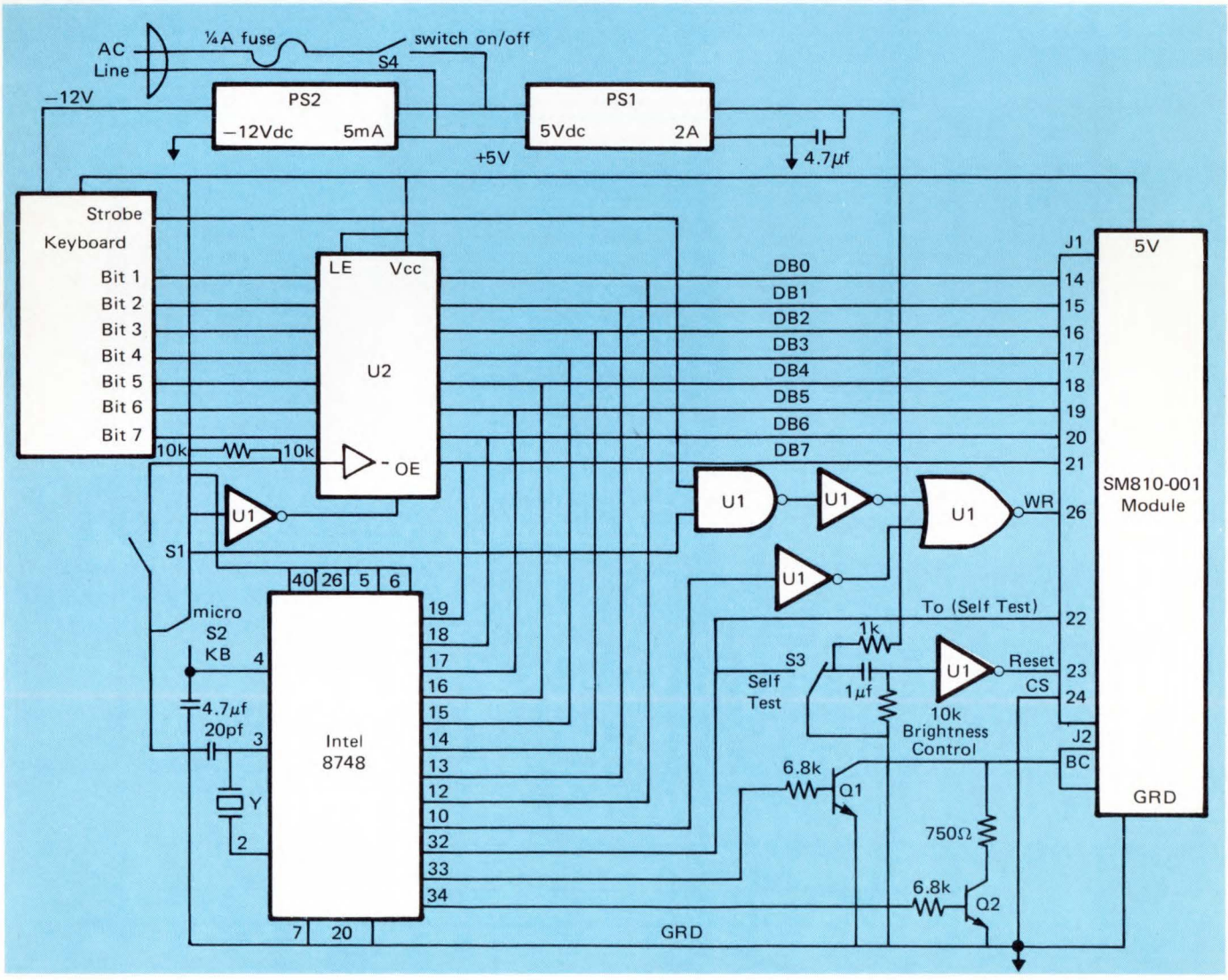
Multiple device interface is possible if the data lines are isolated from interacting with each other. The data bus may be dynamically time shared under control of the host computer, or statically latched onto one device at a time. A simple static dual interface is shown in the Figure.

When S2 is in the "micro" position, control of the display is directed from the 8748 while the keyboard output is disabled. When S2 is switched to "KB", the 8748 is disabled and the keyboard output is enabled. Again, S1 controls the keyboard output, closes for character data and opens for character position. Self test may be initiated by switching S3 to the "Self Test" position when the 8748 is disabled.

Wayne Wong, Beckman Instruments (Display Systems Div), 350 N. Hayden Rd, Scottsdale, AZ 85257.

PARTS LIST

Qty	Description	Part Number
1	Microcomputer	Intel 8748
1	Keyboard	Micro Switch 61SW12-2
1	Power Supply PS1	Semiconductor circuit SP5941
1	Power Supply PS2	Semiconductor circuit SQ1.12.100
1	IC latch U2	74LS373
1	IC multiple gates U1	Motorola MC14572
1	Crystal (Y)	Color Burst 3.579 MHZ
2	Transistor	2N4401 or equivalent
2	Resistor	6.8k ¼w
1	Resistor	750Ω ¼w
1	Resistor	1k ¼w
3	Resistor	10k ¼w
2	Capacitor	4.7μf 10V
1	Capacitor	20pf 100V
1	Capacitor	1μf 10V
4	Switch	SPST
1	Display Module	SM810-001



8085 Pseudo-Random Sequence Generator Replaces MM5538

In some designs, it is necessary to have a white noise generator. One circuit that provides an approximate equivalent is a pseudo-random sequence generator such as National Semiconductor's MM5538 digital noise source (**Fig 1**). We developed a software equivalent for the 8080/8085 (**Fig 2**) which uses 22 bytes of ROM and does not require any R/W RAM.

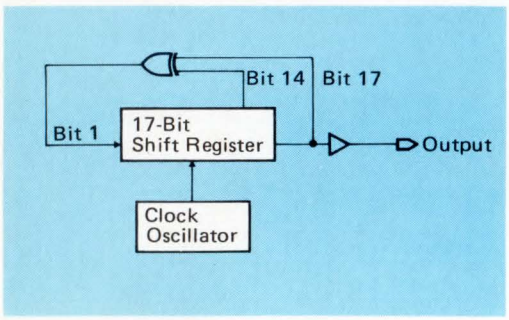


Fig 1 MM5837 circuit.

The register pair, BC, is used as the first 16 bits of the shift register and carry is used as the 17th bit. The program sets the control word for the output port, initializes <BC>, and sets carry. An infinite loop is entered which provides the noise. The lines of code from the label LOOP: to MOV B,A provide the 17-bit shift register. The OUT instruction is located within this section so that the code can be minimized by taking advantage of the fact that bit 7 of register B will be the output signal. The code from label EXOR: to the last RAL provide the exclusive-OR of bits 14 and 17 and restores the carry flag (bit 17) back to the proper state.

With a 17-bit shift register, there are 2^{17} or 131,072 unique states. The cycle time for the loop is about 23 μs using an 8085 CPU with a 6.144 MHz crystal oscillator. The total cycle time before repetition will be about 3 sec. The maximum cycle time for the MM5837 is listed at 2.4 sec. Thus, the software solution is reasonably equivalent.

The software can be modified to provide bursts of white noise, but the subroutine example in **Fig 3** generates a burst of white noise and will increase the total cycle time before repetition to about 4.6 sec.

H.R. Pinnick, Jr, Dept. of Chemistry, Southeast Missouri State Univ., Cape Girardeau, MO 63701

```
;*****************************************************************************
;
TITLE 'NOISE: PSEUDO-RANDOM SEQUENCE GENERATOR MOD 1.0 6/10/80'
;
;*****************************************************************************
;
CTPORT  EQU     28H             ;CONTROL PORT ADDRESS
PORT    EQU     2AH             ;OUTPUT PORT ADDRESS
;
;*****************************************************************************
;
BEGIN:  MVI     A,OFH           ;SET UP CONTROL WORD FOR OUTPUT PORT
        OUT     CTPORT          :OUTPUT TO CONTROL PORT
        LXI     B,O             ;ZERO <BC>
        STC                     ;SET CARRY TO 1
LOOP:   MOV     A,C             ;MOVE FIRST 8 BITS OF SHIFT REGISTER TO
                                ;/<A>
        RAL                     ;MOVE BIT 17 XOR BIT 14 (CARRY) TO BIT 1
                                ;/AND BIT 8 TO CARRY
        MOV     C,A             ;MOVE SHIFTED SHIFT REGISTER BACK TO <C>
        MOV     A,B             ;MOVE NEXT 8 BITS OF SHIFT REGISTER TO
                                ;/<A>
        OUT     PORT            ;BIT 7 WILL BE CARRY.  USE IT AS AN
                                ;/OUTPUT BIT
        RAL                     ;MOVE BIT 8 (CARRY) TO BIT 9 AND BIT 16
                                ;/TO BIT 17 (CARRY)
        MOV     B,A             ;MOVE SHIFTED SHIFT REGISTER BACK TO <B>
EXOR:   RAR                     ;MOVE BIT 17 (CARRY) TO BIT POSITION 14.
        RAR
        RAR
        XRA     B               ;XOR BIT 17 WITH BIT 14
        RAL                     ;MOVE THE XORED RESULT BACK TO BIT 17
        RAL                     ;/(CARRY)
        RAL
        JMP     LOOP            ;CONTINUE NOISE
        END
```

Fig 2

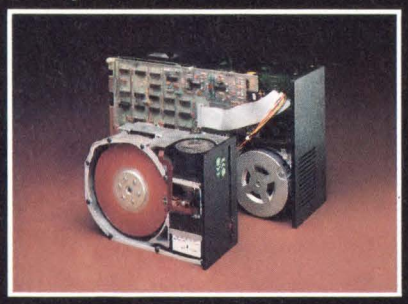
```
;*****************************************************************************
;
TITLE 'NOISE: PSEUDO-RANDOM SEQUENCE GENERATOR PULSED MOD 1.0 6/10/80'
;
;*****************************************************************************
;
CTPORT  EQU     28H             ;CONTROL PORT ADDRESS
LPCNT   EQU     OFFH            ;VALUE OF LOOP COUNTER
PORT    EQU     2AH             ;OUTPUT PORT ADDRESS
SPLOC   EQU     202CH           ;STACK POINTER LOCATION
;
;*****************************************************************************
;
BEGIN:  LXI     SP,SPLOC        ;INITIALIZE STACK POINTER
        MVI     A,OFH           ;SET UP CONTROL WORD FOR OUTPUT PORT
        OUT     CTPORT          ;OUTPUT TO CONTROL PORT
        LXI     B,O             ;ZERO <BC>
        STC                     ;SET CARRY TO 1
        LXI     D,LPCNT         ;LOAD <DE> WITH A LOOP COUNTER
        JMP     LOOP+1          ;JUMP OVER FIRST STATEMENT
LOOP:   PDP     PSW             ;RESTORE BIT 17 (CARRY)
        MOV     A,C             ;MOVE FIRST 8 BITS OF SHIFT REGISTER TO
                                ;/<A>
        RAL                     ;MOVE BIT 17 XOR BIT 14 (CARRY) to BIT 1
                                ;/AND BIT 8 TO CARRY
        MOV     C,A             ;MOVE SHIFTED SHIFT REGISTER BACK TO <C>
        MOV     A,B             ;MOVE NEXT 8 BITS OF SHIFT REGISTER TO
                                ;/<A>
        OUT     PORT            ;BIT 7 WILL BE CARRY. USE IT AS N
                                ;/OUTPUT BIT
        RAL                     ;MOVE BIT 8 (CARRY) TO BIT 9 AND BIT 16
                                ;/TO BIT 17 (CARRY)
        MOV     B,A             ;MOVE SHIFTED SHIFT REGISTER BACK TO <B>
EXOR:   RAR                     ;MOVE BIT 17 (CARRY) TO BIT POSITION 14.
        RAR
        RAR
        XRA     B               ;XOR BIT 17 WITH BIT 14
        RAL     ;               ;MOVE THE XORED RESULT BACK TO BIT 17
        RAL     ;/              ;/(CARRY)
        RAL
        PUSH    PSW             ;SAVE BIT 17 (CARRY)
        DCX     D               ;DECREMENT LOOP COUNTER
        MOV     A,E             ;TEST <DE> FOR ZERO
        ORA     D
        JNZ     LOOP            ;IF NOT ZERO – LOOP, OTHERWISE
        POP     PSW             ;REMOVE PREVIOUS PUSHED PSW
        RST     1               ;EXIT PROGRAM
        END
```

Fig 3

You can't evaluate dreams and promises. Shugart Technology is delivering evaluation units now.

A better choice than eight-inch Winchester.

Our drive is smaller, more cost-effective and easier to back up. Some eight-inch Winchester drives require AC power. This complicates system integration and produces extra heat that can mean additional cooling. We use only 22 watts.



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Our drive has the same track capacity as your double density 8-inch floppy. This means minimal software conversion. You'll find it easier to trade up users, because they can use the same data base.

Test our micro-Winchester with your minifloppy system.

Like the minifloppy, the micro-Winchester has dimensions of 5¾" by 3¼" by 8". It uses the same voltages (+12 and +5) and requires no AC power. Give your customers almost 15 times the capacity of a double-sided minifloppy at less than three times the cost.

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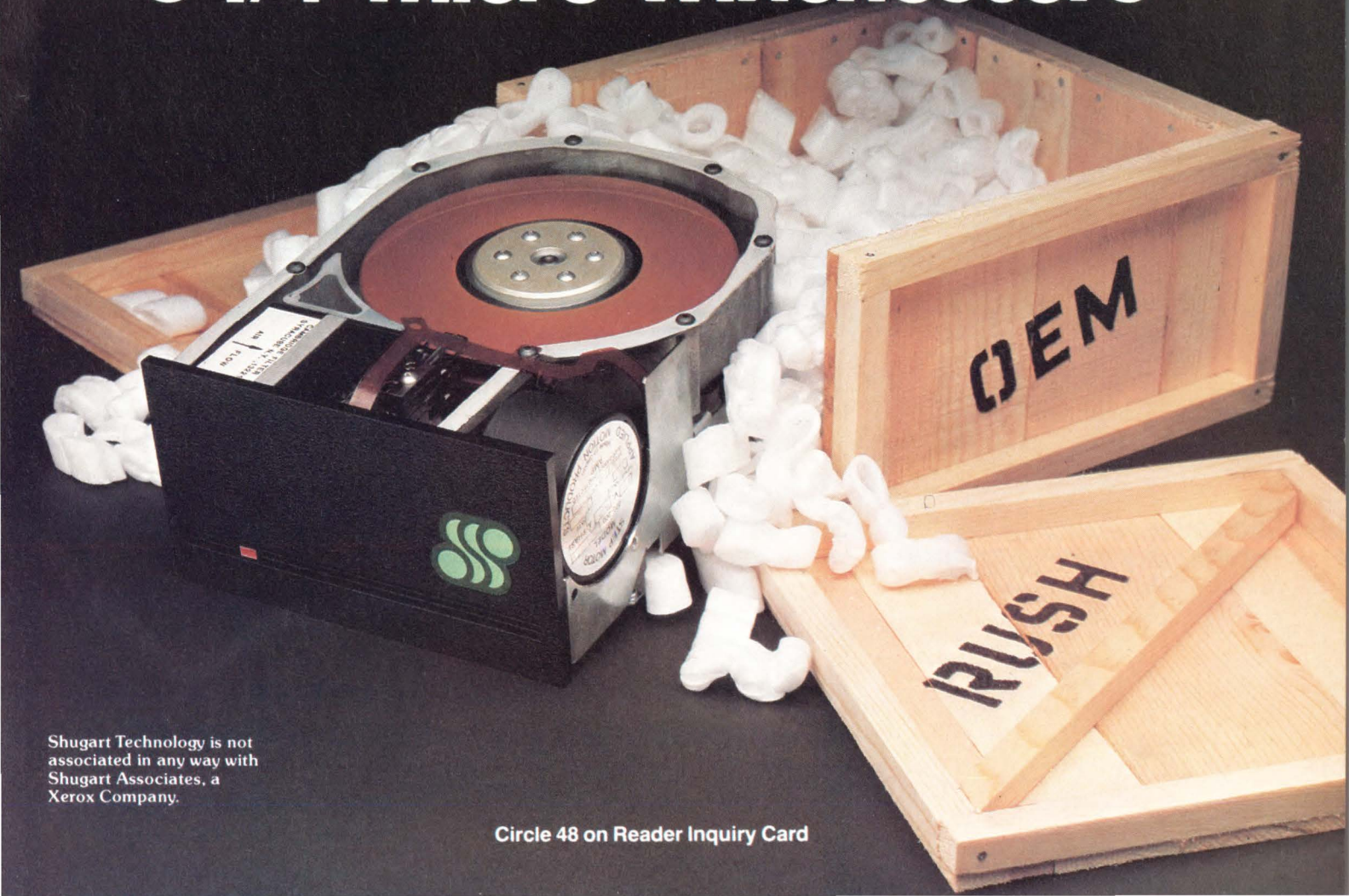

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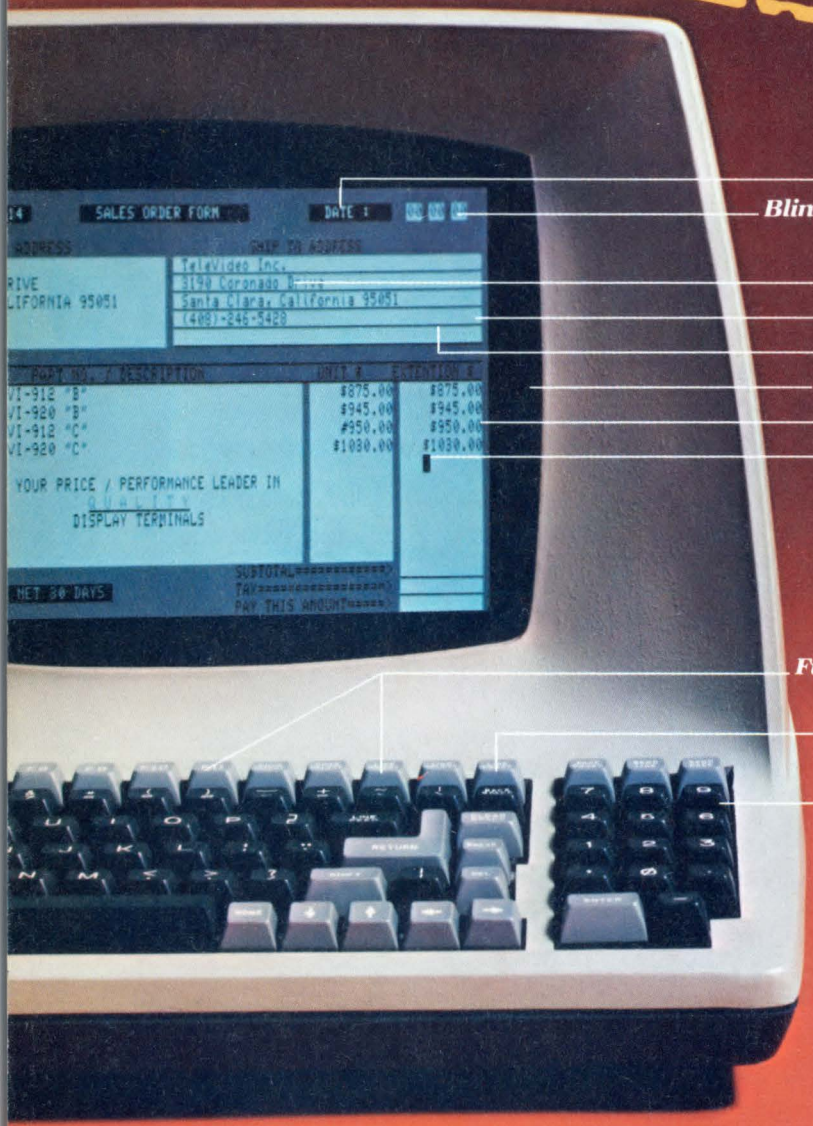

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- *Blinking/blank fields*
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