VOLUME 10, NO. 6

JUNE 1980

Digital Design

Computers • Peripherals • Systems

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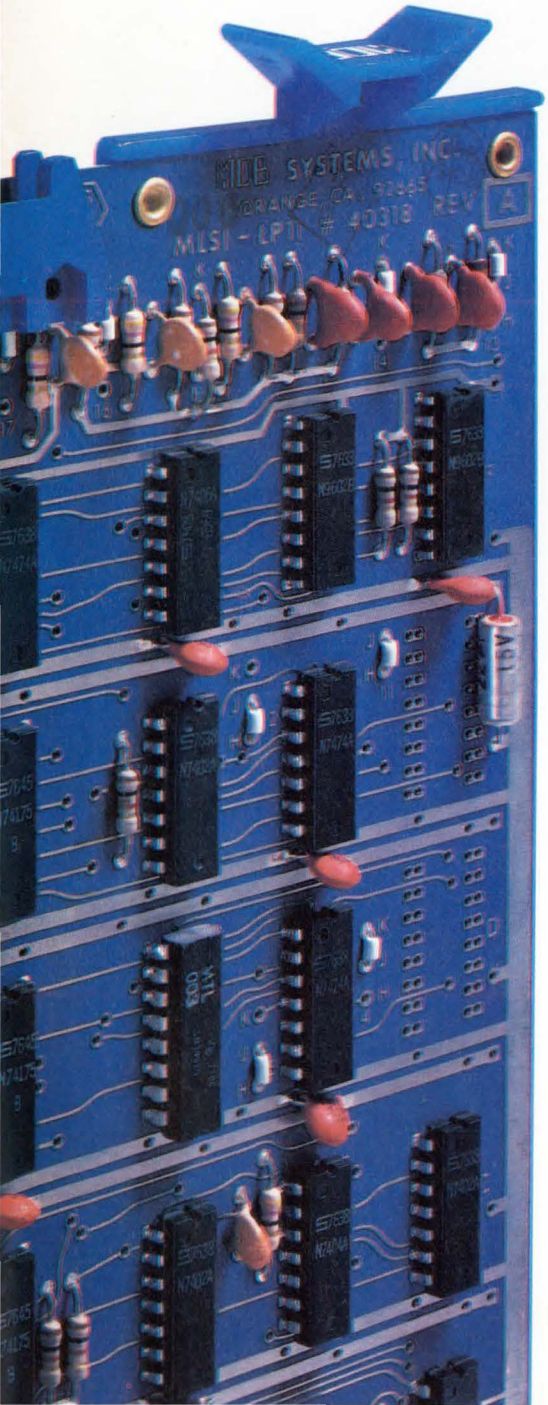

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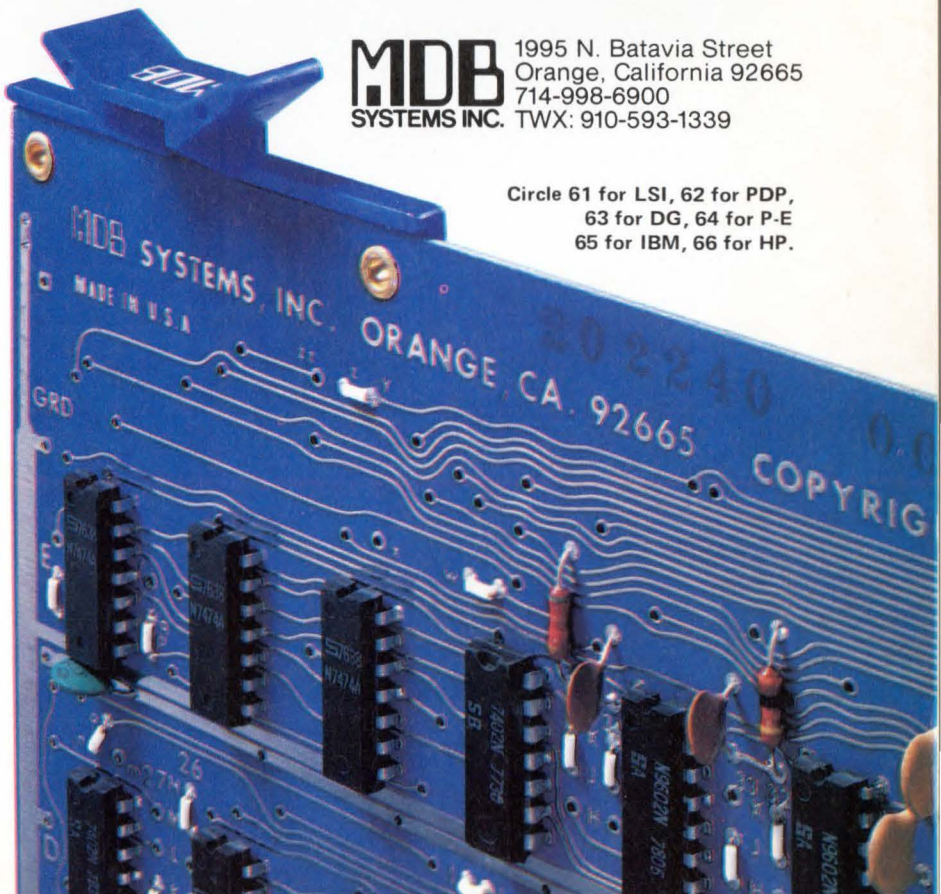

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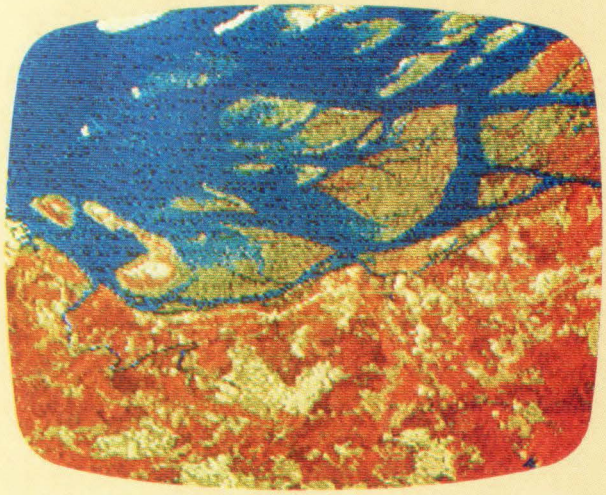

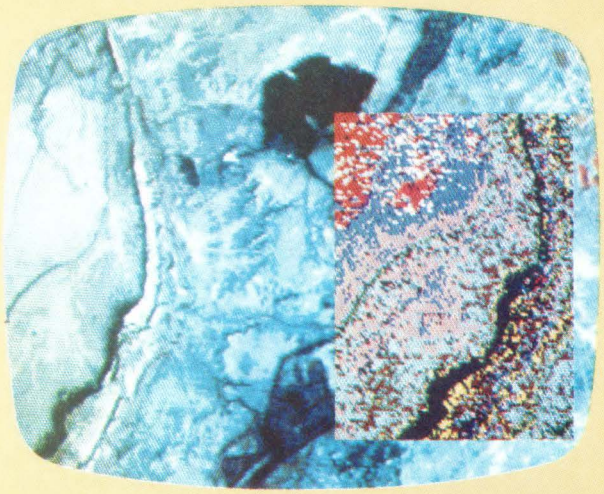

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In addition, the GMR-270 has a display resolution of 512 x 512 pixels and a video format that is RS-170 compatible. It is housed in a rack-mountable chassis and drives standard TV monitors.

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

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VOLUME 10, NO. 6 JUNE 1980

Digital Design

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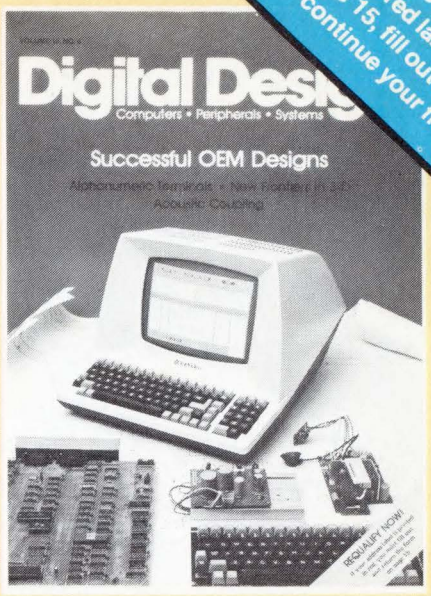
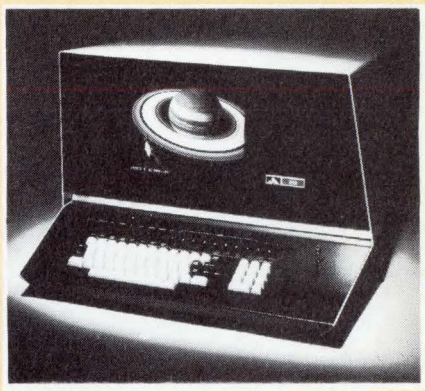
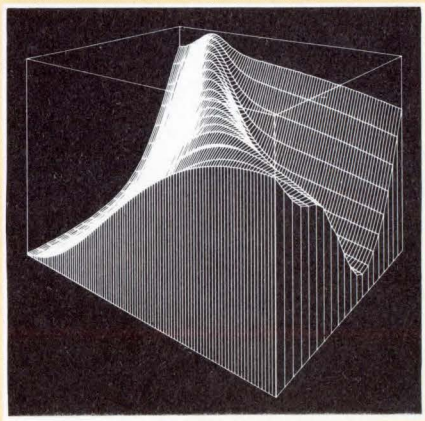


ON OUR COVER

The OEM who starts with a proven product concept, and then centers his design efforts around enhancements with end-user appeal will maximize his opportunity for success. Cover photo courtesy of Televideo, Inc.



p. 49



p. 56

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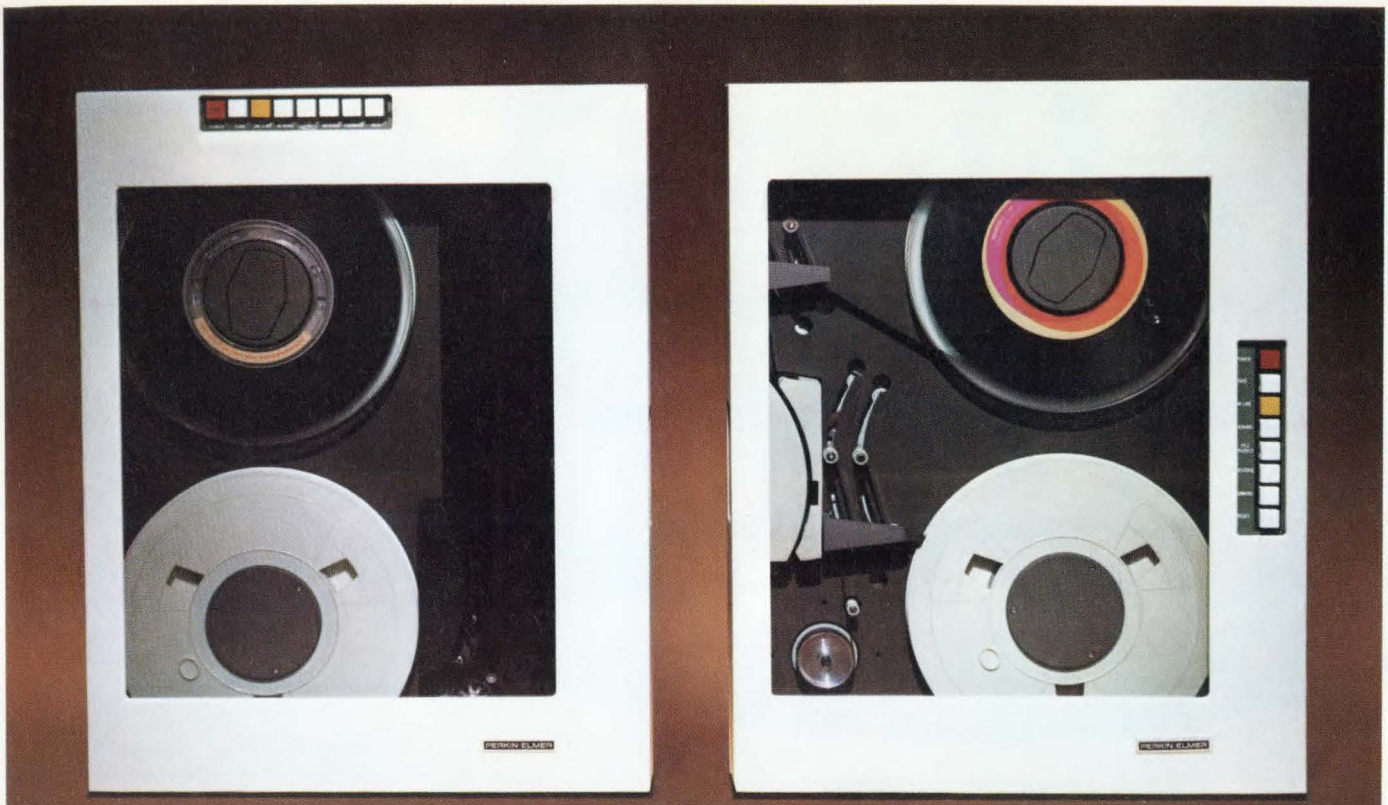

More than just a pretty interface.

The new Perkin-Elmer tape drives– all the features plus good looks.

Our Models 10 and 11 tape drives rate a definite "10."

Check the elegant lines of the new structural foam front door.

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Letters

Data Verification in Streaming Tape Drives

Ed. Note: The December, 1979, issue of *Digital Design* contained an article, "Streaming Tape Drives", written by William Valliant, senior V.P. of Data Electronics, Inc., San Diego, CA. In that essay, he describes how and why magnetic tape recorders, particularly the 1/4″ cartridge type, promise to be rapidly accepted as backup for 8″ Winchester drives.

A number of our readers have requested an explanation of how these drives verify the data they record. We asked Bill Valliant to describe and explain the verification process.

The Author's Reply: A streaming digital cartridge tape drive verifies data "on the fly" with a read-while-write check. That is, reading what is written in real time checks the data. Further, this read-while-write checking does not accept signals that are lower than a very conservative threshold level. The normal read operation can detect significantly lower levels.

In addition, a check character is appended to each data blockette for verification of the data during read passes. Further, decade, format and address checks are made during read-while-write operations, as well as during read-only operations. All of these taken together reduce the chance of an undetected error occurring during streaming to a very small probability.

As to the system problem, prudent design would probably add an error-detection scheme to the data transmitted within the system. This arrangement would provide transmission failure detection, which the streamer cannot detect. Adding a check character to each block would provide for this eventuality. (Possibly even the one used in the disk data format could be employed.) Such a character would add very little space needed on the medium (typically much less than 1% overhead), and decrease the undetected error rate by a significant amount. Furthermore, since error correction characters are commonly added to the disk format, they provide not only error dectection, but error correction.

In any case, the data capacity of the Winchester disk and 1/4″ streaming

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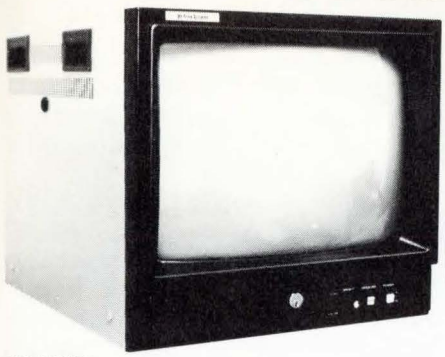

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Scanning Frequency	15-18KHz	15-18KHz	15-35KHz	15-17KHz	15-17KHz	15-17KHz
Vertical	50-60Hz	50-60Hz	50-60Hz	50-60Hz	50-60Hz	50-60Hz
Number of Lines	712 max.	712 max.	1500 max.	680 max.	680 max.	680 max.
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Letters

cartridge tape drives are almost unaffected by these appended characters which provide adequate detection. Hence, both the save and restore operations verify the data.

Finally, you can use main memory for a block-by-block comparison of the backed up data prior to destroying the information on the disk. If performed incrementally, this arrangement does not require any extra space on the magnetic medium.

Add-In/Add-On Computer Memories

Dear Editor:

The January Special Report by Paul Snigier on Add-In/Add-On Computer Memories was especially informative and enlightening. Its length and completeness was a welcome change from cursory articles on this subject. I like such longer, more complete articles. Short ones seldom provide any real information of value to me.

J. R. Lingle
General Electric I & SE
Box 2331
Denver, CO

Special Report

Dear Editor:

Your special report on power supplies ("Special Report: Power Supplies" by P. Snigier in the February issue) was a first rate job. As a manufacturer of switch-mode power supplies, I know whereof I speak.

Bob Lloyd
President
Conver Corp.
Cupertino, CA

Digital Design welcomes comments from its readers. Preference is given to typed letters of 150 words (or less). Address letters to: Editor, *Digital Design*, 1050 Commonwealth Avenue, Boston, MA 02215.

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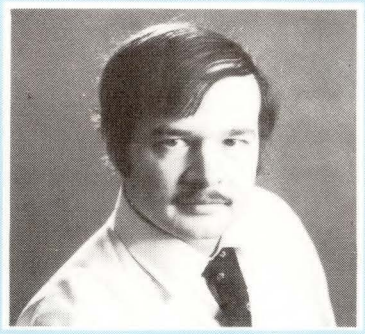
Speakout

Paul Snigier, *Editor*

New Directions For The 1980s



Events are occurring faster than anticipated just a year ago. These events will create new opportunities and require a new breed of system designer. Let's look at two such events – the newly announced 32-bit microprocessor and the 256-kbit RAMs.

Sources say that samples are expected shortly of a 32-bit μP – well before Motorola's own predicted date (last Fall) of 1984. Comtec of Hong Kong commissioned Motorola to provide proprietary software and to redesign the 68000 mask, add eight address drivers and house it in a new package. This 32-bit μP is programmable only in high-level languages, with interpreters for a PL/I-like intermediate language. PDP-11-compatible compilers for Fortran, Cobol and Basic will compile down to the intermediate language. Several versions said to be under development include one 32-bit μP with microcode programmed for floating point arithmetic; one that emulates various mainframe instruction sets; one with writable control letting users down-load their own instruction sets; and one that supports virtual memory. The greater 68000 sophistication, it is believed by some observers, now gives Motorola an edge over its competitors in getting its 32-bit μP to market first. Intel, however, is not resting on past achievements and is developing its 32-bit micro, the 8800, which incorporates the IBM 370 instruction set, enabling users to hire present programmers and utilize existing software. Rumors also exist that a 64-bit μP is actively under development at a certain firm.

Meanwhile, on the memory scene, the two 256-kbit RAMs recently announced by NEC-Toshiba Information Systems and NNT's Musashimo Electrical Communications Lab are only precursors. (NTT also unveiled a 4-Mbit ROM.) Both RAMs run from a single 5-V supply and are compatible with existing 16-k and 64-k RAMs. Although the first is fabricated using conventional techniques, the latter required electron beam writing. Although significant investment is about to be made in EB lithographic equipment, the changes may come faster than anticipated. And the quadrupling of memory every three years now, rather than two, won't slow progress, as the importance of going from a 64-k to 256-k RAM is far different than going from a 1-k to 4-k RAM. As we reach higher scales of integration, it is true that manufacturing costs-per-bit tend to fall slower (the law of diminishing returns when asymptotically approaching theoretical limits), it will become a question of not whether we can achieve such capacities but whether many anticipated applications will ever need such mind-boggling capacities per device!

I use these examples, as exteme as they are (rather than lesser, but more significant ones), to illustrate a point: the world of electronic computers is about to enter a new phase, and it will come more quickly than anticipated a year ago. The result will be sudden societal and market changes. Progress and marketing opportunities are not linearly related to increases in memory or CPU capacity/capabilities; and, as we saw above, the changes brought about in going from a 64-k to 256-k RAM or from a 16-bit to 32-bit μP are more significant (cataclysmic) and far-reaching than in going from a 1-k to 4-k RAM or from a 4-bit to 8-bit μP. True, they've both quadrupled (or doubled), but the changes to occur will be far greater from the former cases.

If this means new opportunity for our industry, what does it mean for us? For the 1980s, in order for industry to take advantage of this enormous computer potential will require experienced EEs in greater quantities. Although the logic designer as we know him won't go the way of vacuum tube designers, he won't be in great demand. The 1980s will require a new breed of EE – a system designer with multidimensional skills and experience. System designers of the 1970s were oriented toward system hardware and software; in the 1980s, they will become more problem- and user-oriented.

Will you be prepared for the transition?

TOREN/GAYNOR

私達はいろいろな言葉を話します。

(We speak many languages)

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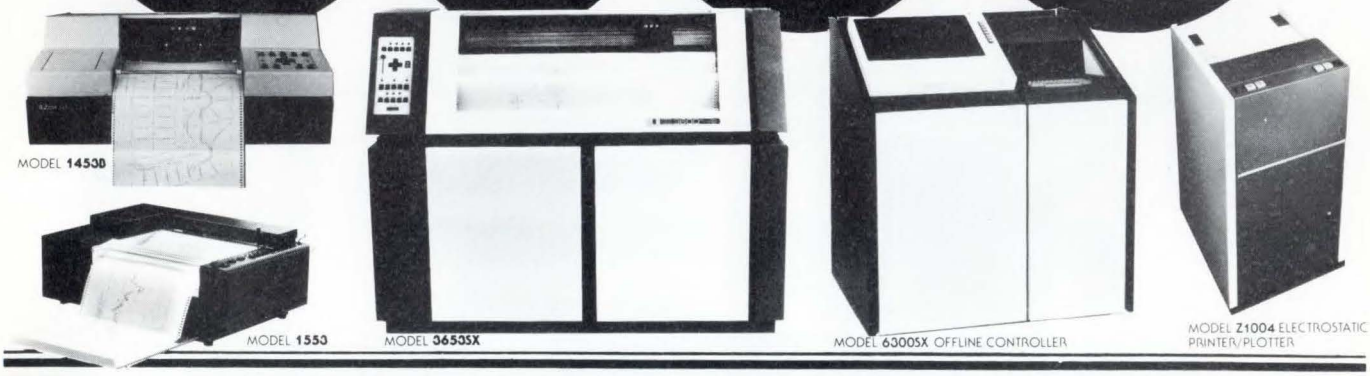

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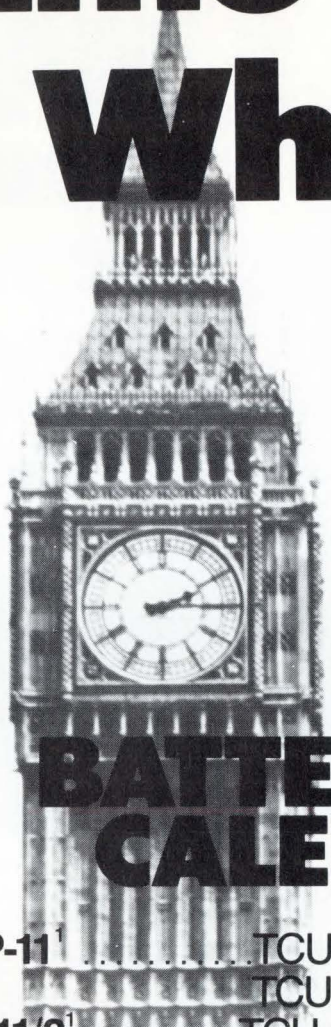

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DIGITAL PATHWAYS

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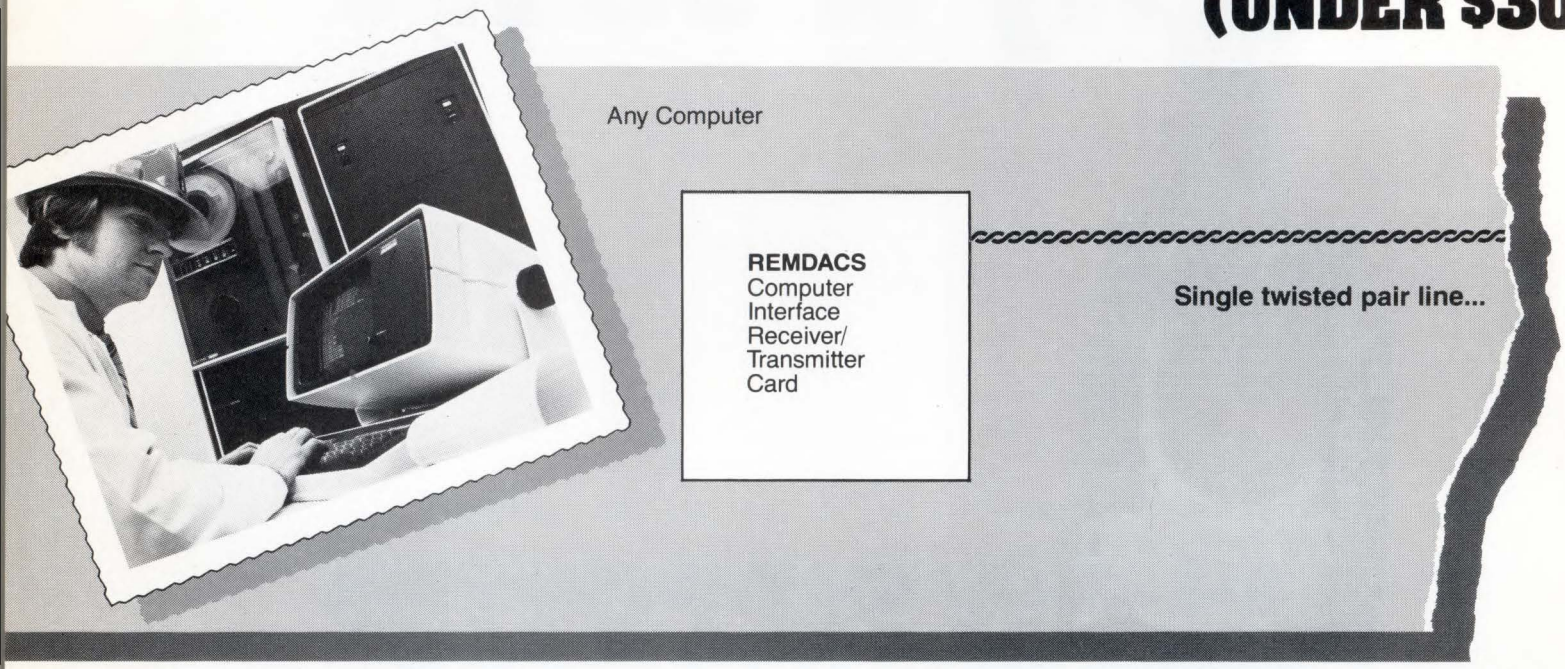

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A central receiver/transmitter station polls all remote stations. Up to 95 channels/second. In a high-security, serial-message format. The host provides only address and action commands. REMDACS provides system control and communications protocol. Converting the data for virtually any host computer. To the host, REMDACS is transparent, looking like a simple data source or control device. Up to 512 remote stations may be attached to one receiver/transmitter, providing thousands of data input channels and control outputs.

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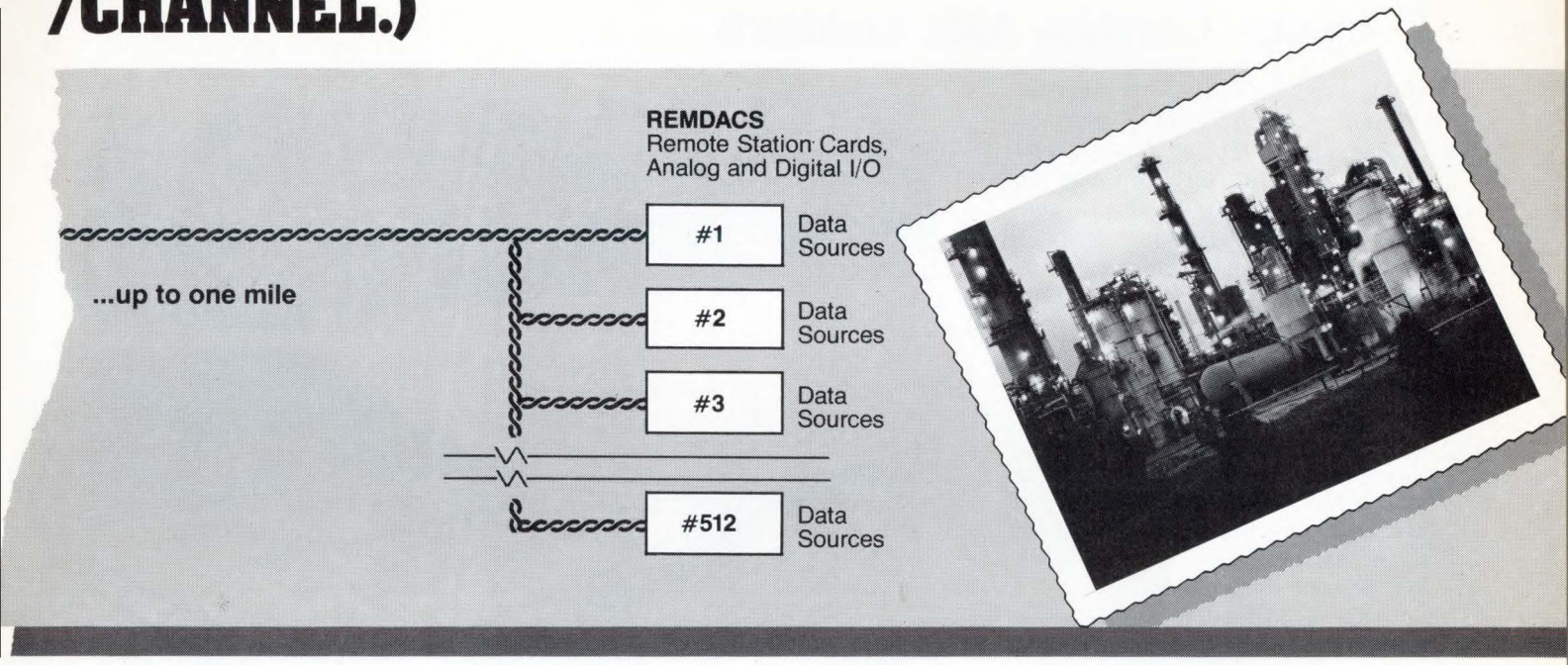
Here's a good way to get familiar with the concept fast. And come out with a working system. The REMDACS Evaluation Kit provides all you need: Two remote station cards, a receiver/transmitter card, an RS-232 serial interface card, a detailed technical manual, a 24 VAC transformer, cables and connectors. All data acquisition and control routines are debugged and stored in firmware. Total tab: $995. And worth every penny. Just in man-hours saved.

ACQUISITION EASY.
/CHANNEL.)



GET GOING IN 1 DAY.

In less than one hour you'll have the kit ready to go, and interfaced through the RS-232 card. Soon after, you'll have your program written—and be hooking up live inputs. Your computer needs only to address a location and give an action command. REMDACS does the rest. And that keeps your job simple.

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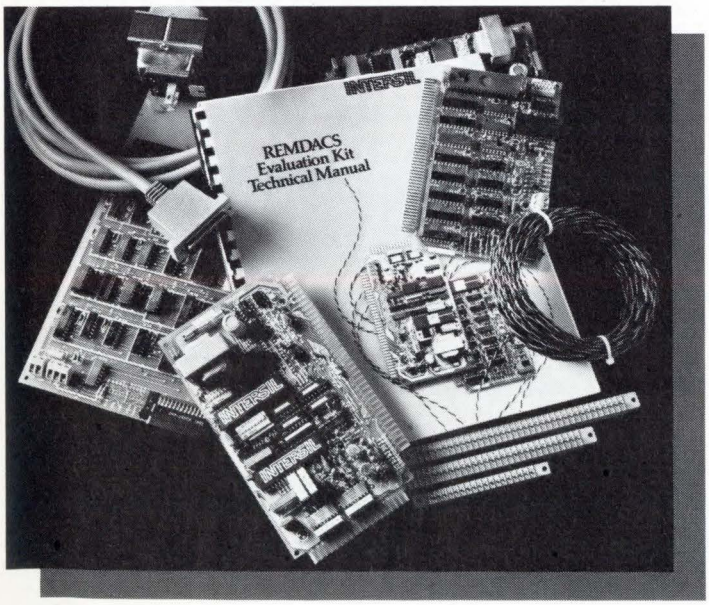

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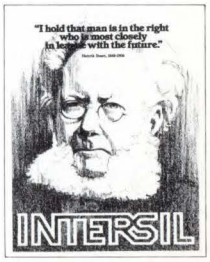

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DD680

Technology Trends

Computer Graphics Aids Architects

OEMers looking for new end users for systems using computer graphics are finding that novel and unique applications are constantly opening up. As a sales tool for architects, computer graphics will open new doors.

Computer-animated graphics (theme of NCC '80) are complementing the sketches used by architects to give clients a visual impression of proposed buildings – from the inside. From an artist's drawing, the computer "draws" a series of sketches – each from a slightly different angle – that are assembled into an animated film. The film acts as guided tour for clients, giving them the impression they are "walking" through the building.

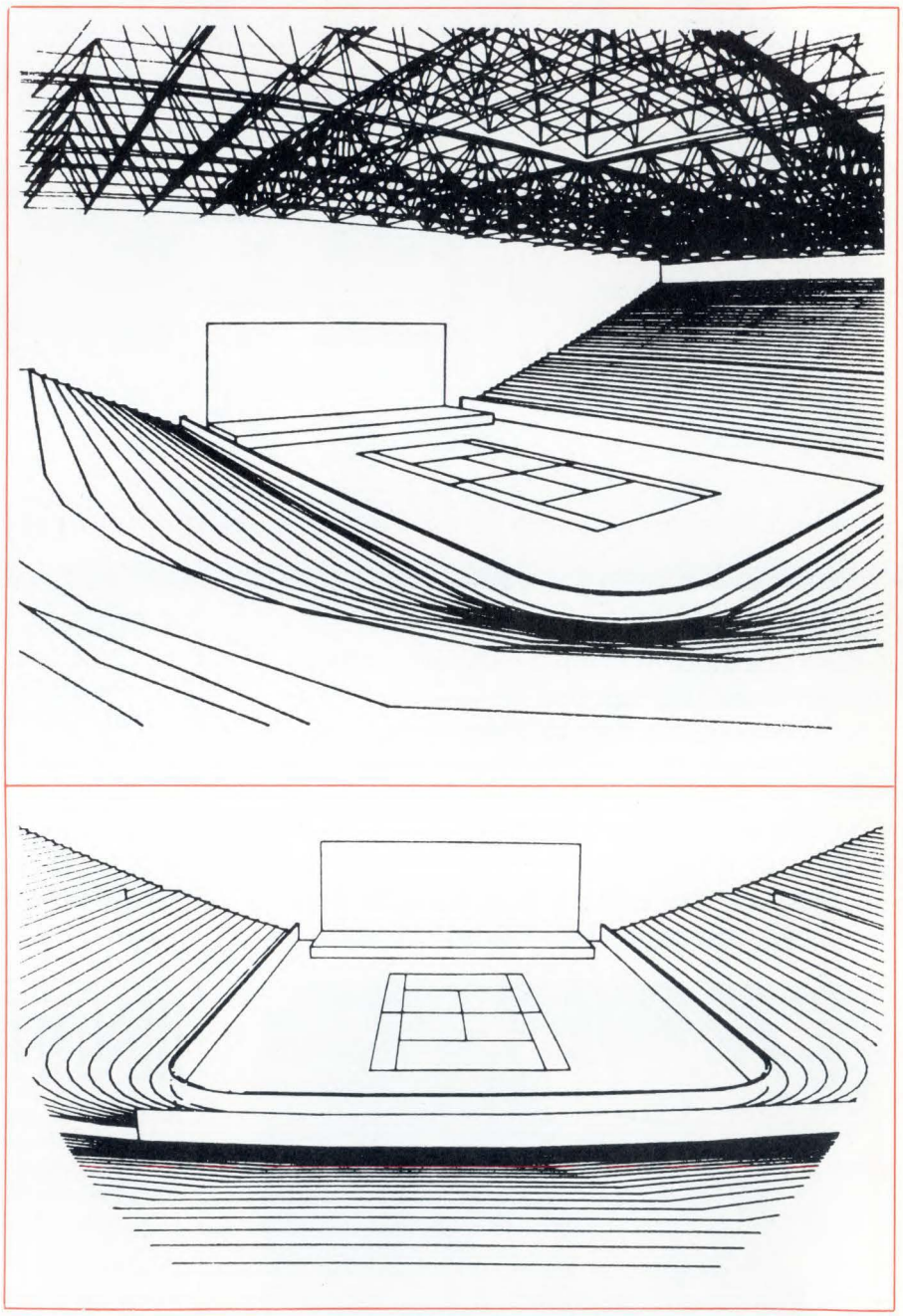
Such a computer technique is used by Easinet, a computer time-sharing service for engineers and architects established by Engineering and Scientific Computers Pty. Ltd. ESC is a subsidiary of Miller, Milston and Ferris Pty. Ltd, Sydney, Australia.

Easinet uses an Eclipse S/130 to quickly sketch building interiors on video display terminals. Barry Westlake, manager of Easinet, said conventional artist's sketches are time-consuming and costly, and do not accurately represent the full visual impact of a new building.

Westlake said this work does not replace the creative design efforts of the architects, but concentrates on perfecting the physical details of their sketches. By using computer-animated graphics and computer terminals, the internal outlines of the building that are not shown in the artist's impression are revealed to the client. This gives the added advantage of facilitating any changes that must be made to a planned structure.

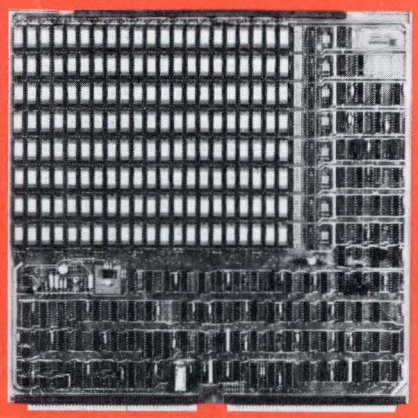
In their work as structural engineers, Miller, Milston and Ferris used computer graphics for the proposed entertainment center at Sydney's Haymarket. Using the S/130 computer system, engineers designed the 12,000-seat auditorium with no intermediate columns. They programmed the computer to check the position of every seat to insure that every person would have an unobstructed view.

In addition, the interactive minicomputer system allowed engineers to determine precisely the best location of the stage and lights. By using various software packages, the S/130 system can also be used to graphically present engineering data and test results.



These two computer sketches, done with a Data General Eclipse S/130, show the proposed entertainment center at the Sydney (Australia) Haymarket.

ADD-ON ADD-IN



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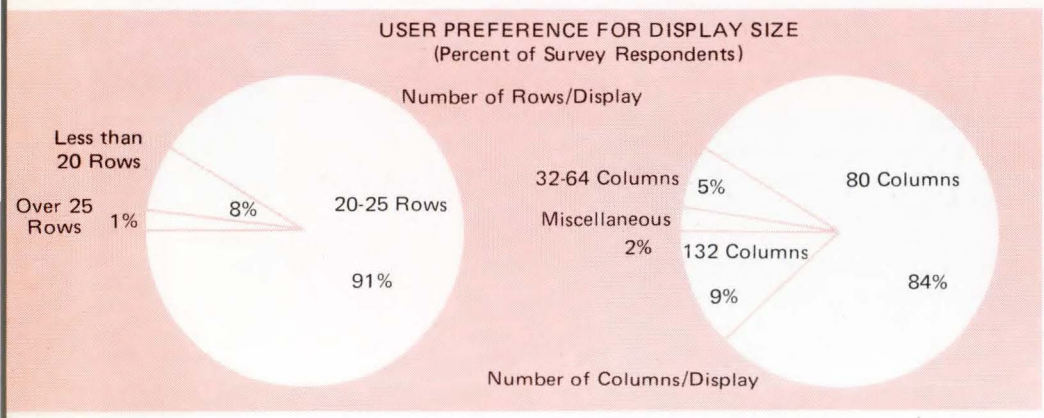
Circle 16 on Reader Inquiry Card

Users Express CRT Terminal Size Preference

Users of alphanumeric CRT terminals express a strong preference for 80-column by 24-row displays. The 1,920-character display will continue to be the de facto standard, according to a recent study by Venture Development Corp. (Wellesley, MA). Today's users overwhelmingly prefer the 80-column display to all other sizes; it has become so standardized that only 5% of users surveyed prefer displays with fewer columns and only 9% have a requirement for more than 80 columns.



The 132-column display is not gaining popularity as many manufacturers had hoped. IBM, DEC, Datamedia, Datagraphix and others all offer CRT terminals with 132 columns, and VDC expects other emulating manufacturers to follow:

Although the 132-column display has applications in selected areas, most users are not willing to pay the increased price for a feature which they feel has only marginal value. Dedicated applications such as data entry, inquiry/response or order entry do not require 132-character displays, and users will not pay the additional premium to get them. "My money is better spent on other features, not on smaller, distorted characters," quipped one user.

Users did, however, express a desire for more total characters per display, but felt this should be done through additional rows – not more columns. A 25th row is highly desirable, as are additional rows, for word processing applications. The 25th row which has been gaining wider acceptance, is used primarily for monitoring system status rather than for display of data.

Users expect the "standard" CRT terminal for information display applications to remain a 24-row, 80-column, 1,920-character unit for the next several years. The addition of the 25th line is expected and will be accepted, particularly by those users who want to monitor their system at the terminal.

The installed base of alphanumeric CRT terminals will grow at a compound rate of 21.6% for the next five years. This growth rate will yield 4,500,000 units installed at year end 1984, up from 1,700,000 at year end 1979.

IBM-Compatible Add-On Memory Grows

Several trends in today's add-on memory marketplace are creating new marketing opportunities for add-on memory manufacturers. Current marketing studies by National Advanced Systems (Palo Alto, CA) project that volume shipments of the "H" system will not begin until late 1982. Consequently, many of today's users of 370/158 through 303X are converting their systems to purchase positions. This decision, an economic move, albeit an emotional step, will further require the user to maximize all available throughput (MIP Performance) from his system.

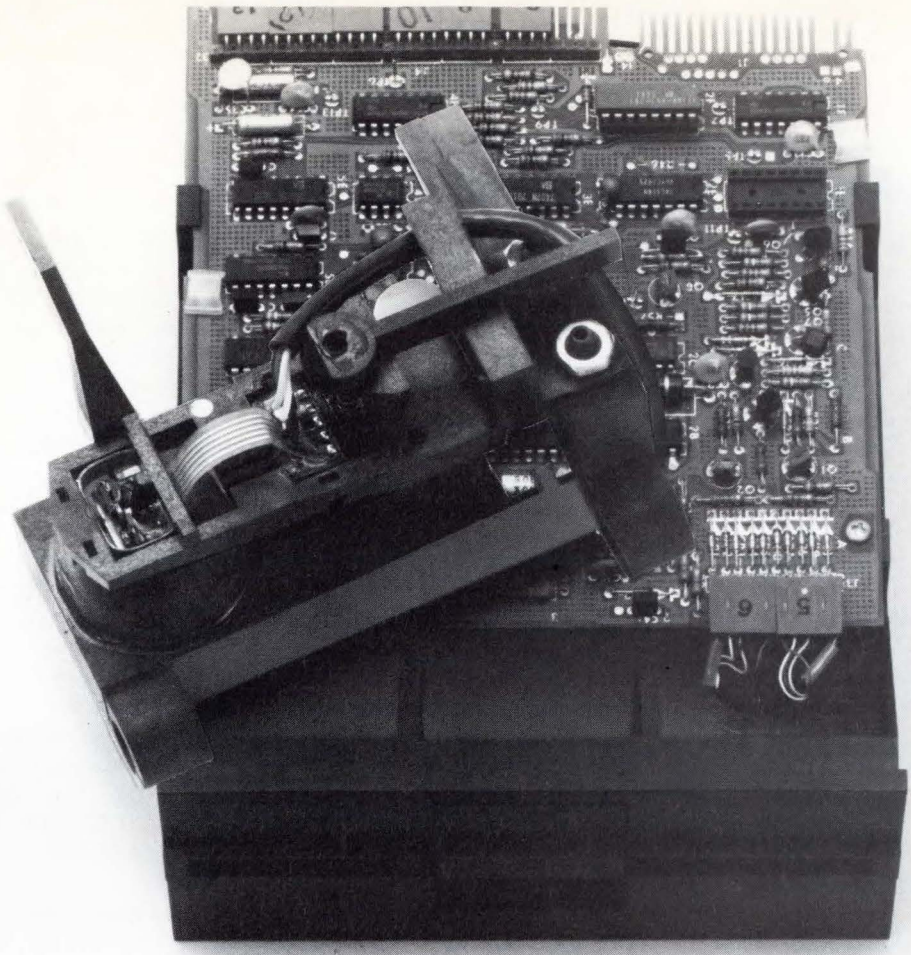
One option holds considerable promise in maximizing available performance from his system – the purchase of add-on memory. This option greatly enhances performance by reducing paging, unclogging channels and allowing larger segments of real memory to be devoted to buffers, data tables, programs, etc.; these benefits decrease both CPU run time and programmer time – thus, an option that is particularly attractive today.

In addition to this market change, another pattern is emerging. Brokers are selling used 158s and 168s to EDP shops which previously had smaller systems and were accustomed to 0.5MB or less for operating under DOS.

Users thought that the 2 to 4MB these machines provided would be more than enough support for at least three years. But there is a common axiom at play constantly in the DP market: "The more you have, the more you need." By now these users have converted from DOS to VS/1 or MVS and have added application programs and are quickly running out of memory. And, in spite of supposedly shorter IBM delivery dates, brokers are turning to independent memory due to the large demand and because they cannot wait for IBM deliveries.

The issues of the recession and tight money have stabilized DP budgets for 1980 – a further market enhancement – because that planned for, new system or second system, has been shelved. The user's load continues to increase sharply. His most viable and cost-effective alternative is therefore to acquire additional memory. In the past, add-on memory sales have increased faster in recession periods.

A look at the European market provides a final perspective on the present boom in add-on memory sales. The market in Europe on a country-by-country basis is growing rapidly. Somewhat behind in installing new IBM 303X CPUs, DP managers are presently approaching system power saturation in their centers. Much like their U.S. counterparts, they are moving to NAS add-on memory to meet pressing load problems.



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Software Development Costs Grow

The growing need for software among general purpose computer users, in addition to further unbundling of software by mainframe vendors, is opening up a tremendous source of potential revenue for both hardware manufacturers and independent software suppliers. In fact, software may well be the market of the 80s, with spending now increasing at a rate faster than total spending. According to IDC (Waltham, MA), general-purpose computer users spent $5.6 billion on software in 1978, and this is expected to swell to $8.4 billion by 1980.

With hardware costs continually shrinking, the demand for computer systems is now at an all time high. This is certain to spur the demand for software – for both new systems and for new applications on existing systems. But, as the demand for computer systems has swelled, the current lack of programmers available for implementation has become a problem. Costs for internal software development have skyrocketed, as companies have been forced to pay top dollar for qualified personnel. Monies allocated to internal development will grow 43% during this period, reaching $6.69 billion in 1980.

In the future, users will depend less on internal development, and will instead seek *outside alternatives* for their software needs. Although 86% of all software dollars were spent in-house in 1978, this percentage will begin to drop, decreasing to 83% by 1980. External spending will increase rapidly – the $770 million spent with outside software suppliers in 1978 will nearly double to $1.45 billion by 1980.

Currently the independent packaged software vendors have the lion's share of the outside software dollars – even surpassing the hardware vendors – and will continue to account for the largest share over the next few years. General purpose computer users spent some $410 million in 1978 with third-party package suppliers, and by 1980 this figure will rise to at least $665 million. Though the hardware vendors accrued far less revenues than the independents in 1978 ($200 million vs $410 million) this segment of the market will increase dramatically through 1980, growing 170% to reach $540 million. Custom software vendors will also have opportunities for growth among general purpose computer users. Spending with these vendors will increase approximately 50% by 1980.

Looking back at the above figures, it is clear that internal software development and maintenance accounts for most of the user's software dollars. The results indicate, that once a user has acquired software from an external source, the propensity to deal with an outside source in the future is considerably greater. Thus, the door is open for the outside suppliers, who may push these external expenditures even higher. For more information, contact IDC, 214 Third Ave., Waltham, MA 02154.

Internal And External Software Spending For General Purpose Computer Sites, 1978-1980 ($ Million)

	1978	%Δ	1979	%Δ	1980
Software Development	$2,835	30%	$3,675	12%	$4,105
Software Maintenance	2,035	26%	2,560	12%	2,855
Internal Subtotal	4,870	28%	6,235	12%	6,960
Custom Programming	160	(3%)	155	58%	245
Hardware Vendor	200	50%	300	80%	540
Independent Software Vendor	410	33%	545	22%	665
External Subtotal	770	30%	1,000	45%	1,450
TOTAL	$5,640	28%	$7,235	16%	$8,410

Will R&D Funding Rise?

Expenditures for U.S. R&D this year may exceed $62 billion, according to a forecast of Battelle's Columbus, Ohio, Labs. This is an increase of $10.2 billion (19.7%) over the $51.6 billion that NSF says was spent for R&D in 1979. Will most of the increase be absorbed by continued inflation? It's estimated at 12.1% from 1979 to 1980. But the forecast estimates about a 7.0% real increase in R&D expenditures – a new peak in total real funding of R&D. If a severe recession hits, it will have offsetting effects on R&D: while industrial commitments may decrease in the short term, federal support may increase in order to maintain stability in the R&D "system" and to guard against a serious decrease in the nation's capacity.

Eliminating Printouts Can Double Hardware

Users can double their hardware configurations by increased reliance on electronic display/output. These findings by Strategic Business Services (San Jose, CA), may alter the OEM and system design outlook. Printers are 34% of the total hardware cost of any new system. Paper costs are responsible for an additional 32% of the system's cost.

Building on this premise of individual system cost factors, and building a global scenario, Strategic develops a $13.5 billion source of financing for

the electronic office out of existing hardware dollars. One-half of the current DP expense, one-half of the current WP expense, and all of the current office copier expense could be rechanneled towards implementation of the electronic office. Even if this implementation used today's technology, this funding would account for $6.75 billion, $1.35 billion and $5.40 billion respectively. This financing could equip 80% of the 43.7 million white collar workers with their own terminals.

How will this impact future markets? The winners will include customized intelligent terminals, intelligent mass storage, computerized office communications systems (for Voice, data and messages) and interconnect message services, broadcast message services, teleconferencing services, interactive training and education services, specialized and general purpose data (and information) services, local packet switching service and backup computer facilities and "bonded data warehouses".

Since 33.4% of the total office cost is in the preparation, duplication, handling and storage of paper, this complements an additional 43% which is attributed to meetings or phone utilization. Expenditures for products and services (as opposed to personnel) will increase from 8.6% to between 16.6 and 24.2%. Imbedded in this mixture is the fact that the actual components responsible for handling user functions in the electronic office will be transparent to users, who will not know or care if their function is hardware, firmware or application software. The market for computer communications products and services will increase from $62.5 billion to between $220 and $322 billion. Strategic Business Services offers to their clients (would-be entrants into these markets) four keys for successful exploitation of their selected markets.

Micros Hit Europe

The European semiconductor market, increasing 6% annually, will reach $4 billion in 1987. But patent expiration and microcomputers will have major impact on Europe's semiconductor market. According to a Frost & Sullivan report, European semiconductor shipments will increase at a 6% annual rate (constant dollars) – from $2.4 billion to $4 billion in 1987. The 8-bit μP will remain the largest seller, its market value in constant dollars leaping eight-fold by 1987. By 1987, the 16-bit μP will grow to $200 million; the 32-bit micros, to $20 million. The single-chip micro market will increase to 81% by 1987. As for RAMs, the 128k RAMs will be a $25 million market; the 256k RAMs, a $10 million market.

Computer Industry Mergers Rise

More electronics and computer firms are being acquired or merged today. The trend to develop broad-based firms, and the rapid growth of systems, have created this.

Merger announcements in the computer manufacturing and services field in 1979 rose 22% to 45 from the 37

recorded in the comparable 1978 period, according to W.T. Grimm & Co. (Chicago, IL). Overall activity for the 40 categories covered by the Grimm study showed 1,117 announcements, up about 1% from the 1,107 reported for the 1978 first half.

Stock was the favorite means of payment in the computer field, running counter to overall results. Of the 29 transactions on which price information was available, 11 were for stock, 9 for cash and 9 for a combination of cash, stock and/or debt. In the overall study cash was used in 53% of the transactions.

Divisional or partial sales in the computer field accounted for 13 of the 45 transactions compared with 10 of 37 in the 1978 first half. Fractional transactions – sales of divisions, subsidiaries, product lines or 10% or more of a company's assets – dropped to 36% of the total number of merger announcements.

This trend to mergers will grow in the long term, since the advent of μPs and VLSI and the trend toward systems require that in order to survive, more firms be horizontally and vertically integrated. Also, more firms outside of electronics or computers suddenly realize that they need electronics and computer technology, and that to compete, they, too, must acquire a technology base.

Engineering Shortage Continues

Medium-size OEM computer firms must stop recruiting solely from within the industry and pay more for outsiders. So warned Lester B. Korn, President of Korn/Ferry Intl. (the world's largest executive search firm) at a meeting of the Computer and Communications Industry Association. The message was clear: mid-sized computer and communications firms will have to attract more professionals with strong functional disciplines to flourish in the coming years. For those who don't act now, the price will be smaller profits, slower growth and an accelerating trend of multinational companies entering the industry.

Computer firms must make the difficult transition to a scientific multi-disciplined management. Without such an infusion of qualified managers, electronics and computer firms will not mature successfully and will be susceptible to unfriendly takeovers, forced mergers and increased difficulty in raising capital in the 80s. Companies no longer can look to IBM and other majors as training grounds for engineering executives because of increased size differentials and trade secret problems.

Executive searches within the computer and electronics fields have doubled in the past five years; and, among recent searches in the field assignments range between $100,000 to $200,000 per year. But, computer executives' salaries lag behind other industries. Historically, the computer and communications industry has relied too heavily on stock options, which often proved illusory, instead of cash compensation. The computer industry must raise its base salary and bonus arrangements and tie them to increased profits. More medium-sized companies are trying to enter international markets and are encountering difficulty in coping with the salary demands of everseas computer and electronics executives.

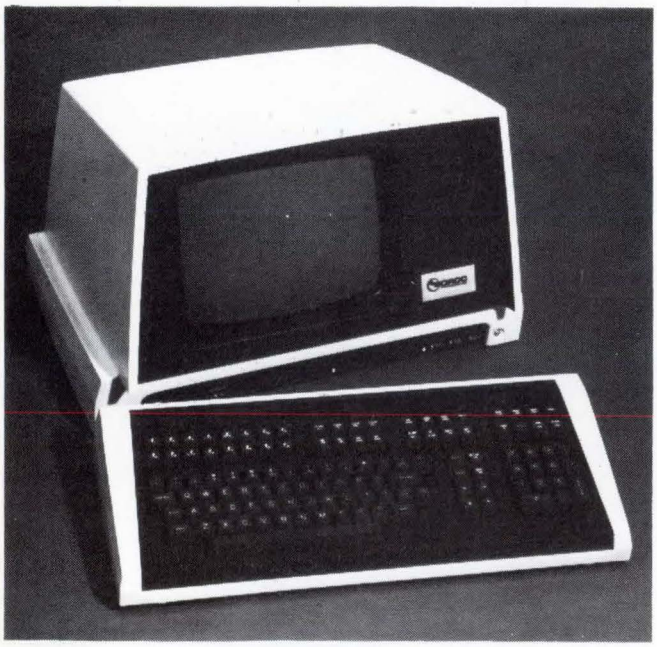
Alphanumeric Terminals: Some Selection Criteria

Paul Snigier, *Editor*

It's no easy task to match a terminal and a computer to make a perfect match – or, if not that, at least an optimum match – for the various customer uses. It's important to define the terminal and the system application characteristics from the start. It's true that changes will be made, but once the characteristics are known well enough to make a preliminary evaluation of the terminals available within the ballpark, it's possible to begin the search. Remember, as with all system design, the less time spent in planning, the longer the design project will take.

Today's alphanumeric display terminals come with a bewildering array of functions that may or may not be of use to the ultimate customer; or if of value, will be of value only if the system under design will use them. In the initial phases of the project, what is needed in terms of actual terminals may not be obvious; but once into the project's initial stages, it becomes more straightforward to specify the correct terminal(s). The system functions by then have been pinned down.

If, in selecting, the system demands two or more different terminals, the decision becomes more complicated; each terminal, even if it provides the same functions, will be implemented differently. For example, manufacturers of video display terminals use several different characters to backspace the cursor – a curse in the life of systems designers looking for interterminal program compatibility. Nor is this limited to backspacing the cursor, as a perusal of several VDT makers' spec sheets or booklets will reveal for the unititiated. What this boils down to is this: when the system designer tries to implement several terminal types into his system design, the greater the compromises he is forced to make. To minimize this "selecting the best of the worst" situation, it's a good idea to select terminals from a common family made by a single manufacturer. Lacking this commonality can greatly restrict the system designer's choices – particularly when changes must be made later on.



Human engineering influences are increasingly more common in CRT terminal design today. With the growing number of terminals ending up in systems sold to end users that expect more usability than in past systems, the trend will continue. Detachable keyboards and swivel-action displays are just two signs of this trend to greater usability. *(Soroc)*

Evaluation criteria

There are several key points to look for before specifying terminals. First, analyze application needs in terms of current needs and growth expectations. Second, define terminal criteria based on above – speeds, line protocol, electrical interface, intelligence levels, operating environment, flexibility, software/hardware system support needed, etc. Third, evaluate potential suppliers – product cost/price performance comparison, reputation (quality/warranty), human factors design considerations, maintainability, product service capability/price, delivery, cost of consumables, lease/purchase options.

In selecting, be aware of problems that currently plague CRT display terminals. These include the following: tube too bulky, limited display size, lacks human factors design considerations, special environments, difficulty pinpointing failure problems and cost control. Of course, it all depends on the specific application, so certain problems may not be important in your particular use(s).

Now, when it comes to terminal advantages, look for the following human-engineering factors, as they pertain to your and/or your customers' application needs. These factors include extensive human factors such as tactile and audible feedback, sculptured keytops stepped for minimum fingers extension and comfort, large 9 x 14 display font with generous spacing between lines and characters, font espcially designed for easy differentiation of similar appearing

Will Flat Panels Challenge CRTs?

Flat panels and CRT terminals will co-exist, with panels selling in vertical market segments where their qualities of weight, ruggedness and size proving an unbeatable advantage over CRTs. All the earlier talk and speculation of panels dethroning CRTs is past: it won't happen. With a more mature look at the flat panel technologies that now exist – or are likely to make it in the next five years – most industry observers feel that flat panels will succeed first in very vertical markets and then later may take over the low-end markets from CRTs. The key to this will be VSLI advances.

Dramatic growth rates in the display market are attracting the entry of several new technologies confined up to now to the laboratory. But at the same time, the strong demand for compact intelligent terminals is spurring researchers to develop multiplexed dot-matrix panels in several technologies – besides the familar panels.

Over the past two years, segmented character displays have outgrown their traditional miniature applications in watches, handheld calculators and instruments. For example, large-area liquid crystal displays, larger than watch and calculator readouts, are now available; and, according to Gnostic Concept's multiclient study ("Display Technology and Market Forecasting"), markets for large-area LCDs should expand at an average annual compound rate of 25.8% over the next five years.

Several new technologies will enter the segmented character display market in the near future. Two of the better-known technologies are electrochromic and electrophoretic, each having its own characteristic advantages in performance and environment. But other equally innovative technologies are standing in the wings.

The rapid proliferation of microprocessors and their rapid acceptance by users made the proliferation of dot matrix panels possible. For example, the familiar Burroughs PGD panel has been on the market for several years; liquid crystal terminal readouts are now available in one- and two-line versions. Several firms will offer multiline panels shortly. Other dot matrix panels are now under development by many firms or are available in prototypes in LED, vacuum fluorescent and electroluminescent technologies. Applications for these panels, as you may expect, will include compact flat terminals that will compete quite favorably with small CRT terminals for applications of the early 1980s – from real estate offices to executive desk tops, from crowded consoles to equally crowded cockpits, from low-cost-but-computer-like calculators to games and toys, and an endless variety of new applications where microcomputers and displays will become cost-effective by the early 1980s.

The mixture of instrument dials in aircraft cockpits soon could be replaced by flat-panel displays – not unlike the picture-frame TV sets being forecast for home use. USAF engineers here who foresee that trend now have the first working model of such a display; and its size and picture quality make it unique.

Measuring three by four inches with 64 lines resolution per inch, the device is being evaluated by Air Force Flight Dynamics Laboratory. Manufactured as a multi-mode matrix display under a joint program between the Air Force and the Canadian Dept. of Industry, Trade and Commerce, the display was delivered to the laboratory's Flight Control Div. by Litton Systems, Ltd., Toronto, Canada.

The display is designed to provide flight-advisory information to the pilot electronically, some of which is not feasible to portray with conventional electromechanical instruments. Presently, in such cases, the CRT is called upon to do the job.

"The tube displays simply are too large and failure prone," said Walter Melnick, laboratory program manager. "By contrast a rugged, solid state, flat-panel display is only three inches deep and could be retrofitted more easily into older aircraft or designed into new models.

"With evidence that graphic displays are soon to invade the military cockpit on a large scale, it is essential that present, total reliance on cathode ray tubes be modified to include a display design which is more compatible with the military cockpit environment," he said.

With the versatile flat-panel display, the pilot can call up information on different flight subsystems, e.g., navigation or weapon delivery, with a flip of a switch. It can also pictorialize an event for the pilot, like his position in space relative to other ground or airborne objects, as well as "write" numbers and letters on the screen.

"Most importantly, the potential reliability of a matrix display is far superior to a tube display," Melnick continued. "We estimate the mean time between failure of a flat panel display is 10,000 hours while that of an average tube display is only about 500 hours.

"And, while a tube display can suddenly and completely burn out, the flat-panel undergoes a kind of graceful degradation. In other words, if several hundred of the thousands of light emitting diodes go out, the display is still readable."

In principle the diodes display compares to a sports stadium scoreboard studded with lightbulbs that blink off and on to announce scores, messages and depict cartoons. Like the scoreboard, which is controlled by an electronic programmer, the diodes in the flat panel are electronically integrated with a computer program that calls up information as requested.

The diodes in the matrix display are tiny green pinpoints of light only 1/8000th-inch in diameter. Each square inch of the display has about 4,000 diodes for a total of more than 49,000 in the 4″ x 3″ display. Development of these diodes and fabrication of the diode "screen" was accomplished by Optotek, Ltd., Ottawa, Canada.

"Fifteen years ago, activating that many LEDs in our display would have been a horrendous job," Melnick said. "We'd have needed electronics the size of a desk to drive the display graphics. Today – thanks to LSI and now VSLI – we can build the electronics into a much smaller package about one-half a cubic foot which could be located remotely from the instrument display panel."

While flat-panel displays could be fabricated from one of several on-going technologies, the diode was selected because it offers great promise for standardization of electronic displays. It is adaptable to the "building block" mode of construction. If made in one-inch squares, the diodes could be assembled into a variety of display sizes for particular aircraft needs.

characters, a specially darkened and etched glass that diffuses surface reflections and increases contrast, tube tilt features allows operator adjustment for ambient lighting condition, and audible/visible alarms and controls for instantaneous operator feedback.

However, do not stop at this, as your evaluation of terminals must include other factors. These factors or selection criteria include: modular design to simplify maintenance, built-in diagnostics to pinpoint problems, extremely attractive cost/peformance ratio, inexpensive consumables (uses ordinary paper), full-character impact printing, extensive forms handling capabilities, downloadable display font and program, extremely quiet display (no-fan), compact lightweight display easily relocated by operator, and rubber non-skid display base.

Other factors

There are several other factors to consider in your selection. Since graphic display terminals and CRT terminals consume such a large proportion of the final system cost – not to mention the service charges later – the factors of reliability and maintainability must be considered very carefully. Trading off these criteria for others will only create long-term troubles for your firm. If your system is for use in a military environment, obviously there is little leeway in your decision; if for industrial or business environments, the decision will depend on the temperature ranges, humidity and other factors. If intended for a modern office environment, will users tolerate a noisy fan? Perhaps not. If used in a warehouse environment, however, or on the floor of a manufacturing facility, then the noise is far more tolerable. If reducing noise means eliminating fans, and eliminating fans means a lowered MTBF, then the answer is to keep the fans – and noise.

Determine how users will use the system. Will the terminals be used for several hours each day or less? Or will the terminals be used for eight, ten or more hours per day? In the latter case, this will improve the monthly maintenance costs for users.

Check into the self-diagnostics. Most diagnostics to date will isolate the problem down to a replaceable module so that problem location is minimized and MTTR is reduced. Is the self-diagnostics operator activiated? Or, as in the case of larger and more sophisticated terminals, is it activated by the host computer? Or is it automatic, activated on each terminal start-up? How much user involvement is called for? Some terminal makers will train users to make simple repairs and have set up formal training classes for this purpose. As more terminals enter the business world with its demand for high MTBFs and low MTTRs and its "unsophisticated" business users – that "don't know a program from a diagram" (as one major computer manufacturer puts it) – then we must anticipate that future terminals will contain even more self-diagnostics, despite complaints aired about the cost. The alternatives – particularly in light of soaring field service and energy-related travel costs – make this trend irresistable. Then there is the matter of how much down-time that the end user can tolerate. POS terminals cannot tolerate this and require that manual entry be possible if the terminal or system goes down. This brings to mind those systems with terminals in remote locations; if the vendor chosen offers service in those areas of anticipated usage, fine; if not, then there could be an extra charge and slower service.

We mentioned human engineering factors already. What was not mentioned is that with more terminals on the market, users and operators have come to expect improved terminals. Uncomfortable terminals or a character display that is a bit off will tire operators more quickly and contribute to increased errors. Lower case characters with descenders below the line are easier to read, and box cursors are easier than the confusing underscore-type. If the terminal will be used on a desktop in some cases and on a high counter in others, then screen angle becomes a consideration – as does glare. This may be true for non-CRT display devices as well. To alleviate these problems, some terminals provide an adjustable viewing angle and swivel action.

As for keyboards (a matter discussed in past *Digital Design* issues), it must be comfortable. Operators find a keyboard is easier to move than the entire terminal. Operators can position the keyboard for best use in each individual's case. So, it's better in such cases to have a detachable keyboard. If the character set is not typewriter-compatible, then training operators introduces an objection that competitors' salesmen raise about the system you design; and in the case of several terminal makers that began with an "oddball" keyboard, several have switched to the standard keyboard layout. However, those special function keys should be color-coded or lighted. Any critical keys used rarely – but which could prove disasterous to the system or programming – would best be positioned further away from the high-frequency keys; and, in extreme cases, should require two-hand operation so no accidents can occur from inexperienced operators. A well-laid-out keyboard should have been tested to minimize operator fatigue and error; and some terminal makers utilize engineer-psychologists to extensively test the human factor aspects of their terminals.

Portability today is more of a factor than in the past – whether the terminal is truly portable (to be taken on the plane or throughout the facility) or merely transported on occassion from room-to-room. In such cases, factors such as terminal weight, size and ruggedness will weigh more heavily in the decisionary process. In such cases, be sure to consider removable keyboards and external power supplies that can be easily disconnected.

In your evaluation, be sure to keep in mind that quite a few features are interdependent in nature. Many of these features and others are also quite limited or even worthless if related software capabilities are nonexistent.

Whether dumb, smart or intelligent, there exists a certain commonality of features. Switch-selectable baud rates and cursor positioning features are obviously found on all ranges, as are full or half-duplex operation. And so is a standard Synchronous Communications RS-232C port. Generally, extras like external video port and extra keypad keys and multiple character sets appear in many of the terminals, except for low-end ones. Synchronous protocols, local memory, real-time clock, data audit and user-programmable keys begin to appear on terminals as intelligence and cost increase. Other features to appear include protected fields, reverse video, blinking field and cursor, dual intensity characters, and other screen enhancements not available on lower-end terminals. High level languages like Basic or Pascal also appear. In the future, expect to see more features on terminals – such as voice input, OCRs, document readers, digitizer input utilizing programmable calculators and other exotic features.

Programmability

Programmability is measured by what the user can accomplish through a locally stored and executed program; if the program must be developed remotely at a distant host com-

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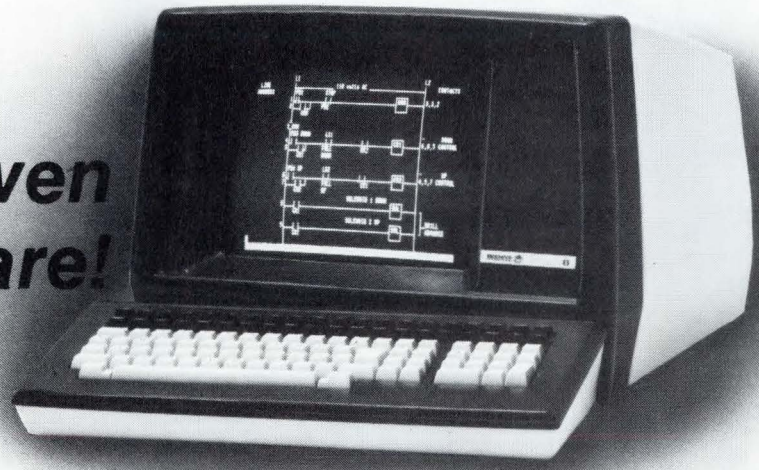

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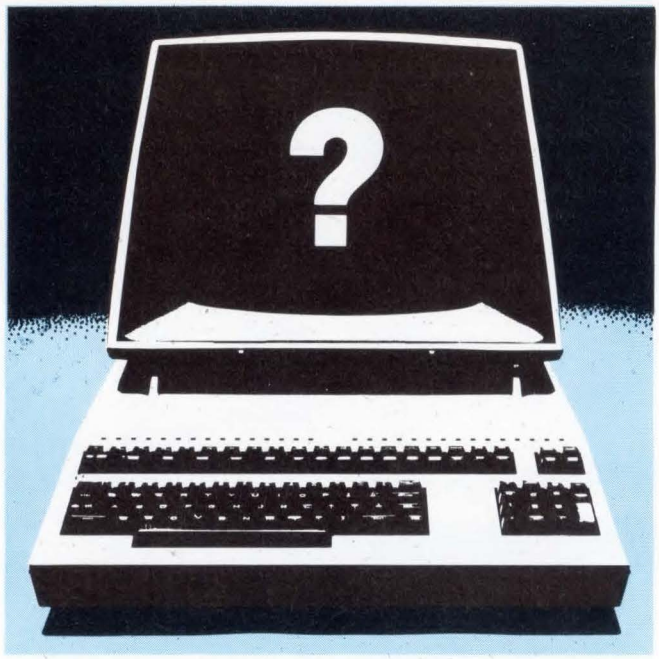
puter, then the terminal must be sure that the terminal can download the program. If done locally, downloading is lower on your criteria listing.

With the LSI and VSLI chips fast finding their way into terminals, terminals may not fall in price; however, *terminal power will rise dramatically*. Not only are PROM-resident languages available (discussed in my April's Special Report on Single Board Computers), but the trend away from dumb terminals will continue.

Programmability capability improves operating system performance by improving system efficiency. In the case of high-volume data entry systems, a terminal's performing data validation will not interrupt the operating system until the terminal is ready to transmit its validated data.

Programmable terminals are flexible and will perform several tasks. Although such a terminal can perform as a synchronous communications port to a second computer at one instant, at the next it may function as a data entry station or be downloaded (receiving the program) and operate as a HASP workstation. (Acronym for Houston Automatic Spooling Operation – an extension to the operating system, providing supplementary job, data and task management functions – job flow control, ordering of tasks, spooling, i.e., temporarily storing data on disk or tape files until something else is processed.)

Data transmission can be an annoyance to the operator if conventional voice-grade lines are used, as the transmission rate is low. Since an intelligent terminal buffers the operator from the slow line speeds, this improves the operator's data processing capabilities – and also how the operator views the system – thus improving the system's productivity.



Exactly what qualities the CRT terminals of the mid-1980s will have are speculative, although it's certain that recent and future VLSI devices (such as the recently-announced 256-k RAMs and 32-bit μPs) will add an unexpected dimension and perhaps radically alter system design philosophy – and even the way we perceive CRT display terminals.

Data stations

The market for applications-oriented work stations require a terminal that just doesn't require all the extra bells and whistles we discussed earlier, and that are so commonly found on the more intelligent terminals. The intelligent terminals are more aimed at the end user and dp-type applications. The application-specific work stations, on the other hand, are aimed at more specific requirements. These data workstations now appearing on the market are designed especially to meet the particular requirements of the OEM workstation designer. Such data stations may have certain features that suit them to their ultimate applications. Bar code readers and/or OCR wands are common, and hardware and software provisions are generally included for these devices. The human engineering of the data station tailors it for that specific intended environment. It provides on-line, fast-access mass storage capabilities and must be designed for the various communications requirements of different OEMs. If necessary, additional hardware devices can be added in a functional hardware-software package. In essence, the data station operating system provides efficient, simple and unambiguous use of the terminal as a resource – an OEM building block. The data stations' operating system features make the system as operator-proof as possible, and for the OEM, aid more in system development. If the intelligent terminal lacks software with provisions for the OEM, tailoring it into an easy-to-use work station for the operator is an onerous design task.

As for data station capabilities, such features as multitasking, command substitution systems, fixed and variable record modes, I/O request and proceed, double buffered I/O, auxiliary communications interfaces and error trapping are becoming available on data stations.

Then there is the small business computer and office automation market – one that you will find yourself in within a short time. Selection criteria will alter dramatically in this exploding field.

S/VSBC markets?

Office automation and S/VSBCs (small/very small business computers) promise to open up what some industry observers feel is a vast and growing market for alphanumeric display terminals. But obstacles exist. Office costs have more than doubled in the 1970s; productivity, on the other hand, rose four percent. Industrial productivity is known to have risen by 85%. The result is that office costs are consuming a greater proportion of organizational budgets.

It is not that MIS (management information systems) solutions have not been attempted. Unfortunately, all the attempts at office automation have produced more talk than effective results, and have not improved office efficiency that much.

The problems came about by the system designers adaptation of existing computer systems or WP (word processing) equipment that was re-treated to handle typing and clerical tasks. Since increased capitalization per worker in industry improved worker output in the 1970s, the reasoning was that the same would work for the office. Not so. Let's see why.

System designers adapted existing computer systems to merely speed-up existing tasks – not redesign tasks so office workers become multitask workers. This, when it was done, was done with little regard to the human or personal element, as I discussed in May's Speakout ("The Time Has Come"). The perfect example of this blatant disregard for the human element was the WP typing pool. By disregarding the interpersonal relationships, by centralizing secretarial functions and by creating a parallel hierarchy, not only did this threaten the executives involved, this approach to office automation ruffled many corporate feathers. This is not to

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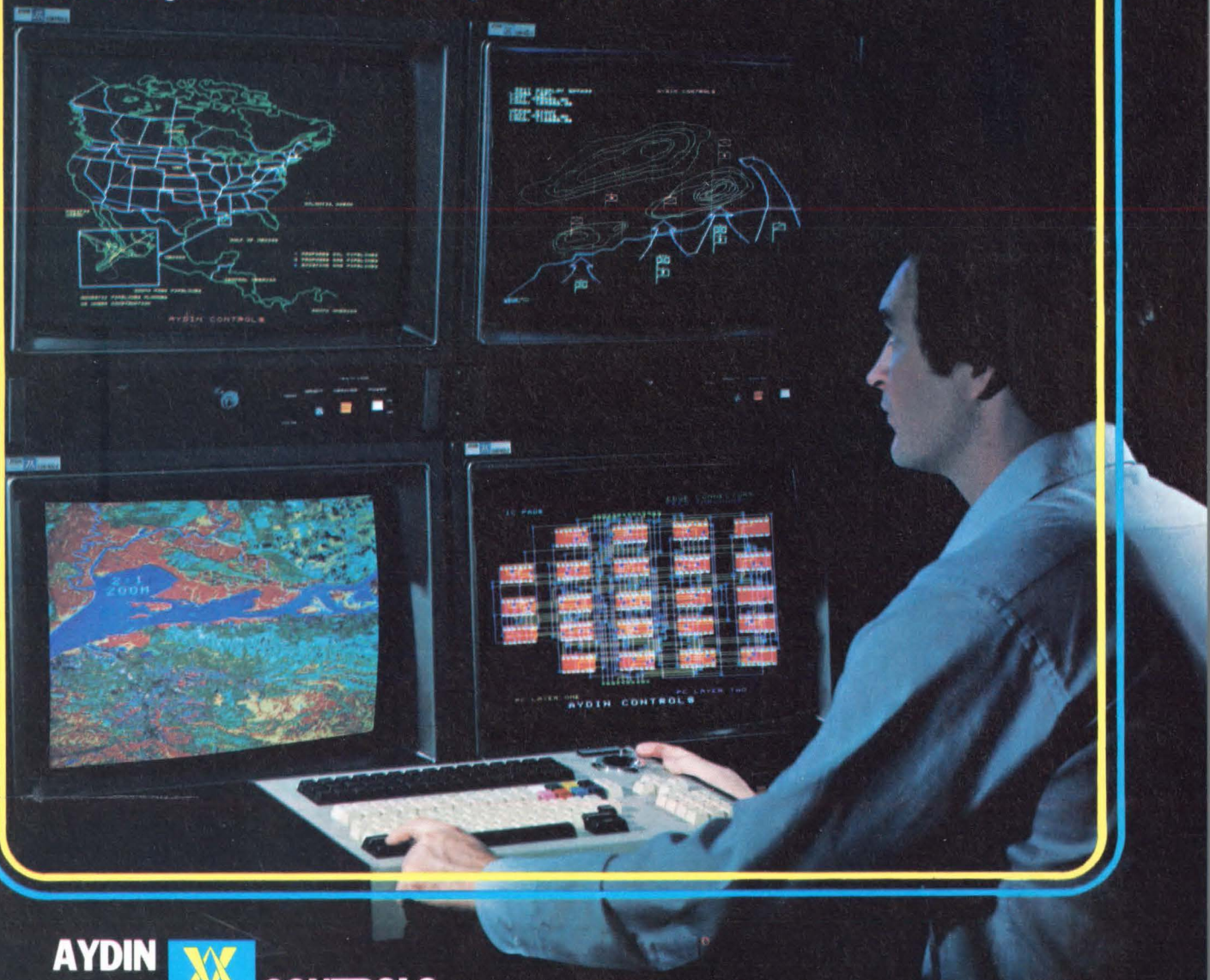

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July

Digital Design
Computers • Peripherals • Systems

Cover Feature:

Printing Terminals Hard Copy Terminals

- Trends
- Problems
- Comparisons
- Developments
- Selection Criteria

This special report covers printing and hardcopy terminals including laser, thermal, ink jet, chaintrain, electrostatic, teleprinter, photographic (fiber optics), drum, matrix vs. formed characters and serial vs. line.

Also articles on software development, digital and microcomputer design.

Aug.

Digital Design
Computers • Peripherals • Systems

Cover Feature:

The World of DEC Compatibility

- Trends
- Problems
- Comparisons
- Developments
- Selection Criteria

Many plug-compatible peripherals are made for DEC computers. But there is much confusion among OEMs (and end users). This investigation into the world of DEC compatibility will outline the choices involved and likely trends.

Also articles on microcomputer programming concepts, selective software analysis and microcomputer programming techniques and 1802 power-on reset/run design.

Sept.

Digital Design
Computers • Peripherals • Systems

Cover Feature:

Printers: Line and Serial

- Trends
- Problems
- Comparisons
- Developments
- Selection Criteria

With greater numbers of OEM products and systems now incorporating printers, the specification tasks of systems designers have become increasingly more difficult. This state-of-the-art review of matrix printers, printers/plotters and serial printers will help OEM systems designers and integrators find the printer which best suits their needs.

Also articles on logic circuit design, microprocessor software routines, and microcomputer software development principles.

condemn the WP typing pool; if integrated properly to augment – and not to replace – interpersonal interactions, it can aid the problem-solvers of today's offices. Perhaps it is just as important for our problem solvers (be they involved in accounting, bookkeeping, marketing, sales or other fields) to tap into data bases quickly. It is more important that our office automation information systems pre-process (predigest, if you will) the raw data. This pre-interpretation of data will no doubt require a great deal of software, and will occupy a greater portion of memory, and perhaps reduce throughput.

Executives (outside of the publishing world) are not that familiar with typing effectively and do more dictating. Thus, any interactive office automation computer system must be tolerant of executive errors and catch misspellings and typos. Once again, this would take a good amount of software, and once again slowing down the system's throughput. Perhaps the solution will come from an unexpected quarter.

If voice entry proves itself for the office environment, not only will OCRs be hurt, but WP systems as we know them today will alter drastically. Voice recognition will not be merely confined to the industrial and manufacturing sectors. Lear Siegler's ADM-3A dumb terminal with its voice recognition enhancement (introduced by Heuristics of Sunnyvale, CA at last month's NCC) uses a Z80, 32 kB of RAM, 8 kB of ROM plus a noise-cancelling mike to input certain typing functions – thus speeding operator input times. To be offered in a self-contained model shortly, Heuristic's 7000 voice controller ($3000) will accept three-second commands.

Speaking of the Z80, this reminds us that Zilog is now expanding its efforts in the modern office and small business computer marketplace, as are others. Commodore Business Machines, which years ago bought out MOS Technology, is shifting more to the small business and office automation fields. Apple is also shifting very heavily into the small business office marketplace, and has begun a major repositioning strategy. As mentioned in greater detail in May's Speakout, the small/very small business computer market is like a nuclear reaction that has finally reached its critical threshold and is about to explode. The key to this is *not* mainly the education of users, but *due to the superior hardware and software now available.* But whatever the driving forces are behind this emerging new market, one thing is quickly emerging: this market will be one of the greatest of market areas for alphanumeric display terminals. It *may* overshadow all other terminal markets.

Alphanumeric display devices

Selection of a display or readout and support circuitry, once a dull and straightforward procedure, is becoming more difficult. New developments, new technologies, different support circuitry, and contradictory specs all contribute to make the system designer's job that more exciting.

Aside from interfacing, brightness can become a misleading factor in the way it's specified. If radiometric, specs rate absolute light-energy output; if photometric, it's in terms of what the operator's eye actually sees – and, obviously, is the more natural spec of the two, and is preferred when making comparisons. If displays are to be used in any environment with high-intensity ambient lighting (includes direct or indirect sunlight), then the question of brightness becomes of paramount importance in making a decision. Foot-lamberts is the spec given on spec sheets for gas-discharge, vacuum-fluorescent and incandescent displays. LEDs, milli- or micro-candellas. The former is a surface-re-

flection luminance unit; the latter, a measure of source intensity. To make matters difficult, it's not so easy to convert these given figures to compare the different devices whose specs are listed on the different spec sheets. To make matters more confusing, some display manufacturers list surface luminance in terms of foot-candles. These specs, though, are not a true measure of what the operator will necessarily see; and to go totally on the basis of these specs is unwise. The operator, being human, does not see things the way a piece of laboratory instrumentation does – as point sources of light. Instead, the operator will make out the alphanumeric characters or patterns in a far more complex manner that no standards in use could possibly measure Rather than discuss the inadequacies of present specs and the limitations of bubble-top lens specs (such as viewing angle – even if polar plots are given), the best advice is this: examine the displays under consideration *under all conditions that the system must operate in.*

The flat panels of the first half of this decade will be positioned in product areas where the systems require a small, light and rugged display with low power consumption – with cost a secondary factor. Aircraft displays need all three requirements, and military aircraft already use such multi-colored flat panels, although the panel sizes are small. AC plasma panels have come on strong in the past four to five years, although LCDs are moving up. But AC plasma panels are probably a dead-end street, as they cannot easily display multi-colored, large-sized displays.

Military markets

The largest panel so far (that we know of) is put out by Science Applications of La Jolla, CA. This 24-inch diagonal AC plasma display displays over 21,000 characters. As used by the military, this 1k x 1k addressable matrix unit has a resolution of 60 picture elements/inch. The active area (17″ x 17″) and half-inch thickness make this panel well-suited for military use – as does its price. What do these flat panels cost? As an example, take the Photonics Technology 24-inch panel; it sells for just under $45k!

The military has looked at DC plasma panels, although production problems make them more costly for the same character density. Offsetting this is the multi-color capability and low power consumption – areas where AC plasma panels suffer. As a mature technology, it's not likely that AC plasma panels can make inroads into large, multi-color markets in the future.

For the military, LCD panels have some big disadvantages. LCDs aren't too promising in the multi-color area and aren't exactly fast-response displays, particularly in cold environments. For portable, small-screen television sets, the market for LCD flat panels does look promising.

Changes. . .

The field continues to change at an unprecedented pace. Several new display devices are announced daily, and not a day goes by that our editors don't receive several such new product announcements. With this accelerating change has come increasing complexity not only in terminal selection, but in increased interface woes between computer and terminals.

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Acoustic Coupling For Data Transmission

Thomas J. McShane
Racal-Vadic Inc.

Data communications over phone lines must use a modem to convert digital information from a computer or terminal in binary form into an analog form suitable for transmission over a telephone network. In a modem, which is a contraction of the words modulator-demodulator, the modulator, or transmitter, accepts binary data from a computer or terminal and converts it into frequencies or tones compatible with the 3kHz bandwidth of the telephone lines. The demodulator or receiver reconverts the analog signals into their original digital form **(Fig 1)**.

Prior to 1967, all modems were hardwired to the telephone line; in that way, a direct electrical connection existed between the modem and the network. Also in 1967, users had to rent all dial-up modems from the local phone company. (You could get modems for leased lines or private networks from non-telco sources.) If a user wanted to move

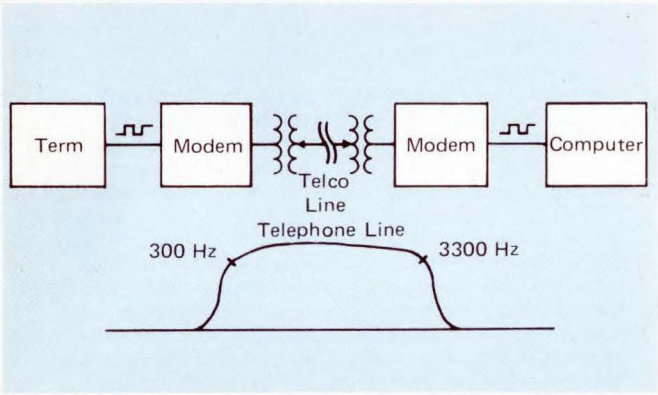

Fig 1 Telephone bandwidth is about 3000 Hz. Modems must alter computer signals to fit within this band.

a terminal, such as a TTY machine, from one location to another, the telco installer had to relocate the data line and modem with each change of location – time-consuming and expensive operation.

Early in 1967, an engineer at Stanford Research Institute, John Van Geen, who wanted to make his TTY machine portable, built a modem similar to Model 103A that the telephone company supplied for a TTY. The lab model he created contained one distinct feature, an acoustic connection to the network via transducers in an acoustic pad and in the telephone handset. Since no direct connection between the modem and the line existed, the user could relocate the terminal at will. **Fig 2** shows a simple block diagram of an acoustic coupler.

Since Stanford Research Institute was not (and still is not) a manufacturing concern, it made the acoustic coupler design available to private industry. Almost immediately, Reid Anderson of the newly formed Anderson-Jacobson Corp. picked it up. Early in the summer of 1967, Wayne Seppler, an engineering consultant working for Anderson-Jacobson, perfected the design and repackaged the SRI lab model. In August, 1967, Anderson-Jacobson sold an acoustic coupler to its first commercial customer.

Problems with acoustic coupling

To understand the technical problems of acoustic coupling, you must begin with the Bell 103 modem. It transmits and receives serial, binary, asynchronous data at speeds up to 300 bits/second. The modulation process is frequency shift keyed (FSK) FM whereby a discrete frequency defines the logical one and a different frequency 200Hz away defines the logical zero. By subdividing the voice channel with filters into two subchannels, it is possible to transmit and receive simultaneously in what is called full-duplex mode. Bell engineers assigned the low channel to the originating end's transmitter and the high channel to its receiver. Conversely, the answering end transmits in the high channel and receives in the low channel. The filters must perform quite accurately to provide sufficient separation for the receiver to demodulate signals which can be as low as –50 dBm in the presence of a local transmitted signal as strong as 0 dBm. Specifications and channel assignments for the full duplex 300 bps asynchronous Bell 103 modem are shown in **Fig 3**.

When you make an acoustic connection to the network, you must solve several technical problems. Since the second harmonic of the transmitted signal from the originating end falls within the local receive band, it provides the basic limitation. The nonlinear resistance of the carbon microphone in the telephone handset causes this harmonic. The intensity of the interferring signal depends upon such factors as the DC loop current from the central office, the characteristics of the particular microphone, the position of the microphone, and the hybrid balance within the telephone itself. Achieving an acceptable amount of interference for most calls requires the lowering of the transmitter level at the originating end relative to what could be put on the line if the modem were hardwired.

Notice that the 2nd harmonic problem disappears at the answering end. Since the answer mode transmits high **(Fig 3)**, its second harmonic falls outside the 3kHz telephone band and does not cause problems for its local receiver. Had Bell reversed the channel assignments in the 103 by letting the originate end transmit high, that arrangement would have improved the performance of acoustic couplers enormously. It is worth noting that most data communications systems involve manual origination and automatic answer at the computer end.

WHEN IT COMES TO PUTTING IT ALL ON DISPLAY, THE ORION-60/S4 STANDS ALONE.

Magnavox combines the superior display and control features of the plasma-panel-based Orion-60 terminals with the powerful S4 Micro-Computer System.

The result is a stand alone graphics system that allows you the freedom to develop a wide variety of graphics application and development programs—while maintaining complete control over program storage, program-generated data, library routines and other facilities.

The Orion-60 display terminal offers full graphics with floppy-disc storage, as well as optional rear-projection functions. It lets you create your own displays and enter data by simply touching the screen with your finger. So you can program your own character sets and generate vectors of any length to absolute coordinates. And because the Orion-60 is plasma-based, you'll get bright, high-contrast images free of jitter or distortion.

The S4 Micro-Computer has system software with development capabilities that are as good or better than those found in many larger computer systems.

Features include CP/M* 8080 system utilities, Fortran with 32K RAM, and a full range of graphic utility routines including window, zoom, sub-image movement and rotation.

The Orion-60/S4.

For a demonstration, call or write Tyler Hunt at Magnavox Display Systems, 2131 South Coliseum Boulevard, Fort Wayne, Indiana 46803, (219) 482-4411.

Magnavox
DISPLAY SYSTEMS

**CP/M is a trademark of Digital Research.*

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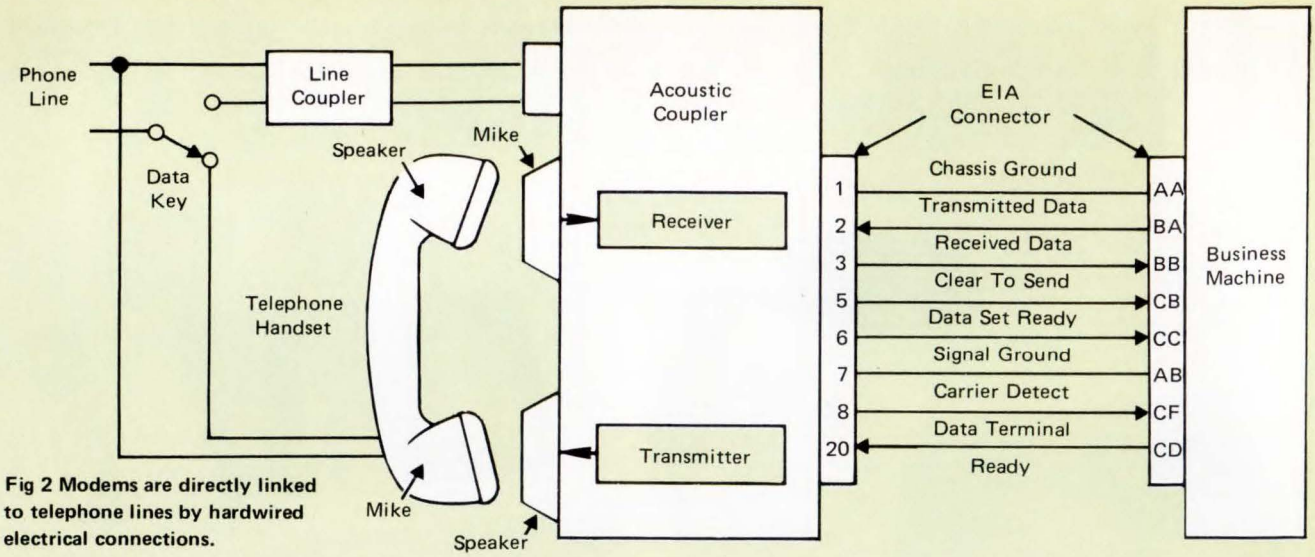


Fig 2 Modems are directly linked to telephone lines by hardwired electrical connections.

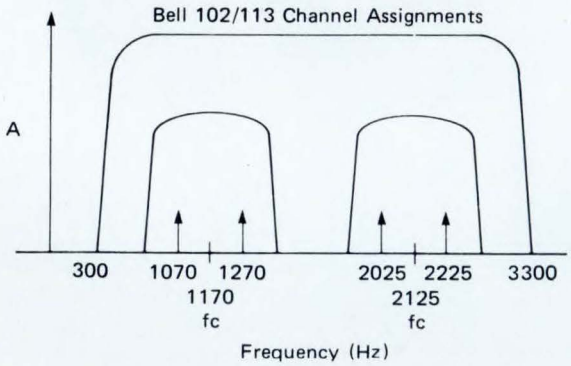
In addition to harmonic interference, you must deal with airborn acoustic noise, shock and vibration in designing an acoustic coupler. Rubber cups and, to some extent, rubber feet on the coupler isolate against noise and mechanical vibrations. An early application of acoustic couplers integrated the device within a TTY. Here, rubber cups provide the essential acoustic isolation.

1200-bps acoustic coupling

In the late 60s and early 70s dial-up 1200 bps asynchronous operation was possible only in a half-duplex mode via the Bell 202C modem. Half-duplex implies transmission in both directions, but only one way at a time. The Bell 202C uses FSK and assigns 1000Hz separation between the logical one and zero. To provide supervisory control (connect status, facilitate line turn around, minimize delay in going from transmit to receive mode) the 202C uses an amplitude-modulated 387Hz reverse channel which can be keyed on and off up to 5 bps and is transmitted in the direction opposite the main data channel. Fig 4 contains the specifications and channel assignments for the half-duplex, 1200 bps asynchronous Bell 202 modem. Anderson-Jacobson, which produced the first 1200 bps, 202C-compatible acoustic coupler, began selling its product to commercial customers in the summer of 1970.

Since the 202C is half duplex, its main channel never transmits and receives at the same time. Therefore, the

Fig 3



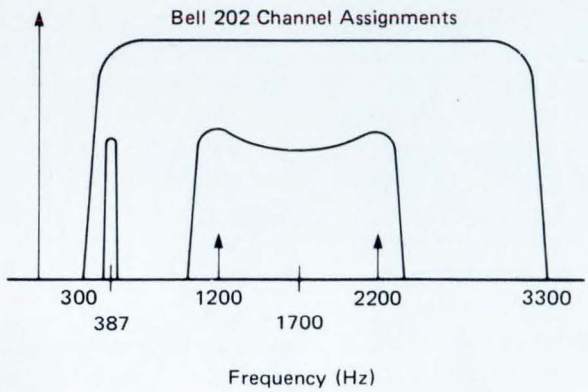
SPECIFICATIONS

Data: Serial, binary, asynchronous, full duplex
Data Transfer Rate: 0 to 300 bps
Modulation: Frequency Shift Keyed (FSK) FM
Frequency Assignment:

	Originating End	Answering End
Transmit	1070 Hz space 1270 Hz mark	2025 Hz space 2225 Hz mark
Receive	2025 Hz space 2225 Hz mark	1070 Hz space 1270 Hz mark

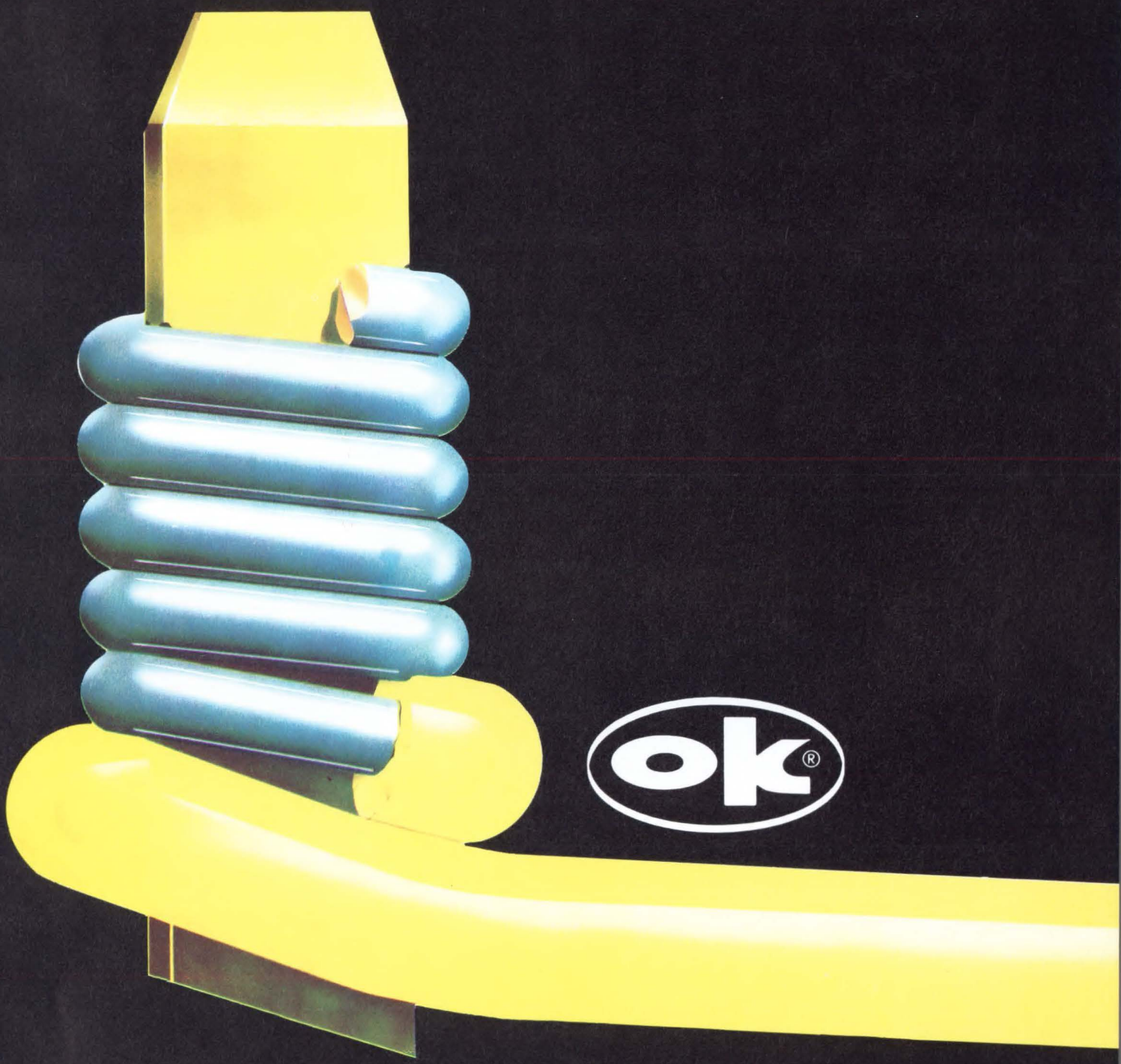
Transmit Level: 0 to −12 dBm
Receive Level: 0 to −50 dBm simultaneous with adjacent channel transmitter at as much as 0 dBm

Fig 4



SPECIFICATIONS

Data:
Serial, binary, asynchronous, half duplex on 2 wire lines
Data Transfer Rate:
0 to 1200 bps — switched network
0 to 1800 bps — leased lines with C2 conditioning
Optional 5 bps AM reverse channel transmitter and receiver available for switched network units
Modulation:
Frequency Shift Keyed (FSK) FM
Frequency Assignment:
Mark 1200 Hz; Space 2200 Hz
Transmit Level:
0 to −12 dBm
Receive Level:
0 to −50 dBm switched network
0 to −40 dBm leased network



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PACKET POWER SUPER-CHARGES YOUR SYSTEM.

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

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

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

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

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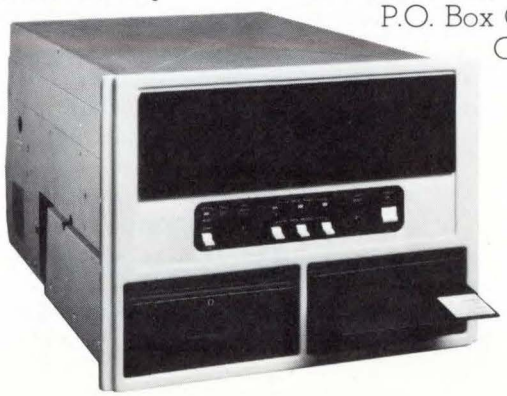
The Data Warehouse is packaged for 19" rack mounting and includes its own power supply. For increased value-added applications, it can be purchased in various "unbundled" configurations.

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



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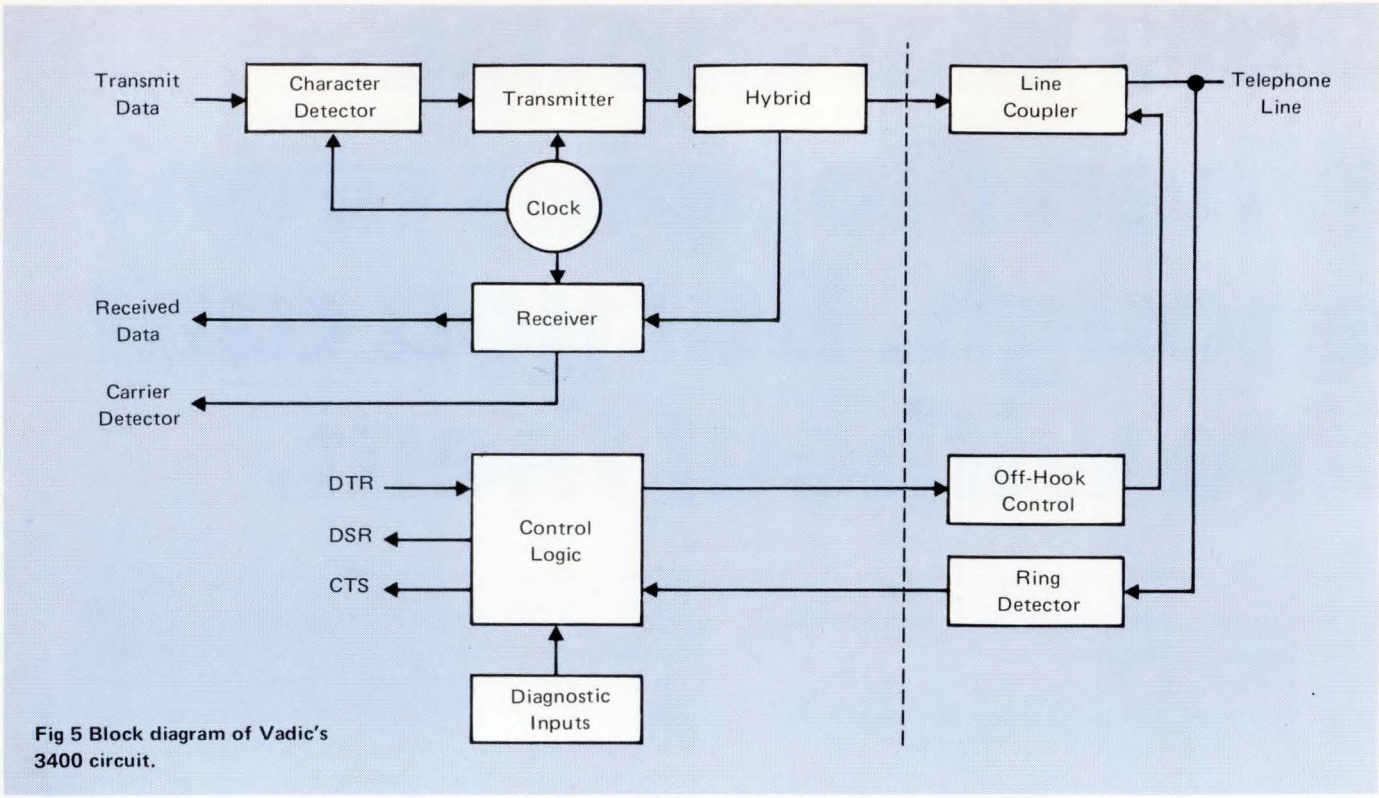

Fig 5 Block diagram of Vadic's 3400 circuit.

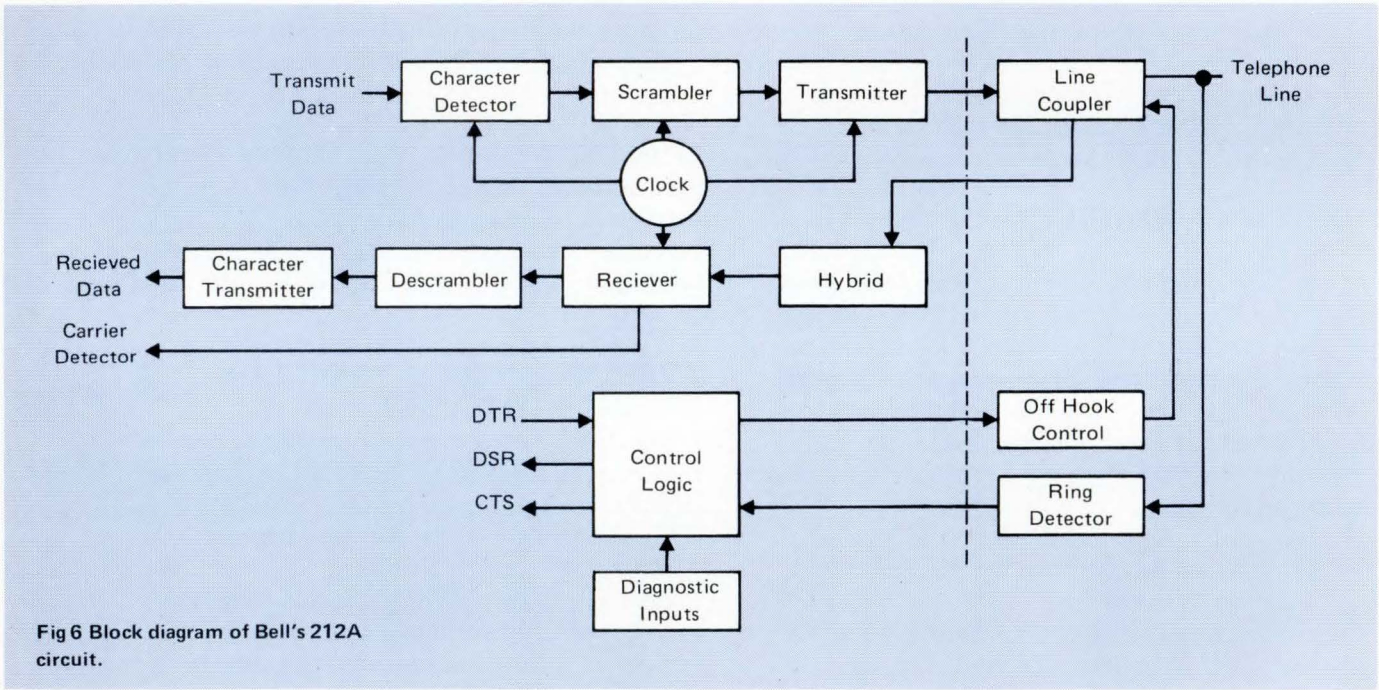

Fig 6 Block diagram of Bell's 212A circuit.

second harmonic problem experienced in the Bell 103A disappears. However, the 3rd harmonic of the reverse channel falls right in the data band and it becomes necessary to compromise the transmit level to achieve optimum performance. In addition, the coupler design must contend with airborn acoustic noise and vibration problems.

Full-duplex 1200-bps acoustic coupling

In April, 1973 Vadic (now Racal-Vadic) introduced the first full-duplex modem capable of operating on dial-up lines at 1200 bps. Since the 1000Hz frequency shift required for the 202C takes up so much of the available telephone channel's bandwidth, there is not enough room for the second channel needed for full duplex (simultaneous transmit and receive) operation. Racal-Vadic overcame the bandwidth problems by utilizing dibit phase shift keying (DPSK) for the modulation process which groups the input serial, binary, data into bit pairs (dibits). Each dibit causes a phase shift in transmitted data. The modem decodes the phase shifts and delivers 2 bits at the received data lead for each detected shift. (In effect, the data is encoded with 2 bits per baud.) This compression, plus the more bandwidth efficient DPSK modulation, create 2 channels via filtering from the dial-up telephone channel. Thus, the VA3400 operates full-duplex at 1200 bps.

Recognizing the problems of second harmonic interference caused by the carbon microphone in the telephone handset, Racal-Vadic chose frequency assignments that helped rather than hindered acoustic coupling. Fig 5 which contains a block diagram and specifications for the VA3400, shows that the VA3400 transmits at 2250Hz in the originate mode. Its second harmonic is at 4500 Hz far removed from tee receiving signal at 1150Hz. In September, 1976 Racal-Vadic and Anderson-Jacobson entered into a joint venture to develop an acoustic version of the VA3400. By late 1978, they began producing the Racal-Vadic VA3434 and Anderson-Jacobson 1234 acoustically-coupled modems.

Bell-compatible full-duplex 1200-bps acoustic coupler?

In November 1976, the Bell System announced a full-duplex, 1200-bps modem for dial-up lines. Designated 212A, the modem also uses DPSK, but the channel assignments are reversed from the VA3400 **(Fig 6)**. The originating transmitter operates at 1200 Hz and the receiver, at 2400 Hz. These frequencies are harmonics of one another. Racal-Vadic and Anderson-Jacobson feel that on local calls a compromise, 212A-compatible coupler could be designed, but it would not be widely used.

Probably no one will really know the reasons behind Bell's choice of channel assignments and frequencies for the 212A. However, you could speculate that Bell has never been fond of acoustic coupling, because it could lead to major service problems. Since many acoustic couplers are used on residential lines, they greatly distort central office queuing statistics. Because acoustic couplers do not tie directly to the network, you could argue that such accessory products are not part of the telco monopoly. Finally, it is difficult for the phone companies to keep track of equipment which is not physically tied down. Although the telcos are learning to deal with this problem, now that we can connect nontelco ancillary equipment to the network, why make matters worse by encouraging the widespread proliferation of acoustic couplers?

State-of-the-art

Acoustic coupling at 300 bps full-duplex with Bell 103-compatible devices is commonplace today. Half-duplex Bell 202-compatible couplers are also available. For acoustic full-duplex operation at 1200 bps, modems, such as the Racal-Vadic VA3400, provide reliable performance with excellent data quality. At this time no one has developed acoustic couplers that operate above 1200 bps. Only time will tell when the market needs and engineering capabilities exist to push the speeds even higher.

Bibliography

(1) "Acoustic & Inductive Coupling for Data and Voice Transmission", Oct., 1972
(Bell System Technical Reference #41803)

(2) "Telecommunications from the Terminal User's Viewpoint" – Racal-Vadic publication. (Available at no charge from RVI, 222 Caspian Dr., Sunnyvale, CA 94086.)

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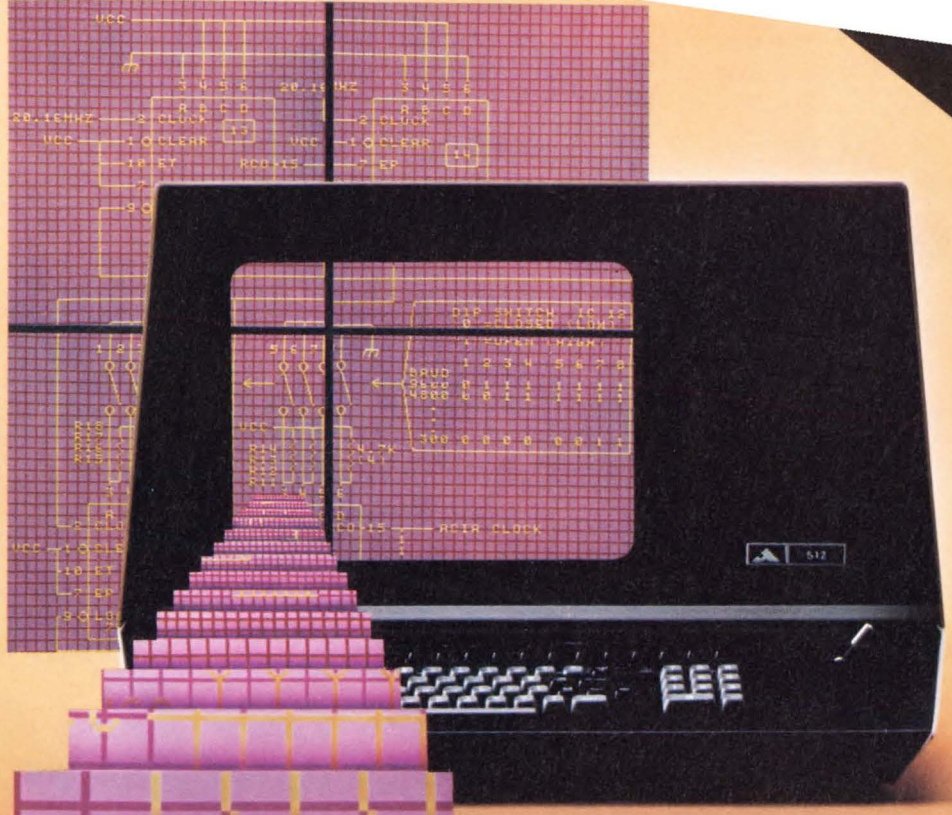
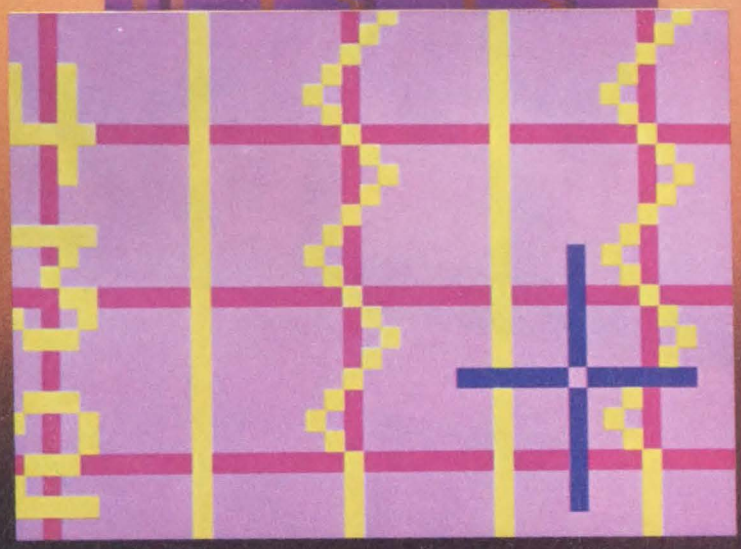


See you at NCGA and SIGGRAPH '80



The AED 512... graphics, imaging, Superoam™ and integer zoom in one desktop terminal!

At the Siggraph '79 Show, it was acclaimed as 'The Incredible Graphics Machine!' Since then, the AED512 full-color graphics and imaging terminal has more than lived up to its reputation among sophisticated users. Its ability to display 256 simultaneous colors (from a total palette of 16.8 million) on a 512 x 483 pixel screen; zoom at integer increments to x16; pan continuously via joystick; perform full-screen DMA transfer in 0.5 second; emulate Tektronix 4014 software; allow overlaying TV images with computerized graphics; permit animation by using read/write masks and colorblink make its under $20,000 price tag seem small. Add to this its unique ability to Superoam an expanded image of 1024 x 1024 pixels and you'll see why the FIVE-TWELVE is features ahead of the competition. For more information contact Jerry Kennedy, Advanced Electronics Design, 440 Potrero Ave., Sunnyvale, California 94086, phone (408) 733-3555.

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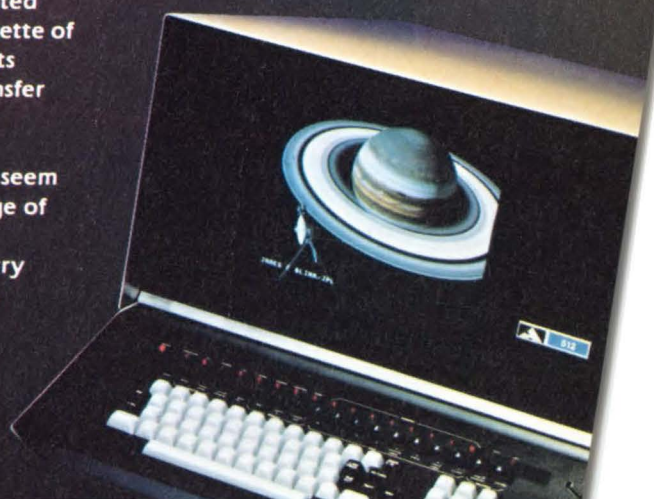

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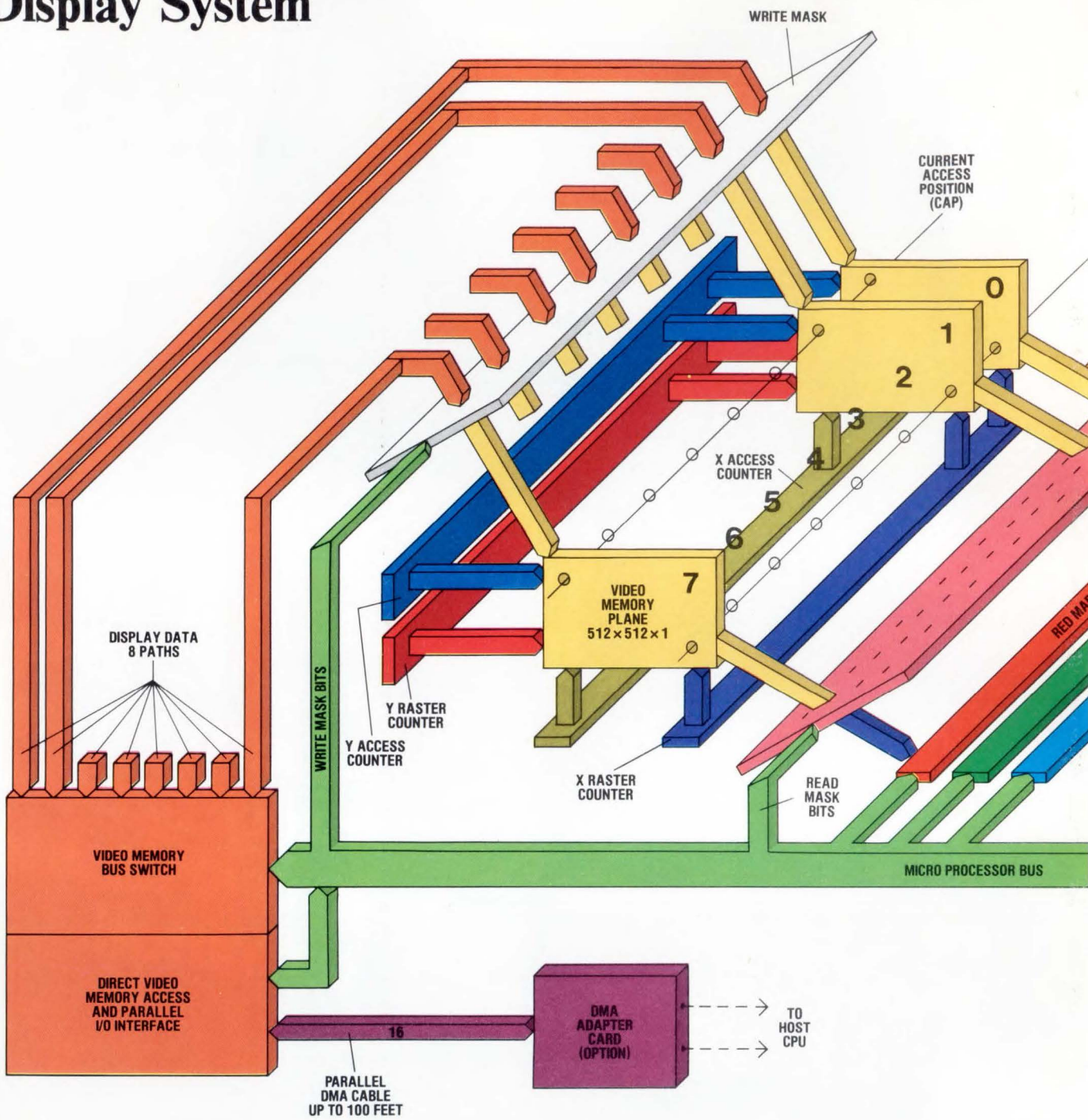
Advanced Graphics Display System



A new, sophisticated (from computer-aided design to image processing), video display terminal is available from AED of California. Its main features are half-second image transfer, continuous joystick panning, full pallette of 16.8 million possible hues and largest refresh memory of any terminal on the market.

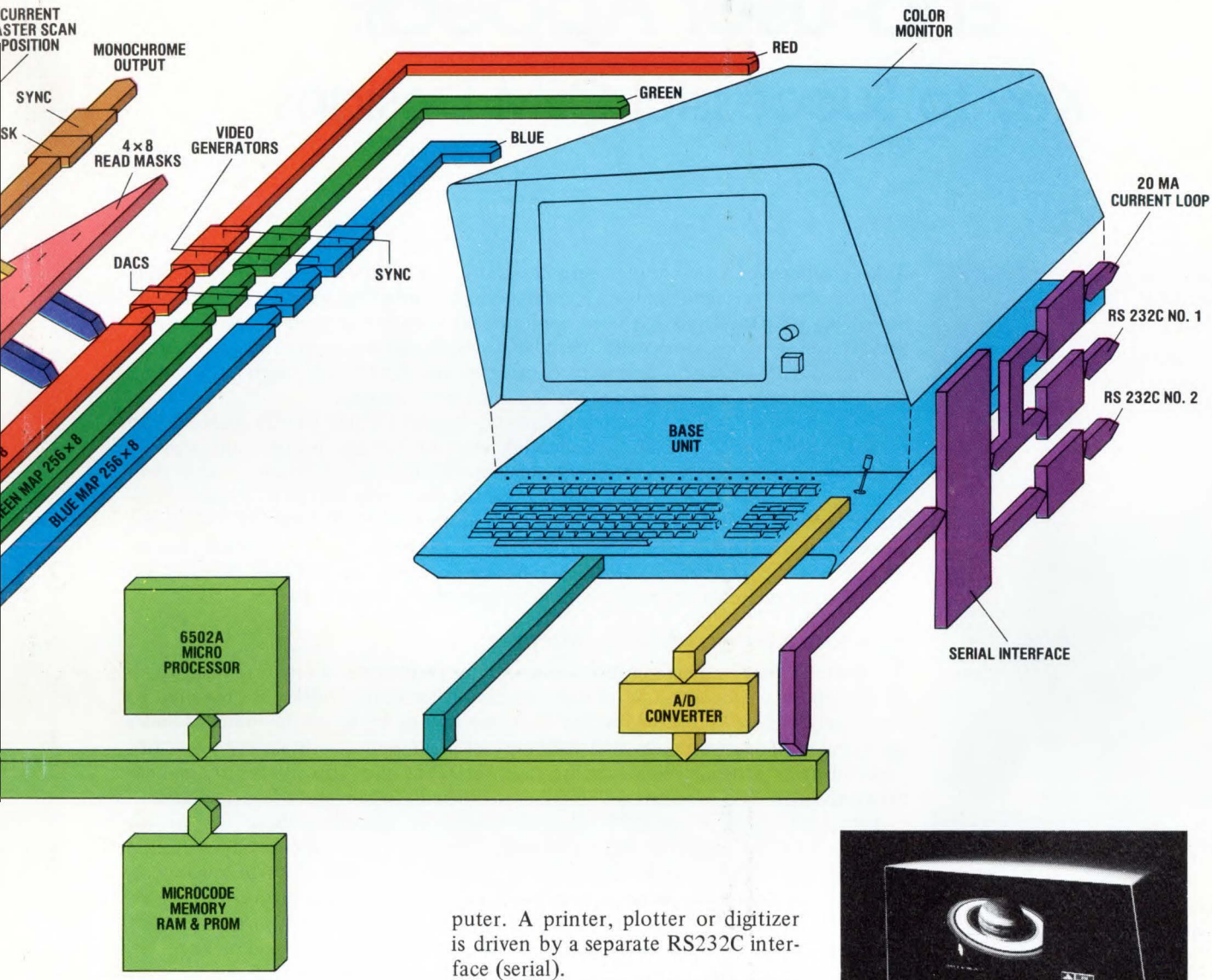
Automatic memory-plane switching during scan allows 'roaming' in an expanded image area of up to 1024 X 2048 pixels through a 512 X 483 pixel viewing window. This feature permits the viewer to trade away color bits for "real estate" (image area.) Dynamically-changing displays can be programmed to produce animation or other effects desired by the user.

The AED 512, with a 26K RAM/ROM memory, is controlled by a 6502A μP at 500 ns. The chip also controls I/O functions as well as performing character, vector, circle and filled area generation. Video memory-plane read/write masks are used for convenient multiple image or overlay processing. This allows the user to view one image while generating another.

Any of the 256 color values may be put into an associated "blink" mode allowing selected foreground objects to blink upon an arbitrary background. Single points of the display can be accessed by keyboard,

DD Spotlight

FOCUS ON A NEW PRODUCT



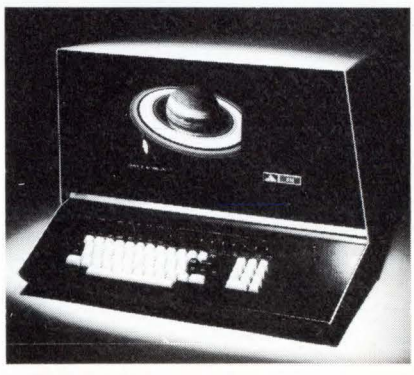
joystick or host computer.

Other features that contribute to the "intelligence" of this display are the ability to display 256 different colors simultaneously on the screen, select exact shades desired, perform horizontal and vertical scrolling, allow continuous panning (by means of joysticks), zoom from 2:1 to 16:1, overlay color images and display 256 shades of gray.

AED's double density floppies, Winchester technology and mass storage disk pack subsystems plug directly into terminal or into host minicomputer. A printer, plotter or digitizer is driven by a separate RS232C interface (serial).

Software available from AED for this unit includes a Terminal Control Package (command functions); Multiple Image and Overlay Processor (for image flipping, overlaying and special viewing); Mezzo Machine Package (for image enhancement and digital filtering); and High-Level Graphics Package (display list editing, image file maintenance, three-dimensional coordinate systems).

The AED 512 can be used with a variety of minicomputers; such as, current DEC hardware, Data General Nova, MicroNova or a Varian. Can also be hooked to a mainframe host computer.



The OEM price of the basic AED 512 Graphics Imaging Display Terminal with one memory plane (but no monitor) is $7,100. (The user may also purchase a monitor, additional memory planes and various interfaces.) Delivery is 12 weeks ARO. **Advanced Electronics Design, Inc.**, 440 Potrero Ave., Sunnyvale, CA 94086. **Circle 131**

End-User Appeal:
Key to Successful OEM Designs

David R. Carson
Televideo, Inc., San Jose, CA

The proliferation of computer peripherals in recent years provides an interesting study of why certain designs are market successes, and others are not. Traditionally, the design of peripherals has been predominantly driven by technological innovation. However, today's successful peripheral designs demand more than clever engineering. And the OEM who fails to recognize this may find himself with a warehouse full of inventory – and/or disappointingly low profit margins.

What then makes for a winning peripheral design in today's OEM market? The answer can be found by carefully evaluating what the end-user wants – and what he is willing to pay for it. It is this important marketing consideration – more than technological innovation – which should be the dominant vector which drives today's OEM design effort. After all, the computer peripheral designed by and for OEMs must ultimately be sold to the end user – generally as part of a total system. And unless the peripheral's features translate to appealing end-user benefits, no amount of engineering innovation will help make the product a market success.

Start with a proven product concept

For the most part, the marketplace for computer peripherals is a mature one, where certain product concepts have proved successful. Ironically, OEMs are tempted to steer clear of these "success formulas" – driven by a desire to set the industry on its ear with an innovative design that leapfrogs all incumbents – or simply by a "not invented here" attitude. Whatever the case, the OEM who fails to identify and exploit proven product concepts will find it more difficult to gain end-user acceptance.

Let's take a look at the CRT terminal market, for example, where there are no less than 30 OEM suppliers. Not surprisingly, most of these suppliers draw from a common base of technology. (See **Table A** for a list of the basic CRT terminal components, along with the percentage each contributes to the manufacturing cost today.) What is surprising, however, is how few of the suppliers exploit proven product concepts – in terms of improving the CRT terminal's appeal to the end user.

Preoccupation with design innovations – without strong enough focus on what the end-user wants – has resulted in terminals with unappealing price/performance ratios. Accordingly, the OEM who starts with a proven product concept, and then centers his design efforts around enhancements with end-user appeal will maximize his opportunity for success. Let's now examine some of the considerations in smart CRT terminal design – and how at least one manufacturer guided his design efforts with the end-user in mind.

Choose features carefully: remember the end-user

With the seemingly "free" features made available with microprocessor technology – and with the promise of custom LSI to boost performance and shrink parts count – the OEM designer must discipline himself early to make the best use of technology. He must avoid engineering myopia, and make end-user appeal his overriding design objective as he sets forth to formulate his product's features.

The features he selects will fall into one of three categories: (1) minimum features required to enter market (e.g. video attributes, numeric keypad, conversational/block modes, etc.), (2) cost-effective features easily added (e.g. multi-page memory, function keys, printer port, etc.) or (3) market trend features to enhance price/per-

formance (e.g. standard typewriter keyboard, 25th status line, high-quality graphics, emulation of other popular terminals, 132 column, etc.).

While there will always be design trade-offs in selecting features, the designer should never forget the ultimate customer – the end-user – when he performs this task. Some features – which may have little utility today – could still have great end-user appeal, and these should not be overlooked. A second page of memory, for example, is very appealing to the end user, even though he may presently have little need for it. This type of feature gives the product a "safe buy" image, in that it insures the user of extra performance when he needs it.

To be successful, an OEM product should be designed to please the end-user.

As another example, consider the self-test feature. No terminal should be designed without an internally generated self-test which verifies the proper operation of the video display circuitry, serial interfaces, UART and control processor. However, this self-test is hidden from the end-user, and usually performed at the OEM level during maintenance. Allowing a self-test to be initiated from the keyboard can provide important marketing value – in that the end-user will take comfort in knowing that he can verify directly the proper operation of his terminal. While such a keyboard initiated self test might not be as thorough as the internally generated one (and, in fact, unnecessary in the mind of the OEM), it may still be cost-effective to provide both types of self test, only to provide that extra measure of end-user appeal over competitive units.

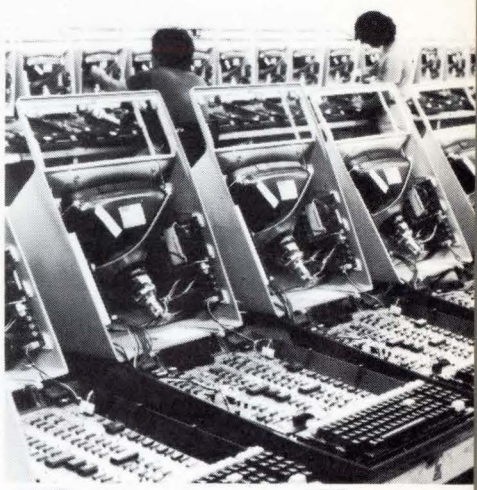
Of course, most features should be selected for their direct benefit to the end-user. **Table B** lists such features for a smart CRT terminal.

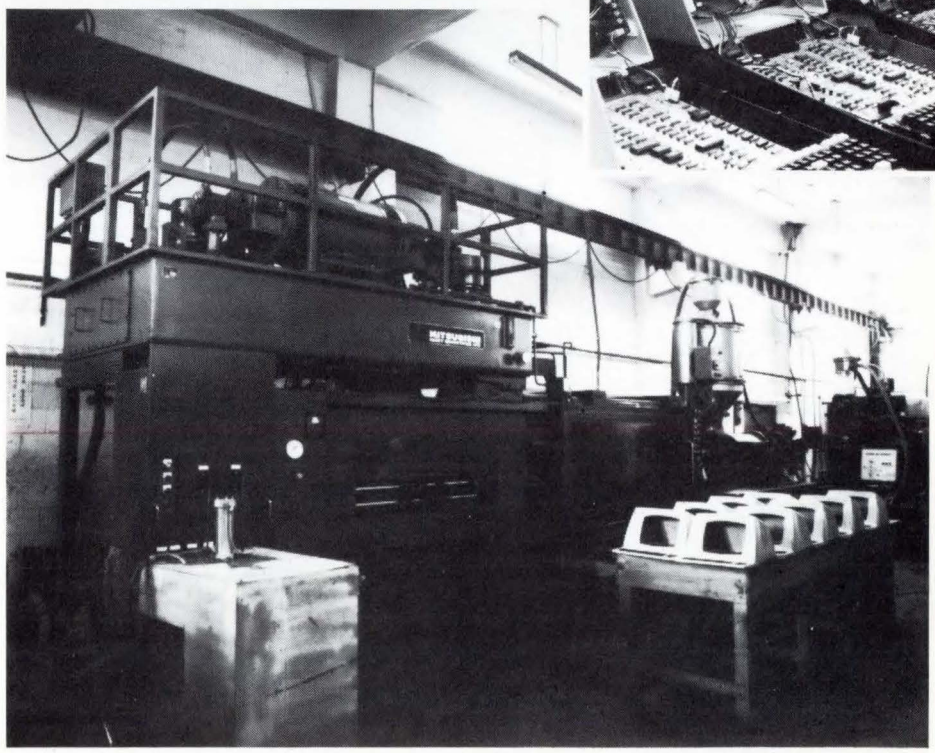
Beware custom LSI pitfalls

There is currently a strong trend toward the use of custom LSI in the design of the circuitry for CRT terminals. Certainly the custom approach brings with it the benefits of fewer parts, lower power requirements, and an opportunity to design in special features unavailable with a standard component approach. The old axiom, "the risks equal the rewards," applies to custom LSI – and the OEM should carefully evaluate the risks, to make sure they're essential to gain a marketing edge.

There was at least one computer OEM who took the custom approach to "outfox" the competition, only to find out that his custom chip wasn't ready – when he was ready to ship. He had to make a tough decision: delay shipment, or ship with an interim daughter board – with unverified reliability – which would add about $50 manufacturing cost (internally) per unit. In this case, the daughter board approach was used – however, the computer OEM lost credibility – and the number of units shipped before the custom chip was available adversely affected his profit margins.

The custom approach can also box you into a single-source vendor, which is very risky. Moreover, the over-integration of parts may limit the useful life and/or flexi-





Proper tooling and hardware configuration mean optical price/performance. The OEM must carefully plan the tooling and hardware approach to achieve expected sales volume, while simultaneously meeting end-user price/performance desires. This planning can lead to the use of high-quality injection molded cases and a modular hardware design which partitions the processor circuitry and the keyboard circuitry into two circuit boards.

Table A. Cost Trends for Most Smart CRT Terminals

Type of Component	% Mfg. Cost	Trend
Logic Board	28%	Increasing due to higher cost of purchasing components, decreases are available with greater use of Micro Processor technology.
CRT Monitor	20%	Decreasing with volumes.
Power Supply	10%	Slight increase.
Keyboard	12%	Material prices rising but some offset due to increased volume; net trend toward a slight rise.
Case	15%	Slight increase due to increase in cost of petroleum related products.
Labor	15%	Declines through the 5,000th unit; further decline can be achieved through a shift to offshore manufacturing.

bility of your product. The trend toward custom LSI designs is based on the notion that the CRT terminal market is technology driven.

At TeleVideo, we opted to use readily available standard components – and we partitioned the design carefully, so as to provide maximum flexibility – not only at the manufacturing level – but at the end-user level as well. More specifically, we did not yield to the temptation to combine the processor board with the keyboard circuitry. By keeping these components separate, we're able to interchange keyboards easily (e.g. Teletype with Selectric-type) – and our customers may easily install their own custom keyboards if they wish. This hardware interchange would have been more costly and cumbersome had we merged the processor board and keyboard circuitry into a single module, in the name of "engineering achievement."

We also planned for easy modular expansion at the board level by putting "hooks" on the processor board, and by designing our case so that a daughter board could be added easily. Unlike the ill-fated product discussed earlier – which used a daughter board in lieu of a custom chip that wasn't ready – the TeleVideo daughter board provides a modular enhancement – in this case, a built-in modem!

Table B. Smart CRT Terminal Features

Upper/Lower Case Characters	A 7 X 10 character matrix with 12 X 10 resolution gives maximum display readability. Character and word recognition is easy, meaning less operator fatigue and misinterpretation of data.
Dual Intensity	Shaded grey backgrounds and characters allowing operator to distinguish protected fields and form material. This helps the operator place the right data in the right place.
Blinking Fields/Blank Fields	Video attributes which make data transfer and terminal interface more accurate, confidential and easily handled. Blinking fields call the operator's attention to important screen information which otherwise might be overlooked. Blank fields, with zero intensity, prevent the display of confidential information.
Reverse Video	This allows black characters on a white field in any area of the screen, and is useful for displaying several types of information at one time on the CRT.
Non-Glare Screen	An etched finish on the face of CRT screens aids greatly in reflection control and easy data recognition.
Protected Fields	Character positions which do not allow overwriting by the operator is identified by a grey field. When fields are protected, the cursor is unable to enter to effect any modifications to data.
Underlining	This attribute allows highlighting of information and points out areas that need to be filled in by the operator.
Blinking Cursor	Whether in blinking or steady-state mode, the character beneath the cursor is always visible with TeleVideo products.
Tabbing	Allows typewriter-like tabbing for fast data entry. Tabs can be set anywhere.
Numeric Pad	This built-in keyboard means faster entry of numeric data, and more flexibility for the operator. They get the speed and convenience of a standard 10-key calculator keyboard.
Line/Character Insert/Delete	The touch of just two keys allows the operator to insert or delete data at will, with the affected line automatically lengthening or shortening to fit the new instructions.

Configure for maintainability and manufacturability

Starting with a proven product concept, then enhancing it with features which have great end-user appeal leaves but two other key areas to consider before price/performance can be optimized. These are the areas of hardware packaging for easy maintenance/upgrading – and factory tooling to support the anticipated production volume.

If these two areas aren't addressed properly, all prior design effort will be compromised. This leads us to an injection molded case over structural foam. The higher front end tooling cost was worth the investment trade off due to the benefits of low per unit production cost, fast high volume productivity, and long life of the mold.

Another important decision was to limit the hardware options – and maximize the incorporation of "standard" features which would have great end-user appeal. By doing this, we were able to reduce inventory requirements for our distributors and OEMs – as well as ourselves. Whenever there's a lot of hardware options, there's also a lot of overhead.

We've already touched upon the modular expansion of the Televideo terminal via accommodation for a built-in modem. Other hardware features offering flexibility at the end-user level include a strappable power supply (110/220V, 50/60 Hz) and switch-selectable character sets.

Since the introduction of smart CRT terminals, rapid growth has derived from the enhancement of proven product concepts with price/performance features end-users want. Remember, end-user appeal is truly the key to successful OEM designs.

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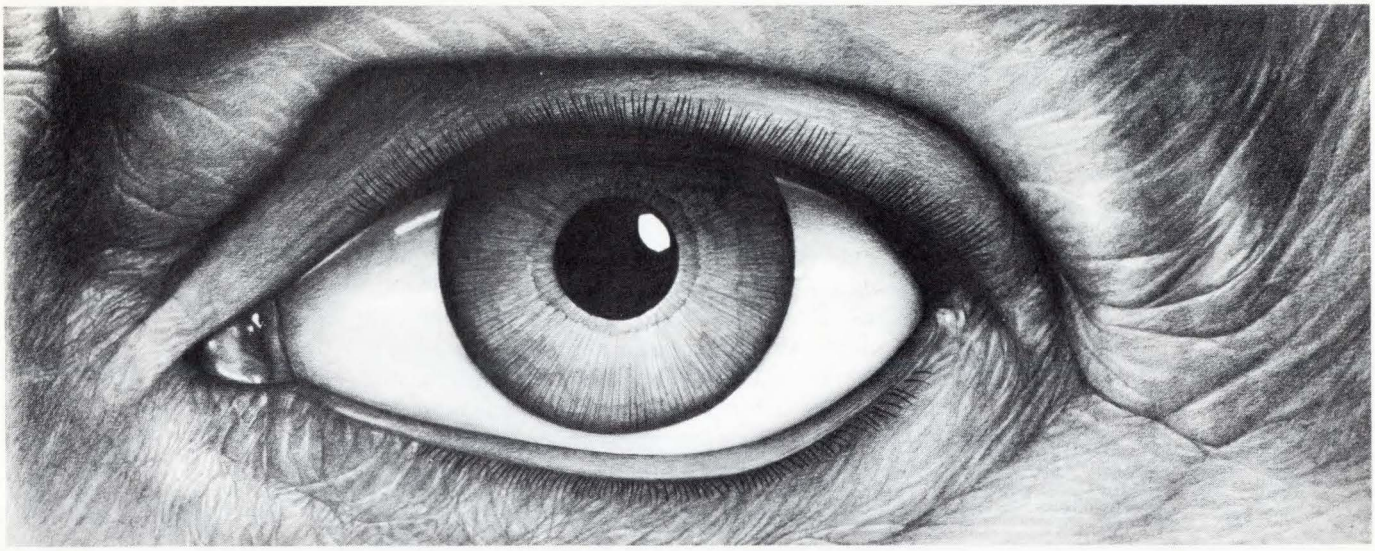
Foresight, foresight, foresight.



If you could make one new improvement in 2315 cartridge disk technology, it would be to double the storage capacity.

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Through The Looking Glass

Three-dimensional computer representation has become the hottest development in color graphics display. Realistic perspectives are being achieved by various means from CAD (Computer Aided Design) to a brand new idea that uses a vibrating flexible mirror. Whether employing Dr. Larry Sher's SpaceGraph™ System (done with mirrors) or the traditional CAD methods, the colorful, digital panoramas being produced are startling and exciting. New fields are being opened for computer applications.

NEW FRONTIERS IN 3-D

Melvin L. Prueitt
Los Alamos Scientific Laboratory
University of California
Los Alamos, NM

(Work performed under the auspices of the Department of Energy.)

Because a surface has many more resolvable points than does a line, large amounts of numerical data can be displayed over a surface. The height of the surface at each point would define the value of the data number corresponding to that point. This, of course, requires three dimensions. Since we cannot produce a three-dimensional sheet of paper, we generate, instead, a perspective projection of the surface. With computers, the perspective transformations are easily made, and the result may be plotted on a graphic output device.

The rest of the work is done by the human optical system. Even though the computer has produced only a drawing on a two-dimensional paper sheet, the brain can instantly transform the image into three dimensions. The viewer can then quickly spot the highlights and detect subtle trends and relationships which probably never could be extracted from tables of numbers.

Three-dimensional plots are of obvious utility for displaying functions of two variables or experimental data from a surface. For example, the smog build-up over a state would be represented by peaks over the location of cities with diminishing mountains trailing downwind. The location and density of known mineral deposits can be displayed in perspective and might show a correlation among surface features which would lead to the discovery of other deposits. Phase transitions in alloys can be shown by plotting pressure along one axis, temperature along another axis, and letting the height represent the minimum free energy.

Data that are often thought to be a function of one variable can be plotted in 3-D if time or some other variable is introduced. Consider the temperature distribution along an electrically heated wire. The distance along the wire could be represented along the y axis of the plot. The temperature would be the height. Now let time increase along the x axis. Thus the entire history of an excursion of the temperature distribution along the wire can be represented on a single perspective plot.

One of the problems of simple 3-D plots is that some of the lines in the foreground may be superimposed on lines in the background, resulting in confusion. The problem is solved by removing the "hidden" lines. Special computer programs are designed to determine what lines should be visible from a given viewpoint. Most hidden-line-removal programs consume an excessive amount of computer time, but the development of new methods have made the process quite efficient.

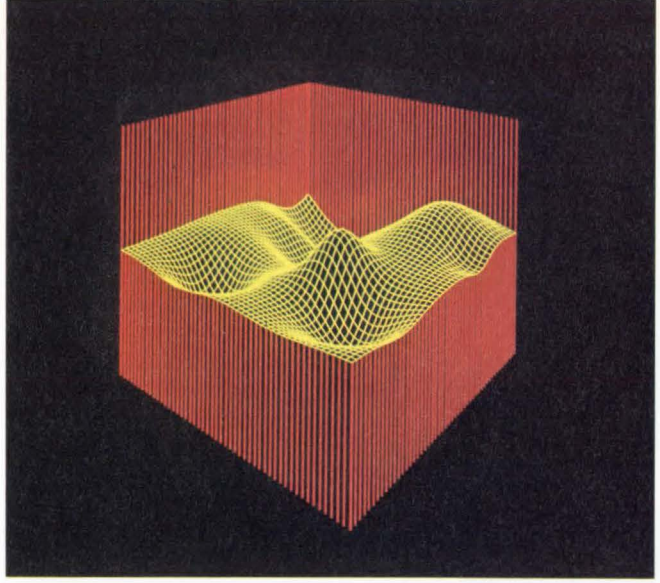
The principal value of computer-drawn perspective plots lies in man's ability to comprehend a visual form more easily than a list of numbers. With ever-faster computers of today, man is in danger of being inundated by floods of numbers unless computers reduce output to a form which can be readily understood.

The 3-D examples shown here illustrate a few of the ways in which computer-drawn perspective plots have been used. Geologists, for example, handle a lot of data governing geologi-

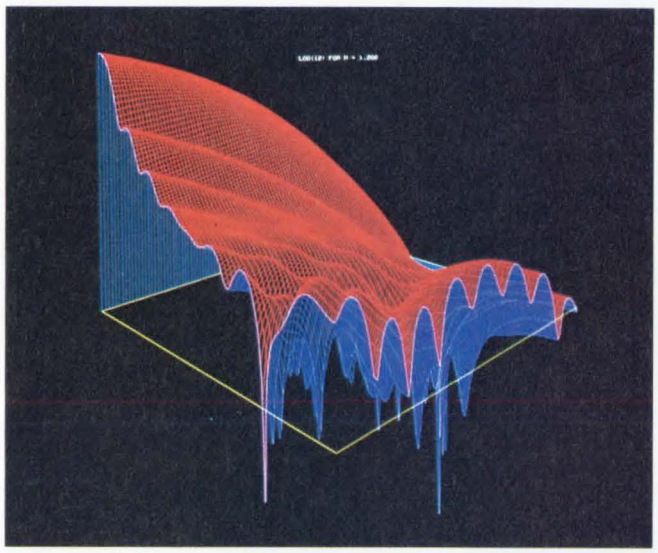
cal formations beneath the surface of the earth. Data are generated by reflection of sound waves from various geological layers and by drill cores. Formations cannot be seen directly except in cross section where the weather has eroded away the obstructing materials. Therefore, it would be useful to have a computer digest raw data and produce a 3-D plot for visual inspection.

One might want to know how a surface would look if it were changed – without really changing it. This type of picture is useful even when the surface is visible. A good example of this is in highway planning. Using a projected 3-D image, a highway engineer can study a proposed route and perhaps spot alternate paths for the road. When the plans for a highway are complete, a computer movie might be made showing the appearance of the highway as viewed from a moving car traveling full length on the new route. This would be useful in detecting potential trouble spots at blind curves, etc.

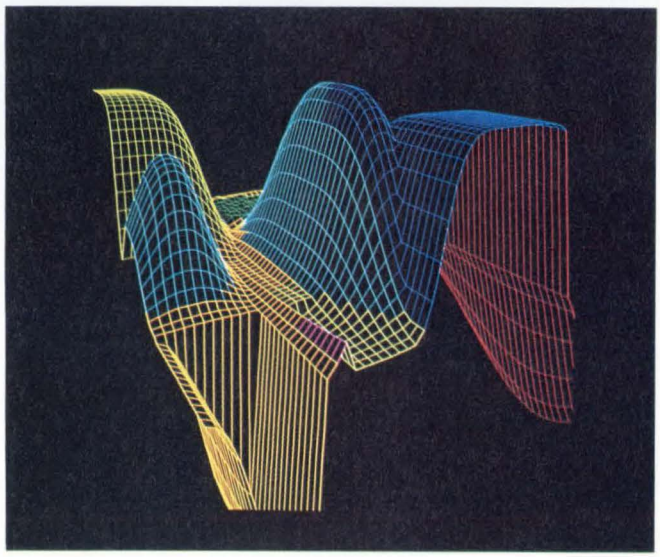
Suppose an infantry officer near the battle front wanted to acquaint his men with unexplored terrain before a night patrol mission. He might show them a topographical map which was produced by aerial reconnaissance. But that would **not** give them a real "feel" for the land. A computer could take the same data used in making the topographical map and create a 3-D picture that would represent the lay of the terrain from the viewpoint of a six-foot man. The officer could show a computer movie that would accurately depict the hills and canyons as they would appear when walking over the terrain.



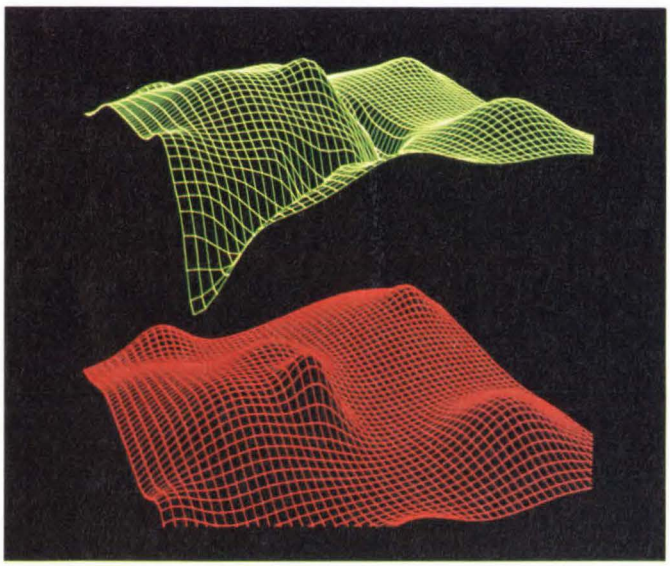
A mathematical function.



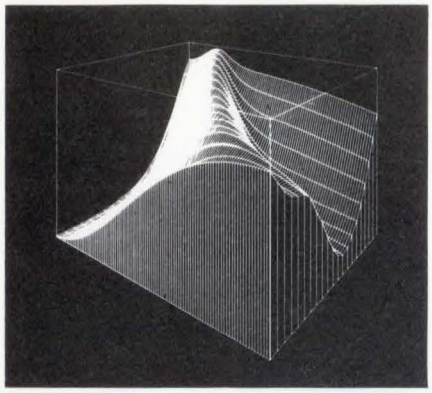
Scattering of light from particles in the atmosphere.

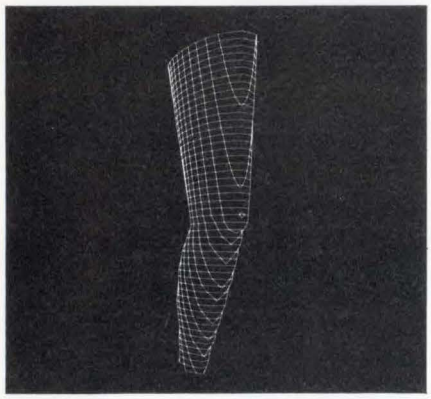


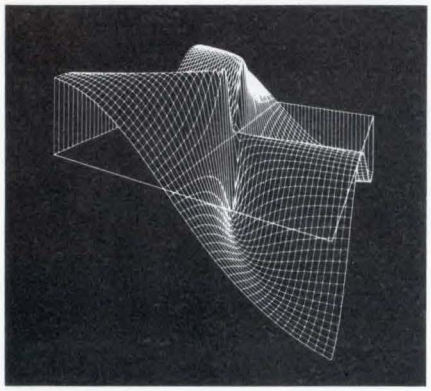
A surface is separated into meaningful areas of color.



Surface of the earth is shown in green. Geological areas under the surface are in red.







It is much less expensive to generate a computer-drawn picture than to build a model. Engineers and designers find the computer handy for getting a 3-D preview of a design before committing the design to actual hardware.

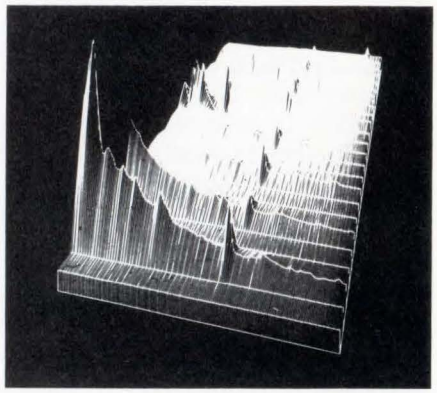
As subjects become more complex, the need for clear graphics becomes greater. The most complex of all scientific studies involves the human body. Physicians often prescribe the wrong treatment because they cannot properly interpret the mass of data supplied by modern medical tests.

Body organs can be plotted and studied in "3-D." The reflection of ultrasonic waves from body organs can be translated by a computer into a plot which represents the shape of the organs. Man is not naturally adept at interpreting x-ray negatives, but these negatives may be scanned to produce data which a computer can digest to make 3-D plots. Then, instead of a variation in shading, the observer sees a lump on the plotted surface.

Professor Lind of Utah State used experimental measurements taken in a magnetic field to produce a 3-D plot showing the general "shape" of the magnetic field. But it revealed something unexpected. Striations running from front to back were a surprise. They represented effects which were not supposed to be in the field. They would never have been discovered by studying the thousands of magnetic field measurements, but the eye picks them out instantly on the 3-D plot.

Enthusiastic use of computer graphics follows when the technologist learns what can be done. A lot of educating still needs to be done to acquaint the engineer, scientist and medical doctor with the potentialities of this type of computer 3-D output as a research tool. We believe that a quick and ready solution to one man's problem will soon convince the next man with a data problem that he needs a similar solution. At this rate, it shouldn't be long before the technological community is fully aware of the enormous possibilities in handling data in graphic, 3-D form.

Three-dimensional representations: *At left, top:* **laser absorption on a material showing angle and depth of penetration;** *middle,* **a leg;** *bottom,* **an equation ($F=xy^2/(x^2+y^4)$).** *Below:* **Nuclear spectra of several isotopes.**



(This condensed article is reprinted by permission from Dr. Prueitt. The original, complete article appeared in the Jan. 1976 issue of Functional Photography.)

REALISTIC SPATIAL DISPLAY

Harry Shershow
Associate Editor

Lab notebooks, these days, are bulging with experiments of computer-assisted 3-D imaging. As one looks upon and marvels at the results being achieved by researchers, one can only wonder at the future prospects for this amazing new technique. Three-dimension experiments have always been unique and fascinating to both experimenters and viewers. The fascination for the viewer has been mostly psychological. Anything that plays tricks with his normal vision, or transports him out of the real world of sunlit illumination is an exciting experience. The viewer is enthralled by magicians' disappearing acts (done with mirrors,) he spends money to look at distorted images of himself in fun houses, he is intrigued by the sights he sees under black light, ultra violet, infra red, microscopes, telescopes, kaleidoscopes and stroboscopes. As the old Tin Pan Alley song used to say, "We all like to look at the world through rose-colored glasses."

Three-dimensional viewing is a fascinating experience for man, and methods to produce such images have been attempted for both entertainment and instruction. The technique began with old-time stereophotography, where two picture postcards were placed in a velvet-lined hand-held viewer then held up to be observed in the sunlight. It is paradoxical to conclude that 3-D pictures as seen through lenses are much more fascinating than the same scenes seen with normal vision. Stereophotography has, in the past, been commercially successful in the theater by projecting two simultaneous

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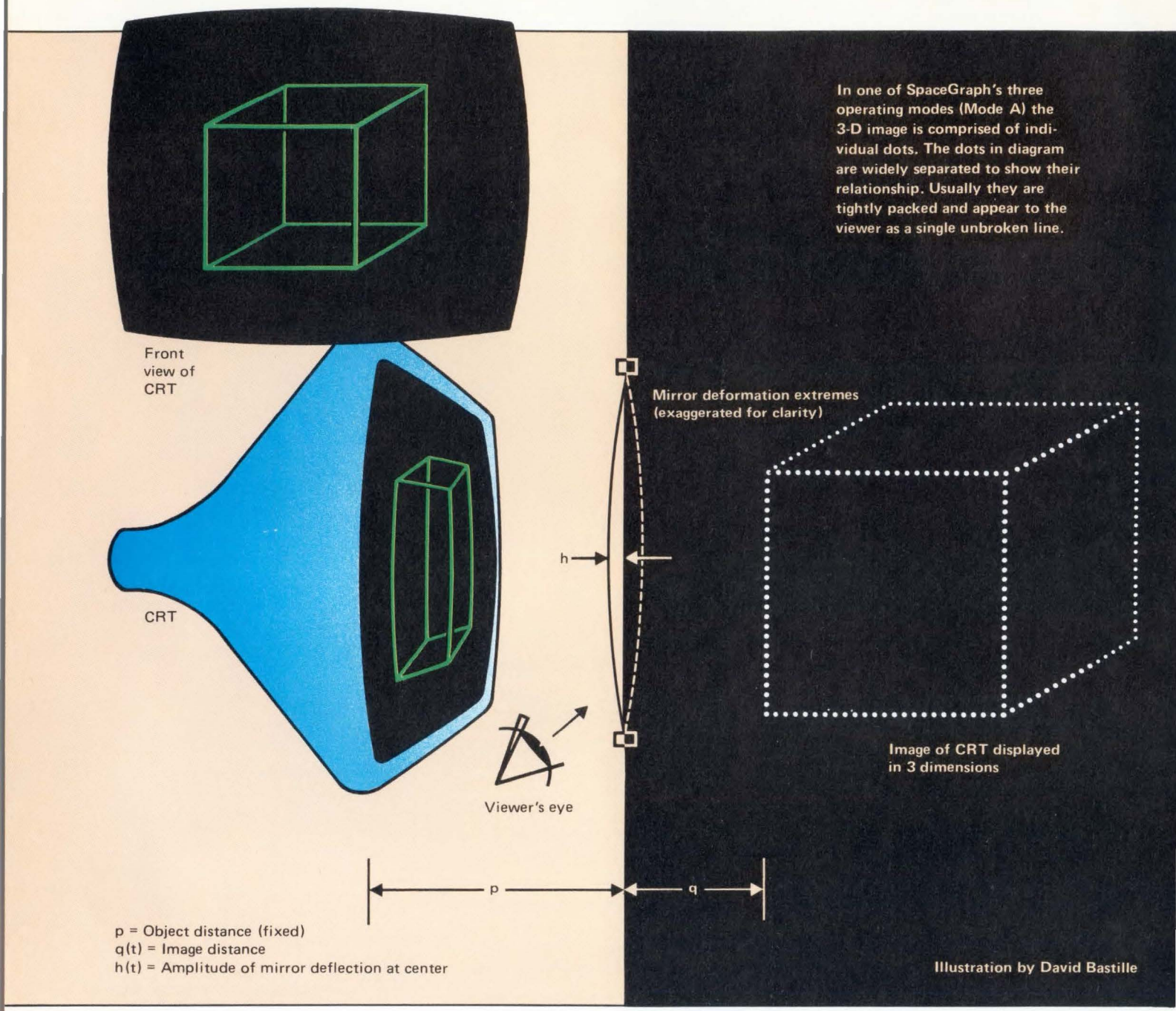

views of an object as seen by a camera from two different positions. Many methods for combining the two separate pictures into a single 3-D effect have been tried. Most popular have been the use of special glasses, each lens filtering out one of the two superimposed pictures on the screen.

Newest development of this "special screen" method has been holography which requires no special viewing aids. The 3-D effect is obtained by manipulating wave lengths of light. Holograms are created by splitting laser light into two beams. One of the beams (a "reference" beam) illuminates the film, the other beam (an "object" beam) illuminates the object. This object illumination, when reflected onto the photographic film, interferes with the wave lengths of laser light that are directly striking the plate. The film is exposed, developed and appears as unrecognizeable wave patterns. It is re-exposed to a laser beam and transmitted over the identical path as the reference beam. The resulting "holographic" image contains all the information about the size, shape position and reflectivity of the object that one would receive when looking at the object itself. These images of focused light can be seen floating in space behind the film plate, straddling it or in front of it.

A newer method of 3-D representation, the SpaceGraph System, was recently demonstrated by the inventor, Dr. Larry Sher, of a Cambridge research company.

Dr. Sher, a senior scientist at the laboratories of Cambridge-based Bolt Beranek and Newman, began his 3-D research in 1974. At that time he was studying display options for image data collected by a high-voltage electron microscope. That display problem resulted in developing a method for displaying 3-D scalar fields. Later, this method was expanded to permit the display of line drawings. The latter development was the seed from which SpaceGraph has grown. Dr. Sher uses a vibrating mirror to transform ordinary images as seen in 2-D on a CRT screen into visually stunning space-filling 3-D images.

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When lights go out in Sher's laboratory and the fourth dimension of space (the mysterious space behind mirrors) comes into view, one sees as many strange things as Alice in Wonderland might have seen. A representation of data-information-bits becomes, for example, the Milky Way Galaxy with its billions of stars and its endless stretch of space. A special pointer with a red light on its top (another Sher innovation) is moved around in this void and it travels, in a few seconds, 100,000 light years from Sagittarius to Cygnus, the diameter-fixing stars of the Milky Way.

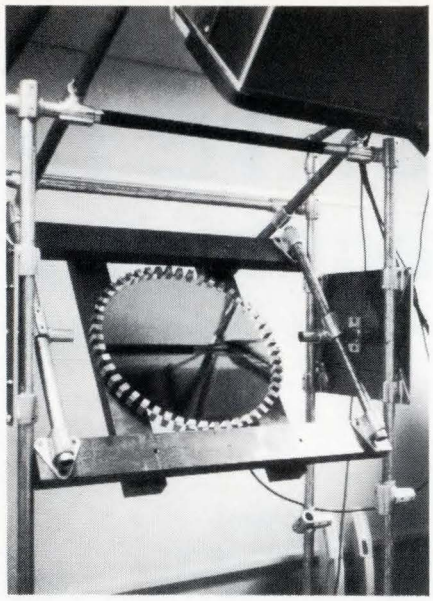
This new system requires no response from the viewer; such as, special glass, or rotating the image. The viewer simply "looks into a mirror" and sees a three-dimensional object sitting in space.

"The SpaceGraph display," says Dr. Sher, "uses a computer-driven CRT that rapidly presents pictures of successively deeper layers of a desired space-filling image. The user views this succession of pictures in a moving mirror so that each layer appears farther from the viewer than the one preceding. The layers are displayed sufficiently rapidly so that the user's eye fuses the series of layers into a single, flicker-free 3-D image. The image is visible over a wide angle, in particular, viewers can move their heads several feet to change their viewing angle by up to 60°. The volume of the image is about equal to that of a basketball."

Images with SpaceGraph can be produced in three modes: A, B, or C. Combinations of any two modes are possible. In all modes the brightness of individual picture elements is variable, through 8 or 16 levels of gray scale.

In Mode A, the 3-D image is comprised of individual dots, usually densely arranged into lines. Alphanumeric characters (such as for labeling) may be freely incorporated into the image. Mode A is appropriate for representations of three-dimensional objects in outline, such as in a mechanical modeling application, or schematic line drawings, such as chemical molecules. This mode is also useful in representing discrete points in a volume, such as in plotting three- or four-dimensional data (where brightness supplies the fourth dimension) to facilitate eye/brain pattern recognition.

In Mode B, the SpaceGraph display traces out a series of left-to-right profiles (also variable in brightness), the end result being the 3-D image of a textured surface. This mode of display



The SpaceGraph™ System has two major components. An overhead CRT (for producing a 2-D image); and a round flexible mirror anchored as shown. When the lights go out and the CRT image is focused on the vibrating mirror, a 3-D image appears in the mirror's reflection.

is well suited to the representation of weather data, any function of data of the form f(x,y), or terrain displays (perhaps for flight stimulation or site modeling).

In Mode C, the CRT provides a sequence of gray-scale, television-type images that comprise a spatial volume; i.e., a space-filling, semitransparent, 3-D television projection. A medical application particularly well suited to this form of display is computerized tomography, where successive X-ray-acquired slices can be reassembled into a three-dimensional image – a visually transparent patient. Displays in Mode C are also useful for medical ultrasonography, as well as ultrasonic applications, such as in nondestructive testing. Often, this kind of volume display is uniquely capable of displaying three-dimensional scalar fields; e.g., a pressure distribution throughout a volume, electron density in a crystal lattice, or any mathematical function of data of the form f(x, y, z).

The space-filling, nonrotating, interactive qualities of the SpaceGraph display, plus its three modes, make it extremely versatile. For example, chemists can use the SpaceGraph display to match molecular structures to electronic density data (by overlaying a line drawing of a molecule on a Mode C representation of its electron density). Engineers can use the SpaceGraph display to follow and understand spatially complex networks, such as multilayer printed circuits or refinery piping. Surgeons can use the SpaceGraph display to show facial contours before and after reconstructive surgery. Flight controllers can see altitude in holding patterns, as well as plan position, for more effective coordination of aircraft movements in these crowded volumes.

"Because it is impractical to oscillate a large-screen CRT at a 30 Hz rate," says Dr. Sher, "the visual equivalent is used: oscillating an optical image of the phosphor screen. This alternative is physically practical, because the CRT can be stationary and the time-varying optics can take a very simple form.

"The simplest optical arrangement is an oscillating plane mirror, (see Fig. 1). Because of the equality of image and object distance, the leverage of the plane mirror is double; the image moves 2x as far as the mirror. For a good view of the image, the mirror should be large compared to the CRT.

Principles of Operation – Acoustical

"The key pitfall in designing a vibrating-mirror display is the inadvertent production of acoustic noise levels ranging from 'unpleasant' to 'intolerable.' Perceptually, the energy spectrum tells all. The ear is notably insensitive to frequencies at or below about 30 Hz. But 40 Hz is already more perceptible. Therefore, it is important to keep mirror motion as purely sinusoidal (at or below 30 Hz) as possible.

"In our current model, two factors contribute to quietness. (1) The mirror is designed as a mechanically resonant structure, with its fundamental resonant frequency (in the mode of interest – one circular node) at the desired frequency of operation. This arrangement is energy efficient and has clean sinusoidal behavior. (2) Because the circular plate mirror vibrates with one concentric circular node, the edge of the front surface recedes as the center advances, and vice versa. This behavior reduces the already low radiation efficiency of the plate, whose diameter is only 3.5% of the wavelength of 30 Hz sound in air. Also, the visual effect of extending the mirror beyond its supporting hinge is extremely favorable, because the viewer has more freedom of head movement.

Principles of Operation – Mechanical

"A vibratory structure whose deformed shapes at resonance are used

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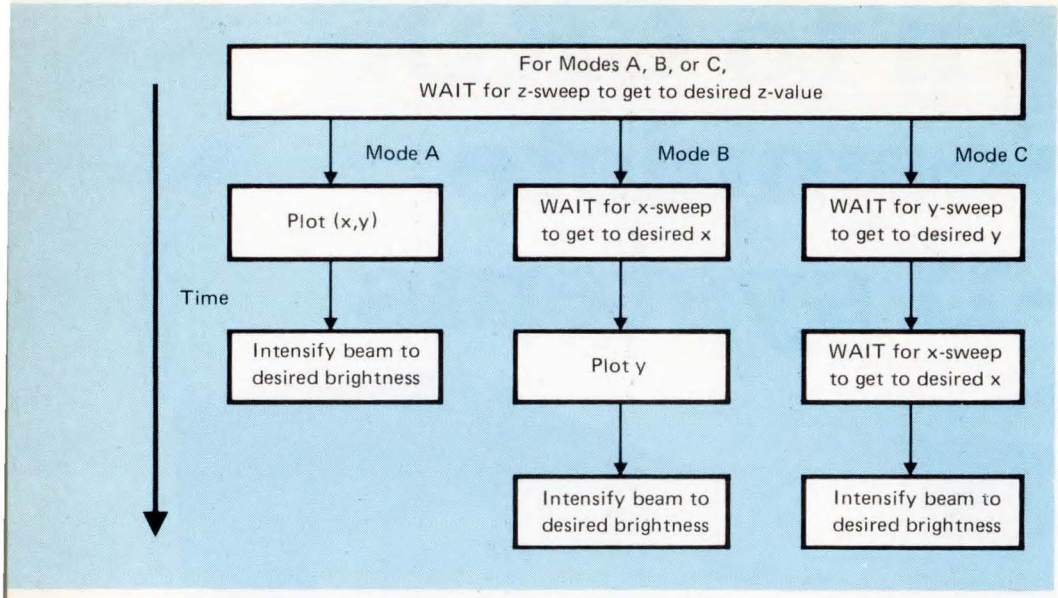


Fig 2 To display a lone image element, Modes A, B, and C involve increasing amounts of waiting.

optically and whose acoustical output is potentially malignant presents a delicate design problem. For that reason, I resorted to a numerical model of the structure so as to iterate toward an optimal structure without many expensive construction/trial cycles.

"The mirror, critical component of the system, is a flexible plastic plate, 1/8″ thick, which has been metallized on one surface.

"Mechanical driving power for the plate is supplied by air pressure from an attached woofer. Only a few watts are necessary, even for large plates. Acoustic power radiating from the plate (and from the woofer-cone's back surface) is very small, and the air coupling from woofer to resonant plate is efficient. Other drives are possible, because only little power is required and because sinusoidal motion is the native behavior of a resonant structure. However, one must be creative to match the reliability and low cost of a commercial woofer".

SpaceGraph is described by Dr. Sher as providing a "space-filling" image. "It is three dimensional," he says, "in most of the ways real objects are. Several people can view the same display at one time without special glasses or without assuming special observing positions. And viewers can look over, under and to the side of the image simply by moving their heads."

Unlike rotating 3-D graphics displays, SpaceGraph provides an image that is stationary. This characteristic enhances the user's ability to study a structure in intimate detail. SpaceGraph permits easy interactive modification of the image and, in that, is not like holographic display.

The key to the SpaceGraph unit, as already suggested, is the mirror mechanism. The mirror, in Dr. Sher's current prototype, is a circular plate, 40 cm. in diameter. It is suspended by a concentric circular hinge on its back surface. It begins to vibrate due to the forces of air pressure generated from the audio woofer abutted on the back side. The vibrations bend the mirror into a continuous smooth series of concave-convex configurations. The circular hinge sets up a perimeter vibration to enforce the vibration from the center. The resulting pulsations of the flexible mirror produce a quiet acoustic rumble at 30 Hz. Although the mirror's center vibrates only 4 mm, peak-to-peak, the mirror image of the phosphor CRT screen appears to move through a distance of 33.8 cm., sweeping out the display volume and, in effect, filling the image space behind the plane of the mirror.

Principle of Application

The control of a CRT's x or y axis is always 'plot' or 'sweep.' With 'plot,' the x-position, for example, set to a specific value to be maintained until further notice. With 'sweep,' the x-position has a different response. It assumes all legal values sequentially, usually in a linear motion. Since a raw CRT has two spatial axes, and each can operate in either of these two modes, there are four possibilities. Eliminating plot x/sweep y, (a symmetrical variant of sweep x/plot y,) there remain three distinct graphics modes and all are in common use: **plot x/plot y**, a "vector" or "directed beam" display device; **sweep x/plot y**, a "time-base oscilloscope", and **sweep x/sweep y**, a "raster" display device.

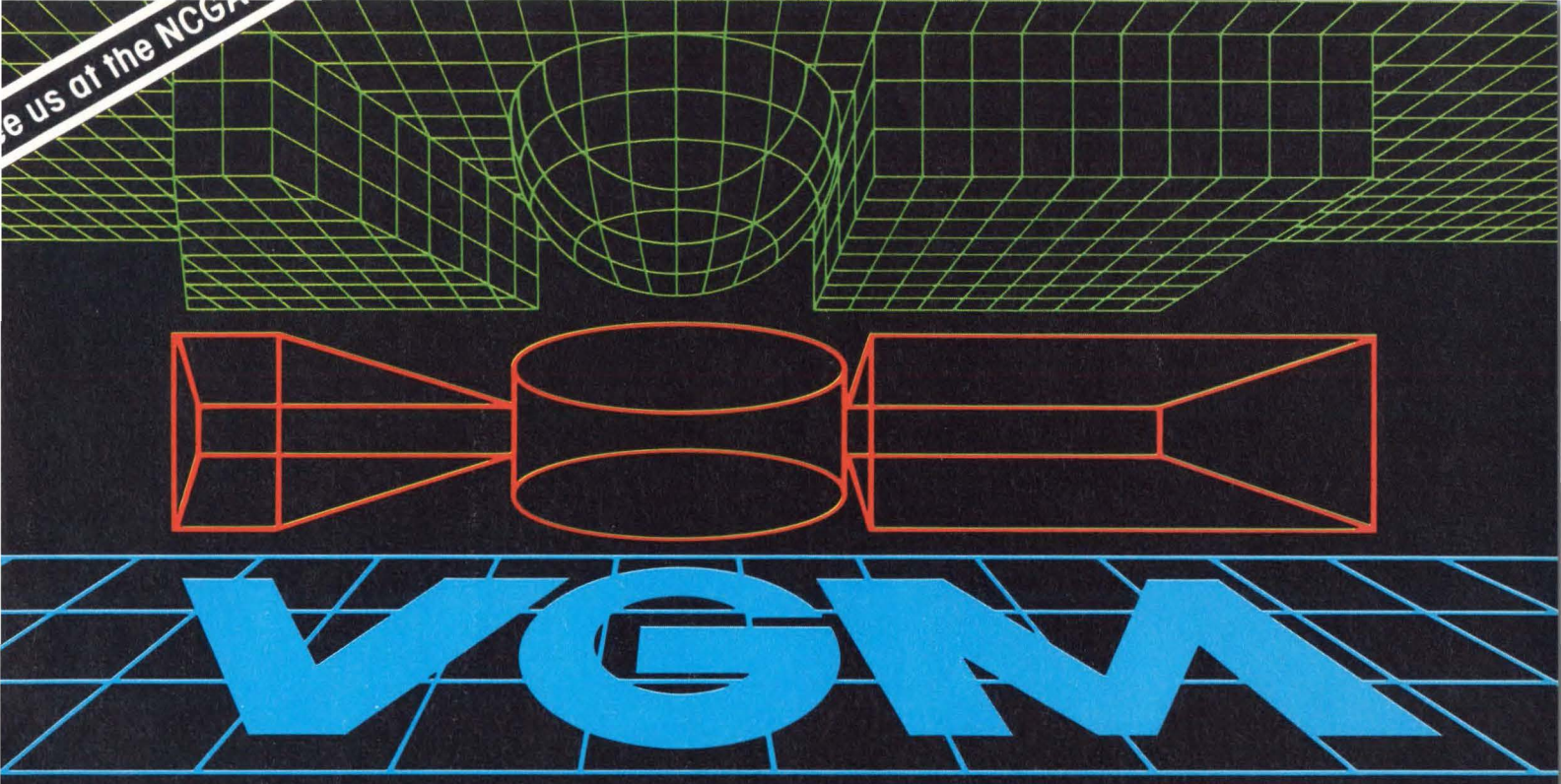
If the **swept** spatial axis created by the moving mirror is called z, then a direct extension of the foregoing categories of possible graphics modes is as follows: Mode A, (plot x/plot y/sweep z); Mode B, (sweep x/plot y/sweep z); Mode C, (sweep x/sweep y/sweep z). This three-way distinction is shown in Figure 2.

The essential idea is that a volume element (at x, y, z) can be lit up to a specified brightness by one of three methods. The diagram shows that Mode C could entail a lot of waiting. Waiting is anathema to a refresh-type display because there is a fixed interval of about 33 msec in which to draw the image elements at **most** of the possible (x, y, z) locations. For the same reason, Mode B should be used only when there are image elements at most of the possible (x, z) locations (there is no waiting for y). It follows that Mode A is suited to sparse images.

Use of Mode 'A'

"As z is swept," explains Dr. Sher, "a sequence of (x, y) values is plotted on the CRT. The image memory only stores the sequence of (x, y) values, (the display file,) since z is implicit in the order. For purposes of creating the display file from a simple logical description of the desired image, (the 'raw picture,') it is possible to imagine the raw picture as existing in a number ('N') of depth zones. If N were small the spatial resolution in z would suffer. The problem on how to size N is answered by the conclusion that N should be as large as possible. The largest possible value of N is such that each such depth zone contains the minimal possible image element – a dot. SpaceGraph's mode 'A' works in that way, plotting one dot in each of many (thousands) depth zones.

"Creating lines from dots means that the number of dots is the figure of merit rather than the more traditional figures of merit based on the number and/or lengths of long and short vectors. Since 10 dots, by observation, makes 1 cm. of vector (in the display volume, not on the CRT), a conversion from 15000 dots to length of vector gives 1500 cm. By visual trials, this length of vector has been found to be sufficient for most applications.



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Please contact: S. Leonard Spitz, Technical Programs Manager, International Printed Circuit Conference, 1050 Commonwealth Avenue, Boston, MA 02215. Telephone (617) 232-5470.

Use of Mode 'B'

"Mode 'B' essentially draws profiles and stacks them in depth. Terrain, for example, as defined by contour lines, is easily converted to profiles and shown in mode 'B'. In general, this mode is suited for any scalar functions of two independent variables; such as, altitude as a function of latitude and longitude. Using brightness, in addition, one can show an additional scalar function; for example, **temperature** and altitude as a function of latitude and longitude. Another use of brightness removes hidden surfaces which otherwise would be visible. However, hidden line elimination in the usual 2-D sense does not work here, because a line may or may not be hidden depending on viewer's head movement. An excellent expedient has been implemented which gradually dims out the line in space as it approaches a permanently hidden place.

Use of Mode 'C'

"Mode 'C' naturally lends itself to the display of three-dimensional scalar fields (isotope concentration at each lattice point in a volume, for example, or density to X-rays for each volume element in a patient's head.) The presentation provided by Mode C is objective, free of the artifacts of slicing, and is in a form admitting interaction with the viewer. Here, 'objective' implies that two viewers can see the same 3-D image at the same time. This is different than the two seeing the same set of 2-D images and then independently making mental constructs to 3-D. 'Free of the artifacts of slicing' implies that a solid sphere will be displayed like a solid sphere, not like a set of solid disks. 'In a form admitting interaction' implies that the viewer can reasonably request a revised presentation; for example, a spatial vignette excluding nonessential and possible-obscuring foreground and background imagery. This interactivity distinguishes SpaceGraph images from holographic images."

When SpaceGraph leaves Dr. Sher's lab, at BB&N, where will it go? What is its future? Genisco Technology Corp., 3545 Cadillac Ave., Costa Mesa, California, is providing the next step. That company, says its president, Hank Stover, already has been granted exclusive manufacturing and distribution rights in US, Mexico and Canada, plus non-exclusive rights in the rest of the world. Genisco is now entering into the commercial development phase of production in which they will be converting Sher's laboratory prototype into a commercially acceptable product. Current plans include the production of a shielded work station, (shielded from ambient light.)

Operators will be staring into black fields and taking readings and measurements from the light points suspended in the image areas. It will be, for them, like looking up at the clustered nebulae of the Milky Way on a dark, clear night and being able to measure the distances from one star to another. The proposed work station, says Stover, will probably be a stand-alone device in its smaller configuration. Larger units will be offered for accessing large data bases in a host computer. Part of Genisco's current development is the planned introduction of a μP of original design to increase the refresh memory of SpaceGraph's xyz data. Future Genisco developments include special purpose processors capable of producing vectors at high speed and, consequently, producing animation. One such proposed application will be a "reproduction" of dynamic holding patterns near airfields. Actual locations and actual flight paths of moving planes will be shown as they circle or approach landing fields. Air controllers would be able to scan the skies for miles around and create a three dimensional picture of the traffic.

Another particularly exciting area in which SpaceGraph will prove valuable, will be in CAD (Computer Aided Design.) This new generic display device uses existing application software and provides the very image qualities which people have been attempting to create for years.

Genisco plans to demonstrate its first commercial SpaceGraph work station late in 1980. Actual production models will be available shortly thereafter. Prices are expected to be somewhere around $100,000 per station. That, says Genisco, will be a very modest price to pay for a device that offers to the physician (as one of its applications) the equivalent of X-ray vision. Anatomical analyses by SpaceGraph is one of the features that Larry Sher demonstrates in his laboratory.

(SpaceGraph is a registered trade mark of Bolt Beranek and Newman, Inc., of Cambridge, MA)

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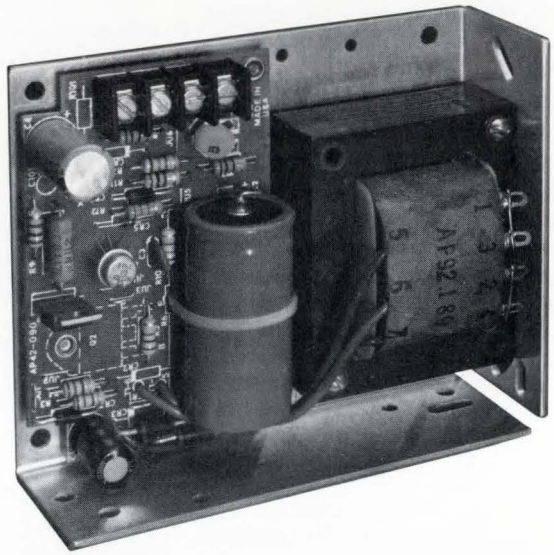

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EAPS 12-1.6U	12	1.6	±0.05%	±0.10%	5mV				
EAPS 15-1.5U	15	1.5	±0.05%	±0.10%	5mV				
EAPS 24-1U	24	1.0	±0.05%	±0.10%	5mV				

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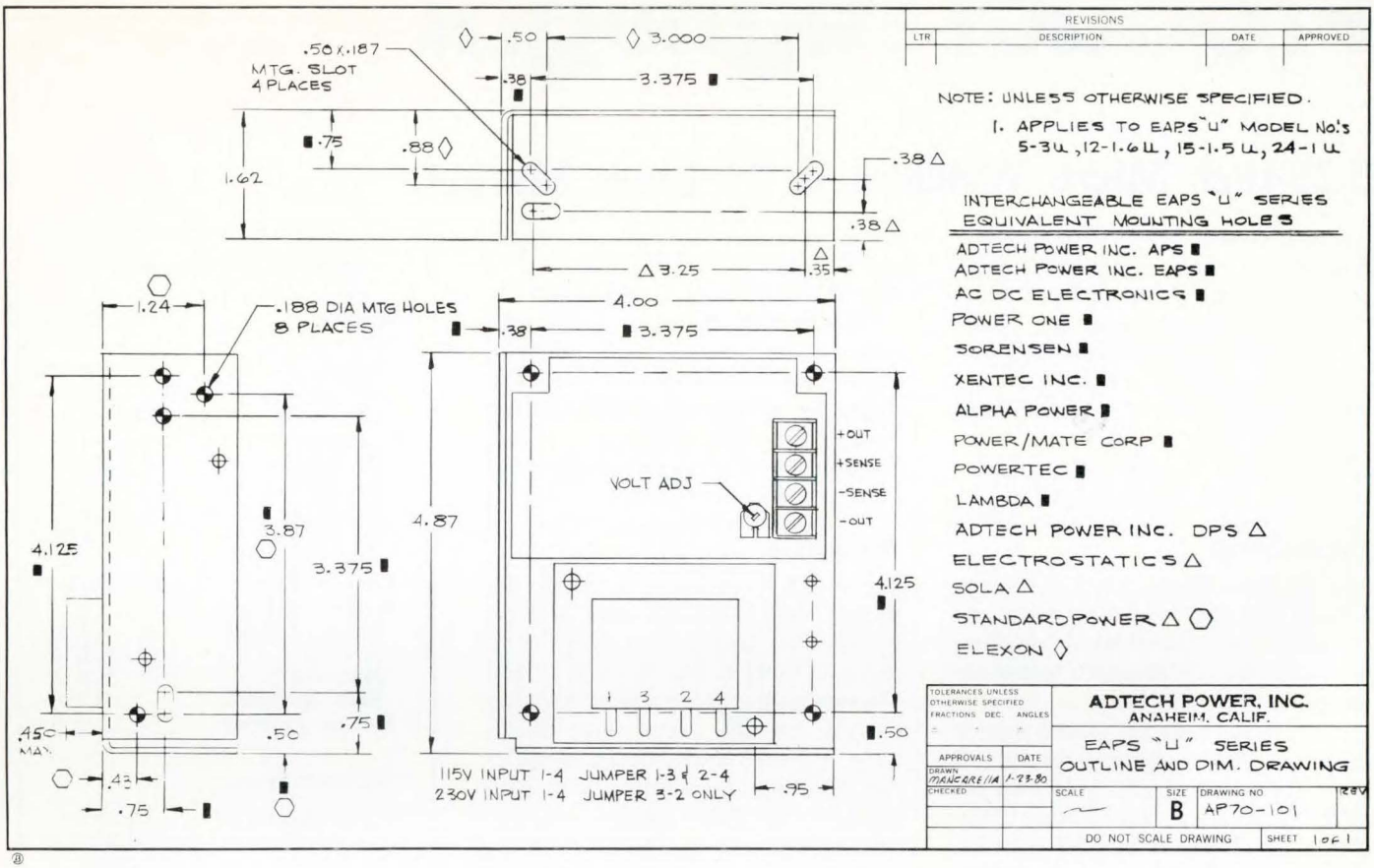

EAPS "U" SERIES SPECIFICATIONS

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

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

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

Ripple: Less than 5mV peak to peak.

Transient Response: Less than 50 micro-seconds.

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

Reverse Polarity Protection: Standard.

Remote Sensing: Standard with open sense lead protection.

Output Adjustment: ±5% minimum.

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

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

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

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

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

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

Overvoltage Protection: Optional.

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Product Highlight

5.25-Inch Micro Winchesters To Enter Market

Are your present systems that use minifloppys for main storage becoming "memory bound"? If so, consider using the 5.25″ hard disk drive. The ST500 5.25″ Micro-Winchester is physically compatible with the industry standard minifloppy and uses the same voltages (+12 VDC and +5 VDC). It offers approximately 15 times the capacity at less than three times the cost.

The technology

The ST500 utilizes Winchester technology; disks are sealed in an airtight enclosure with an integral air filter which continually cleans air within the drive.

The R/W heads are loaded against the disks with approximately 20 g of force compared to 350 g of load for other disk drive technologies. Winchester heads are in contact with the disks when the drive is not running but begin to "fly" above the surface very quickly due to the light load force. The Winchester disks are designed to handle this momentary head-to-disk contact without damage due to a special lubricant in the disk oxide.

There is a dramatic increase in reliability while increasing both bit and track densities. However, since the ability to remove the disks from the machine has been eliminated, a new problem occurs in the form of back-up, which we will discuss later.

The product

As for the specs and interface to the ST500, note that the track and bit densities are greater than others compared in **Table 1.** The fact that a fixed non-removable disk is used and the size of the disk being small allows these to be achieved without sacrificing reliability. In addition, the main element that limits track expansion and contractions of the disk resulting from heat, has been dramatically reduced by using the base casting to dissipate heat through fins designed into the casting.

PERFORMANCE SPECS

Capacity	ST506
Unformatted	
Per Drive	6.38 Mbytes
Per Surface	1.59 Mbytes
Per Track	10417 Bytes
Formatted	
Per Drive	5.0 Mbytes
Per Surface	1.25 Bytes
Per Track	8192 Bytes
Per Sector	256 Bytes
Sectors/Track	32
Transfer Rate	5.0 Mbits/sec.
Access Time	
Track to Track	3 ms
Average	170 ms
Maximum	500 ms
Settling Time	15 ms
Average Latency	8.33 msec

Functional Specs

Rotational Speed	3600 rpm
Recording Density	7690 bpi
Flux Density	7690 fci
Track Density	254 tpi
Cylinders	153
Tracks	612
R/W Heads	4
Index	1

Table 1.

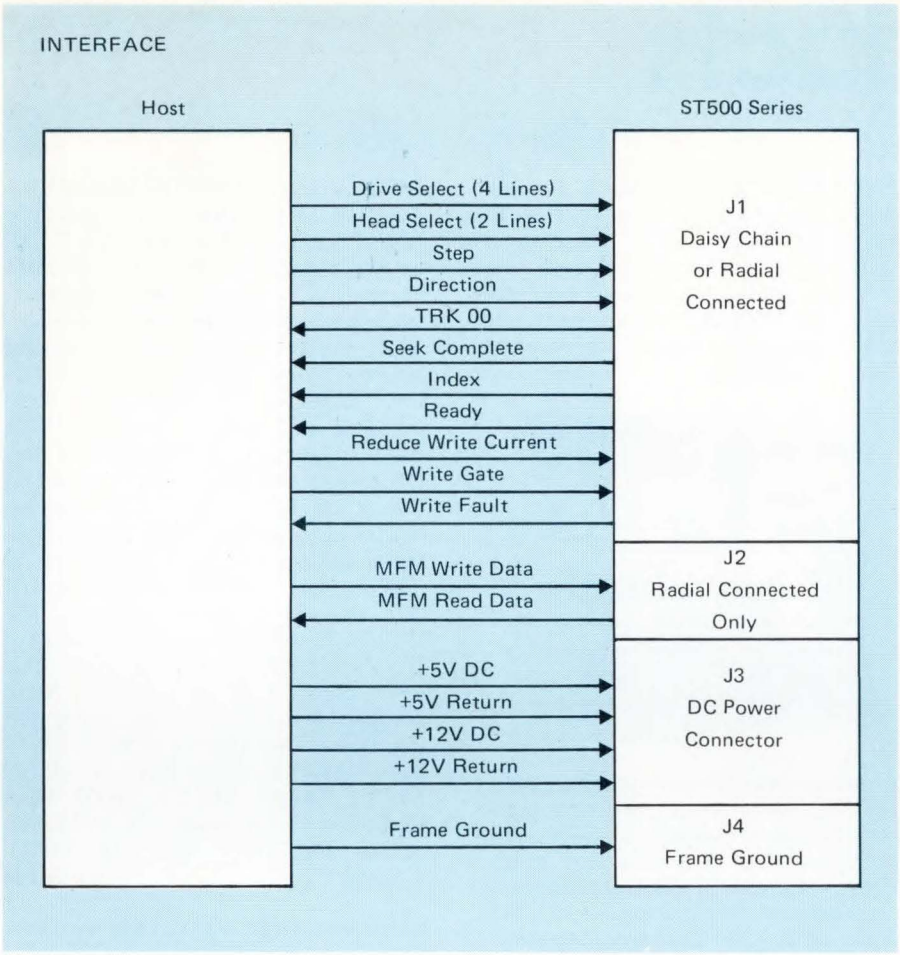
	Shugart Technology ST500	Xerox/Shugart Associates SA400	SA450	SA801	SA851	SA1002
Price Qty. 500	$925	215	325	380	590	995
Capacity Mbytes	6.380	.219	.438	.800	1.600	5.330
Cost/Mbyte	$145	981	742	475	369	187
Trk-Trk/ Avg. Access	3ms/170ms	25/298	25/298	8/211	3/91	19/70
Data Rate Mbits/sec	5.0	.25	.25	.500	.500	4.34
Rec Density Inside Trk (BPI)	7690	5162	5456	6400	6816	6270
Track Density (TPI)	254	48	48	48	48	172
Power Dissipation (Watts)	30	13	14.5	80	57	150
AC	no	no	yes	yes	yes	yes
DC	+12+5	+12+5	+12+5	+24+5 −5	+24+5 −7 to −16	+24+5 −5
Weight lbs.	3	3	3	13	13	17
Track Capacity FORMATTED (Kbytes)	8.2	5.1	5.1	8.2	8.2	8.2

Above offers a comparison between other low cost memory peripherals from Shugart Associates and the Shugart Technology ST500 Micro-Winchester. Shipments of evaluation units will begin in June with initial production units in September.

Historically, disk drive suppliers have, for varied reasons, not standardized on a common interface. Most floppy disk drive suppliers, due to the large market share of Shugart Associates, have now adopted this "Defacto Standard" interface. In order to ease the interfacing problems for customers, Shugart Technology has as close as possible adopted the SA1000 interface, because they feel this will become the industry standard for low-cost Winchester Disk Drives. A controller design that can handle the SA1000 can, with a few minor modifications, handle the ST500 Micro Winchester. Due to the similarity of interfaces, a single controller can more easily be designed to handle the ST500 and floppy disk drives for back-up and I/O.

Back-up

The need to "back-up" the data base that is being utilized by the computer is widely accepted. This function has been performed on computer systems ever since the first computer. Since



both the software and data bases could be destroyed by many means it is generally preferred to keep a duplicate copy external to the system. However, the frequency of back-up has been determined mainly by the reliability of the hardware in the system, how often the data base is modified and the size of the data base. Typically, the entire system disk is backed-up daily, even though only a small portion of the data is used. Additional disk drives and disk packs were required which adds significant costs to a system. Quite often, loss of the data resulted from the physical handling of the disk packs themselves and contamination. Winchester technology eliminates contamination and handling problems.

Back-up methods currently being proposed to back-up Winchester disk drives are floppy disks, tape cartridges, streaming tape drives and even additional Winchester disk drives. Each of these may be a viable alternative depending on cost, applications and size of data bases to be backed-up. Shugart Technology proposes that the floppy disk is the optimum back-up device for low cost systems with data bases under 15 megabytes. In particular, for the Micro Winchester, it would require only six minifloppy diskettes to back-up the entire ST500 Micro Winchester, and even less if the customer backs-up only transactions that have been affected that day. The similarity in size, interface and voltage requirements of the ST500 Micro Winchester and the minifloppy disk drive makes them the ideal architecture for low cost systems design.

The company

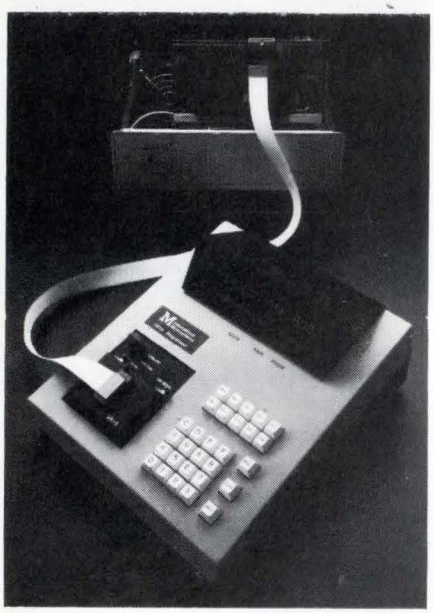
Shugart Technology, Scotts Valley, CA, was founded in October 1979 by two former founders of Shugart Associates, Al Shugart and Finis Conner, to design, manufacture and market a 5 1/4″ Micro-Winchester Disk Drive to low-cost systems manufacturers. These include small business systems, WP, and mini/micro computer systems. Shugart Technology should not be confused with Shugart Associates, A Xerox Company. Although Al Shugart and Finis Conner were among the co-founders of Shugart Associates, they no longer have any connection with their old company.

For more information, write to Shugart Technology, 340 El Pueblo Rd., Suite C, Scotts Valley, CA 95066.

Circle 154

New Products

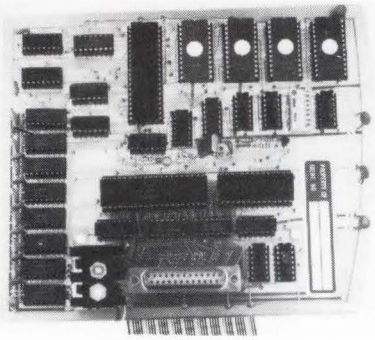
PROM EMULATION PERSONALITY MODULE for the IM1010 PROM programming system allows users to effortlessly test and change programs before commiting them to PROMs, saving engineering time and significantly speeding up product development. ROSI has a 4Kx8 RAM for emulation which means for example, that one



2732, two 2716's, or four 2708's can be emulated. The 4Kx8 RAM also allows PROM addresses to line up with RAM addresses. A switch is provided to relocate the first address of the emulation PROM on any 32 byte ROSI boundary. $500-1995. **International Microsystems, Inc.**, 11554 "C" Ave., Auburn, CA 95603. **Circle 289**

LINE PRINTER CONTROLLER With DMA to interface with Data General's Nova and Eclipse computers, DLP 2200 supports Centronics, Dataproducts and other printers emulating these interfaces. The new controller may also be used with other computers that emulate Data General's Nova and Eclipse. DLP 2200 features a unique SELF TEST mode. when activated, a 96-char. ASCII set is sent to the printer for 132 col. to test operate the controller, cable and line printer. The SELF TEST routine simplifies installation and trouble-shooting of controllers. DIP switches select any of 64 device codes for controller configuration. DLP 1200, $805; DLP 2200, $1,500; Programmable Interval Timer option, $500; Long Lines Option, $200. **Datasystem Corp.**, 8716 Production Ave., San Diego, CA 92121. **Circle 253**

POWERFUL INTERFACES for text processing and plotting include Word/Character Manipulation – auto superscripting – (multi level), auto subscripting (multi level), auto boldface, auto shadowprint, auto underline, auto overstrike, word wraparound. Line Manipulation – bidirectional



printing, bidirectional tabbing, direct tabbing, saved spaces, auto backspacing, auto insertion of backspaces. Also includes: Page Manipulation, Printer Control, Plotting, Twintrack/Widetrack Applications. **Data Capital Co.**, 702 Whitney St., San Leandro, CA 94577. **Circle 286**

WINCHESTER DISK DATA STORAGE UNIT Interfacing with a single cable to all Intel MDS models, the new MicroSupport™ Model 105 Data Storage Unit, (10 M) reads Intel formatted disks. Environmentally sealed and exceptionally reliable Shugart 8-inch Winchester disks enable storing 20 times more data than floppy disk. Unit also provides operating speeds up to 20 times faster than currently available with Intel systems.

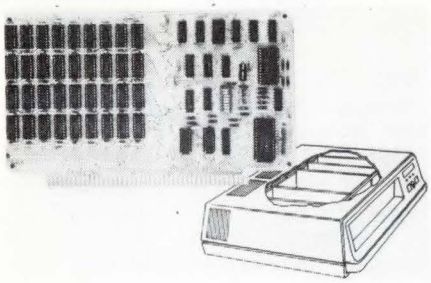
Has built-in error correction, microprocessor based controller and power supply. Company officials say that the new Model 105 add-on memory unit offers to Intel MDS user an economic, viable alternative to having to buy the newer Series II Intel MDS when additional data storage capabilities are needed. They added that the new unit can extend the life of their present system and, in fact, make it technologically superior to the newer Intel cartridge disk. **Advant, Inc.**, 696 Trimble Rd., San Jose, CA 95131. **Circle 300**

EMULATING DISK CONTROLLERS. The EDC24 for LSI-11s interfaces any LSI-11 having a Qbus interface to one or two Storage Module Drive or SMD-compatible drives. This quad-size singleboard controller emulates several DEC disk subsystems, including RK06/07 and RM02/03. The EDC24 also emulates MiniComputer Technology's own SMC11 controller. Features include: (1) 32-bit ECC for data error detection/correction, correcting bursts up to 11 bits; (2) CRC for header error detection; (3) single-command multiple-sector transfers up to 64K words; (4) selectable DMA throttle rate and (5) 3-sector buffering. The EDC22 Emulating Disk Controller for DG Nova and Eclipse or compatible CPUs controls up to 4 SMD or SMD-compatible drives. The EDC21 Emulating Disk Controller for DEC PDP-11 has a Unibus interface. EDC24, $4500; EDC22, $4400; EDC21, $4500. **Mini-Computer Technology**, 2470 Embarcadero Way, Palo Alto, CA 94303. **Circle 294**

WIDE BELTBED PLOTTER with vertical plotting surface, this unit operates like a drum, but provides plot size of a flatbed. Like a drum it moves paper under the pen, as well as pen over the paper. Like a flatbed, however, it plots on cut sheets of paper up to 52″ wide and 80″ long (cut sheets are taped to a Mylar belt running between the drum and idler roller). The new plotter, Model 970, operates at up to 30″/second with 2G acceleration and has a

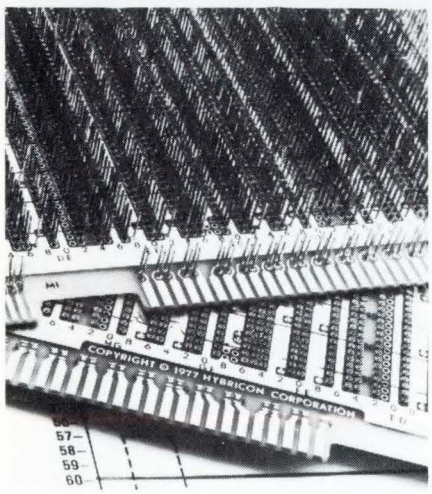
drawing resolution of .00049″. Four pens plot in multiple colors and line widths. System operates online, offline, and in remote/timesharing environments. Speeds up to 9600 baud. Priced at less than $51,000. **CALCOMP**, California Computer Products, Inc., 2411 W. LaPalma Ave., Anaheim, CA 92801. **Circle 297**

NEW RAM CARD FOR EXORCISER This 64K dynamic RAM micro-module is designed for the Motorola EXORciser* and other EXORciser* bus compatible systems. Designated the M64EX, the memory module features transparent refresh and optional parity check. Unit includes an exclusive address translator circuit that accommodates program-controlled memory allocation, a feature useful in applica-



tions such as multi-tasking. The M64EX permits any combination of 4K blocks of RAM – within the upper 32K-bytes of memory space – to be enabled or disabled with an on-board DIP switch. Prices: 64K RAM $875, with Parity Check $1,025. 48K RAM $795, with Parith Check $945. **Percom Data Co.**, 211 N. Kirby, Garland, TX 75042. **Circle 299**

WIRE WRAPPABLE BOARDS. The 4-DE2-VHF, 4-DE4-VHF and 4-DE6-VHF are fully compatible with DEC's hardware. They are in the popular Hybricon 4-Format style which is selectively loaded with screw machined socket pins, thus requiring no DIP sockets. These boards exhibit the unique advantages of all of the Hybricon VHF boards with such features as: continuous, very high frequency ground



plane, additional secondary ground plane, multiple power busses, complete versatility for intermixing all size DIPs and discrete components in any configuration; and, unmatched, low noise and high-frequency performance. $146.95-$395. **Hybricon Corp.**, 410 Great Rd., Littleton, MA 01460. **Circle 293**

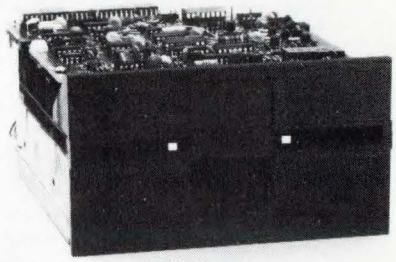
VT-52 EMULATOR. The "concept 520" family emulates the std. features of the VT-52, including cursor control; left, right, up, and down; home cursor; direct cursor addressing; reverse line feed; clear functions; and alternate keypad mode. Each of the four members of the "concept 520" family is totally compatible with DEC software. $1675 (1); $1330 (75). **Human Designed Systems, Inc.**, 3700 Market St., Philadelphia, PA 19104. **Circle 282**

FIBER OPTIC MODULES. Model T-6006 transmitter module uses a high-brightness IRED while the T-6056 receiver module uses a high-sensitivity PIN photodetector. A fiber optic pigtail is provided with each module to allow connection to the main fiber optic cable. The user can specify the ITT fiber type to be used as a pigtail. Applications for the modules include data busses, industrial controls, monitoring links, computer interconnect links, and for communications within a building or from building to building.

When used with the proper ITT optical fiber, these modules handle data rates ranging from zero data transmissions (true DC operation) to 5 Mb/s NRZ over optical cables as long as 1.5 km w/o repeaters. Because the modules can operate without requiring that data transitions be present at the transmitter input, arbitrarily long strips of TTL HIGH or LOW data, or even data bursts can be accommodated w/o rcur. DC drift problems. $750. **ITT, Electro-Optical Products Div.**, 7635 Plantation Rd., Roanoke, VA 24019. **Circle 288**

LOW COST PRINTER COMBINATION PACKAGE Unit combines word processing software, interface board, and letter quality, 55 cps parallel printer. Increased printing speed and optional, convenient twin-sheet feeding are featured. Other features of the Micro-Pro/NEC System include capability of simultaneous use of high speed line printers and dual synchronous/asynchronous serial ports with FIFO buffering to prevent loss of keystrokes during disk I/O and MP/M task switching. Eight-level interrupt controller and dual interval timer circuitry included. Available from nearly 300 dealers at $3195, the entire printer subsystem comes assembled, tested and with full factory guarantee. **Micro-Pro International Corp.**, 1299 Fourth St., San Rafael, CA 94901. **Circle 298**

MINI-FLOPPY DRIVES. With up to 1 MB (unformatted) storage and 3-ms track-to-track access time, TM-100 consists of four models – two single-head (TM-100-1 and TM-100-3) and two double-head models (TM-100-2 and TM-100-4). The TM-100-1 drive features storage capacity of 250KB (unformatted), 40 tracks/diskette, and recording density of 5535 BPI. The



TM-100-3 has an unformatted storage capacity of 500KB on 80 tracks/diskette, and a recording density of 5535 BPI. TM-100-2 has 80 tracks/diskette and recording density of 5877 BPI; TM-100-4, 160 tracks/diskette and 5877 BPI recording density. TM-100-1, under $200. **Tandon Corp.**, 933 Oso Ave., Chatsworth, CA 91311. **Circle 277**

PRINTERS. The 4520 is a bi-directional printer with a printing speed of 100 cps. Its noise level is under 60 dB (A), is μP-controlled, has a 100% duty cycle, is 9 X 9 matrix and accommodates paper roll or fanfold. Either serial or industry std. parallel interface is included with the 4520. Under $1000. The 4542 ($4000) printer provides the full graphic capability and micro step control of Facit's unique 9 x 9 matrix Stored-Force Flex Hammer Head. It features two-color print-

out, gray scale and proportioned spacing, which increases the thruput to more than 250 cps. The 4042 is a compact reader/punch table top unit ($2500) based on the Facit 4030 reader and the Facit 4070 tape punch. **Facit, Inc.**, 66 Field Point Rd., Greenwich, CT 06830. **Circle 292**

New Products

NEW 3-D OPTION FOR STANDARD GRAPHIC DISPLAY. A terminal that displays three-dimensional, rotating images with perspective projection as an option to its standard terminal was demonstrated by Sanders during the NCC. The demonstrations included a 3-D view of a rotating clock with moving hands, gears and pinions. Operators were able to stop the rotation and view the clock from any angle; reset time and rotate the clock at different speeds. The display was shown on Sanders Model 5753 coordinate converter plugged into a standard Graphic 7 terminal system. Objects can be defined within a 64K (X) by 64K (Y) by 32K (Z) image space and presented on a 1K screen or any portion thereof. 3D windowing, in conjunction with independent screen coordinate mapping, allows the presentation of any data within a software definable X,Y,Z, image space to be presented on the full screen or any portion of the screen. Model 5753 Coordinate Converter Option is $9,600. A graphic 7 system with 3-D coordinate converter and keyboard display, data entry devices and computer interface is available in OEM quantities for under $30,000. **Sanders Associates, Inc.**, Daniel Webster Hway. S., Nashua, NH 03061. **Circle 153**

OCTAL DRIVERS FOR MOS RAM. These octal dynamic memory drivers have three-state outputs. The devices are designed and specified to drive the capacitive input characteristics of the address and control lines of MOS dynamic RAMS. The Am2965 and Am2966 are pin-compatible with the popular inverting 'S40 and non-inverting 'S244. An internal collector resistor in the lower output driver controls the output fall and undershoot without slowing output rise. The upper output driver has a rise time symmetrical with the lower output's controlled fall time. This allows optimization of dynamic RAM performance by minimizing skew between upper and lower drives on the same chip. The Am2965 and Am2966 specify propagation time of approximately 10nsec with a 50pF input capacitance and 26nsec with 500pF. Output-to-output skew is typically less than +0.5nsec. Typical power consumption of these 20-pin, +5Vdc only parts is 450mW. Both devices undergo 100% product assurance testing to MIL-STD-883. These drivers are available at prices starting at $4.80 in 100-unit lots for a molded DIP. Delivery is off the shelf. **Advanced Micro Devices, Inc.**, 901 Thompson Pl., Sunnyvale, CA 94086. **Circle 186**

WINCHESTER BACKUP. This unit features software transparent operation to host processors and system emulation of original manufacturer disk subsystems. In its Winchester backup combination, the DEC user can get an 80 M (unformatted) Winchester drive and an 80 M (unformatted) removable storage module device with the Computroller V, which allows both to transfer at 1209 up to K/bytes per second, for about $23,000. The systems for the Unibus systems are designated DD-786W. Similar systems are available for Data General and Interdata processors. This extended capability of the Computroller V is available in all current models including those in use, and meets a couple of obvious requirements for Winchester. One as a workable backup to Winchester drives; the other is for a cost-efficient combination that will also work with the large data capacity that will eventually be available on Winchester drives. Besides software transparency, Diva Computroller V handles up to 8 disk drives per unit, with total capacity of 300 M per drive, up to 1209 K/s transfer rate, internal on-the-fly error correction and self-check routines. **Diva, Inc.**, 607 Industrial Way West, Eatontown, NJ 07724. **Circle 192**

ITEM NO.
WK-7

CMOS SAFE

IC INSERTION/EXTRACTION KIT

KIT INCLUDES

- MOS-1416 14-16 CMOS SAFE INSERTER
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- EX-1 14-16 EXTRACTOR
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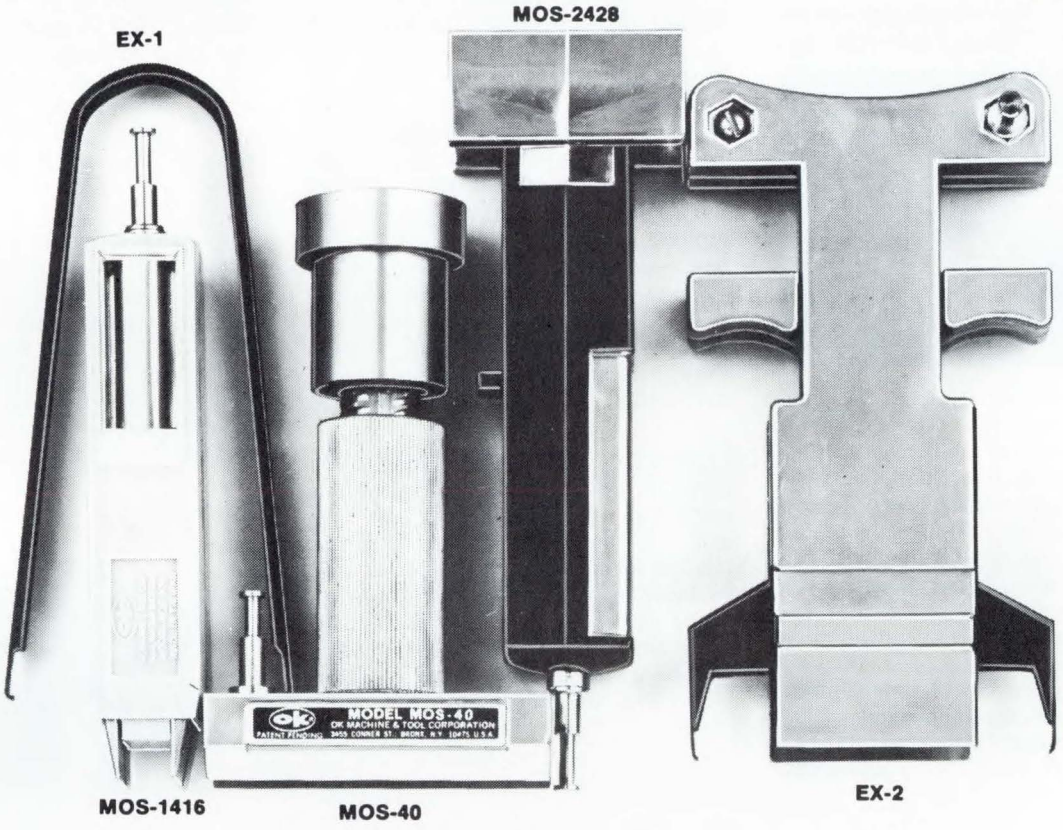

WK-7	COMPLETE IC INSERTER/EXTRACTOR KIT	$29.95

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EX-2	24-40 PIN CMOS SAFE EXTRACTOR TOOL	$ 7.95

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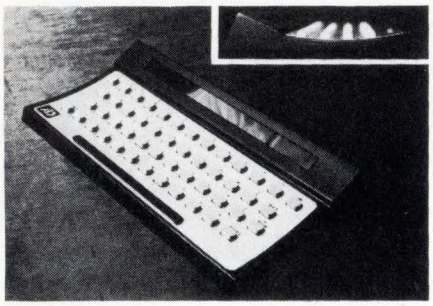
Circle 38 on Reader Inquiry Card

New Products

NEW KEYBOARD TECHNOLOGY A new series of custom keyboards which offer previously unavailable styling, cost and sealing capabilities in a microprofile mode. The new "Microkey" series has: Unique keytop button appearances; 0.060 inch key travel (Button II Series), Soft, 2.5 ounce operating touch (Button II Series); Uniform, crisp, tactile feedback from each key; Sealing of all contact areas from dust and liquids; Price of less than $.50 per key for non-encoded outputs. The line is available in five styling and actuation series called Basic, Environmental,

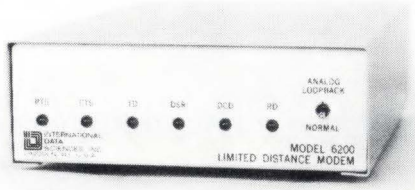


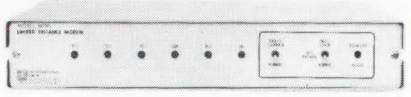
Button I, Button II, and Designer Series. Keyboard bezel, legend overlay, and keytop buttons can be customized to provide a unique look for new equipment. The printed legend sheet allows legend sets to be easily modified for different applications with little tooling expense. Pricing scaled to size of keyboard and number of installed electronic devices. Typical pricing for an AID non-encoded, 70 key array is less than $30 for 1000 piece lots. **Advanced Input Devices,** P.O. Box 1818, Coeor d'Alene, ID 83814.
Circle 135

FREE 24-PAGE APPLICATION NOTE ON LCD. An 8-page data sheet and a 24-page application note can aid designers in using this one-line, 40-character, 5 X 10 dot matrix LCD system. The LX140 is designed for optimum readability in high ambient light. It is a rugged, low-powered, low-voltage display system that interfaces directly with a microprocessor through a single peripheral device. The data sheet includes optical and electrical operating characteristics, pinouts, read and write cycle timing diagrams, character cell address organization, package dimensions, and a polar plot showing the viewing cone for various contrast ratios. The 24-page application note adds more detailed information. Data sheet and application note are both available from Kylex at no cost. The LX140 itself sells for $199 in quantities of 100. **Kylex, Inc.,** 420 Bernardo Ave., Mountain View, CA 94043.
Circle 134

DATA BASE ACCESS WITH DESKTOP COMPUTERS Users of desktop computers with an IEEE-488 interface can now access census data, mapping data and other large data bases available commercially or from government sources on nine- or seven-track tape. Dylon 2001 and 9001 half-inch tape systems provide IEEE-488 (GPIB) desktop computers with fast access to information which may be available only on nine- or seven-track tape. Once the IEEE-488 desktop computer user has the half-inch magnetic tape, he can read selected files or records, such as census tract demographics, into the desktop memory. A dedicated Z-80A microprocessor manages the IEEE-488 bus interface, formatter and tape transport functions within the system. Systems are configured in a variety of reel sizes and densities, with tape speeds up to 75 ips. Data transfer rates can be greater than 100,000 bps. The Dylon systems can accommodate lengths up to 16,384 characters and storage densities up to 40 M on one reel of tape. Prices start at $7,995. Delivery, 60 days. OEM and quantity discounts available. **Dylon Corp.,** 3670 Ruffin Rd., San Diego, CA 92123.
Circle 136

LIMITED DISTANCE MODEMS. Unit is designed for asynchronous operation over TELCO or private 2- and 4-wire non-loaded metallic (twisted-pair) conductors at speeds up to 9600 bps. Used in both point-to-point and multidrop network configurations, suited for local data distribution up to 7 miles using 26-gauge wire. The modem employs a pulse

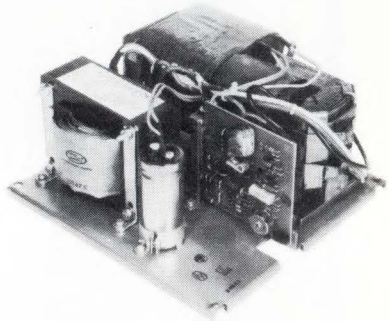




modulation scheme that varies the transmit signal polarity on a balanced line. Transmit and receive lines are transformer coupled; no DC continuity is required. $300. (A 20 mA TTY Current Loop interface is also available.) Company also offers another model for synchronous operation. **International Data Sciences, Inc.,** 7 Wellington Rd., Lincoln, RI 02865.
Circle 138

"CONSTELLATION" MULTIPLEXER Transforms 2 to 64 personal computers into an interactive multi-user network sharing high speed access to up to 40 million bytes of Corvus hard disk capacity. Computers in a CONSTELLATION network can share peripherals, such as a common printer, and communicate in a fully interactive mode. The CONSTELLATION host multiplexer contains hardware that polls up to 8 computers. A two-level network containing up to 8 host multiplexers connected to a central multiplexer allows up to 64 computers to share the disk. Total capacity of disk system is up to 40 M (four 8″ Winchester disk drives). Any personal computer compatible with the standard Corvus disk system is compatible. $750. Interfaces begin at $235. Delivery in 30 days. **Corvus Systems,** 2029 O'Toole Ave., San Jose, CA 95131.
Circle 140

A.C. LINE CONDITIONER Providing 2,000 VA of regulated and filtered power from a 90 - 130 VAC source, this unit regulates live charges at ± 1% and ± 1.5% for load changes of 25% to 100% load. Power efficiency is up to 90% at full load and operates with natural convection cooling in ambients of from 0 to 55°C. Output voltage is



120 VAC adjustable ± 3%. Model C474 also provides regulation and filtering, supplies high surge current ratings, has no semiconductors in the AC path and is U.L. recognized for use in data processing equipment. $374.20 in 1-9 quantity. **Adtech Power, Inc.,** 1621 S. Sinclair St., Anaheim, CA 92806.
Circle 139

IMAGE PROCESSING LIBRARY This Image Processing Library has 11 2-D filtering convolution and FFT routines. The library provides computational tools to filter and enhance monochrome color, and multi-spectral scanner images. Routines are written in highly efficient AP Assembly Language, but callable from host FORTRAN. $500. 60 days ARO. **Floating Point Systems, Inc.,** Box 23489, Portland, OR 97223.
Circle 250

From concept...to prototype...to production. Faster. With Multiwire® circuit boards.

Just give us a net list and board layout. You'll get a computer-generated design, prototypes, and delivery of production boards in a fraction of the time you would expect.

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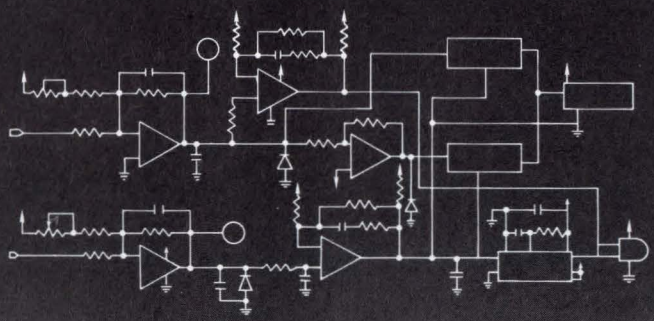

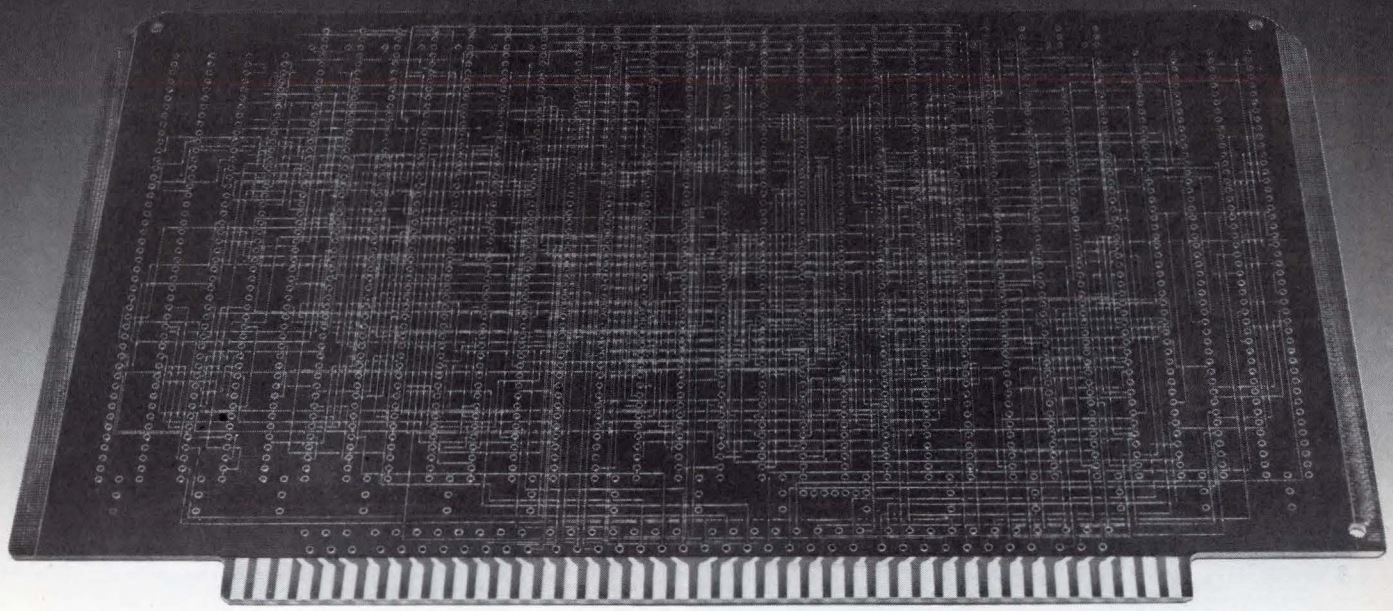

Licenses to design and manufacture Multiwire circuit boards are available from PCK Technology Division, Kollmorgen Corporation, 31 Sea Cliff Avenue, Glen Cove, NY 11542. Phone: (516) 448-1166.

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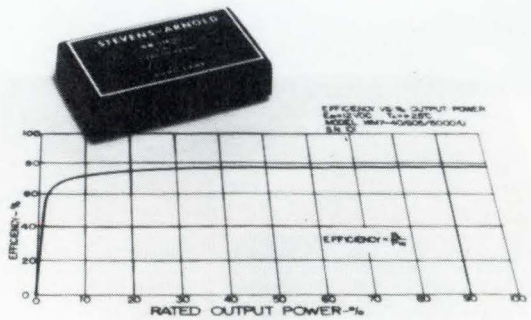
New Products

THREE BAND-PRINTER OPTIONS MADE STANDARD. Three, previously optional, 3000 Series band printer features have been made no-cost standards on Data Printer's three-model family. The three now-standard features are a 6/8 lpi selector, a multiple forms length adjustment and a paper motion detector. The 6/8 lpi selection allows more horizontal lines of print to be compressed within the vertical inch in which six lines of print are traditionally allowed. With the forms length control feature, users of Data Printer's 3000 Series may adjust the printer's memory to accommodate up to 16 different forms length settings of from 3 inches to 18 inches. The paper motion detector constantly monitors the flow of paper through the printer and automatically stops all printing if a paper jam occurs. Cirrent single OEM prices are $4740 to $6470. **Data Printer Corp.**, 99 Middlesex St., Malden, MA 02148. **Circle 160**

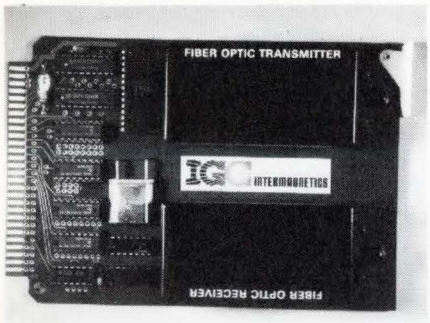
10-BIT, 20 MHz A/D CONVERTER. With this device users can double sample rates in radar digitizing applications, greatly improve picture quality in digital television applications by increasing grey scale resolution by a factor of four, digitize baseband signals in secure communications applications, and extend spectrum analysis bandwidths by a factor of 100 over presently available systems. The MOD-1020 A/D converter utilizes monolithic and hybrid technology to implement a digitally-correcting subranging (DCS) scheme. The MOD-1020 includes all circuitry necessary for a complete, 10-bit accurate conversion, such as track-and-hold, encoder, timing logic, references and output latches. Only power supplies and an encode command must be furnished to perform conversions. Packaged on a 7″ x 5″ x 0.5″ PC card, MOD-1020 is available from stock. $1,795 in quantities of 100. **Analog Devices**, Computer Labs Div., 505 Edwardia Dr., Greensboro, NC 27409. **Circle 234**

DC/DC SWITCHING REGULATOR This unit delivers 5VDC @ 5A of logic power from a nominal 12VDC input over a 7VDC to 40VDC input range. No extreme parameter degradations appear over the total input range. Efficiency remains within a few % of the 75% (@FL) figure over the entire input range and is virtually flat from 1/2 to FL. Surface temperature rise above T_A is only +4°C/package watt dissipated. When fully loaded, the case temperature rise



above T_A will only be +25°C. There are no external heat sinks required nor derating necessary over the −25°C to +71°C ambient operating temperature range. The WM7-40/505/5000AJ undergoes 100 hours of burn in. The 5V model also has standard O.V.P., short circuit current limiting and remote sensing with protection against disconnection. Delivery: Stock to 12 weeks. Price: 1-9 pieces, $89.00; 100's, $73.00. **Stevens-Arnold, Inc.**, 7 Elkins St., South Boston, MA 02127 **Circle 197**

FIBER OPTIC INTERFACE CARD. This STD bus card provides a single full duplex fiber optic serial I/O port which can be used to transmit data in electrically noisy environments over distances up to 0.5 km. Separate transmit and receive fiber optic connectors are provided at the card top and are compatible with a wide variety of optical fibers. Mating connectors and fiber optic cables are available as options. The single duplex channel operates at programmable Baud rates from 110 to 48K. The card may be



used in a system with separate mating fiber optic transmitter and receiver or with a second serial fiber optic card. The fiber optic interface meets all mechanical and electrical standards for the STD bus, is compatible with Z-80, 8080 and 6800 systems, and requires a single +5 volt power supply. **Intermagnetics General Corp.**, Box 566, Guilderland, NY 12084. **Circle 278**

F8/3870 CROSS ASSEMBLER FOR CP/M for the F8/3870 runs under the CP/M OS used with the 8080, 8085 or Z-80. Source code input is in a form similar to source code input for MAC or ASM. The optional output consists of list and/or object files. The listing file paginates, prints page headings, and produces a symbol table. The object file is in a format ready to down-load into a Fairchild or MOSTEK Development System. Cross Assembler on a single-density 8″ floppy disk. $200. **Warner Associates**, Box 134, Los Gatos, CA 95030. **Circle 291**

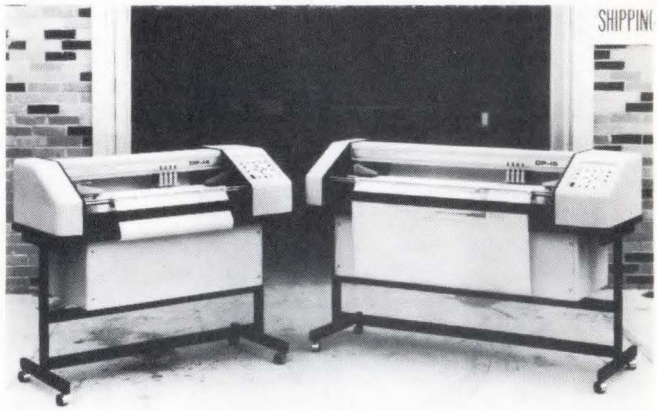
PASCAL. Micro Concurrent Pascal (mCP) is a structured systems implementation language for both minis and μPs which cuts program development time 50%. mCP permits development of complete OSs; it provides process, monitor and class constructs of Concurrent Pascal and introduces the device monitor construct. The device monitor construct permits hardware interaction directly from mCP; device drivers and interrupt handling are accomplished through device monitors written entirely in mCP. Run-time errors may also be handled directly in mCP. Run-time object for Intel Development Systems (ISIS), $1200. **Enertec, Inc.**, 19 Jenkins Ave., Lansdale, PA 19446. **Circle 272**

MULTI-USER, HARD DISK OPTIONS This 6809-based series of Chieftain Business Systems features multi-user and 20 megabyte hard disk options. The hard disk provides 10M of fixed and 10M of removable storage and can be accessed by up to 4 users. By incorporating the 6809 microprocessor, users can run applications programs written in BASIC at over two and one-half times the speed of comparable 6800-based computers. A wide range of programs are available for business applications including Payroll Processing, Inventory Control, Accounts Payable, Order Entry, Accounts Receivable, Invoice Entry and General Ledger. The Chieftain Business System's basic configuration also includes a 1920-character video display terminal and either a high-speed line printer or letter-quality daisywheel printer. Word processing software is standard. Single quantity prices range from $5,000 to $8,400, depending on disk storage and printer, with 30 day availability ARO. The hard disk and multi-user options are an additional $8,500. Dealer and OEM prices are available. Delivery 30-60 days ARO. **Smoke Signal Broadcasting**, 31336 Via Colinas, Westlake Village, CA 91361. **Circle 296**

New Products

NEW CATALOG FOR SYSTEMS DESIGNERS This 14 page booklet describes a new generation of I/O Systems from Opto 22. The addressable boards, PAMUX for local job site monitoring and control in a parallel I/O configuration, and SAMUX for remote job sites via a serial communication linkage, feature Opto 22's optically coupled power I/O modules for industrial interfaces. Both PAMUX and SAMUX have on-board switch selection of address and allow any mix of AC/DC INPUT/OUTPUT power I/O modules. SAMUX offers a choice of RS232, 4-20 ma current loop, RS422 balanced differential or optically coupled interfaces to match the host computer and job site requirements. This free new catalog provides tips on how PAMUX and/or SAMUX can help systems designers. **Opto 22**, 15461 Springdale St., Huntington Beach, CA 92649. **Circle 141**

PLOTTING SYSTEMS. The CPS 14/15 systems offer a std. 4-pen plotting capability (10 or 15 ips) under program control and produces 4-color drawings in sizes A, B, C & D on paper, mylar or vellum. The plotters are in widths from 22″ to 34″. An optional 12″ drum is available. Both have



up to 172 U & L-case firmware generated symbols. It scales plot size up to 9X original size. **Houston Instrument**, 1 Houston Sq., Austin, TX 78753. **Circle 146**

MINIATURE TOOLS FOR MODEL MAKING. A free catalog illustrates hand-held miniature tools. All motorized, the tools are useful for making prototypes. Solid-state-electronic devices develop high torque at all speeds and are widely used in numerous industrial and hobby applications. Basically the "Miniature Power Tool" is a flexible shaft machine, consisting of a motor which drives a handpiece by means of a protected flexible shaft. Floor or hand control provides continuous variable speed. Hundreds of accessory points permit grinding, carving, drilling, sanding, deburring, engraving, polishing, routing and brushing. **Foredom Electric Co.**, Bethel, CT 06801. **Circle 175**

32K STATIC MEMORY VM832 STATIC Semiconductor Memory is compatible with PDP 8A/8E with a hex-wide expander cabinet. 32K words are available on a single-Hex-Wide PCB. The design provides the CPU with max. speed; there is never any degradation to the system or any STALLS in the memory timing due to refresh logic associated with dynamic memory ICs. 5Vdc, 4.2A. $1850, **Computer Extension Systems, Inc.**, 17511 El Camino Real, Houston, TX 77058. **Circle 147**

BIDIRECTIONAL TOTALIZER Model 822 is suited for a broad range of counting functions in indust. process or product test systems. The full complement of up-down counting functions, with count direction control, are user-programmable. It totalizes 2 inputs (by adding and/or sub-

tracting one from the other based on phase relationship or logic input). It has a 5- or 7-digit LED display. Both offer polarity/overflow indication. Size: 1.89 H X 6.60 W X 6.86″ D. 5 digit $415; 7 digit, $467. **United Systems Corp.**, 918 Woodley Rd., Dayton, OH 45403. **Circle 145**

DATABASE MANAGEMENT SYSTEM The first commercially available database machine for the OEM market. A backend processor, it is packaged in a self-contained, low cost, rack mountable enclosure which provides the customer with a complete database management system based on the relational model of data. The IDM 500 supports multiple databases up to 32 gigabytes total capacity with transaction rates of 2-25 per second. It has been designed to be host-computer independent and to provide data independence between the database and the application programs. All of these features are offered for an OEM quantity price of $15,000 to $50,000. The first public showing of the IDM took place at the Newporter Inn in Newport Beach, CA during the NCC Show, May 19-22, 1980. For a product brochure, write **Britton-Lee, Inc.**, Albright Way, Los Gatos, CA 95030. **Circle 148**

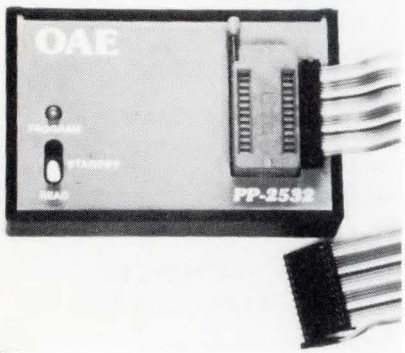
POWER CONVERSION CATALOG. A 46-pg. catalog "An Introduction to Power Line Conditioning," details the complete line of solid state AC Power Conversion Products. It covers high isolation transformers, precision AC line conditioners, UPS, DC-AC inverters and AC power sources/freq. converters. **Elgar**, 8225 Mercury Court, San Diego, CA 92111. **Circle 152**

STREAMING CARTRIDGE DRIVES. This data sheet describes "The Streamer," S-3 Series 10 and 20 MByte Cartridge Mag. Tape Drives. These low-cost tape drives are used for Winchester-disk back-up and use std. 1/4″ ANSI/ECMA tape cartridges and transfer data at a 5-MByte/min. rate. The 10 and 20-MByte drives sell, in OEM quantities, for $746 and $788, respectively. **Data Electronics, Inc.**, 10150 Sorrento Valley Rd., San Diego, CA 92121. **Circle 151**

COLORGRAPHIC HARDCOPY. Aydin now purchases and resells Matrix' Models 2000 and 4000 Color Graphic Hard Copy Photography Systems under Aydin name and warranty. This colorgraphic hard copy equipment enhances Aydin's Color Graphic Computer Systems. These camera systems are compatible to all Aydin display generators. **Aydin Controls**, 414 Commerce Dr., Ft. Washington, PA 19034. **Circle 149**

New Products

PROM PROGRAMMER. The PP-2532 – for the unique 4K x 8, 5V-only, TMS 2532 EPROM – uses a 4′ flat ribbon cable that connects it to any PROM socket via a 24-pin plug. Data is sent over the 8 lower address lines

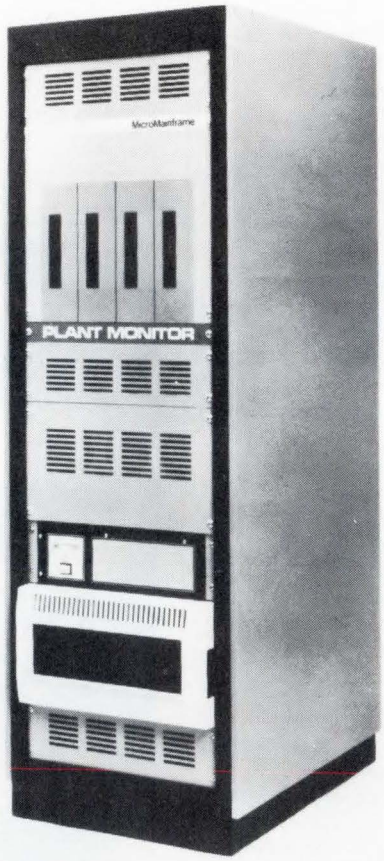


to the programmer. No additional supplies are required, and all timing control sequences are handled by the programmer. $295. **Oliver Advanced Engineering, Inc.**, 676 West Wilson Ave., Glendale, CA 91203. **Circle 290**

"THE ILLUSTRATED DICTIONARY OF ELECTRONICS" More than 800 pages of complete and modern definitions for over 24,000 electronics/computer terms. This comprehensive work will be of immense benefit to anyone connected with electronics. Its 868 pages reflect 80 years of electronic progress. 472 illustrations include wiring diagrams, drawings of various devices and components, charts of pulses and sine waves. Edited by Rufus Turner, the book covers digital electronics, microwave communications, microcomputers, impedance, data communications, physics, integrated circuits, AC and DC current, high-speed switching and control, artificial intelligence, solid-state devices, videographics, etc. $19.95 hb. $14.95 pb. **Tab Books**, Blue Ridge Summit, PA 17214. **Circle 133**

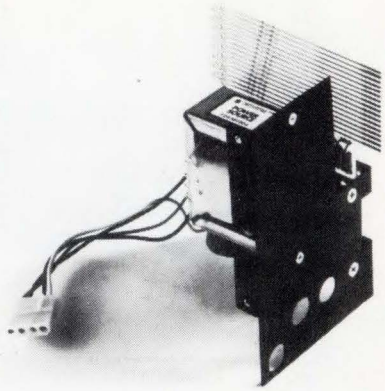
DSD 440 FLOPPY SYSTEM DSD 440 – said to be the only alternative to the DEC RX02 that's 100% software, hardware and media compatible with LSI-11, PDP-11 and PDP-8 (including those with extended memory) – can be configured as an RX02 for DEC double density or IBM 3740 single-density recording, or as RX01 for backward operating system compatibility. A 512-byte hardware bootstrap is built into all PDP-11 and LSI-11 interfaces. It loads system software automatically from either single- or double-density diskettes. Extensive self-testing is DIP-switch selectable with the "Hyperdiagnostics" that run without being connected to a computer. The low profile 5-1/4″ DSD 440 features write protection and diskette formatting. The optimized DSD 440 microcode increases system throughput when using the RT-11 foreground/background monitor. In particular, DSD 440 with an LSI-11 runs and empties buffer operations 20% faster than an RX02. **Data Systems Design, Inc.**, 3130 Coronado Dr., Santa Clara, CA 95051. **Circle 255**

DISK I/O PROCESSING SYSTEM. The F6440 "Cyblok" is an easy to expand disk I/O processor that operates independently within a μP-based mainframe made up of loosely-coupled groups of computational and I/O processors. It can handle up to 8 disk spindles of 80 MB each, expandable to 300 MB each. Serving as a resource element in a dispersed modular data flow architecture, it permits easy adaptation to unforseen memory requirements. As more memory is



needed, additional F6440's simply plug into the system network. Providing a continuous average throughput exceeding 1 MB per sec., the F6440 features a 32-bit wide internal design that allows continuous transfers from more than one disk simultaneously. $22,630. **Functional Automation (Gould, Inc.)**, 3 Graham Dr., Nashua, NH 03060. **Circle 283**

FLOPPY POWER SUPPLY. Model FDF Power Supply has a built-in paddleboard connector with 17 double-ended feed-thrus to facilitate interconnection with any Shugart or compatible 5-1/4″ floppy disk drive. Serving as a 1-to-1 extension of the drive connector, it permits jumper

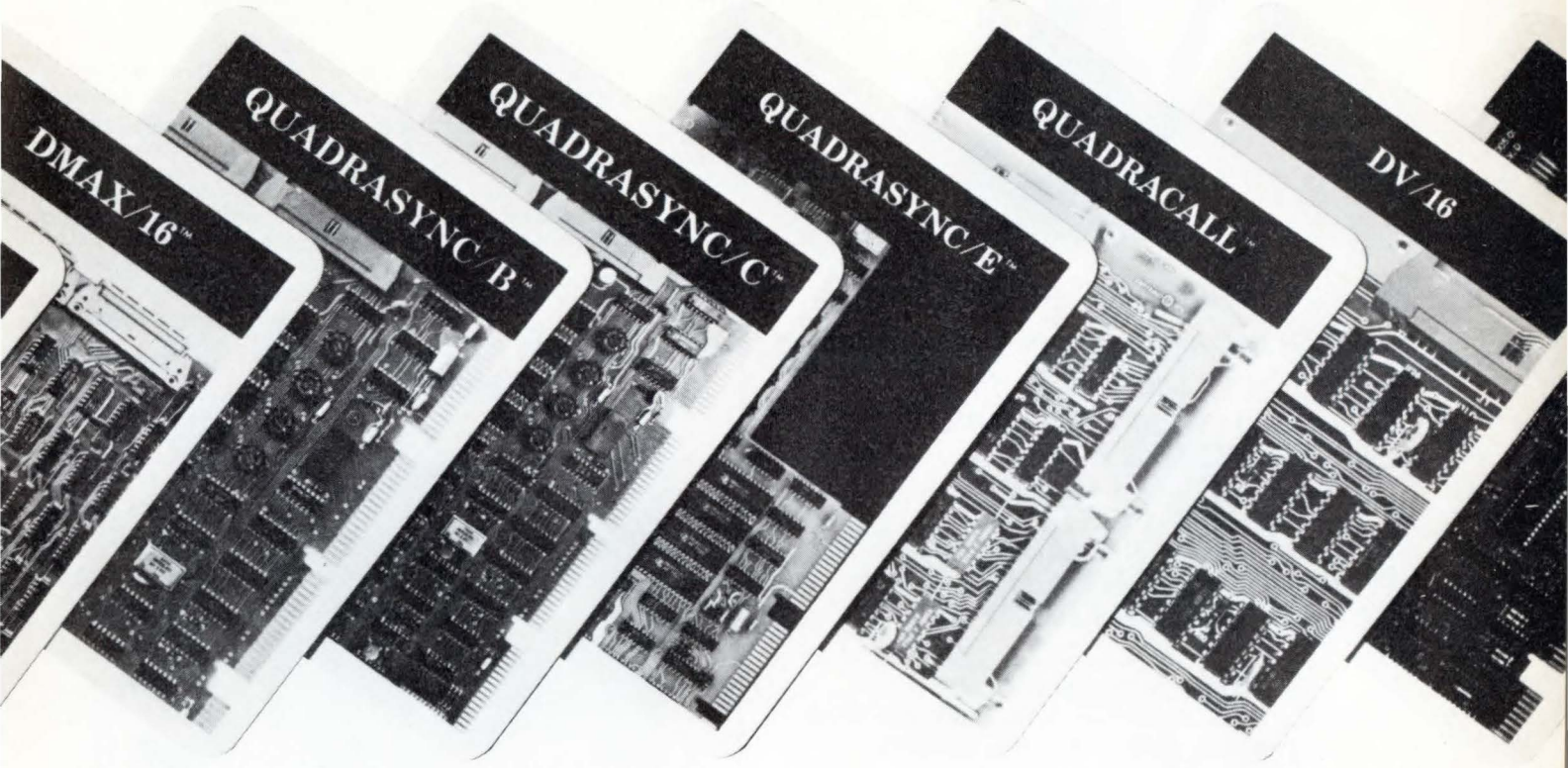


modification of drive address lines external to the drive itself. Equipped with an AMP-type connector, the Semiconductor Circuits Model FDF Power Supply provides outputs of +12Vdc at 1 A (1-1/2 A peak), and +5Vdc at 700 mA; OVP is optional. Measuring 3-3/4″L × 5-1/4″H × 3-3/8″W, it incorporates a 110/220 VAC transformer. $59.95. **Semiconductor Circuits, Inc.**, 218 River St., Haverhill, MA 01830. **Circle 268**

BIDIRECTIONAL DOT MATRIX PRINTER, DS-180, prints at 180 cps using bi-directional, logic-seeking carriage control. Its μP-controlled printhead automatically performs high speed tabs over blank text space and takes the optimum path to the next printable character. Throughput is 500 lpm at 10 cpl and 75 lpm at 132 cps, with typical text printed at 200 lpm. OEM pricing under $1000. **Datasouth Computer Corp.**, 627 Minuet Ln., Charlotte, NC 28210. **Circle 217**

ASYNCHRONOUS TO SYNCHRONOUS CONVERTER This converter permits efficient utilization of a network within the area of low cost asynchronous terminals. The ASCI-1 features increased buffer capacity with increased reliability. The unit operates at data rates of 1200 to 19,200. Loopback switches provide reliable diagnostics for rapidly isolating a malfunction-tion. The low power, C-MOS design allows operation on power from input signals of the terminal and modem. No outside power supply is necessary. $315 with quantity discounts available. Delivery 30-45 days ARO. **Tri Comm Industries, Inc.**, 20 Fitch St., E. Norwalk, CT 06855. **Circle 142**

Hotline to your PDP-11



Able deals a powerful data-communications hand

We've moved well into data communications and already have a fist full of cards that sell for less than the competition but do a lot more. They all will save you space, power, bus loading and money while giving better performance, reliability, flexibility, and convenience. Take a look at the facts, then decide for yourself.

DMAX/16™
(16-LINE DH11 REPLACEMENT)

INSTALLS IN: <half DH11 space. **DATA RATES:** All standard baud rates **plus** 19.2K baud and one user programmable rate (16 baud rates). **PROCESSING ADVANTAGES:** Word transfers (in lieu of byte DMA) cut processing overhead by half! **OPERATING MODES:** Full or half duplex with full modem control via DM/16 option. **CAPACITY:** Up to 256 lines on a single PDP-11 at 2 bus loads per 16-lines.

QUADRASYNC/B™
(4-LINE DL11 REPLACEMENT/EIA)

INSTALLS IN: 1 SPC slot, 4 lines at 1 bus load. **DATA RATES:** 7 selectable rates for any of the 4 lines (150-9600). **ELECTRICAL:** EIA standard RS232C (Modem control not supported). **VECTOR/ADDRESS SELECTION:** Vector and address values to be set on boundaries of 00_8 to 40_8. 16 continuous word address for Vector or Address.

QUADRASYNC/C™
(4-LINE DL11 REPLACEMENT/CL)

INSTALLS IN: 1 SPC slot, 4 lines at 1 bus load. **DATA RATES:** 7 selectable rates for any of the 4 lines (150-9600). **ELECTRICAL:** 20MA current loop (Send : Receive). **VECTOR/ADDRESS SELECTION:** Vector and address values to be set on boundaries of 00_8 to 40_8. 16 continuous word address for Vector or Address.

QUADRASYNC/E™
(4-LINE DL11-E REPLACEMENT)

INSTALLS IN: 1 SPC slot, 4 lines at 1 bus load. **DATA RATES:** 7 selectable rates for any of the 4 lines (150-9600). **ELECTRICAL:** EIA standard RS-232C with modem control. **VECTOR/ADDRESS SELECTION:** 16 continuous word address for Vector or Address—starting values selected on any boundary.

QUADRACALL™
(4-LINE DN11 REPLACEMENT)

INSTALLS IN: 1 SPC slot, 4 lines at 1 bus load. **PERFORMANCE:** Interfaces up to 4 Bell 801 ACU's with Unibus for autodial link-ups. **INPUT/OUTPUT:** 5-input signals from ACU are handled by EIA RS-232 receivers. 6-output signals are transmitted using EIA RS232 drivers. **VECTOR/ADDRESS SELECTION:** Allows selection of device address and vector by use of pencil switches.

DV/16
(8, 16, 24 or 32-LINE DV11 REPLACEMENT)

INSTALLS IN: <half DV11 space providing byte protocol handling for sync/async communications such as DEC DDMCP, IBM BISYNC, etc. **OPERATING ADVANTAGE:** User may mix sync and async lines in combinations of 4 or 8 lines by on-board switch selection with modem control. Fully software compatible with all DV11 performance features.

Along with our powerful communication package and world-wide product support we have a complete selection of cache buffer memories, Fastbus memories, DMA interfaces, PDP-11 bus repeaters and LSI Q-bus adaptors. Write for details. You'll find out why our customers consider us the leader among manufacturers of PDP enhancements.

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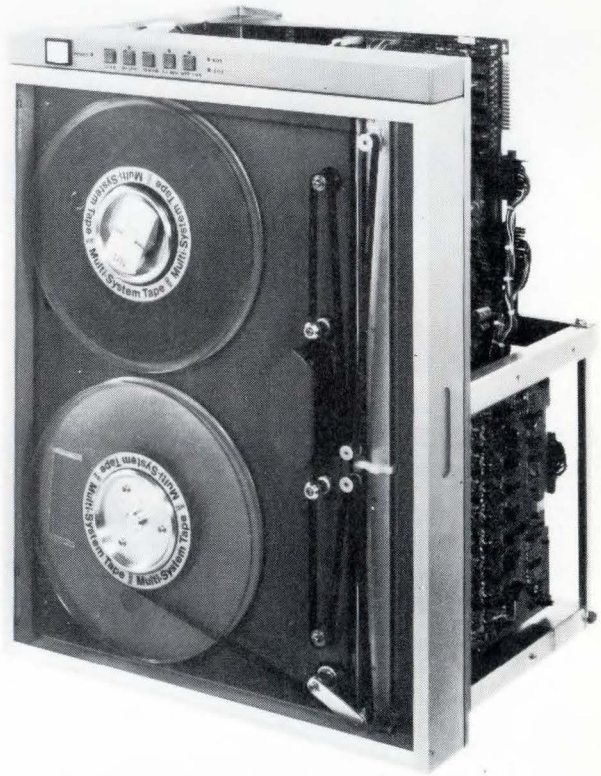
Circle 53 on Reader Inquiry Card

New Products

"FLEX" DOS. This new version of FLEX is available for users of custom or non-std. 6800 and 6809 systems. It is fully compatible with versions of FLEX supplied by several manufacturers. The only major system requirement is a 256-byte, soft-sectored floppy disk. When the adaptation is complete, the user's system will be capable of running any standard FLEX software. $150, disk with editor and assembler, and manuals. **Technical Systems Consultants, Inc.,** Box 2570, West Lafayette, IN 47906. **Circle 150**

MAGNETIC TAPE TRANSPORT. New units include patented low inertia tape tensioning system, 75 ips tape velocity, 300 ips rewind speed, flexible NRZI, PE or Dual Density formats, positive reel lock mechanism and simplified tape loading. A new guide rail hinging drive to a standard 19 inch rack simplifies installation procedure. Tape damage during loading is avoided by addition of new 'soft load' circuitry. Maintainability has been improved by a simplified mechanical parts arrangement. Tape tensioning for TDX Series II is accomplished by a patented low inertial slide mechanism. **TDX Peripherals,** Div. of GAW Control Corp., 150 New York Ave., Halesite, NY 11743. **Circle 132**



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

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Automated Testing for Electronics Manufacturing

January 19-22, 1981, Pasadena Center, Pasadena, CA

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- Economics of Loaded Board Testing
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Abstract deadline August 1, 1980

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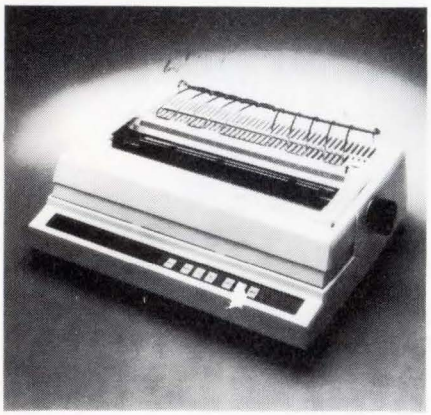
Send abstracts (200-500 words) and short biographies by **August 1, 1980,** to Meg Bowen, **ATE Seminar/Exhibit,** c/o Benwill Publishing Corp., 1050 Commonwealth Ave., Boston, MA 02215. Or call: (617) 232-5470.

(Co-sponsored by Circuits Manufacturing, Digital Design and Electronics Test magazines)

New Products

PRINTER uses plastic/metallized daisywheels interchangeably. Model 630 uses plastic and metallized print wheels interchangeably. Printing speed varies from 32 to 40 cps. OEMs or systems integrators don't have to anticipate the end user's requirements for a metallized or plastic print wheel. Model 630s use all of the more than 100 different Diablo and Xerox plastic and metal print wheels – 88, 92 and 96 characters – in 10- or 12-pitch or true proportional spacing. The new printers also use all HyType II ribbons, including single-color single-strike, multistrike and fabric ribbons, and 2-color fabric ribbons. A variety of paper handling options is offered, including friction and pin-feed platens. $860 (500); $1705, (500). **Diablo Systems Inc., A Xerox Co.**, 24500 Industrial Blvd., Hayward, CA 94545.

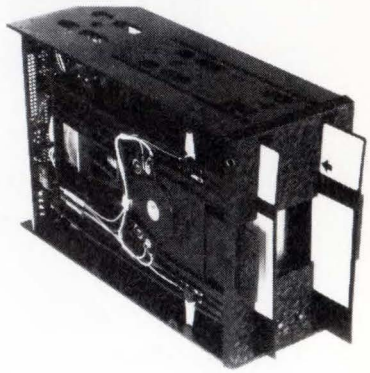


Circle 270

5.25″ FLOPPY DRIVE. This single-sided 5.25″ flexible disk drive, the CDC 9408, is available in single- and double-density versions. Features include formatted capacities of 71.6 KB in single density and 143.3 KB in double-density formats, IBM format compatibility and industry std. mech. and elec. interface compatibility. Head positioning is handled through a band stepper mechanism. $350. **Control Data Corp.**, Box O, Minneapolis, MN 55440 **Circle 284**

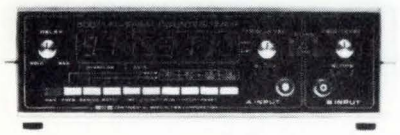
TM990-COMPATIBLE BUBBLE MEMORY. The TM990 board, designated TM990/211, offers up to 768-KB nonvolatile storage capacity. TM990/211 uses the TIB1000 Mbit bubble memory device. The module has an on-board custom controller, TIB0903, which provides complete interface to the TM990 bus. Data transfers are via the CRU mode. The module can do single or multi-page transfers, at a maximum data transfer rate of 85 kbps. The module can be purchased to provide 128k, 256k, 512k, or 768-kbytes of non-volatile storage. Avg. access time is 11.2 ms. $3200-$15,200. **Texas Instruments Inc.**, M/S 308, Dallas, TX 75265. **Circle 281**

TWO 5.25″ FLOPPIES fit in space of one. Model A-40 "DAM" Floppy provides single-side, dual-density recording on 40 tracks of each diskette. Track-to-track access time of 12ms produces a random average seek time of 170ms. Unformatted storage is



256 KB/diskette or 512 KB/drive. Provides backup capability in compact computer systems. $450 (1000). **T and E Engineering**, at 1015 W. 190th St., Gardena, CA 90248. **Circle 280**

COUNTER-TIMER. The 5001 is a time and frequency measuring instrument that performs 5 functions: freq. counting, period and multiple-period averaging, time-interval and multiple time-interval averaging, freq. ratio and unit counting. As a freq. counter, 5001 UCT provides a selection of 4 gate times -0.01, 0.1, 1.0 and 10 sec. and an



8-digit display for a selectable resolution of 100 Hz, 1 Hz or 0.1 Hz, respectively. In each range, the dp is automatically positioned for a direct readout in kHz units. **Continental Specialties Corp.**, 70 Fulton Terrace, New Haven, CT 06509. **Circle 269**

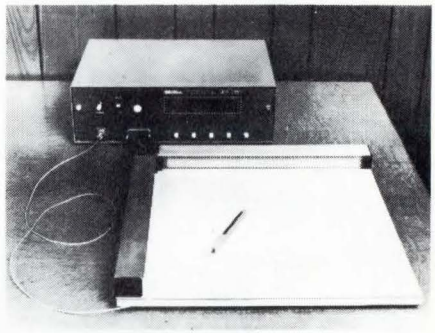
PICTURE DIGITIZER & DISPLAY SYSTEM. The EyeCom II system is a complete image input and display device for quantifying the brightness variations in a scene or image. It features video display, alphanumeric display, graphic overlay, and picture refresh display. Interactive capabilities include: joystick cursor control, alphanumeric keyboard, and 12″ B/W display monitor. The precision video scanner can be easily adapted to scan film or view through a microscope. System resolution is 640x480 (512 for

European systems) elements/field of view, with the brightness range being 256 gray levels (8-bits). **Spatial Data Systems, Inc.**, Box 249, Goleta, CA 93017. **Circle 287**

UCSD PASCAL Adaptable System can be used on 8080, Z-80, 6502, 6800 and 6809 systems that use any type of floppy disk storage, including single or double density, standard or minidisks, and hard or soft sectoring. Programs developed with the UCSD Pascal system are compiled into a universal pseudocode (p-code) that can be executed using the UCSD Pascal interpreter and operating system, allowing the same program to run on a wide range of μCs w/o change. UCSD Pascal Adaptable System is available through licensing agreements with SofTech Microsystems, with quantity discounts. **SofTech Microsystems, Inc.**, 9494 Black Mountain Rd., San Diego, CA 92126. **Circle 285**

FIBEROPTIC PRODUCTS include: an 8-port multiplexer, a high-speed RS-232 asynch. data link, a high-speed RS-232 synch. data link, and RS-232C and TTL-compatible long-distance data links. The MU8-1 multiplexer ($5995) is an 8-port MUXer that transmits 8 asynch RS-232C (V.24) data channels at 20 KBPS/channel. Working with the TTK-D1R fiberoptic interface (also included in the $5995 price), the MU8-1 transmits all 8 channels up to 1-km over a single duplex fiberoptic cable. MU8-1 is also available in a 2-km configuration. Std. MU8-1 features include built-in monitoring and handshaking between multiplexer ends. The MU8-1 is available in either desk top or rack mounted configurations. **Valtec Corp.**, W. Boylston, MA 01583. **Circle 274**

SONIC DIGITIZER incorporates μP. Model GP-6-30 provides origin offset, incremental mode, and alphanumeric ASCII menu capability. Origin offset allows arbitrary establishment of origin anywhere on plane; incremental mode allows elimination of redundant



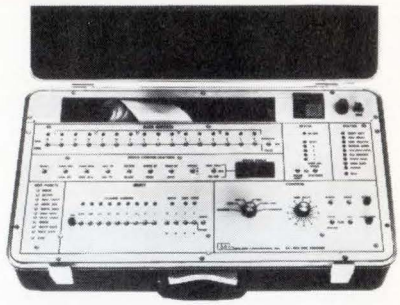
data; menu capability provides simultaneous alphanumeric data entry. Digital display is BCD cartesian (X,Y) coordinates. Output available compatible with RS-232C, HPIB or IEEE 488-1975. **Science Accessories Corp.**, 970 Kings Highway West, Southport, CT 06490. **Circle 271**

New Products

MULTIPLE-WALL HEAT-SHRINKABLE. "Insultite" MW (Multiple Wall) tubing combines proven heat-shrinkable protection with encapsulation to keep out moisture, oils, and corrosive environments. The outer wall shrinks and compresses the meltable inner wall to simultaneously insulate and encapsulate. On cooling, insulation becomes

rigid to provide durable protection. It comes in 8 std. diameters (1/8″ to 1″), in 4′ lengths. The degree of MW shrinkage offers the user insulation/encapsulation protection for a wide range of different shapes and dimensions, with only a few MW sizes required to do the job. **Electronic Chemicals Co.**, Burlington, MA 01803. **Circle 273**

DISK EXERCISER, DX-1000, does complete check-out of Caelus 303 and 306, Dynex 6000 Series, and Diablo 44B disk drives now can be performed by the Wilson Model DX-1000 Disk Exerciser. A series of switch-selectable tests and data exercises can be performed on 2315/5440-type disk drives using the DX-1000. These include restore, seek, seek incrementing, decrement seek, increment or decrement up or down the disk and random patterns of incrementing. Digital readout of seek time in msec, RPM in seconds and sector count, provides a reliable method to insure that the disk drive is operating within factory specs. A seek relay control is provided for setup of adjustments to align the disk drive, and an offset feature permits accurate head positioning. Three basic data patterns are offered: 16 bits of fixed track address data, 16 bits of incrementing data, and 16 bits of random data. These patterns permit writing any desired format, header or data block for troubleshooting or worst-case testing. A switch is provided for selecting a variety of drive configurations: 2200 or 2400 bpi, 1500 or 2400 rpm, 100 or 200 tracks per inch, write PE or NRZI data, and read PE or NRZI data. Also, a switch permits se-



lection of the head or track to be monitored on automatic. $1995. **Wilson Laboratories, Inc.**, 2237 N. Batavia St., Orange, CA 92655.

Circle 275

VT-100 EMULATING TERMINAL, the Mime 100, features all Std. VT-100 functions including DEC's optional advanced video package. Additional enhancements include editing capabilities, a VT-52 type printer port, 20-mA current loop, a no-scroll indicator, and a "tube saver" feature which turns off the video when the terminal is not in use. All enhancements are Std. Mime 100 features. $1795. **Micro-Term, Inc.**, 1314 Hanley Industrial Ct., St. Louis, MO 63144.

Circle 276

HARD COPY OUTPUT FOR INTERACTIVE GRAPHIC DISPLAY This high speed image capture capability requires no host software nor overhead processing time, for output to electrostatic printer/plotters. Graphics Hardcopy Interface (GHCI) consists of a proprietary microprogrammed processor and expandable vector storage

memory. Features of the GHCI include: multi-station/multi-image capture capabilities, 100, 160 or 200 dot per inch plotter support compatible with popular electrostatic printer/plotters, plotter widths from 8-1/2″ to 72″, "strip" chart capabilities, user definable output mapping. $9,995 for the graphics hardcopy unit. **Adage, Inc.**, 1079 Commonwealth Ave., Boston, MA 02215. **Circle 295**

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New Products

TAPE FORMATTER TDF 4050 Formatter – now installed internally in the industry-proven, dual-format TDI 1050 Synchronous Tape Transport – negates need for an external formatter to control the R/Wing of data. The TDF will R/W ANSI, IBM and ECMA-compatible tapes and will work with 9-track 1600 bpi PE and 800 bpi NRZI tape drives and 7-track 200/566/800 bpi NRZI tape drives. It's contained on one 19″ X 10″ PC board and can control from 1 to 4 tape transports – at same or half speed, or a mix of different formats with dual stack heads. It can handle 6 different tape drive speeds. It can R/W PE and NRZI at specified speed or half that speed when drives of different speeds are connected. **Tandberg Data Inc.**, 4060 Morena Blvd., San Diego, CA 92117. **Circle 254**

BUS EXPANDER New unit provides Optical Isolation for instrument being operated from the IEEE-488 BUS. Model 4830 allows Isolation of a single instrument or a collection of up to 14 instruments from the Controller's IEEE BUS. An additional feature is ability to function as an IEEE BUS EXPANDER. By plugging the unit into an existing IEEE BUS system (where it replaces a single instrument load) expansion capability is achieved for 14 additional instruments on the same IEEE Controller. Model 4830 allows the selection of Talk Addresses for the Isolated IEEE BUS to prevent interaction of handshake lines between the Primary IEEE BUS and the Isolated IEEE BUS. Unique logic is provided to allow high speed response to the Bus Attention line to maintain system speed and integrity. $795. **ICS Electronics Corp.**, 1450 Koll Circle Suite 105, San Jose, CA 95112. **Circle 264**

LOW COST CRT CONTROLLER This controller handles all functions required for a 16 line x 64 character video display. Functions include CRT Refresh, Character Entry, and Cursor Management. The new unit, Model 96364A/B, contains an internal oscillator which produces the composite sync output. It easily interfaces to any computer or microprocessor, or serves as a stand-alone video processor through such standard functions as Erase Page, Erase Line and Erase to End of Line. The CRT 96364A generates a 50Hz vertical sync while the 96364B generates a 60Hz vertical sync. Units are avilable in a 28 pin dual-in-line package. Units are $20.00 each in single piece quantities. **Standard Microsystems Corp.**, 35 Marcus Blvd., Hauppauge, NY 11787. **Circle 265**

MEMOREX DISK SUBSYSTEM Model 3652, a 635-Mbyte/spindle disk storage, subsystem, is a dual-spindle, double-capacity version of the widely-used 317.5 Mbyte 3650 drive (IBM 3350 equivalent). It provides users with over 1.2-gigabytes of stored data/module, but occupies the same area as the 3650. A significant increase in system throughput also can be achieved with the 3652's standard Intelligent Dual Interface feature (patent pending) that provides: dynamic dual port access to each disk drive spindle, 2-string switching, and automatic back-up of the disk string via one of 2 controllers. $6,845/mo (on 2-yr lease); $191,000 purchased. **Memorex Corp.**, San Tomas at Central Expwy., Santa Clara, CA 95052. **Circle 129**

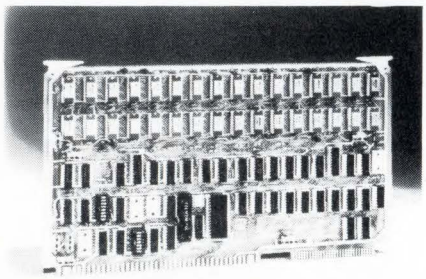
MICROPROGRAMMING AID The "Step 2 Instrument" is claimed to be the most powerful development system for fast firmware debugging and system testing. It spans a spectrum of uses – ROM logic, controllers, 2900 bit-slice, and fourth-generation mainframes. Step 3 configures to match your system says the company – not vice versa – and has real-time memory simulation (as fast as 50 ns in your system). "Step 2's microcode editor makes machine-code manipulation a snap, regardless of word length (8 to 192 bits) or field structure. Also, it's compatible with existing software, and supported by user-definable assembler, TMA." From $4950. **Step Engineering**, 714 Palomar Ave., Sunnyvale, CA 94086. **Circle 251**

45 MB 8″ HARD DISK Micropolis' hard disk offers optional capacities of 9, 27 and 45 MB, respectively, in a unit profile that measures 8.55″W X 4.625″H X 14.25″D. It's fully interchangeable with a typical 8″ floppy. Access time averages 34 msec. The lower half of the drive package contains platters, disk head and positioner, and is completely sealed. Air is drawn into and expelled from the cavity through 0.3μ filters. A brushless DC motor, custom-designed to accommodate the package's low profile, drives the spindle at 3600 RPM. The upper half contains the electronics package on 3 PC boards, including the optional intelligent controller board ($500, OEM qty). The controller allows selection of a number of standard hard-sectored formats. Other features include handling of drives, direct or buffered data transfers, automatic verification and re-tries, multi-sector transfers, error correction and a versatile command structure. 25,000 MTBF hours. 1201-1, $1,350 (1000). **Micropolis Corp.**, 7959 Deering Ave., Canoga Park, CA 91304. **Circle 249**

New Products

80-BIT SHIFT REGISTER Octal 80-bit static shift register MM5034 is a 22-pin DIP for CRT terminal applications requiring heavy use of memory to update screen information. The only 8-byte-wide shift register available, it is designed for use with the DP8350 CRT controller IC. MM5034 replaces two 4-byte shift registers, thereby lowering component count. Use the DP8350 as a recirculating line buffer between the CRT memory and a character generator IC to give the system controller greater access to the CRT memory. High board density a problem? If simple data-in/data-out operation is all you need, then try the MM5034, a 20-pin DIP. It's identical to the MM5035, except for its lack of TRI-STATE output control lines. MM5035, $8.16; MM5034, $8.40 (100-999). **National Semiconductor, Inc.**, 2900 Semiconductor Dr., Santa Clara, CA 95051. **Circle 128**

NEW 48K RAM BOARD. This unit is fully compatible with SNC 80 Bus and reliability is assured with 168-hr. burn-in at 55°C. Onboard LSI Refresh for 16K Dynamic RAMs. All ICs in sockets. 8 or 16 bit mode. 20 address bits allow one M addressing. Compatible with Intel's new 16 bit iSBC 86/



12. Access time: 450 ns max. Cycle time: 700 ns max. Price of the RAM-048 is $1565. In quantities of 10-24, the price is $1410. **Electronic Solutions, Inc.**, 5780 Chesapeake Ct., San Diego, CA 92123. **Circle 208**

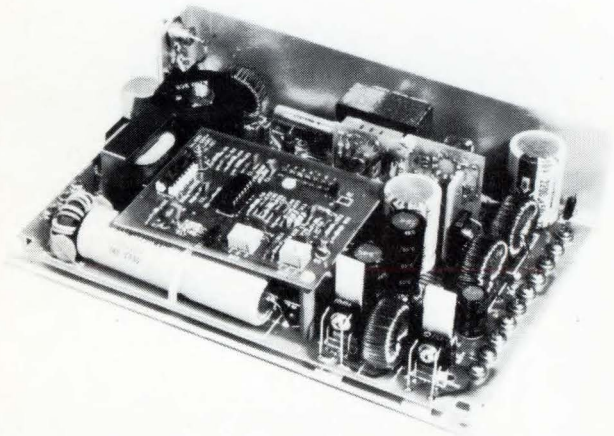
DATA CARTRIDGE MAGNETIC TAPE CONTROLLER. This full DMA controller is transparent to the DEC operating system because it emulates the DEC TM-11/TU-10-1/2" magnetic tape system. The 6400 bpi MFM formatting offers unformatted capacities up to 17 M per cartridge, making the unit an ideal backup to 8" Winchester disk drives. Data is written on four tracks in serial mode, one track at a time, yielding high tape utilization factors. The TC-180 controller interfaces cartridge drives from DEI, Kennedy, Qantex, DRI and Tandberg at densities of 1600 to 6400 bpi. The two card controller mounts in any two adjacent SPC slots and connects with the cartridge drive via two ribbon cables through the computer. The TC-180 is supplied with drive cables, documentation, diagnostics, and a one-year warranty. Delivery time is 30 days. **Western Peripherals,** Div. of Wespercorp, 14321 Myford Rd., Tustin, CA 92680 **Circle 218**

SELF-PROMPTING, PORTABLE COMPUTER. Called the Miniterm(R) Model 1206/PAT (Programmed Applications Terminal), this highly intelligent portable operates through the use of pre-programmed application modules. These modules can be tailored to user's environment and programmed in a way to prompt the user interactively. Units can be operated by people who have no previous EDP training. All of the 1206/PAT terminal functions and user interaction are controlled by application modules consisting of BASIC source programs which are automatically called and loaded via minicassette and other optional storage media when the computer is switched on. The new computer has a 64K processor with 32K of RAM work space available to execute the application programs. Standard features include an 80 column, 50 cps thermal printer, integral minicassette drive, built-in modern and acoustic coupler. Available in the third calendar quarter of this year, standard models of Miniterm 1206/PAT portable terminal will be $5,195, quantity one. Quantity discounts available. **Computer Devices,** 25 North Ave., Burlington, MA 01803. **Circle 266**

HIGH RESOLUTION DISPLAYS Fast 16K MOS/RAM refresh memories go up to 1280 pixels/line X 1024 lines, in gray scales, and 1024^2 full color versions. All directly addressable. This 16-bit user-programmable graphics processor achieves optimum operation with 150 ns cycle time, 55 mnemonic instructions, automatic DMA, selective erase, choice of 4096 colors or 256 gray shades, and over 32 refresh memory planes control – using a "group select" method. Scroll and zoom, and a character/vector generator are included. Other features: up to 12 monitors from a single system; TV/video mixing; remote monitoring; RS-232 ports; automatic "Circumfill". Interfaces for most popular minicomputers are available as standards (a specific configuration fabricated where a stock unit won't do). Offerings include Basic Graphics instruction set, an efficient Cross Assembler, and a special GRASP package of FORTRAN subroutines – to simplify programming of particular display configurations. **Genisco Computers,** 17805 Sky Park Circle Dr., Irvine, CA 92714. **Circle 127**

5″ CRT FOR HP's FACTORY DATA TERMINALS. This new 5″ CRT displays up to two pages of information – one page of 16 lines with 32 normal-size characters per line and one page of eight lines of 16 large-size characters. The large character-size mode and special antireflective screen assure easy reading, even when terminals are in brightly-lighted locations. The new CRT option can be fitted onto a desk-top HP 3075 or the wall-mounted HP 3076 terminals. The new CRT option adds $936 to the price of any of the HP 3075 or HP 3076 data capture terminals. Prices range from $2,488 to $5,560, depending on other options fitted. HP volume-end-user discounts, ranging up to 30 percent, apply. Current delivery estimates are eight weeks. **Hewlett-Packard Co.**, 1507 Page Mill Road, Palo Alto, CA 94304. **Circle 163**

SWITCHING POWER SUPPLY HAS FIVE OUTPUTS. Five independent DC outputs provide total output power of 200 watts. The standard unit has a 5V regulated output and two 12 or 15V regulated outputs, plus 5V and 24V semi-regulated outputs. Special units are manufactured to order with voltages specified from 5 to 28V for each of the three regulated outputs and 5 to 50V for the two semi-regulated outputs. The use of a new monolithic chip permits reduc-



tion of parts count by 20% for a much higher MTBF, backed by a two year warranty. Reliability of the ESM 200 has been improved by use of computer-aided "worst-case analysis," individual testing of every IC and semiconductor, and a comprehensive burn-in program. Protective circuits include overload, short circuit, reverse polarity and soft start protection. Holdup time is 16 milliseconds after loss of AC power. Adjustable voltage, OVP on primary output and adjustable current limiting are standard. ESM-200 supplies meet UL and CSA requirements. $319, each. **Power/Mate Corp.**, 514 South River St., Hackensack, NJ 07601.

Circle 200

FLOPPY DISK ACCESSORY. The H-77 Floppy Disk System provides all the storage and programming capacity needed for most computer applications. When the H-77 Floppy Disk System is used with the All-In-One Computer, room is provided for up to 3 floppy drives. Factory assembled and tested WH-87 Floppy Disk System, mail order ($1195) includes 2 drives; H-88-6 Adaptor kit ($50) is required to install the WH-87. **Heath Co.**, Dept. 350-280, Benton Harbor, MI 49022. **Circle 143**

MULTIBUS-COMPATIBLE MULTIMEMORY BOARD contains sockets and memory interface logic for up to 16 24-pin memory devices. It accommodates all std. EPROMs (2708, 2516/2517, 2532/2732), std. masked ROMs (2316, 2332, 2332A) and static RAMs (4118, 4028). It can contain a max. of 64K bytes of EPROMs or 32K bytes of static RAMs. $175. **Artec Electronics**, 605 Old County Rd., San Carlos, CA 94070. **Circle 144**

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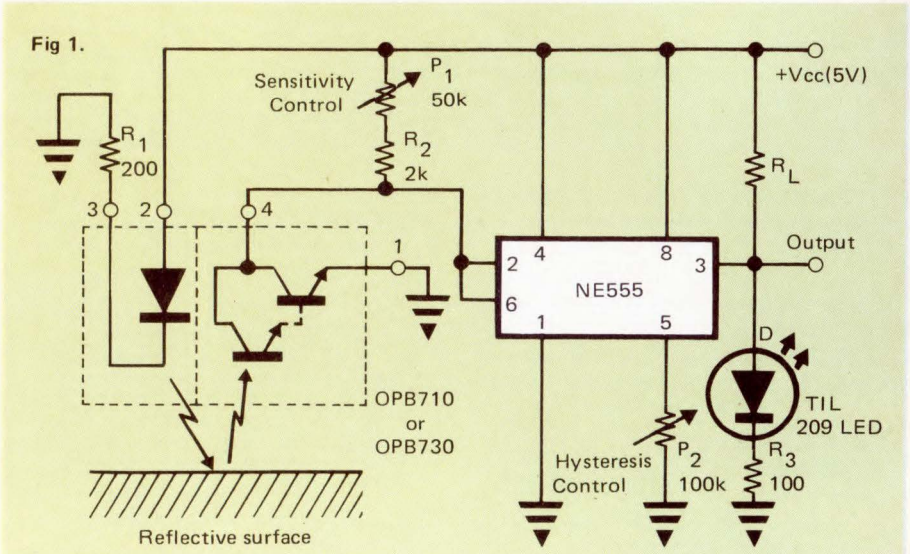
Designers' Notebook

Reflective Object Sensor

Reflective object sensors (ROS) like Optron's OPB 710 and OPB 730 find wide applications in industrial controls and instrumentation. Applications include end of tape sensing, punched card reader, moving tape reader etc. The device consists of a gallium arsenide infra-red LED and a silicon planar n–p–n photoresistor mounted on a single four-lead To-72 header. Type OPB 730 is a photodarlington and has better sensitivity. A built-in light barrier in both devices prevents response to radiation from the LED unless a reflecting surface is within the field of view of the photosensor.

Fig. 1 shows an inexpensive interfacing circuit for ROS with a minimum parts count, thanks to the ubiquitous IC timer 555.

Fig 1.



+Vcc	+5V	10V	15V
R_1	200Ω	420Ω	620Ω
R_3	100Ω	220Ω	330Ω

The circuit also provides sentivity and hysteresis control.

In operation, light emitted by the IR emitter diode of OPB 730 is not received by the photodarlington in the absence of a light reflecting object, and hence pin 2 and 6 of the timer will be "high", and the output pin 3 will be "low". When a reflecting object is in the field of view of the sensor, photodarlington OPB 730 will be turned ON due to the reflected light, and the voltage at pin 2 and 6 of the timer will fall below 1/3 V_{cc} causing the output to go "high". An LED may be provided for indication if necessary.

The circuit shown operates on a V_{cc} of 5V, and the output is TTL compatible. Other voltages for V_{cc} up to 15V are possible if R_1 and R_3 are suitably selected, as shown in the table.

Sudarshan Sarpangal, ISRO Satellite Centre, AI-6 Peenya Industrial Estate, Peenya 560058, Bangalore, India.

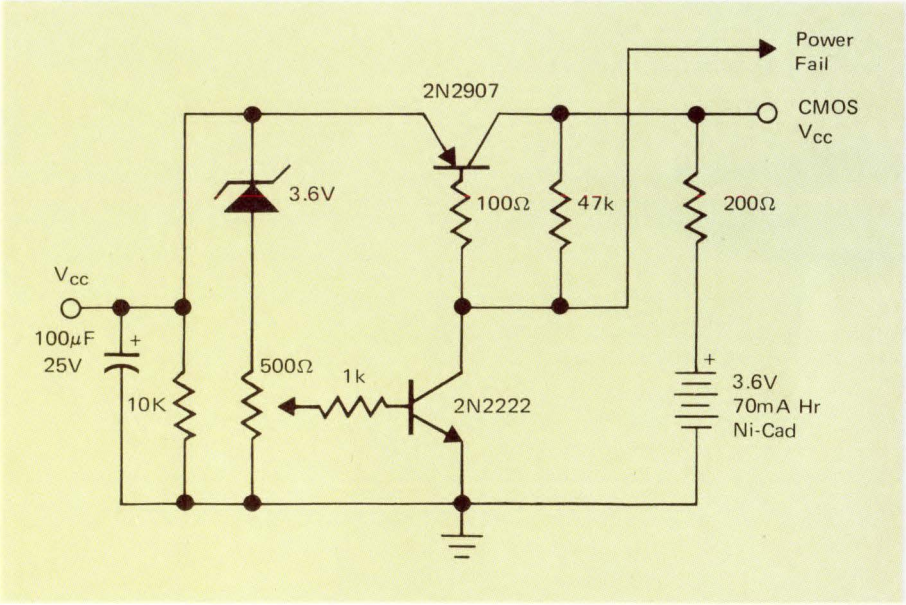
Rate this design: circle 10L, 10M or 10H on Reader Inquiry Card

Battery Back-Up Powers Memory

If your digital systems need battery back-up for data retention during power interruptions, this circuit will provide power to the memory during power outages. It also doubles as a battery-charging circuit during normal operation.

In addition to providing a standby supply, you or the users must take precautions to guarantee that none of the CMOS inputs are left floating during the power outage. The easiest way to accomplish this is to add 10k pull-up resistors from all board inputs to CMOS V_{cc}.

Engr. staff, Harris Semiconductor, Melbourne, FL.



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NMOS Clock Module Clocks Events

The National Semiconductor MA 1023ARL NMOS clock module may be converted for use as a laboratory "stop watch". The "stop watch" action is achieved by control of the mains derived clock pulses, in conjunction with the "fast set" and "slow set" control lines. Manual control is possible with the additional components.

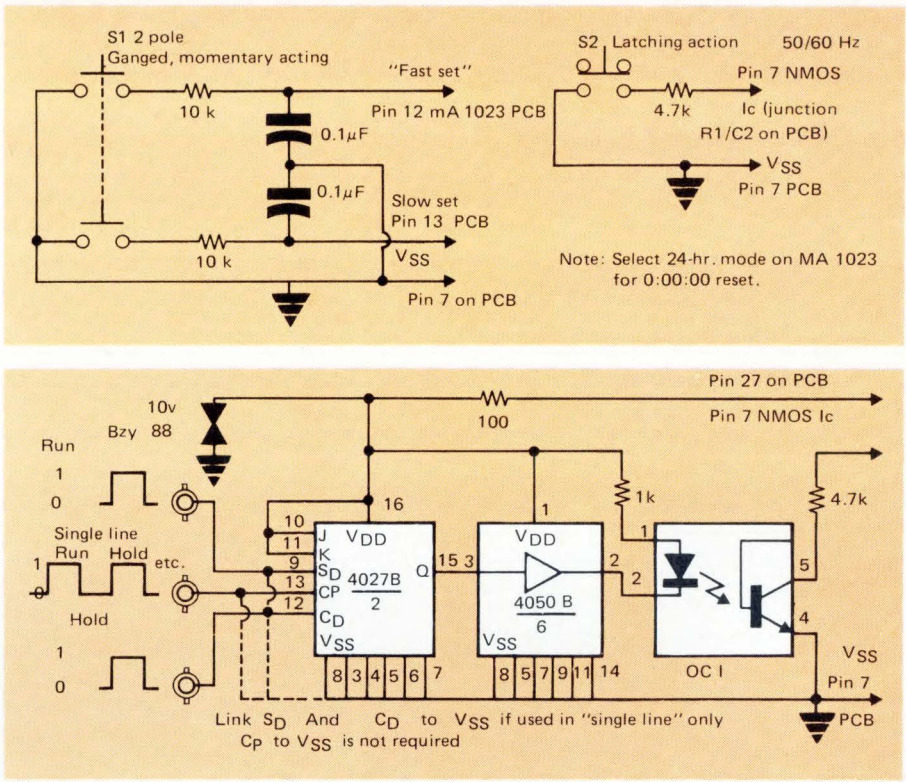
With either method of control the "stop watch" is in the RUN mode when clock pulses reach pin 7 of the IC, and in the HOLD mode when they are inhibited.

The display is set to zero by closing S1 whilst in the RUN mode and then selecting HOLD prior to release of S1.

If the "stop watch" is required to totalize time intervals, S1 is only used for initial clearance of the display.

M. R. Taylor, City of London Polytechnic, Dept. of Chemistry, Sir John Cass School of Science & Technology, London EC3N 2EY, England.

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



Addition of components converts clock module into an event timer.

Pulse-Width Controlled Attenuator Circuit

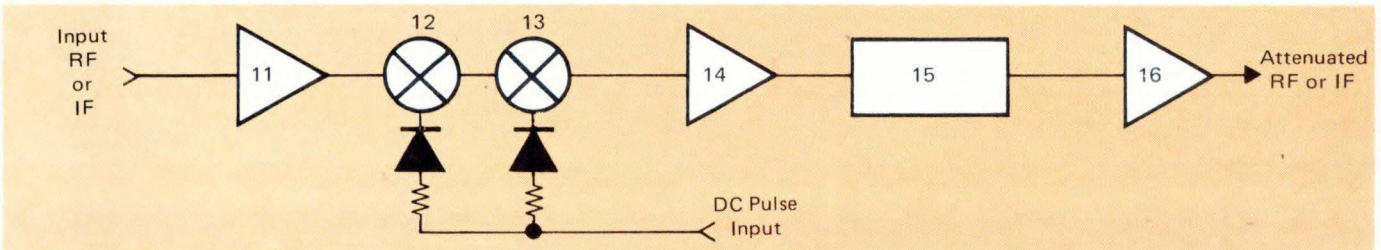
This combination of switching diodes with a dc-to-pulse width modulator in an attenuator configuration, particularly for if and rf (that is very linear), has very low phase shift over a wide AGC range (about 2° for 60 dB). Pulse width control is used such that 100% duty cycle produces zero attenuation, and 0% produces infinite attenuation, with linear variation therebetween. Our problem was to develop a gain control circuit that has wide dynamic range and having a phase shift that is independent of attenuation, for use in an AGC system. The gain control circuit would handle modulated as well as continuous tone signals.

To meet these requirements, we designed an attenuator circuit that takes an ac signal and switches it on and off using diode switches, such that the attenuation is proportional to the duty cycle of the switching voltage. Amplifiers 11, 14 and 16 are isolation amplifiers which isolate the switch circuit comprised of the diodes and mixers 12 and 13. Mixer circuits are used because they are easy to implement; any type of rf switch may be used, such as PIN diodes. The basic requirement is that there is a high on–off ratio; the higher the on–off ratio, the greater the attenuation possible before phase shift starts to build up. The isolation amplifiers 11, 14 and 16 isolate the switch circuit so that widely changing impedances of the switches 12 and 13 are not reflected back to the source, and also from filter 15.

It's very important that filter 15 be properly matched, otherwise phase will drift with pulse changes. The reason for having bandpass filter 15 is that with a clean signal (a single carrier) applied to the input switch, the ac output is the carrier and many sidebands spaced at the pulse frequency. The purpose of the filter is to filter out sidebands, leaving just the carrier again. The output is then essentially the same as the input except that carrier amplitude is a function of pulse width. The filter should be narrow band compared to the pulse repetition rate, so that side bands created by the switch are down 60 dB or more. Using a linear AGC control voltage is advantageous in determining if power input by substitution methods. Also, it simplifies receiver loop design analysis.

J.W. MacConnell, JPL, Cal. Inst. of Technology, Pasadena, CA.

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



New Solar Panel Regulation Scheme Aids μCs

Microcomputers powered by solar cells have run into problems that can now be solved. In the application of a shunt regulator for optimum voltage regulation of solar panels, our regulator uses the internal resistance of the solar panel (which varies non-linearly with illumination) to effect regulation; and it does not decrease the panel voltage output at rated current when the illumination decreases. It allows the maximum length of time per day over which the solar panel delivers rated power to a microcomputer or digital system.

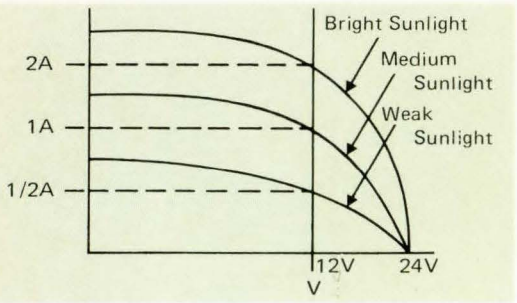


Fig 1 Solar array voltage-current curves.

Our problem was to regulate the output of a solar panel that delivers 20V open circuit to 12V, and allow use of the panel at rapid output for as much of the day as possible. Now, for commercial installations of solar panels delivering on the order of approximately 10 kW of dc power to electric motors or battery-charging circuits μC-based systems and various electronics, voltage regulation is necessary to prevent motor speed changes and to prevent overcharging of batteries.

The solution resulting from our work, which was supported by NASA, was to develop a regulator for shunt operation with the solar panel. Used in conjunction with the panel internal resistance, optimum voltage regulation was obtained. The regulator is adaptable to any wattage of solar cell arrays, since it utilizes a parallel transistor arrangement that can be scaled up by adding transistors to handle maximum current.

Although solar cell array voltage output remains fairly constant, solar panel current handling capability varies quite widely as illumination varies. **(Fig 1)**. Typical solar panel power curves are shown for three levels of incident sunlight. For example, if a regulated 12V solar panel output is desired, 2A may have to be drawn from the panel when it is receiving bright sunlight. The 2A would be the sum of the load current, plus the regulator shunt current. Later in the day to get 12V out, only 1A would have to be drawn. In weak sunlight, 0.5A is all that could be drawn at 12V.

A commercial appliance such as a TV set (i.e., a 12V dc portable) does not operate properly with more than 13V applied. Thus, a solar panel capable of producing 18V at a 1A load would require a regulator in order to provide 12V dc for the set. To prevent the voltage from going too high when the sun is at zenith angles, a voltage regulator **(Fig 2)** must be used. When the sunlight diminishes to the point where the load current alone draws down the panel voltage to 12V, the regulator no longer operates. It then looks like an open circuit to the solar panel and consumes no power from the solar panel. In contrast, any type of series regulator would drop the voltage at all load current values. As shown in the figure, the 12V reference voltage is set by a series of diodes D1, 2, 3, 4 and Zener Diode D5. A resistor R_1 is in series with the diode string across the solar panel output, and controls the V_{BE} which is the base-emitter bias voltage on the shunt transistors Q_1 and Q_2. When there is a voltage in excess of 12V output from the solar panel, a reverse voltage $+V_{BE}$ is developed across Resistor R_1 which removes the bias from transistors Q_1 and Q_2 causing them to conduct current through resistors R_2 and R_3 to common.

The completed voltage regulator we used in a demonstration of solar energy conversion reduces a solar panel voltage of 18V max. down to 12V dc and utilizes the maximum amount of the sun's energy during daylight hours.

Theodore A. Casad, JPL, Cal. Inst. of Tech., Pasadena, CA.

Rate this design: circle 5L, 5M or 5H on Reader Inquiry Card.

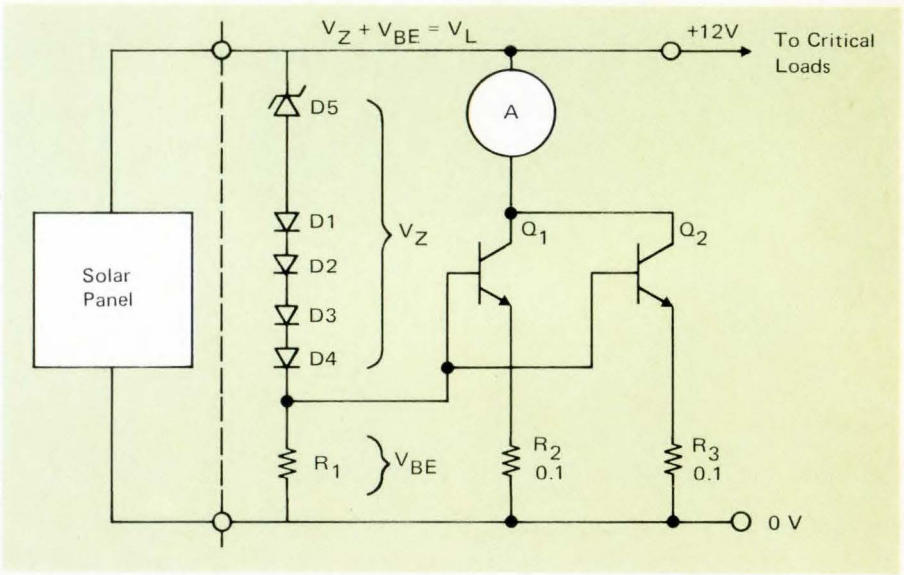


Fig 2 Voltage regulator prevents overvoltage damage to μC or other circuits.

CD4018 Makes Three-Phase Generator

With reference to the circuit shown on page 79 of the November 1979 issue, a CD4018 can be used instead of a CD4047 and 1N4148s. In Richardson's circuit, he provided three outputs, phase shifted by 120° to provide (after buffering and filtering), drive to a low-voltage three phase supply.

Instead, tie 2, 3, 7,8, 9, 10, 12, 15 low, 16 high; Pin 14 = input; pins 5, (6 and 1 tied together), 13 are outputs. This gives three phases shifted 120° with less parts; the circuit shown gives three phases shifted 60°, not 120°, as stated. (The 4018 could also shift phase 60°.)

J. W. Hole, Sandia Laboratories, Box 5800, Albuquerque, NM.

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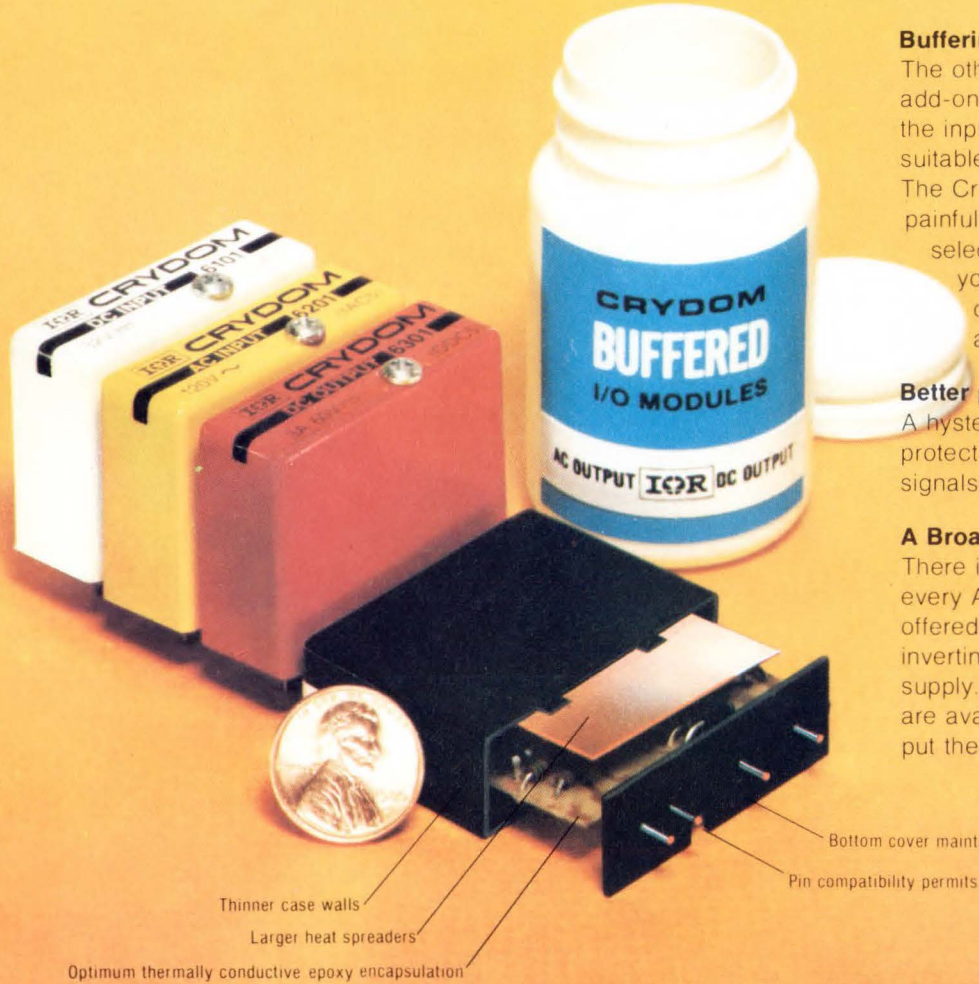
Physically and electrically equivalent and pin compatible with older versions offered by other manufacturers, the new Crydom Series 6 Input/Output modules offer several advantages the others can't provide.

Higher Output Current.
All Crydom output modules can control loads up to 3.5 Amps @ 45°C as compared to 3 Amps (or less) for the others. A larger heat spreader, thinner case walls and optimum thermal conductivity encapsulating epoxy enable ours to dissipate heat faster and run cooler, permitting greater current handling capability.



Buffering: The big design advantage.
The others' output modules require special add-on, external buffering circuits to reduce the input drive requirements to a level suitable for microprocessor MOS devices. The Crydom Touch has eliminated this often painful exercise. Buffering is built into selected output modules to reduce your design time and production costs. And you'll end up with an uncluttered control assembly.

Better protection against circuit noise.
A hysteresis factor of 30% provides added protection by blocking out most transient signals. The others don't offer this feature.

A Broad Line.
There is a Crydom Series 6 model to match every AC and DC Input or Output module offered by the others, plus inverting and non-inverting buffered output modules they can't supply. Mounting boards for up to 24 modules are available. Send for our new catalog, and put the Crydom Touch into your new system!

Series 6 I/O Modules are available at competitive prices from Crydom Distributors everywhere!

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