VOLUME 10, NO. 4 APRIL 1980

The Magazine of Systems Electronics

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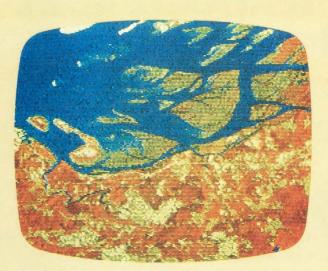
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APRIL 1980



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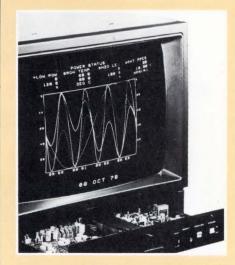
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64K ROM Expands Program Beyond 4K



ON OUR COVER

Flexible disk drives, a mainstay in the mass memory storage spectrum, continue to evolve and find new applications. Cover concept by Paul Snigier; photo by Ex-Cell-O Corp., Remex Div.







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Letters

6250 BPI GCR Tape Drives

Dear Editor:

I read with great interest the December issue of Digital Design and greatly appreciated the 1979-1980 product review on various types of peripherals in memory devices. Compliments are especially in order for the author of the article on "Floppy Disk Drives" as it presented a realistic picture of that marketplace and the problems that have occured, and realistic solutions to those problems.

In reviewing the article on magnetic tape, I found much of that to be interesting and accurate, especially in the area of Winchester 8" backup, cartridge tapes and the long term viability of 1/2-inch tape. However, one significant part of the magnetic tape market was glossed over, and this is the area of 6250 BPI GCR tape drives. It was glossed over with the words that "it has not found great acceptance because of high cost and lack of compatibility with other systems." In the large mainframe market, the predominance of tape systems being shipped today do have 6250 BPI capability.

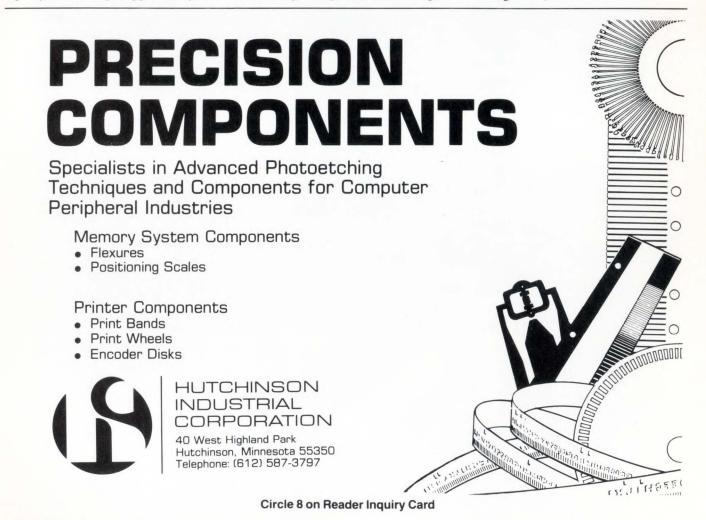
Recently many mini/midi computer companies have also announced 6250 BPI tape for their CPUs. This has been preceded and followed by similar announcements from systems houses. The 6250 marketplace has been identified over the next few years as one which will grow some 89% per year.

The use of GCR transports is prominent in the data processing world today for obvious reasons. The most significant is the inherent reliability of a GCR tape system, due to two-track error correction. It also provides high data throughput, quick access to data, and the high packing density resulting in media cost savings. The problem relative to interchange with other densities in a particular shop has been resolved with the advent of triple density tape drives that are now available for the marketplace. I feel that the tape transport development has not been a series of subtle advances, but of startling innovations. The most startling innovations in tape drive technology did occur in the last few years - one required by the specifications of 6250 short gap performance. This breakthrough innovation is the very-low inertia capstan invented at Gulliver Technology Corp. and now incorpor-

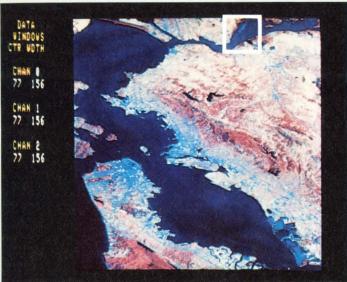
ated in the drives manufactured by Telex Computer Products. The author makes the comment that the complexity of 6250 is very significant. This is true; and, in fact, the technology required is such that, in order to meet the specifications of 6250, a company must commit massive cash and engineering resources to meet the specifications. It is not the same as going from 800 to 1600 BPI; but, is a much more significant effort. This development effort has been characterized by the fact that today there are really only two viable suppliers of the OEM type 6250 tape drives, those being Telex Computer Products and Storage Technology.

It appears that in the area of 6250, the author is speaking from his company's perspective, which, at this time, frankly does not have an announced product. The capital requirements may in fact preclude companies such as Kennedy to come out with a product of this magnitude. Streamer tapes at 1600 BPI are viable products for Kennedy, et al, since they do have this technology. In my opinion, the 1/2" streamer market is real, but will take the normal market development time. Daniel R. O'Neill Amperf Corp.

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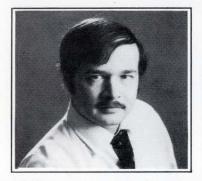


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Paul Snigier, Editor

Color Display Growth: The Sky's The Limit



Sales are booming in the color CRT graphics industry. The market for computer graphic devices and systems will grow at a compound annual rate of 30%, reaching an estimated \$1.7 billion in 28 months.

Investors, aware of this growth potential in color graphic displays and systems, have promptly bought out offerings. A study entitled *CRT Graphic Terminals and Systems Markets* (recently released by Venture Development Corp. of Wellesley, MA) predicts "spectacular growth of both CRT graphics terminals and turnkey systems." In listing the performance of public companies with most of their business in computer graphics, VDC's study showed an overall upward trend in shipments (in million dollars) — up an average of 45.5% in the last year over the year prior to that. As for profits, they rose

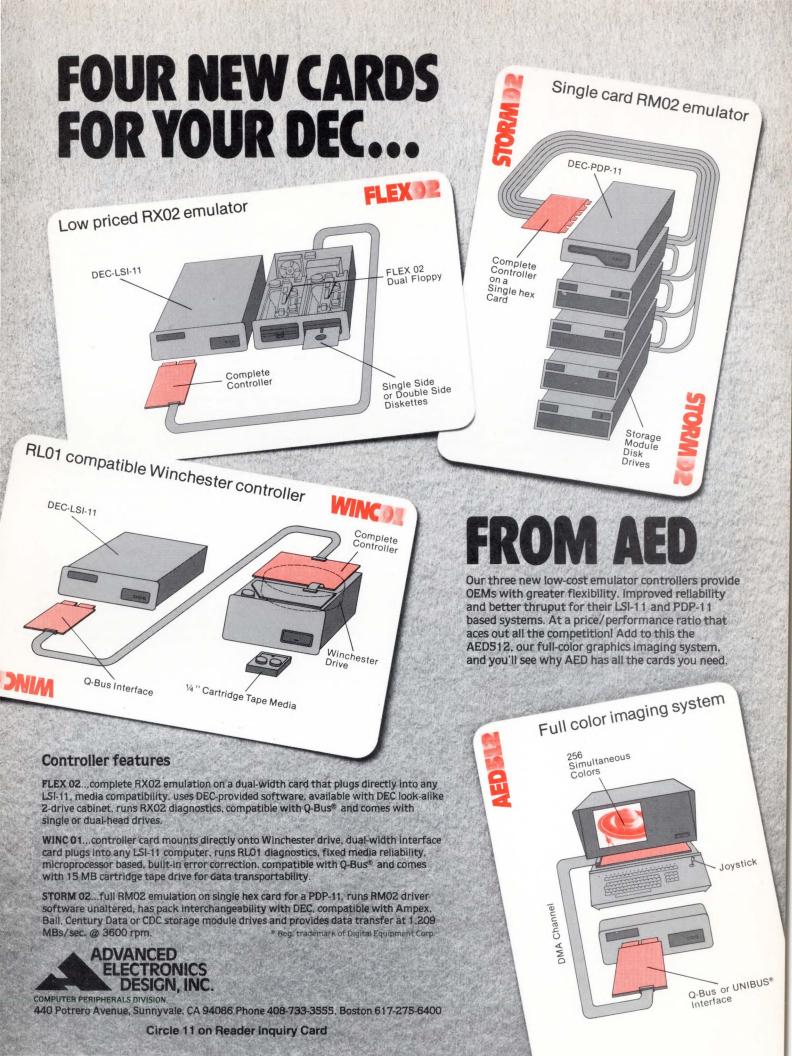
64.5% in one year. In these times of 15-18% inflation, such investments more than outperformed the Dow Jones. There are a number of smaller, CRT color graphics terminal makers that are still privately owned and independent; and they, too, are showing remarkable growth.

This demand for graphic display devices will intensify for both μ P and μ C-based systems that demand graphic display of information (whether passive or interactive). On the other side, graphic displays are falling in price while performances rise. Graphics capability and improved response times are resulting from new processor and memory architectures, with newer systems unburdening the host processor from processing vast arrays of vector and data manipulations. CRT controllers, reducing IC parts count, will improve reliability and shorten development times.

Applications include CAD²/CAM (computer aided design, drafting and manufacturing). Real-time simulation is used for interactive training, where a novice pilot can practice realistic takeoffs, landings and weapon delivery. Or, a captain-trainee may maneuver an oil tanker without damage. With rising energy costs, interactive training is proving safer, faster and less costly. With improved textured shading techniques and increased realism in these newer computer graphics, previous objections no longer hold. As a powerful analytical tool, image processing is finding its way into larger banks and businesses to create models from large data bases and to aid management in analyzing trends, project control and other management information systems. Low-end graphics will soon enter small business computer systems. The use of color graphic display devices in industrial control systems will grow rapidly, with many of these applications requiring limited color graphics displays. Other applications exist; and ultimately, any application where information transfer or interaction is needed will be a candidate for graphic display devices.

The future will see computer graphic modeling trends that will result in lower-cost units available in new industrial and commercial applications. With greater processing power, better algorithms and software, better texturing, improved blending (to avoid double imaging, size changes, edge wobbling, etc.) the costs will continue to fall, until these displays are affordable by vast markets yet untapped. Make no mistake about this: costs will plummet. In the recent past, prices were steep: line graphics software ran to \$50,000; solid geometry packages, to \$130,000 or so; and full color, real-time surface systems, to \$1,500,000. This has changed. With costs continuing to dramatically fall, color graphics will become even more commonly used in the early to mid 1980s. As a system designer, can you afford to ignore color graphics?

(A more detailed discussion of the subject is in my article "Graphic Display Devices", which appears elsewhere in this issue.)



Technology Trends

Growth of the Fiber Optics Market

The market for fiber optic connectors won't falter; instead, it will grow tenfold or more over the next decade, reaching more than \$30 million by the end of the 1980s. Growth rates in the early 1980s will average more than 30% per year. Why? Skyrocketing gold and copper prices will accelerate the trend towards the use of fiber optics for communications. According to a new research report from International Resource Development Inc., the interconnection of computers and terminals will emerge as the primary market for fiber optic connectors and telecommunications applications will consume more cable.

Will oil price hurt?

Most fiber optic cables are jacketed in petroleum-derived plastic coatings (like copper cables). Will this hurt? No. Much smaller amounts of plastic are required for a *comparable* communications channel capacity, and the rise in the petroleum prices further improves the fiber optics' competitive position. Most connectors used with copper cables are plated with gold; fiber optic connectors are made primarily from such materials as nylon and plastic.

What about the basic problems encountered in the mid-1970s with early fiber optic connectors (high attenuation and poor repeatability)? They have now largely been solved, and prices are falling rapidly. One of the early Deutsch fiber optic connectors, for example, was priced at \$150. Some types of connectors will sell for \$1 or less by 1983!

Automotive markets "take off"

Because fiber optics provides immunity from EM interference, with light weight and elimination of ground loops, rapid growth is expected in automotive applications of fiber optics. Starting around 1983, the use of fiber optics for the transmission of sensor and actuator data, and also for dashboard indicators, will become standard in the U.S. auto industry, and will have spread to most models of cars in the 1985-86 time frame. Since the distance which light must be transmitted in an auto is only a few feet, the insertion loss through the connector is not a difficult requirement to meet; however, fiber optic connectors for automotive applications must be ruugged, durable, and resistant to corrosion and vibration. The relatively low unit value of connectors for this application will prevent this segment from dominating

Will Robots Multiply?

After 15 years of "slow and painful" growth, will the market for industrial robots "explode"? According to a new 208-pg. report ("Industrial Robots in the 1980's") from IRD (of Norwalk, CT), the sudden marketplace success of the robot vendors in 1979 shows that building robots has become a seller's market. Major manufacturers have order backlogs of a year or more.

Vision capability is next

Most robots today rely upon pre-programmed paths and steps, but manufacturers are developing industrial robots with greatly improved adaptive capabilities, so that they can deal with abnormal (as well as expected) circumstances. The IRD report predicts the evolution of heuristic robots - which can learn from their own experience how to do their jobs better - and experts predict vision capability to be "commonplace" in the robots of the late 1980s. Some of the new families of robots will be especially aimed at the high-precision assembly of equipment with small and delicate parts, including electronic devices and household appliances. Some day, robots will be used to assemble other robots, thus in a sense endowing robots with reproductive capacity. Frimpter points out that even then robots will be dependent upon human production controllers for the flow of parts from which to create new robots.

the overall connector market.

AMP is the leading supplier in the current U.S. market for fiber optic connectors, followed by Deutsch, Amphenol and ITT-Canon, Western-Electric and TRW-Cinch; and, although mass-production of fiber optic connectors provides the leading suppliers with a built-in economic advantage, there are many specialty "niches" in the market to support smaller suppliers.

Edging towards robot production

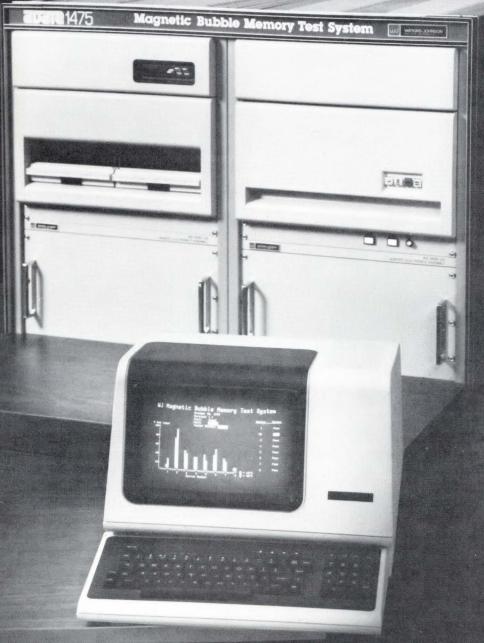
Although the major robot manufacturers today generally are specialty suppliers such as Unimation, or machine tools manufacturers such as Cincinnati Milacron, there is increasing interest in the robot market on the part of several computer manufacturers. Will TI and DEC be significant new entrants into the industrial robot business? Perhaps. The growth of the market will provide new opportunities.

Who's worried?

Is labor seriously concerned about displacement? No. At least, not yet. Perhaps because robots still account for such a small volume of "bluecollar" production operations - the current robot market amounts to only \$40 million/year - organized labor in the U.S. has been "relatively accommodating" about the deployment of robots. In part this is due to the successful use of robots in very unpleasant environments, such as foundries, where the robots perform the "dirtiest and hottest" tasks. The European labor view of robots is less relaxed, with more resistance in Europe than in the U.S. towards a major expansion in robot usage. If this narrow-minded attitude prevails in England and Europe, U.S. productivity will accelerate while European productivity falters and its competitive position in world markets is jeapordized.

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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.

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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.,

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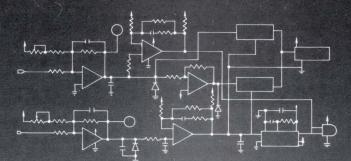
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Technology Trends

By Planning Ahead, IBM Stays Ahead

IBM has already led the world into an age of automation and promises to do it again. New applications development tools will be made available. What is the reason behind IBM's success?

IBM traditionally has gained most of its revenue by providing products and services to new, fast-growing business applications. These are typically accounts that do not call just for the replacement of existing systems; IBM prefers to address itself to those industry applications with the highest growth potential.

The IBM philosophy of operations also demands an IBM dominance of the intended market segment. Thomas J. Watson, who formulated most of IBM's operating principles, was a firm believer that if IBM could be the largest market share producer it should then also have the lowest cost and the highest profit margins. Realizing this, market share dominance has always been of primary importance to IBM.

Watson also taught IBM that the most rewarding way to acquire market dominance is to create or capture it early. This requires early recognition of the market and its high growth potential. To IBM this means market recognition 10 to 20 years in advance and product development efforts 7 to 10 years before market entry! To this purpose IBM currently spends approximately 1% of its annual revenues towards marketing intelligence activities. IBM is also spending 8% of its annual revenues on technical R&D.

Based on IBM's past history, it's a strong advocate of "the earlier the investment is made, the higher the longrange return on investment will be." With few exceptions, IBM has entered new high-growth markets at their infancy with a highly mature IBM product. In each case, they've been successful.

IBM has dominated the business computer market - in spite of increasing technical and marketing changes.

In the recent Transamerica vs. IBM trial held in San Francisco, IBM responded to anti-trust charges by proclaiming that its business success is attributed to its understanding of the marketplace and to its ability to keep pace with technological developments. It is these two factors combined with its master strategy for product marketing that will enable IBM to penetrate and dominate the marketplace of the mid and late 1980s.

What is market dominance? According to IBM philosophy, it can only be achieved through product visibility and through a superior marketing effort. In the SBC arena - with its 35-40% growth - visibility has been accomplished through the introduction of aggressively marketed multifunctional systems which cut across pre-established industry lines and create new defacto standards. In addition, these systems usually provide new, unique and significant functions. An instantaneous market demand usually

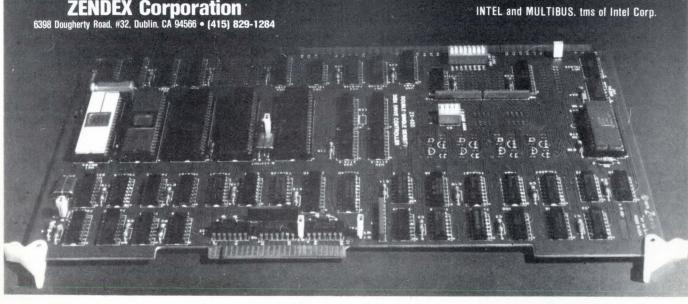


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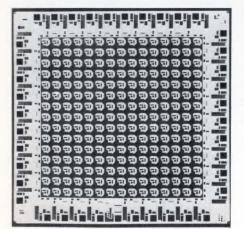
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Typical Applications Disk and CRT Controllers Dynamic and Static Memory Controllers Keyboard Scanners Memory Interface Logic Control Logic — CPU Boards ALU Accumulators D/A — A/D Controllers



Technology Trends

results (which places IBM in the spotlight).

For an example (and there are many), let's look at the introduction of the System/34: it's a good example of IBM's strategy. In a single stroke the System/34 cut across the following pre-established marketing segments: (1) clustered data entry; (2) intelligent data entry terminals; (3) distributed data entry and processing; (4) remote batch workstations; (5) programmable interactive-terminal clusters; (6) small business computer; and (7) turnkey, industry-oriented minicomputers.

It met with instant market acceptance. In the three weeks following market introduction, IBM received more system orders than the total number of units that were shipped by Basic Four, Datapoint, Four-Phase, and Sycor in the previous two years. Consequently, the System/34 implemented a new class of machines. In a similar manner, IBM's System/38 (a forerunner of GSD's new fighting machines) met with overnight succes. You can bet that most of IBM's future SBCs will follow this same pattern.

As for product marketing strategy, IBM intends to be successful in the market by a very carefully planned and executed three-pronged product marketing approach. IBM's three elements of success will be: (1) market leadership; (2) account control; and (3) maximizing account expenditures.

IBM will provide at least one SBC alternative for every price, price/performance, and price function niche in the market. To achieve this goal, IBM will employ such tactics as multiple growth paths; incremental growth path packaging, and pitting one IBM division against another. In addition, products like the System/34 and 38 will be enhanced for many years to come.

Can IBM gain marketing dominance in almost all SBC segments? Probably. But this will not happen immediately. IBM's new level of SBC aggressiveness will cause tense moments for many suppliers. This same aggressiveness will expand the entire market and accelerate the consumer learning curve. It will provide increased opportunities for the astute competitors. If you are aware and prepare, there is no reason why you won't reap the benefits from these transitions.

(This information was extracted from a report, "IBM's Long Range Strategies for Small Business Computers," published by Creative Strategies International, 4340 Stevens Creek Blvd., Suite 275, San Jose, CA.)

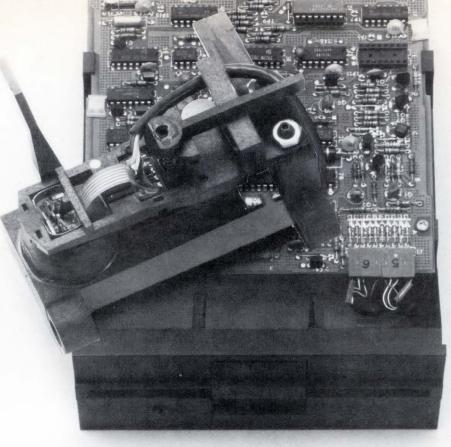
Major Increase In Serial Printer Market

Worldwide shipments of serial impact printers will reach 1.18 million units in 1983, a compound annual growth rate of 29%. During the same forecast period, revenues will see a somewhat slower growth due to anticipated OEM price reductions of 4-6% annually, according to the results of a major multiclient study on the computer printer industry recently released by Creative Strategies International of San Jose, CA.

During the five-year period, fullyformed character printer technology will continue to dominate WP as product developments double speeds to the 80-90 cps range and prices to the end user decrease to under \$1,000.



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Tandon Drives. Heads above the Rest

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

Tandon now introduces their own mini-floppy disk drive. The TM-100 family consists of four models, and offers the widest range and the highest storage capacities of any 5¹/₄" mini-floppy. What's high? Try 250K to 1000K bytes of storage. With a track-to-track access time of 3 to 5 ms. And a price that is lower than any other comparable unit. The TM-100 series design is based on Tandon's patented head design and superior head technology. This guarantees 20,000 hours of wear in media contact, and at least 4 x 10^6 passes per track. Tandon's unique head finish eliminates the need for a head load solenoid. The heads needn't be unloaded even if not reading or writing!

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Technology Trends

The dramatic growth for WP will result in a 35% compound annual growth rate for these solid character printers.

Matrix impact printer technology will see improvements in resolution and print quality and will be increasingly utilized in text-editing and similar applications. The high demand for personal and small business computers will create a significant demand for lowspeed printers.

But end users are worried about printer reliability. Also, they want increased speed, and this need is a major factor in the decision to purchase or replace a printer.

The serial-impact printer industry has evolved in tandem with: (1) the computer industry and (2) the need for low cost, lower speed printers in specific computer industry segments. In 1979, about 45 of the 65 computer printer companies serving the U.S. markets manufactured serial impact printers. They tended to address the needs of only one major segment of the market. However, expect to see a change in this trend: any company with the general expertise to make computer printers should be viewed as a potential competitor in any serial impact printer segment.

Selling To PRC? Here's How

If you are contemplating the sale of electronics to the People's Republic of China (PRC), a trip is vital. There is no substitute for a visit to the PRC. Any computer or peripherals firm contemplating the sale of any type of product or service will fail - unless it has personally experienced the PRC. And, the only way to gain admission is with an invitation.

Nearly 40% of companies surveyed indicated that they planned to pursue the PRC as a market. While direct marketing was favored by most, many were turning to reps (chiefly from Japan and Hong Kong) to enter the market. Using consultants is a good idea, along with reps on a commission basis.

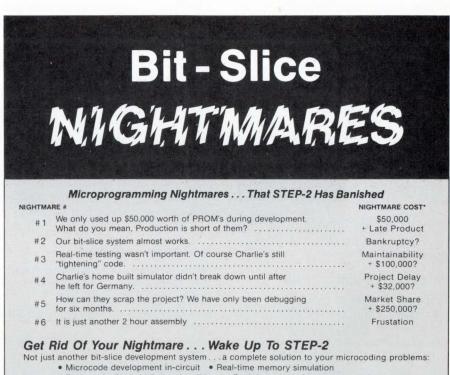
Selling costs can be unusually high. This stems from several factors, not the least of which is getting into the PRC and meeting with the "right" people. One unhappy visitor said his trip was a ten-day, 10,000-mile cold call. Preparation is critical to a successful trip.

Creative techniques are reinforced by a directory of 4500 prospects which is provided along with the report. These names represent qualified and valid prospects for data processing, word processing and communications products.

The report also includes a special phone book of key contacts. Since the PRC does not publish such a directory, this aid is invaluable.

PASCAL is key software language. The products most likely to be quicklyaccepted by the PRC are software-based on PASCAL. The PRC rationale for this is that PASCAL is a close relative of ALGOL. Since ALGOL was introduced by the Russians, it gained in popularity and acceptance in China.

Further information is available from Strategic Business Services at 4320 Stevens Creek Blvd, Suite 215, San Jose, CA 95129.



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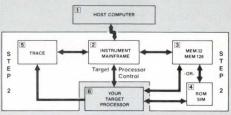
STEP-2 is a standalone interactive development instrument with: integral CRT, keyboard, word oriented microcode editor, communications facility with upload/download routines, controlport for target processor, reconfigurable memory, and simple, fast-learn command routines. All in the base price.

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Bonus: STEP-2 handles one memory array or several, pipelined or not.



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Software DESIGN SERIES

Dr. Lance A. Leventhal *Emulative Systems Co. San Diego, CA*

The New World of Software Publishing

Although manufacturers have been selling home computers for several years, the mass market for software is still in its infancy. The concept of a software store, a hit program, or a late night concert of your favorite computer offerings still boggles nearly everyone's imagination. But clearly these conditions will not continue. After all, not too long ago the concept of purchasing phonograph records, audio tapes, electronic calculators or computers at stores dedicated to their sale would have seemed equally outlandish. At this very moment, the mass market for home video disks or cassettes is beginning to be large enough to become apparent to many of us.

Software publishing trends

Software production clearly is as complex as the production of phonograph or audio tape. This complexity provides advantages for publishers who are already producing records or tapes. However, production appears to be a minor problem when compared to acquisitions, evaluation and marketing.

One special part of production involves the preparation of program documentation. Perhaps the best analogy parallels what game manufacturers do when they provide instruction manuals for complex games. This need for documentation gives traditional book publishers an advantage, since the preparation of program documentation resembles the production of a book or manual. Clearly, the publisher could then promote his software. A few publishers pursue this approach.

Evaluation, editing and production all take time. As with books or records, the delay from idea to published program rarely spans less than a year, unless the original form is very close to the final product. Although this delay creates some problems in timeliness, it is essential for creating a quality product. However, all these stages are very labor-intensive, add greatly to the cost that must be recovered and limit the number of programs that can be handled. Remember that the publisher (and the programmer, like an author or composer) normally sees little or no financial return until long after he has published the program.

We have not even mentioned other parts of the publishing cycle, such as cover and jacket design, advertising, copyrighting and catalog entries. Remember that a mass-market program must catch the user's eye, just as a book or phonograph record does. Graphics, sound and other attentiongrabbers are essential in mass sales.

Marketing software

What- then, about marketing software? Clearly, you can use many approaches to sell the product such as:

•A developed network of dedicated stores

•Distribution through established computer stores

•Distribution through stores that primarily sell other products, such as hobby electronics, home entertainment, games or books.

As of now, the market is too small to justify mass media advertising or the development of networks of dedicated stores. Note that in the last few years the popularity of dedicated record stores has become a major phenomenon. As for computer stores, while they are growing, there are as yet too few of them to become major distribution outlets. Perhaps the most promising possibility is to market software through hobby electronics or home entertainment stores. However, these two types of stores have had their problems in recent years. Sales have failed to keep pace with inflation and the great growth years appear to be over. Will computer owners who are program customers look for software at these stores? That question has not yet been answered, and the future of how software will be mass-marketed has not been settled.

Many companies already possess inherent marketing advantages:

•The owners of computer magazines, for example, can use them to promote the software they publish.

•Publishers of other materials can use their retail outlets to sell software.

•Franchisers of computer stores can use their stores as software outlets.

•Retail chains of various types can use their branches to promote software.

You don't have to be a great prognosticator to deduce that major book publishers, as well as calculator, computer and game manufacturers would benefit from inherent advantages, if they chose to move into the software business. Which of these will succeed? We will not hazard a guess.

Special problems

Some special problems that a software publisher faces include reliability, reproductibility, plus lack of formatting, configuration, graphics and interfacing standards in computers. They also have the difficult task of controlling program piracy.

Software reliability must be reasonably high, since no publisher wants to correct thousands of copies of a cassette or disk. But note that the reliability need not be any higher than massmarket hardware, since you can hardly expect a program to work better than a garden-variety phonograph-record player or television set.

Reproducibility remains difficult, particularly on cassette tapes. Most users have found that home computers cannot often read their own tapes – much less those produced on other machines or by mass marketers! Cassette recorders and cassettes used with computers require a higher level of precision and care than do those used with audio equipment.

Lack of a standard medium means that the same program must be available in several different formats. Cassette formats, of course, differ widely and even disk formats vary.

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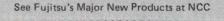
And whether you order the M2211 (80 MB) or the M2201 (50 MB) drive you can say goodbye to data staging. Plus you get a servo/track record system that assures the cartridge interchangeability you need. With features like these it's no wonder Fujitsu's got the world on a platter.

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Software DESIGN SERIES

Lack of standards in the computer industry means that many different versions of the same program are required. Imagine the problems that would exist, if many of the phonograph record players were different in type and were incompatible. Even languages like BASIC vary enormously, and operating systems, I/O drivers and other system software vary even more. In part, the usual vicious circle of events will solve this problem most programs will be available for the most popular computers, and these computers will become even more popular because of the availability of more programs. A recent survey by Personal Computing magazine showed that 30% of the respondents own Radio Shack TRS-80 and that only 7.4% own an Apple II.

Many of the most attractive and popular capabilities of home computers are completely unstandardized. In particular, graphics on home computers are different enough to make translation of a program with extensive graphics almost impossible. Voice input/output devices and other accessories show a similar lack of standards.

Interfaces for specialized peripherals vary tremendously. The software and hardware required to use peripherals, such as a letter-quality printer, digitizer or mark-sense card reader vary so much that they limit the size of the total market. Here again, the availability of software may serve to reduce the number of different interfaces in wide use.

Copying of programs, like copying phonograph records or audio tapes, is easy. In fact, so easy that reproduction limits the price that the publisher can charge for programs. Too high a price encourages piracy and trading. Program copying is difficult to control, since legitimate users need backup copies in case of erasure, media failures or other problems.

Selecting popular programs

What kinds of software will be popular? The answer is that the market will be as wide as the market for books, with obvious demands for entertainment, education, business and information management. We note, in particular, the following areas: games, accounting, computer-aided instructions, business calculations (such as mortgage rates, loan payments or cost estimates), computer music, computer art, word processing, business functions (such as inventory, mailing lists, and insurance forms), statistics, simulation (including business forecasting,) operations research, data acquisition and analysis, and income tax.

Any topic that has been popular enough to support a number of published books will certainly support published programs. Of course, one book publishing problem will remain: those who understand the subject often cannot write well, while those who can write well often do not understand the subject. The same dichotomy will (does) exist between practitioners and programmers: only a few people are skillful enough to bridge the gap. Successful mass program writers are going to be a rare and highly sought-after commodity, just as authors and songwriters are. How long will it take before programmers join the other celebrities on the network talk shows?

Certainly any industry or grouping listed in the Yellow Pages of a major city telephone book offers a large potential market for appropriate computer programs. Alphabetically listed are accountants, apartment managers, bakers, boat manufacturers, churches, circuit board manufacturers, dentists, dress designers, egg brokers, engineers, funeral fabric stores. parlors. gift shops, golf courses, health food suppliers, home loan agencies, ice cream parlors, investment counselors and so on. Any group that supports a trade magazine, a national conference or an association needs software programs. Certainly, the large abundance of conventions and magazines indicates that no shortage of appropriate groups exists.

Like other forms of publishing, software publishing will encompass an international as well as national market. Of course, the international market will make a great deal of translation necessary, not only of the documentation but of any written communication within the program. Business methods, tax structures and customs will require major rewriting of many programs, if not completely new versions. Among the problems that will exist in the international market are the orientation of major programming languages (like BASIC) toward English and the orientation of most computer systems toward alphabetic/written languages rather than character-based languages like Chinese and Japanese.

Users and programmers

Note that much of the software industry will not assume any user knowledge of programming, any more than the phonograph record industry assumes an understanding of music or any musical skills. Certainly, there will be lots of room (and market) for those who have programming skills, but most people will use – not write – programs.

Current and future trends

Where is the software industry now? National advertising of small computers and software has only begun. Within the last year, we have seen the first mass market program reach the 50,000 level in sales (Micro Chess from Personal Software, Inc., of Sunnyvale, CA) and the first small computer program reach the million dollar level in sales (MicroSoft BASIC from Micro-Soft of Bellevue, WA). Even at a production rate of one new program a day, the number of programs produced will hardly equal the number of titles available from a major book publisher.

In fact, we have yet to see widespread public acceptance of computers and mass-produced software. Most people don't care. And, most people are still awed by computers and could no more see themselves buying and using one, than they could see themselves buying and using their own nuclear reactor or space satellite! Will a new generation, having grown up with computers and being as accustomed to them as we are to books and phonograph records, have to reach adulthood before the mass software market will reach maturity? Perhaps not.

About the author

Dr. Lance A. Leventhal is an independent consultant who heads Emulative Systems Co., specializing in microprocessors and microprogramming. He also serves as the technical editor for the Society for Computer Simulation and as a contributing editor for Digital Design. He is a recognized authority, a national lecturer on microprocessors for the IEEE, the author of eight books and over 50 articles on microprocessors.

Several microprocessor books authored by Dr. Leventhal have become best sellers; among them are assembly language program texts on the 8080A/ 8085, Z80 and 6800. (All are available from Osborne, 630 Bancroft Way, Berkeley, CA.)

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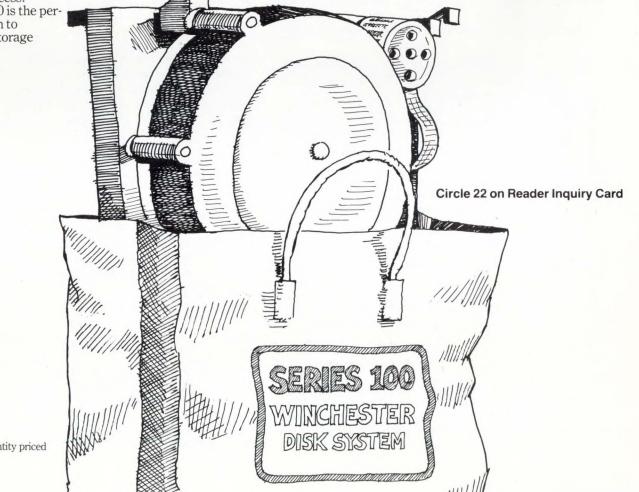
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Present And Future Trends In Logic Analyzers

When the digital world began to explode in the early seventies, the oscilloscope gave way to logic analyzers, or was married to a scope multiplexer for viewing stored data. These data, displayed as ones or zeros, provided words on the oscilloscope corresponding to the data stream under test. The system under test provides clock pulses to record this data synchronously. A trigger word assigned through front panel switches determined what data would be captured. After a word had been triggered, one could view data words on either side of the trigger word. Many logic analyzers still use this oscilloscope/multiplexer combination and simple word triggering. Fig 1 shows the basic trigger concept.

The logic analyzer is to the digital world, what the oscilloscope is to the analog world. There are now several logic analyzers on the market, and sometimes you have a difficult time determining which system can offer those features to significantly aid in debugging the users' systems. Price and manufacturers brand recognition are not as important as performance of the analyzer in determining usefulness. With that in mind, this article will explain logic analyzer theory and application.

One universal component to all logic analyzers is their

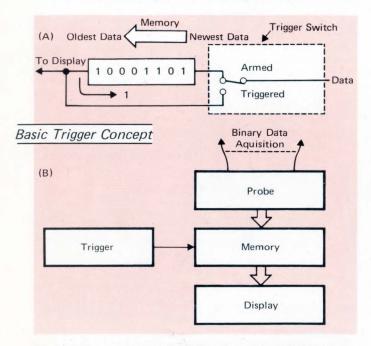


Fig 1 (A) Binary data is acquired. When the word specfied for triggering and the data acquired is equal, triggering takes place. The trigger word is stored in memory. (B) Data is acquired via probes, a trigger is activated, and the memory stores the data. Then this data is reformatted for display.

memory. All analyzers detect, "trap", and record, a set of digital inputs, by sampling input data and storing it in memory. Memories vary between manufacturers from 64 to 2048 bits-per-channel monitored. After the logic analyzer samples and stores the desired data, it displays this data in some convenient manner, typically via a CRT or oscilloscope. With exception to some tricky data manipulation internal to the analyzer, this is all that a logic analyzer does.

Now let's take a further look into how a logic analyzer performs its functions.

The modern logic analyzer acquires multichannel data simultaneously, stores this data in a sequential-access memory, and stops its data storage process with a "trigger". Then data is formatted and displayed for evaluation (Fig 1B). This manner of data acquisition allows the user to capture and analyze a fault or trigger condition. Further, depending on memory length, one can determine activity in his data stream leading up to the fault or trigger (pre-trigger data) or subsequent activity after the event (post-trigger data). Modern analyzers offer both data (state) and timing information for hardware and software (firmware) analysis.

To prempt erroneous readings during data acquisition, one must further qualify the incoming data. One means of qualification is to select appropriate threshold levels before acquisition. To distinguish between high and low states of incoming data, each channel has a voltage comparator (Fig 2). Any signal voltage higher than the comparator

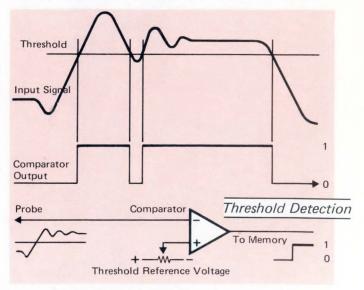


Fig 2 The above diagram shows threshold detector via use of a comparator technique.

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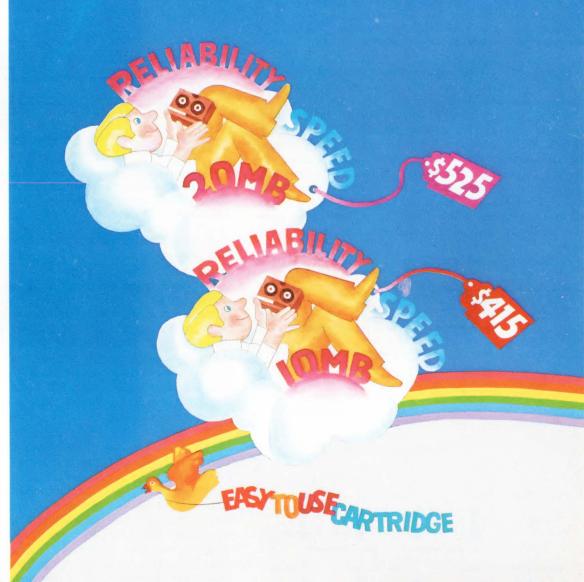
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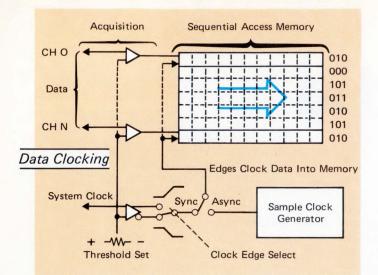


Fig 3 The Sequential Access Memory is depicted as a group of simple shift registers. In practice most analyzers use high speed RAMs addressed by a counter. However, the operation is the same, old data is lost (written over) as new data is stored.

threshold will be high; any lower than the threshold will be low. Many manufacturers offer a potentiometer to select different threshold levels.

Logic Analyzers sample data at discreet times. Binary states are stored in memory at the edge of a clock signal. (Fig 3). When sampling data synchronously, data is sampled by a clock from the system under test. This is commonly termed "synchronous sampling". Sampling synchronously allows the user to record the states of input channels at sequential system clock times while ignoring narrow pulses known as glitches (Fig 4). Logic State Analyzers sample synchronously; logic timing analyzers sample asynchronously.

In some microprocessor systems the Z80 for example,

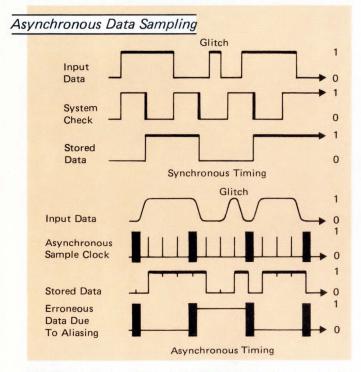


Fig 4 Here are the conditions in the data stream as they are recorded synchronously and asynchronously. Note that glitches captured asynchronously show up as one bit wide pulses. one might only wish to monitor R/W data when the processor is talking to a port. Further, the user might not want to record R/W pulses which are activated simultaneously for talking to the Z80 memory. In such a case, one could store data selectively, by using an external qualifier, which when selected high would allow capture of memory R/W pulses; when low, port R/W data; when in don't care, both memory and port read/write data. Using such qualifiers would allow user to record selective data and, in effect, double the logic analyzer memory.

For gathering logic timing information, you would sample asynchronously, using a clock internal to the logic analyzer. This clock, to provide good resolution, should be able to sample data between 3 and 10 times faster than the system under test. If the logic timing analyzer clock is slower than the system clock "Aliasing" will occur. (Fig 4). In logic timing analyzers pulses too narrow to meet minimum pulse width criteria are detected by a glitch latch. Transitions that occur between sample clocks are displayed as one clock period wide pulses, during the next clock interval (Fig 4).

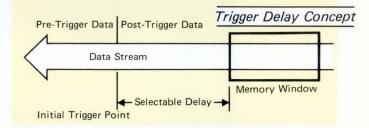


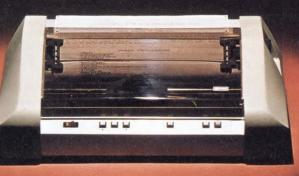
Fig 5 Using one specific trigger word, one can select a delay by clock counts to take a "snapshot" of data. By setting a sequence of delays one can acquire "snapshots" of "blocks" of data along the data stream.

As we said earlier, the trigger word stops the data acquisition process and tells the analyzer to store these data. Most analyzers have a variable trigger point which allows one to look at events before the trigger word (pre trigger) or events after the trigger word (post trigger). Depending on the situation, a user might wish to view a few or many events leading up to the trigger or after the trigger. Thus, the need for a variable trigger point. Because data sequences can be very long and memory capacity is finite, it is desirable to have some means of positioning a memory "window". You can delay memory storage of selected data from the initial trigger point easily, by using a delay generator and counting system clock pulses until the desired window is framed for a "snapshot" (Fig 5). By using the same trigger word and varying clock delay one can break a given program into "blocks" which can be individually and thoroughly examined.

Many programs, having nested loops or subroutines, exhibit multiple word or loop passes. Thus, the need to count these passes to determine whether a subroutine has been successfully terminated gave rise to a pass counter. Pass counting not only registers completion of a given subroutine, but also can define at which point a routine might prematurely terminate. Many new analyzers have at least one level of pass counting. For example, one offers 4 levels of sequential word triggering at up to 48 bits width per word.

Sequential word triggering can be a powerful technique for selecting a unique program path out of a seemingly ambiguous set of paths. In Fig 6 the analyzer will trigger on word B, but only when it is preceded by word A. In hard-

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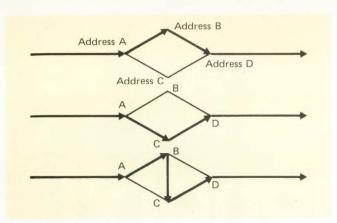


Fig 6 Above are three possible sequences of data flow. Through sequential triggering and "pass" counting one can monitor either condition.

ware terms, A arms the analyzer and B (or the nth occurrance of B) triggers it.

In software terms, you can picture a program path through a subroutine beginning with word A and ending with word D. Between A and D, there are three distinct paths by way of B and C. These are ABD, ACD, ABCD. The three paths can be distinguished by triggering on sequences of words, BD, AC, and BC respectively (Fig 6). Such triggering requires multiple triggering levels, and with subroutines having multiple loop passes, it is also necessary to monitor the number of occurrances.

As for reference memory capabilities, setting comparison limits are new features which deserve more attention. With a reference memory, you can load known data and compare it to data acquired from a system with a "bug". When the bug is determined, you can easily trigger on noncomparison and develop a history of occurrances before and after the fault for review. With some systems you can also acquire a hard copy of such events.

Basically, such a logic analyzer captures a normal block of data from a suspected portion of a program, using triggering criteria X, Y, and Z, and transfers it into a second reference memory inside the analyzer. Next, using the comparison mode, the analyzer will wait for data that meets XYZ criteria. When that data arrives, it will compare the captured data with the normal data in the reference memory. If the data do not compare, the instrument triggers. If the data do compare, it re-arms and waits for XYZ criteria to reoccur.

Some add a useful twist to this process and can define both the channel width and the word depth of the memory used for comparison. For example, suppose an unusual combination of data in subroutine A is suspected of jumping to an incorrect address. If the data in subroutine A is always changing, then it is possible to limit the comparison to just 16 address channels, even though the analyzer is simultaneously recording the data bus information.

Next, given that subroutine A is 103 addresses long, the comparison can be limited to just those 103 words in the reference memory. This is very useful should subroutine A be accessed from any number of different places and exit into other subroutines.

What is coming? The 1980's will give rise to more sophisticated measurement through logic analysis in the μP area.

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Fiber Optics Successfully Links Microcomputers

This article describes how a system of microcomputer terminals can be linked together by a fiber optic data link. The system uses a transmitter and receiver design providing a two-terminal full-duplex system with the flexibility to expand into a multi-station applications for process controllers, computer peripherals, POS terminals, order entry, etc.

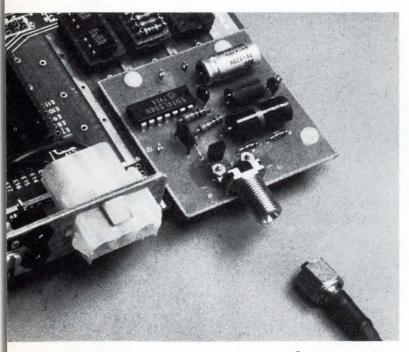
Transmitter and receiver

The FOAC consists of a ferruled semiconductor and a compatible connector, allowing the transmitter and receiver to be used with any optical cable types or fiber core diameters.

The fiber optic transmitter's light source is an LED (#MFOE-103F) driven by an inverter and a driver transmitter (MC74LS04), and is capable of data rates to 1 Mbit/sec.

The completely shielded receiver circuit is an edgecoupled design using a ferruled PIN diode light detector (MFOD-104F). The receiver's best performance is at 100 KHz with a 10^{-9} bit error rate.

The allowable distance between the transmitter and the receiver depends very much on the receiver design, the optical power launched into the fiber and the fiber type selected for the system. Fiber cable attenuation, pulse dispersion and numerical aperture are important considerations. The system was demonstrated with 70m of Siecor type 155



Fiber optic transmitter module consists of T^2L drive circuits and ferruled optical source in an active connector.

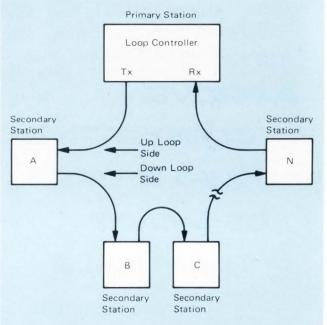


Fig 1 Loop configuration includes N secondary stations.

cable between stations. Our calculations indicate a cable length greater than 120m is possible. With use of a more sensitive receiver circuit or more transmitted optical power the maximum cable length and data rate may be enhanced.

The fiber optic transmitter and receiver are coupled to the MC6854 ADLC through a clock recovery and loopthrough circuit. The clock recovery circuit synchronizes a 1-MHz oscillator (divided down to the 62.5-kHz data rate) to the incoming received data. The data and separated clock information is then presented to the MC6854 ADLC. The 62.5-KHz clock is also used to shift the data back out to the transmitter for the next down-loop station. To keep the loop intact during local power down situations or servicing operations, provisions were made for a separate power supply or rechargeable battery backup to power only the optical transmitter and receiver. The loop-through control then diverts the receiver output directly to the transmitter input to keep the repeater function operating.

Software

Connecting a series of terminals together requires a well defined and efficient communications protocol to manage the data link. For this design a Bit-Oriented-Protocol known as Synchronous Data Link Control (SDLC) was chosen. (SDLC protocol is described in IBM SDLC General Information Document #GA27-3093-1). This protocol provides an efficient method for establishing and terminating the conversation between two stations, identifying senders and receivers, acknowledging received information and error recovery.

A transmit sequence from the primary station to a sec-

ondary station begins with transmission of the Information Frame (1-Frame) containing the address of the intended secondary station in the address field. When a secondary receives a 1-Frame with its address, it takes in that frame and stores it in a receive buffer. In SDLC all frames contain a 16 bit error checking code (FCS) which precedes the closing flag. The receiving station will check this error code to validate transmission accuracy, and respond with the appropriate acknowledge (ACK) or not acknowledge (NAK) frame when it sees a "GO-AHEAD" flag up to seven frames later. A secondary is permitted to suspend the repeater function and go "on loop" to transmit a frame only when it receives a "GO-AHEAD" flag from the primary station.

Wider bandwidths

The data throughput capabilities of the microprocessor operating at 1 MHz imposed a maximum data rate of about 75 Kbit/sec. Using a 6844 Direct Memory Access Controller

(DMAC) to reduce the amount of processor overhead in data handling and a wider bandwidth receiver design, data rates up to 1 Mbaud have been demonstrated. Because of the extremely wide bandwidth of the optical fibers, any further increase in data rate can easily be accommodated by the existing fiber, thus eliminating the expense and trouble of installing a new upgraded transmission cable.

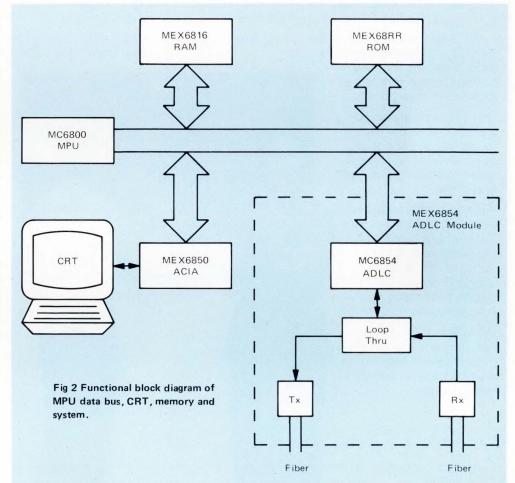
A practical, cost-effective solution to a specific applications problem has been described. It is certainly recognized that some of the limitations to this approach may be avoided or modifications made to it by using directional couplers, splitters, or twoway fiber optic cables.

Hardware

In our design, each μ C terminal consists of a full duplex data port with two optical fibers, one for transmit data and one for receive data. The most basic configuration would consist of two stations communicating in a full-duplex

mode. As more terminals are added they are organized in a loop configuration. One station is configured as a primary station and has control responsibility for the data link, and the remaining stations are designed secondaries (Fig 1). All data flow is initiated by the primary and passes through one or more secondaries in a serial fashion until it returns back to the receiver section of the primary. Loop operation requires the data link to operate in a half-duplex onedirection-only mode. Each secondary station is a repeater of its up-loop data to the next down-loop station. Signals sent out by the primary are relayed from station to station. Any secondary recognizing its address in the address field of the Information Frame takes in that frame and acts on it. This frame is still transferred to all other stations down the loop. The opportunity for secondary stations to transmit is initiated when the primary station transmits a POLL command (request for a response from the secondary). Control of the loop is transferred to a secondary when it receives a "GOAHEAD" flag following the POLL command. A complete set of rules also handles error detection and error recovery.

The hardware in each station is based upon an EXORterm 220 M6800 development system, which is an intelligent CRT display terminal with an integral development facility that provides a motherboard and card cage capable of holding up to eight μ P modules. Each station is made up of standard 6800 micromodules including an MPU module, an MEX6816-22 16K static RAM module, an MEX68RR 8K ROM module, and an MEX6850 ACIA module to interface to the CRT terminal. An MEX6854 Advanced Data Link Controller (ADLC) module with fiber optic transmitter and receiver onboard provides the interface to the



fiber optic link.

The 6854 ADLC performs the complex interface function between the MPU data bus and a synchronous communications channel employing a Bit-Oriented-Protocol. It is an NMOS LSI intelligent peripheral device that automatically performs many of the functions required by the communications protocol, thus reducing the amount of software required and increasing the data throughput rate (Fig 2).

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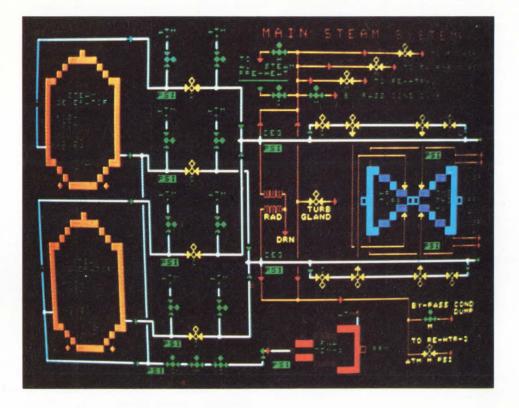
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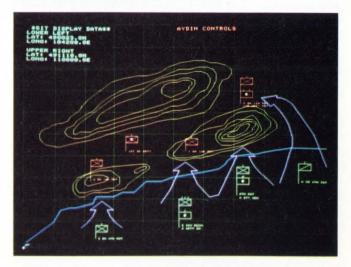
Paul Snigier, Editor

With the rapid growth of graphic display devices into new system applications, and the falling costs and improved performance levels, the chances are that every system designer will soon be specifying and integrating graphic display terminals or devices into industrial control systems. With this in mind, we will examine some of the selection criteria needed to make intelligent choices. But before we do this, it is important to understand certain basics.

Matrix manipulation

Information traditionally has been displayed in tabular and alphanumeric form. Only with the advent of graphic display devices did graphical representation of data come on the scene. By using color or black and white to portray spatial relationships, more information could be conveyed to users. With logical statements or instructions in memory used to define connecting addresses (hues), it was only a matter of manipulating matrices to enlarge, reduce, modify or maneuver graphic images. If no interaction with the display was possible, it was passive; if not, and interaction was possible, the display was active. In the latter case, by quickly changing the graphic image, the user could investigate alternative approaches to a problem.

Two types of graphic display systems exist – storage and (stroke writing and raster scanning) refresh. Stroke writing writes on the CRT like an artist using a pen; raster scanning, as is well known, does it the hard way by scanning the entire CRT, with the beam brightening when desired. Raster scanning uses more memory, since each coordinate point must reference memory. This disadvantage is offset by an ability to handle color graphics and selective image-erasing capability. Before we look at a specific case, let's begin by examining the graphic display technology itself.



Above: Industrial control applications will utilize more color graphic displays. *Below:* Terrain and contour mapping represent untapped market applications. (*Aydin photos.*)

Software is the key

Increased intelligence and greater processing power at lower costs is having an effect upon computer graphics; and computer displays now produce color pictures in full three dimensions, with dimensional capability approaching that of photographs in their realism. Will stick drawings remain the mainstay among CAD^2/CAM (computer aided design, drafting and manufacturing) users and other users? Perhaps, although improved software and newer computers are making realistic displays at lower cost more attractive.

Shadow placement, extensive calculations and perspective alteration — these and other techniques requiring extensive software have been overcome; and realistic displays are now being used to generate product promotions, instructional films, flight simulations, advertising materials and fill the needs of a sundry host of other applications that grow as costs plummet.

Unfortunately, color 3-D images require so much number crunching capability that software to date has been unable to provide updated pictures in real time that do not create a jumpy motion due to inadequate updating. To lick this problem, designers have taken several approaches to graphics high-speed processing hardware.

Spatial relationships

Surface description geometry, the standard technique for writing graphics software, evolved from the earlier framework (stick) graphics seen so often. In operation, the procedure is simple: the framework is removed and a 3-D contour is "stretched" over the surface. Each frame segment forms a flat polygon, and light reflected from each is defined by a vector. Now, to approximate a smoothly-curved surface, these vectors that specify reflection are incremented over the object's surface, thus creating the appearance of a smooth surface.

The first big advance was software that could transform x, y, z coordinates into x', y', z' coordinates such that new coordinates defined a perspective. The mathematics were straightforward, as you would guess, but the program would create many lines; the procedure was needlessly lengthy – even for the early and low-power computers of the 1960s.

Next, programs were written that considered only the points of intersection of lines, transforming these vertices to new locations through matrix translations. With the addition of a third or z-axis, the software could automatically generate a 2-D view — once the observer's location was specified. The given object, defined as a series of matrices, and multiplied by a matrix incorporating rotations, scaling and translations, generated a perspective view that was accurate. Unfortunately, the object resembled stick figures — not reality. This was adequate for modeling machinery and CAD-CAM.

Next, programmers defined surfaces of objects; and clusters of these polygons formed the surface, with prioritization determining which polygon could mask which other one when maneuvered about in three dimensions. With surface definition via polygons now possible, the next step was to simulate lighting effects, whether from a single source, or multiple sources, whether sunshine or indoor lighting. A vector of a given magnitude, which corresponded to polygon surface reflectivity, is defined such that it is normal to each polygon surface. Thus, vector magnitude defines the amount of reflected light. With a program knowing the position of the light source and the reflectivity vector for that polygon, it performs a scalar multiplication to obtain a scalar value to be associated with that polygon. This is the shading of that polygon.

The object, now comprised of a multi-faceted array of different-shaded polygons, begins to resemble the object. To smooth out these polygons, software-smoothing routines alter the reflectivity vectors and break the polygons into pixels (small squares). Interpolation smooths the intensity over each polygon, creating a gradual transition of intensity.

In solid-description geometry, fundamental geometric shapes such as cones, cubes, pyramids and spheres are used, with software adding or removing elements. This creates the final shape. Instead of a matrix of vectors, this solid description geometry (which is used a good deal in computer aided manufacturing and design) stores in memory an array of separate solid characteristics.

Even with some of the larger machines, using software to perform the numerous calculations needed for realistic and continuous motion, with an updating of frames at a sufficient rate to avoid jerkiness, is certainly asking the software to do too much; instead, dedicated software is used that utilizes pipelining and can handle large vectors or arrays of data. A single instruction can perform an operation (such as multiply, subtract or add) concurrently on a large array of data. A data block passing through the pipeline processor is first operated upon by one operation, followed by a second, and so on, with subsequent data blocks following behind it. When the pipeline is full, the first data block will be outputted. Lower-cost array processors should provide increased number crunching capability and will lower overall graphic processing costs.

As for applications, flight simulators for airline pilots and NASA astronauts are well known. Other simulators exist and by maneuvering an oil tanker, space shuttle arm, crane or airliner, a trainee can quickly gain practical operating experience – without damaging the tanker or 747. Although realistic simulation is made, these solid-description, geometrically-defined objects (most often used in simulators) need not be perfect in realism as they are instantly recognizable by the operator. Most such solid description geometry programs have required large mainframes. For example, to generate 12 basic shapes, one such program used to create objects used over 200 kbytes on a 32-bit machine.

Industrial control and color graphics

Industrial control applications represent one explosive area expected to continue its demand for graphic display devices. These displays are being installed in numerous applications, including: electric power utilities, hydro, fossil fuel and nuclear power generation facilities, oil and gas pipelines, process control, transportation, medical, business reporting, management information systems, financial reporting systems, order entry, simulation, training and command and control applications. Printing, papermaking, wafer fabrication and other facilities are also application categories.

The use of color, although more costly, is often preferred due to improved operator recognition and lowered probability of operator error. Unfortunately, color sometimes has unexpected effects. Researchers in information transfer by visual displays have extensively researched this subject, particularly for military systems. Although innumerable color differences may be detected by the human eye, any more than eight may confuse operators, since the operator must take more time to differentiate between them. Generally, red represents an anomaly or dangerous situation, except in the power industry where red signifies equipment is on and green represents an off-state. Some utilities use



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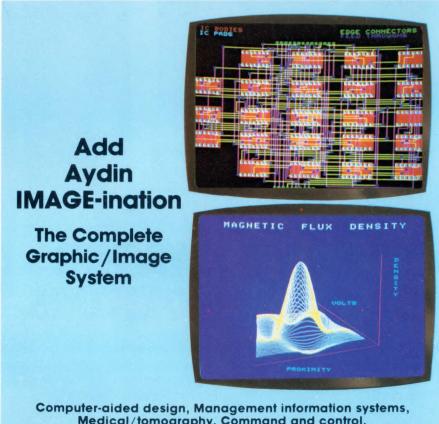
MODEL	HM-2519	HM-2619/2613	HM-2719/2713	HM-1519	
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Resolution	High	High	High	Standard	
Convergence	High	Self- convergence	Self- convergence	Conventional	
Number of LinesMax 720 525/625 std		Max 720 525/625 std	Max 720 525/625 std	Max 720 525/625/std	
CRT Delta gun Dot shadow mask 0.31mm dot pitch		In-line gun Dot shadow mask 0.31mm dot pitch	In-line gun Dot shadow mask 0.31mm dot pitch	Delta gun Dot shadow mask 0.61mm dot pitch	
Display 4,000 char. Capability Analog		4,000/2,000 char. Analog	4,000/2,000 char. Analog	2,000 char. Analog	
Video Amplifier Bandwidth	25 MHz ± 3 dB	25 MHz ± 3 dB	25 MHz ± 3 dB	25 MHz ± 3 dB	

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yellow and magenta to signify alarms or dangerous conditions. Blinking colors usually signify that some function needs attention, and may signify alarm conditions of various priority if blinking at different rates; that is, the higher its rate, the worse the situation. The shape of the blinking alarm differs; it may be a red-on-white background box. Partial blinking is sometimes used to prevent loss of information (if viewed quickly). The overuse of blinking (and its distraction of operators) has been curtailed in more recent graphic devices.

Color combinations are important, as are backgrounds. If greater attention is needed, a higher contrast is superior. Red-on-a-black-background is harder to notice than on a white background; and yellow on a white background is an even worse contrast. But, if yellow appears on a green background, the "vibration" (optical illusion) distracts and produces eye fatigue. Or, almost as bad is the other extreme: a color contrast so extreme (such as yellow on a black background)



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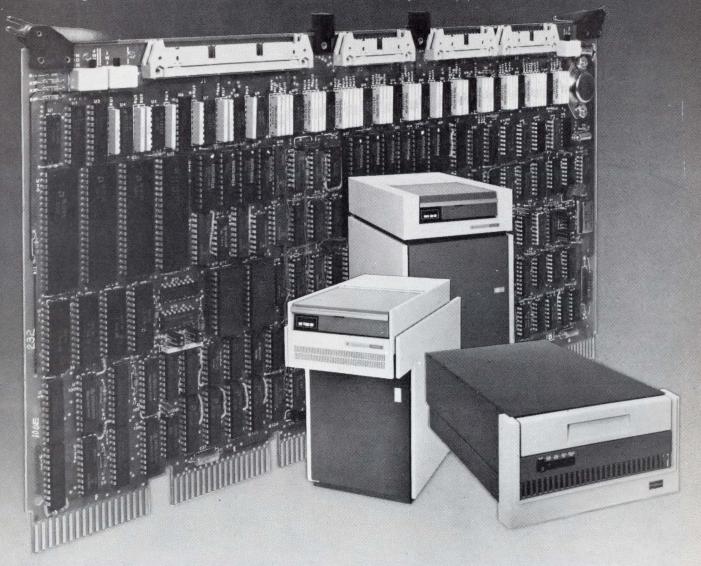
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that a ten-second after-image occurs. This causes increasing operator error. Then (as long known to all sign painters), certain color combinations work well - if the character or symbol has significant weight against that given background color. For example, blue, if of sufficient size, will stand out against a black background; but, if smaller, will "vanish." Few billboards are painted that way; and for graphic terminal users to expect operators to extract information readily is asking for trouble. Pure colors, also, are harsh. Muted colors are easier on the eyes a fact also long-known by artists and advertising personnel. Good color combinations are black-on-yellow, red-onwhite, blue-on-white and green-onwhite. Obviously, those functions or alarms of higher priority should be provided with more noticeable color combinations.

Graphic display researchers find that overloading the screen (over 25%) clutters the screen. Some systems designers neglect this arbitrary limit, going on the basis (often valid) that experienced operators mentally blank out unchanging variables. If alarm messages appear, they can run over 20 to 25 lines and would not come under this loading rule. This 25% loading factor rule is only a rule-of-thumb, and may vary. Each application is different, and we suggest that each systems designer conduct research for his particular application(s). For example, the loading factor will be higher when symbols are used to represent the different industrial control processes (such as a simplified outline of a steel vat, pump or valve). If three-dimensional displays are used, informational transfer to operator is improved by a third (once again, depending upon the application). How long should descriptive labels be? Under 12 characters, if possible, although in a sophisticated system, this is not always possible if there are thousands of required descriptors. If the descriptor is lengthy, then use the inverted pyramid style: place the most urgent information at the top; the least important, at the bottom. Unlike chemical or printing facilities, power utilities use generators surrounded with intense electromagnetic fields that have been know to create convergence problems. What does this mean? In such applications, higherpriority, alphanumeric information should be kept away from the screen's edges. Audio signals, including alarms, are available. Audio signals may also be deactivated.

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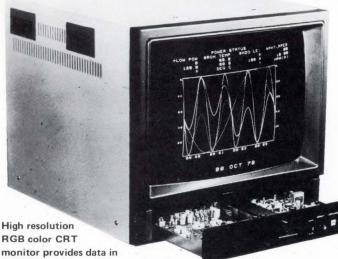
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The future of graphic display devices is bright; and with the lowering of costs and increased OEM system design sophistication -- not to mention the increase in user awareness - graphic display devices will invade hitherto untouched markets. One area, the industrial and process control market opens up new design possibilities for system designers.

A color terminal costs more, but many graphic display users believe it is worth the added price – when it is available. One of the reasons for use of color in interactive computer graphics is to cause critical or dangerous conditions to stand out. Red tends to indicate the need for special attention in computer graphics as it does in traffic systems where the red light means "Stop!" When graphics are used to control electric power lines, red indicates failure. In railroad control systems, red means the track is occupied. In image processing of earth satellite photographs, however, forest areas are indicated by red rather than by the logical green. What is achieved by the artificial colors which are produced when satellite pictures are processed and enhanced is a more understandable image. At least it is more understandable to someone trained in interpretation of "false" colors.



RGB color CRT monitor provides data in curve format (Aydin Controls 8025).

Most image processing applications require color. "CRT Graphics Terminals and Systems," a report from Venture Development Corp. (Wellesley, MA), notes an important exception in the x-ray scanner. Radiologists, who customarily diagnose from x-ray films, do not like color. They are accustomed to interpret shades of gray, and they feel that arbitrary assignment of colors to various shades is confusing. Because information from x-ray photographs is monochromatic, color assignments must be arbitrary; red is assigned to one shade, yellow to another, etc. This makes interpretation easier to teach to medical people who are not fully trained in radiology because, for the untrained eye, contrasting colors are easier to see than shades of gray.

Three different technologies are used in interactive computer graphics: storage tubes, random scan and raster scan. Storage tubes are monochromatic; random scan CRT's can have limited color capabilities; raster scan terminals can provide a full range of colors.

Direct view storage tubes have dominated the market for CRT graphics turnkey systems used in Computer Aided Design and Computer Aided Manufacture (CAD/CAM). Made by Tektronix, Inc., this type of CRT provides the high resolution required for intricate mechanical maps and drawings, at relatively low cost. CAD/CAM users are interested in color, but so far it is difficult to obtain with the desired resolution.

Random scan, a display technique in which the electron beam sweeps directly along the desired path on the face of the screen, can obtain high resolution, but at this time at much higher cost than storage tubes. Color is possible through the use of beam penetration.

Color is produced by the beam penetration method through variations in the velocity of the electrons. The phosphor on the face of the screen is applied in several layers of different materials. The color is determined by the distance the electron beam can penetrate into the phosphor. The number of colors is limited; variations in intensity and shading are not feasible. Accordingly, market acceptance has been limited.

Raster scan is the display method used in home TV sets. Colors are bright and may assume an almost infinite variety of shades and hues. The shadow mask color technology used in raster scan displays was developed for home color TV at great expense over a number of years. CRT color graphics thus reaps the benefit of this research. Most computer CRT graphics use tubes of higher quality than those used in home TV, but they employ similar techniques.

Because the added cost of color is being reduced, color is taking over in most graphics displays; 73% of raster scan graphics displays now provide color. This percentage will increase to 90% by 1983.

Generally, color is not especially desired for alphanumeric terminals; most will remain monochromatic.

A factor which has inhibited the growth of the color display market has been the lack of color hard copy. Most interactive computer graphics systems require permanent records in addition to the evanescent CRT display.

Until recently, instant color copy was unavailable; color copy could be obtained only by photography or by color ink-jet printers. Black and white copy could be obtained quickly through the Tektronix 4632 video hard copy unit,

but no zerographic color copy peripheral was available.

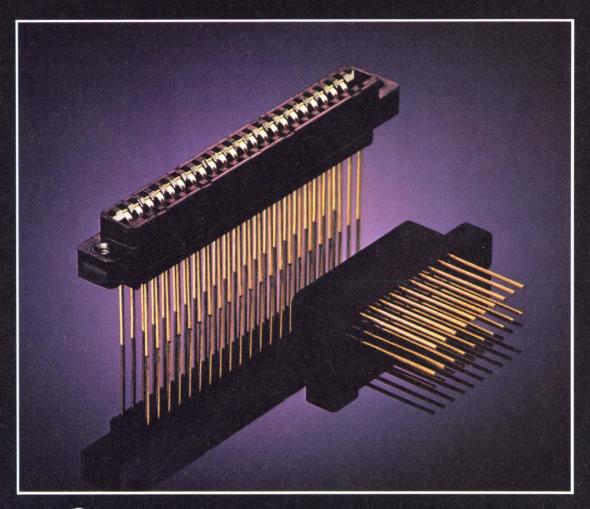
Now, Xerox has moved into this gap with its 6500 Color Graphics Printer which was introduced at the 1978 National Computer Conference. Ramtek, the leading manufacturer of raster scan terminals, has developed an electrical interface for Xerox equipment. The industry giant, Tektronix, Inc., has also developed an interface to adapt the color printer to the Tektronix 4027 raster scan color terminal, which Tektronix added to their line of monochromatic storage tube terminals.

Dunn Instrument Corp. has developed a camera/peripheral to record color displays on high quality 8" x 10" Polaroid prints. Matrix Instruments is reported to be developing a computer graphics hard copy instrument using Polaroid prints.

VDC expects color graphics to gain acceptance throughout the entire graphics industries. Already, producers of process controls, such as Foxboro, Fisher Controls, and duPont, have switched to color graphics. The electrical power industry has been using color for some time. Management information graphics systems are moving toward color more slowly. However, now that executives see color in their TV's, the pressure to provide color on CRT business graphics is likely to prove irresistible.

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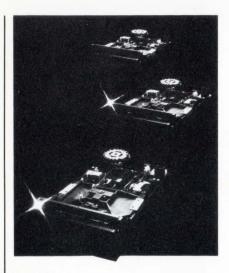


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Special Report: Flexible Disk Drives



Staff Report

T he flexible (floppy) disk is a circular, flexible plastic magnetic storage disk held in a plastic jacket. When inserted into a disk drive, a spindle grasps the disk through a central hole and spins the disk at 300 RPM. A small hole in the jacket permits sensor detection of a disk hole, thus determining the disk's rotational position at all all times. Cut in the jacket, an elongated hole enables a R/W head to access any track. Track-to-disk access time for the head is about 3 ms.

Compared with cassettes or cartridges, a floppy provides better random-access capability. Low cost (6.50 or so for a single-sided disk), small size (4 x 8 x 14 in. or smaller) reliability and ease of mailing provide unbeatable advantages that 8" or 5" Winchesters or cassettes and cartridges cannot touch. Floppy access time is 160 ms or better; cassettes, a sluggish 20 sec. The cassette recorder travels 1-7/8 ips; the floppy disk drive, 80 ips.

A floppy primer

The floppy disk consists of a magnetic recording material that is so supple, to make it possible to handle this material, it is wrapped in an open weave wiping pad and sealed in a square plastic envelope. According to Square 1, although floppy disks record and play in the same general manner that cassette tapes do, there are several differences: because the flat disk rotates instead of being rolled around a spool, it is easier to get to any part of the record quickly. Another difference is that disks are read by having the head pulled and pushed over a large slot in the envelope.

Sectors. Each track is divided into a given number of sectors (like an English dart board). Some manufacturers depend on timing holes in the floppy disk to locate where the sectors begin and end; others use a single hole, and electronically time where the sectors start. Others drop the head on the proper track and read off pre-recorded sector identification marks from the disk itself.

Hard Sectored means that sectors are timed from several holes in the disk; Soft Sectored means that a single sector hole is timed and counted from there. Preformatted means that the sector identification is pre-recorded on the disk before you get it. There is always less chance for error if you tell the supplier your disk drive brand name and number when you order. Tracks of a disk are parallel to each other, just as cassette tracks are. Because the head is movable, it can slide from track to track. Each track then, forms a ring around the center hole. Each manufacturer of disk drives has his own patented way to position the head over the proper track with the necessary accuracy so that the recording will be in the same place when played back on another drive.

If we were to compare the cassette recorder to the disk drive, for their relative speeds, we'd find that the cassette pulls its tape through at a nice and gentle 1 7/8 inches per second. The floppy disk, however, spins at 350 RPM and reads at about 80 ips. The cassette recorder can reproduce music with sounds up to about 18 kHz, while the disk reads eight-bit words at about 250k words/second. This higher performance means closer tolerance and tighter specifications all around. A tape recording with a bad spot in it that lasted one thousandth of a second is hardly

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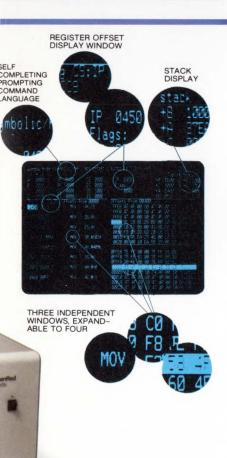
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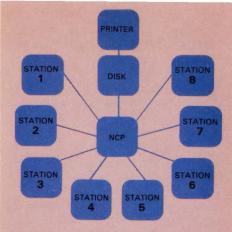
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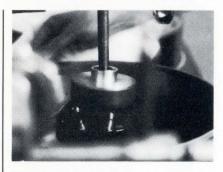
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noticed, but if a disk has a missing one-thousandth of a second, the computer will miss over 2 thousand words. You can buy inexpensive disks at good prices (just as you can buy inexpensive cassettes), but it takes care to assure high quality and high performance. Quality and precision simply cost more to produce, and OEMs and end users must weigh the various diskettes in light of performance.

There are problems in manufacturing a disk that can make a difference in the way it performs. Are you buying disks and using valuable time to put information on them? If so, you should know about these technicalities. One has to do with signal modulation. When you coat the magnetic material on a disk, you must have a means to make sure that the magnetic particles are all evenly mixed and spread over the surface, so that you have a disk that records accurately. The magnetic particles are like tiny sticks. Ideally, they should be layed down so that they curve around the disk in the same direction as the track. For practical reasons the disks are stamped out of long sheets. One-direction particle orientation produces high modulation.

High-quality disks have the particles oriented randomly. Disks that do not have the particles randomly distributed over the recording surface suffer from what is technically called amplitude variation. Random particle orientation produces low modulation.

Let's look at the anatomy of the material. By making an imaginary diskette large enough some of the dimensions are more easily understood. Start with a piece of polyester 21' thick and 10.5 miles in diameter. The entire slab must not be more than 2" thicker or



Floppy-disk head-lapping operation in Pertec's assembly line.

thinner than 21' thick. Then, spread pencils onto both sides of the slab until they are 10" thick with the erasers every which way. Add glop to hold the pencils there and polish the top of the glop until there is no more than 0.25" variance over the entire surface. The reason for polishing is obvious: to make the surface smooth so that it will not wear out the disk drive's head. The American National Standards Institute (ANSI) has established an ideal surface smoothness for floppy diskettes. They say that surface smoothness MUST be 3.0 microinches. If less, this makes the head last longer and ride smoother, and it gets better performance.

Formatting magnetic media

Formatting, a procedure performed prior to initialization, prepares the media for the system. The procedure is important because it writes an address field and a data field for each sector of every track. Formatting accomplishes three important objectives: (1) it furnishes data for address checking before the transfer of data, (2) it establishes (where necessary) bad sector flags that the system controller looks for before data transfer and (3) formatting provides splice areas that separate sector addresses and data fields (again, before the transfer of data).

If initialization is attempted before a magnetic medium has been formatted, BAD SECTOR/BAD BLOCK error messages appear. If such an error message is encountered while the user does his own formatting, these sectors and blocks can be reallocated during initialization.

Unformatted magnetic media offer several advantages which justify the purchase of the formatter program used to format such media. With such a program, the process of formatting is simple and takes a few minutes. Yet, it permits the user to personally check the quality of each storage medium sector by sector and enables the user to qualify the medium's R/W capability more closely. This familiarity with the medium helps the user because he or she knows the specific characteristics of each pack, cartridge, or diskette. Furthermore, media formatted on a specific system are more compatible with that system.

As we said earlier, the standard diskette is designed for use with a format in which the sector information is prerecorded. In this case, a single hole on the diskette serves as a reference point. The detection of this hole is accomplished by a transducer which is made



Shugart Technology's new 5-1/4" Micro-Winny disk drive.

up of a phototransistor/LED combination. The transducer produces an index pulse once per revolution of the diskette. To reiterate, a diskette that has equally spaced fixed sector holes on the same radius as the index hole is referred to as being hard sectored. Sector timing is accomplished by sensing these holes. A timing diagram compares the hard-sectored diskette with 32 sector holes and the single-hole diskette. The format in which sector information is pre-recorded on the diskette is referred to as the soft sectored format. An address-mark method is normally used to pre-record the sector information.

The information stored on the diskette surface is organized in concentric tracks. Each track consists of a continuous string of sectors, each of which contains a group of bytes comprising one record of data. Data are recorded in a sector on a bit-serial basis. Bits of information to be stored are first encoded, then recorded in a specific sector. The user's system will, however, determine the particular data encoding scheme to be used for data storage, depending on the type of recording medium and the bandwidth limitations of the read channel. The term "information," refers to any sequence of flux transitions written on the diskette consistent with the data encoding scheme employed by the user.

Data encoding

An information bit is considered to occupy a bit-cell which contains a data-bit preceded by a clock-bit. We will take the Pertec flexible disk drive as our example, although others will be similar, so the concepts we discussed may be transferred. In the general case, each clock-bit and data-bit has a value of either one or zero; the presence of a magnetic flux transition (with its associated read-back pulse) represents a binary zero. Each byte is written starting with the most significant clock-bit first,

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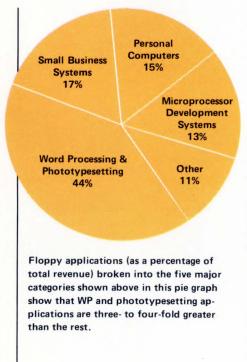
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then the most significant data-bit, and so on until the least significant data-bit is written. For convenience, the byte is defined by two hexadecimal numbers representing the eight clock-bit sequence and eight databit sequence, respectively. The general case is of a byte of information consisting of a clock-bit pattern of hex D7 and a data-bit pattern of hex FC. With the exception of special mark bytes, every byte of information utilizes the double-frequency encoding scheme in which a clock transition is provided for every encoded bit of information. In this case there are eight clock transitions per byte and the clock-bit pattern is hex FF. A mark byte is an encoded byte of information which has missing clock transitions in its clock-transition pattern. Therefore, a mark byte is specified by assigning a fixed data-bit pattern along with its associated clockbit pattern (other than hex FF). This unique combination of data-bit and clock-bit pattern is not allowed in an address field, data field, or gap. Hence, mark bytes can be used as flags for the beginning of a track, address field, or data field, respectively referred to as an Index Mark, an Address Mark, or a Data Mark.



Data decoding

The disk drive provides a pulse (200 ns, nom.) for each flux transition recorded on the medium. The leading edge of these pulses represents the flux transitions recorded on the medium. Flux transitions recorded on the rotating magnetic medium undergo time distortion during playback; the amount of distortion becomes more pronounced at higher recording densities. This time distortion is commonly referred to as peak-shift effect because it has the tendency to shift the analog peaks in the read amplifier output.

Any decoding circuit designed to recover data recorded on the disk surface must take into account the speed variation of the disk drive and the peak-shift in the playback signal. Both of these parameters can adversely affect the decoder margins.

A decoder circuit must be designed to ensure that the contribution of the circuit to decoder tolerances is negligible compared to peak-shift and speed variation effects. The speed variation of the disk drive contributes to deviation of the data rate from its nominal value; however, the use of a phaselock-loop circuit in decoding data significantly reduces the effect of speed variation on decoder tolerances.

The double-frequency code used in the disk drive possesses a self-clocking property in that it provides at least one flux transition (a pulse of 200 ns, nom.) for every bit cell. The selfclocking property is fundamental in the use of a phase-lock loop for data decoding.

The phase lock loop produces a clock signal which is phase locked to the data, and whose frequency is equal to the maximum flux transition rate for the data encoding scheme employed. The maximum flux transition rate for the double-frequency code is twice the bit data rate. For example, Pertec uses a Data Separator circuit that utilizes a PLL to accomplish the data/clock-bit separation and address-mark detection. This PLL design is optimized to provide sufficient bandwidth to lock onto data within the preamble (6 bytes 192 μ s); however, it is not so wide as to track phase errors produced by the peak-shift effects. With it, data decoding consists of separating the composite read data and clock waveform into data bits and clock bits. This is accomplished through data and clock windows and their associated clock waveforms provided by the phase-lock loop. Once the data and clock bits are

separated, the detection of mark bytes, e.g., address mark, is achieved by comparing the data-bit and clockbit patterns stored in the data and clock shift registers. The following paragraph discusses a possible logic implementation of the data encoding, data and clock bit separation, and address-mark detection scheme.

Each diskette must be initialized before it can be used for data storage. The initialization operation consists of pre-recording sector information on the diskette. During this operation, each track is written on in one continuous operation from index to index. The leading edge of an index pulse is always used as the starting point for the initialize operation.

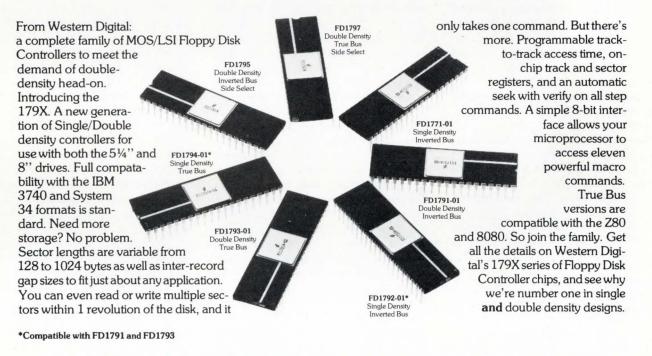
The term "logical data format" refers to that aspect of diskette format which determines its software interaction with the user's system. Starting from the outermost track, each diskette is divided into one index track (number 00), 73 data tracks (numbers 01 through 73), two alternate tracks (numbers 74 and 75), and one spare track (number 76). The spare track is not currently used in the IBM System 3740. Each track is divided into 26 sectors. The logical record length of each sector can vary from 1 to 128 bytes.

In the format used to initialize each track on the diskette, each byte is written starting with the most significant clock bit first, then the most significant data bit, and so on until the least significant data bit is written. Bit position zero in each byte contains the most significant bit. It should be noted, however, that the data field for track 00 (Index Track) differs from the others.

The term "physical data format" refers to that aspect of the diskette format which determines its hardware interaction with the user's system. The components of physical data include: Mark Bytes (i.e., format Index Mark, Address Mark, Data Mark, Address Field, Data Field, and Gap Fields. Mark bytes are used to signal the beginning of a track, address field, or data field. As previously described, mark bytes are unique combinations of data-bit and clockbit patterns which are not allowed in address fields, data fields, or gaps. A gap is that portion of a track, filled with zeros and/or ones during the initialize operation, which provides for a preamble and sufficient buffer space. This offsets the effects of deviations from the nominal data

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Floppy Applications

TYPES

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systems	.Intel, Zilog
Personal computer	North Star, Tandy (Radio Shack), Apple
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mass storage	Texas Instruments, Computer Automation
Data entry	.Data 100, Mohawk Data
Intelligent terminal	.Data 100, ADDS
Program load	.Four-Phase, Storage Technology
Process control	AccoBristol, Foxboro
Point of sale	Incoterm (Honeywell)
Medical instrumentation	Technicon, Pfizer Medical

density on the track due to tolerances of disk speed and write frequency.

An address field contains a group of 6 bytes. A data field contains a group of 128 bytes which comprises one record of data followed by two Cyclic Redundancy Check (CRC) bytes.

Each field (address or data) on the diskette is appended with CRC bytes. These two bytes are generated from a cyclic permutation of data bits starting with bit zero of the mark byte and ending with bit seven of the last byte within a field (address or data) excluding the CRC bytes. This cyclic permutation is the remainder from the division of data bits in a field (represented as an algebraic polynomial) by a generator polynomial G(X).

Formatter provides timing

The formatter, when used in conjunction with the disk drive, provides all control and timing necessary to form a data storage/retrieval system suitable for use in data processing applications. In addition to read and write commands, formatter commands are provided for data search, read-after-write data checking, and write initialize operations. The formatter also performs automatic checks on data, addressing, sector and various programming and hardware error conditions.

A sloppy floppy solution

Floppies have had their share of troubles, and damaged floppies are not uncommon. A disk not being fully inserted results in the drive's clamping hub not entering the disk hole. Damage is evidenced by coating removal and dimpling where the disk is forced against the rotating spindle. More severe damage is evidenced by permanent distortion of the disk where it is forced into the spindle aperture, thus rendering the data non-recoverable and the disk unusable.

A high friction disk prevents proper registration. A disk must move within the jacket while being clamped to allow registration. The ease with which movement occurs varies: the disk may be manufactured with high inherent friction or it may result from jacket warpage (usually due to heat). The force to move the disk is applied to the thin edge of the disk and it is marginal whether the disk will move or simply bend over. This condition is aggravated in most drives where a clamping force is applied before the disk is fully registered. The resulting effect is loss of data caused by eccentric disk rotation. In more severe cases the disk is ruined by permanent distortion.

One interesting solution, the "Hardhole," has surfaced from Stoddard Engineering (Westlake, VI. CA). This is a reinforcing ring that is placed around a floppy-disk's spindle hole. It is made of "Mylar" (the same material as an IBM Diskette) with self-adhesive backing. It is intended to be installed by an operator employing a precision locating tool that registers the ring to the disk. It is installed on one side of the disk for normal applications where repeated disk interchanges are not common. For more severe applications a ring may be placed on each side of the disk. Multiple layers may be installed to restore severely damaged disks or where experience indicates a high incidence of disk damage due to operator error or a drive design fault.

To install a "Hardhole" is simplicity, claims its maker. Remove it from its backing and place it over the tool with adhesive side up. Locate the disk over the tool and press down to adhere the ring to the disk in proper registration. Remove the disk from the tool and rub the ring with a finger to further adhere it to the disk. Exercise care while installing the ring, do not touch the disk data area.

Selection criteria

What should you look for in selecting a floppy disk system? First, decide if you want to buy a complete system with drive, interfacing and control electronics. If so your work is easy: you will connect the units directly to a micro or terminal via an RS-232C or 20 mA current loop connector. However, should you (as a large OEM) buy mechanical drive and R/W heads alone, you may wind up providing the electronics; and if you're a large OEM, you will most likely buy drives with on-board electronics to control head movement, stop and start disk contact, and raise the 1 mV R/W head's signal to 5 V.

Second, decide on the disk type. Do you want an 8- or 5.25-in disk? As a rule of thumb, minifloppy systems only offer 40% of standard-size floppy useable data storage (but at 70% of the price) and take up a lot less space.

Third, determine your memory capacity needs, differentiating between useable and absolute storage. For example, although a typical single-sided, single-density 8-in floppy stores 400 Kbytes, a portion is used for formatting or memory organization.

Soft and hard sectoring

As opposed to soft sectoring, hard sectoring is used mostly with minifloppies and provides manufacturing economies. It is a hardware-oriented scheme providing 10, 16 or 32 evenly-spaced holes (with an extra hole for reference) cut equidistant from the center to define sectors. When a hole rotates past a sensor, a generated pulse provides rotational reference.

Although most minifloppies possess 35 or 40 tracks, are hard-sectored into 10 sectors with 256 bytes/track, exceptions to the 35/40 tracks exist: the Xebec diskette has 77 tracks, the same

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number found in 8-in floppies.

Manufacturers who use hard sectoring formats on 8-in floppies divide each of the 77 tracks into 16 or 32 sectors of 256 or 128 bytes each to give an extra 20% capacity. But if you go this route, don't expect to easily exchange disks with IBM 3740 formatted units.

To access data on both doublesided disk sides without removing them, and to gain greater capacity, some manufacturers offer dual doublesided drives/assembly.

In double-density recording, by doubling the bits/in or on 35-, 40 or 77-in 77-track disks, the bits/in/track doubles. Double density units store more than 1 Mbyte; single-density, single-sided drives, only 256 Kbytes. Unfortunately, leading manufacturers have had double-sided drive delivery woes from problems (head design wearing down media, etc.) but claim these bugs are nearly licked. So, the market is nine months behind; but be prepared for possible delivery slippage next year as everyone switches.

Although single-density disks record with double-frequency recording (FM), double-density recording uses a modified FM (MFM) technique. The data stream from the head goes through the controller electronics (often on the CPU-to-floppy interface), which places them in useable form.



Floppy disk drives and controllers continue their evolutionary trends, as illustrated by this Micro/Sys (LaCanada – Flintridge, CA) SB 8500 floppy disk controller.

Head access times

To position the R/W head on the correct track, most drives use one of three methods. Lower cost drives use a stepper motor that drives a head screw, causing the R/W head to move up or down. In a linear voice coil mechanism (similar to hard disks) closedloop feedback eliminates settling time and makes for a fast average access time under 35 ms. On the other hand, average access time (time to traverse half the disk tracks) is unimportant if the head never travels more than one or two tracks/move! In band positioning, stepper motor motion joins the head cartridge assembly via a stainless steel band to provide 3 ms track-to-track access times.

Use a system incapable of initializing, employ an uncommon formatting arrangement, and tie in with a disk system manufacturer not actively marketing disks and you're in trouble. If a common formatting configuration is not used, then you've chosen a more costly route; be sure the manufacturer offers initializing (formatting the disk) with his system. And keep an eye to the future since today's variety of data format standards will give way to widely-accepted standards (probably set by IBM).

When considering drive vendors, ask them for a list of disk manufacturers; if there's only one or two, beware almost inevitable availability and price troubles could anger your customers. Also, beware of excessive disk wear in the hub and R/W area (especially in some of the double-sided units). Other complaints include ceramic heads (often of lower quality) that arrive misaligned in the carriage, damaged center hub clamps and inaccurately positioned disks.

Most suppliers claim their floppies are IBM compatible; in truth this is usually more or less so. But beware! It's no guarantee they are compatible with *each other*.

Finally, show the manufacturer your intended applications. And to be safe, ask disk vendors how their disks perform on the drives you are considering; they may have a different tale than the optimistic tune struck by the drive manufacturers.

Floppy growth unchallenged

Will 8" or 5" Winchesters or magnetic bubble memories K.O. floppy disk drive growth? Despite what some soothsayers of doom prognosticate, this scenario will not come to pass. This is not to say that mini and micro Winchester disks and bubble memories will not find niches within the mass memory marketplace.

During the next five years, floppy disk drives will begin to be displaced from some applications by newer technologies with superior price/performance - in particular low-cost hard disks and magnetic bubble memories. However, erosion in floppies' functional market share will be more than offset by expanded production of microcomputer-based systems. A recent study, Floppy Disks and Low-Cost Winchesters (Creative Strategies International, San Jose, CA), has forecast that worldwide shipments of small disk drives, which include 8-inch floppy disks, 5-inch minifloppies, and Winchester-technology hard disks up to eight inches in diameter, will grow from one million units last year to 3.39 million units in 1983 - a compound annual growth rate of 36%! But there is a twist. Most of this growth, the CSI study found, will occur at the high and low ends of the product spectrum, as the 8-inch floppy market is affected by the low-cost Winchester and improved minifloppies. Will this scenario take place? Perhaps late 1980 and early 1981 will tell for sure how things will stack up. Let's look at the industry in more detail to gain some idea of likely scenarios.

Disk drives up through 8" in diameter, including both the floppy and rigid varieties, have been divided into eight market classes. Four of the classes, covering devices already in production at the OEM level, are: single and double-sided 8" floppies, and single and double-sided 5.25" "minifloppies." The four remaining classes concern new disk products which have recently been or are expected to be introduced. They are "mini-Winchesters," "micro-Winchesters," and consumer- and commercial-grade very lowcost minifloppies.

"Mini-Winchesters" are 8" diameter hard disks, whose access speed advantage over floppies will facilitate the appearance of virtual memory, database management, and multi-tasking on microcomputer systems. These mini-Winchesters should virtually become the industry's standard database storage peripheral for business computers before 1984.

"Micro-Winchesters" are disks less than 8" in diameter, both rigid and flexible, which rotate at speeds that are approximately ten times faster than floppies and which use "flying" (air bearing) recording heads. Capac-

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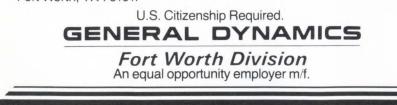
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ities will initially be in the one to three megabyte range, with pricing comparable to today's one-half megabyte, double-sided minifloppies.

Consumer- and commercial-grade very low-cost minifloppies, made initially in Japan with highly automated consumer electronic manufacturing methods, are being targeted at the "personal computer" market and will be offered at price points under \$50 for large OEM quantities. Such is the industry. What about the market?

The worldwide small disk market will grow from an "if sold OEM" value of \$284 million last year, to more than \$758 million in 1983, measured in constant dollars. This is a 28% compound annual growth rate, differing from the 36% projected unit volume growth because of price declines and changes in the product mix.

The next major technical development in floppies will be a further doubling of storage capacity through increased "track density" – the number of recording tracks per inch along the diskette radius. This has already been achieved on minifloppies and is expected to appear more on 8" drives within the next two years. A yet additional doubling of storage capacity (to almost 5 megabytes) should be achieved with a "track following" technique.

As for technology, CSI forecast that the greatest increase in demand will be for minifloppies, 8" hard disks, and micro-Winchesters. Minifloppy production is expected to expand from 307,000 units in 1979 to 1,800,000 units in 1983 — a 56% growth rate. Mini- and micro-Winchesters will go from about 13,000 units in 1979, their first year on the market, to over 580,000 units in 1983. In contrast, 8" floppy disk drives are projected to reach maximum production levels late in the forecast period, and then begin to decline.

Flying head disk drives (such as the mini- and micro-Winchesters) will offer nearly an order of magnitude speed increase and capacities up to the 60 megabyte range at a relatively low incremental cost. Thus, they are likely to eventually displace floppies from the on-line storage role in applications such as small business computers.

Two other technological innovations that are expected to cause an impact on the small disk market during the forecast period are backend processors and on-line archives. Backend processors, also sometimes called

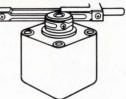
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MPI's patented stepper-band positioner provides

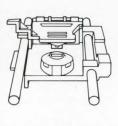
the industry's fastest access time (5ms) and most accurate positioning. The stepper band is simpler in design compared to a cam or lead screw. It is virtually frictionless, which pro-



vides extremely accurate and reliable positioning, yet requires the lowest power. As a result, it moves five times faster than other positioning systems.

2 HEAD & CARRIAGE

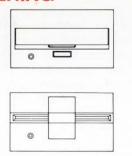
Our high-performance mini floppy drive was developed as a dual-head, double-track, double-density unit. It is not an up-graded single-head, single-density design. The carriage and head concepts are based on IBM's – except for one important innovation: our bottom head is fixed,



while only the top head loads. The heads are centered between two parallel rods (not cantilevered) to eliminate radial-positioning errors. To minimize media wear, we designed the longest head carriage which insures flater head landings.

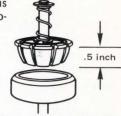
3 HUMAN ENGINEERING

Our dual-head (Model 52) and single-head (Model 51) drives are human engineered. Key features include: a full-closing, pushbutton front door to provide greater media protection; a patented ejector mechanism that makes diskette removal easier; and a choice of bezels.



1 DISKETTE CENTERING

True diskette centering is accomplished by MPI's proprietary clutch mechanism. As the front door is closing, our extralong clutch expands and gently engages the mylar media. When the clutch is seated, the



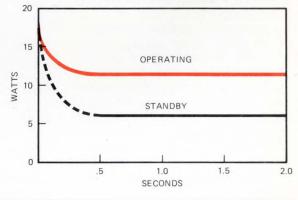
diskette is locked securely in position to within .0008 inches. The result: most accurate positioning, longer diskette life, and trouble-free operation. MPI's diskette ejector — an industry first — pops the diskette out within easy finger-tip reach.

5 POWER CONSUMPTION

MPI drives have the industry's lowest power consumption (6W standby, 12W operating) due to the following:

- A high-precision stepper motor with Samarium-Cobalt magnets. This motor is accurate to 3%, has less heat dissipation, and longer life;
- Proprietary electronics, packaged on a single PCB, incorporating low-power Schottky; and
- A low-friction positioning mechanism.

OPERATING AND STANDBY POWER





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database computers, consist of specialized integrated circuits combining the disk controller and database management functions. On-line archives will provide a thousand or more megabytes of storage at a price commensurate with microcomputer-based systems, thus allowing users to keep all their data permanently on-line.

Competition in the floppy disk market is changing. Since its beginning in 1973, the OEM floppy disk industry has been characterized by small startup companies getting a foothold and then selling out to larger firms. Recently, however, the new entrants have been primarily foreign firms penetrating the American market in a variety of ways.

Many industry participants anticipate a "squeeze" in the low end of the OEM floppy market. This projected "squeeze" will be due to increased competition from foreign competitors, combined with a tendency toward backward integration into captive production by customers with large-unit volume requirements. Thus, many of the OEM manufacturers are turning their sights toward the high end of the market, particularly the mini/micro-Winchester drives. There are, say, two dozen entrants in the 8" hard disk OEM markets, and others especially start-ups - will continue to surface. The micro-Winchester area, in contrast, seems much less competitive -- at this point.

There will be no marked changes in market share in the existing product categories, because of the strength of industry leaders. This strength has been increased by the shift to doublesided drives because, unlike the smaller producers, they tend to manufacture their recording heads in-house, and because they have the engineering resources to deal with the technical problems associated with double-sided drives.

The big question of floppy and hard disk competition may be seen as less controversial in 1981. Industry spokesmen, such as Gary Goodman of Remex (Div. of Ex-Cell-O Corp.), see the relationship between floppies and low-cost Winchester rigid disks (specifically the compact 8" models that store from 5 to 20 MB and fit into the slot occupied by a standard floppy) as more complementary. True, small Winchesters may supplant flexible disks in such applications as microprocessor development systems -- but floppies will move into the I/O slot.

The hard disk has significant capa-

Floppy Disk Drive Factors

When selecting a flexible disk drive, consider these factors in your evaluation . . .

- Capacity
- Cost/bit
- Environmental needs
- Future system needs
- Warranty (from shipping or installation date?)
- Reliability/Maintainability
- Service (On-site? Local service center? Spare parts?)
- Data transfer rate
- Interface
- Size
- Multiple vendors
- Training (On-site?)

city and reliability features it's not removable. Otherwise, costs rise. So, the floppy is its logical, removable companion. Whether for I/O or data backup, the floppy offers natural disk-to-disk compatibility that simplifies controller design and optimizes operating speed and efficiency with the hard disk. While the floppy lacks the capacity to backup 100% of the Winchester's data, it does fall within the 6-to-1 ratio considered optimum for backup applications. In addition, since most systems require backup only on a transactional basis, the floppy is an ideal medium; it does not waste costly capacity to store small blocks of data.

At least one system designed for the microcomputer market demonstrated floppy/Winchester compatibility. Called Data Warehouse, it combines a 14" Winchester (which can easily be 8"), with two dual-head and doubledensity 8" floppies and controls all three devices with one highly intelligent, DMA oriented controller. The system, virtually a computer in itself, demonstrates the optimum performance achievable by taking advantage of the Winchester's and floppy's common command structure, architecture and operating characteristics.

No technology in 1980 will supplant the small, speedy, removable, random access floppy. This year's shipments are estimated at over two million. For some time, demand will continue to exceed supply, But, as the market grows, this will also change; and, 1980 looms as a shake-out year for 8" drives, with some companies leaving the business and others increasing their commitment to a dedicated source. Will the market be dominated by three or four independents? It's possible.

New product introductions will continue. Here are some possible developments. There is a need for lowcost 3" or 4" diskette drive for portable terminals and systems, such as smart typewriters. The technology exists, as does a spec for such diskettes. Expect to see "super floppies" based on advanced head and media technology that offer higher track and data densities. Is there a need for multiple flexible-disk, single-spindle, mass-storage system? Could such widespread use of low-cost systems provide increased data capacities sought after by the WP industry? The time-effectiveness value of such systems may not prove sufficient to overcome negative factors to ensure rapid market penetration. Time will tell. It's certain, though, that increased reliability and more optional features will continue to appear on existing drives. The industry will use more LSI technology to increase reliability and provide additional functions, and these new functions could well be some usually found in the system controller.

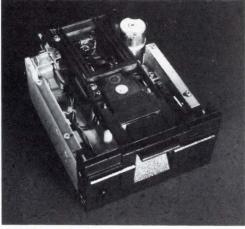
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FD250

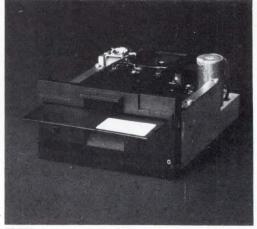
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FD200

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New Products

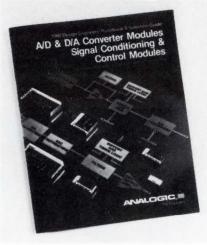
GRAPHICS COMPATIBILITY WITH NEW PACKAGE A new hardware/ software package from Sanders enables users of its Graphic 7 display system to achieve interactive stroke/refresh graphics with the DEC VAX-11/780 computer. Compatibility is provided by Model 5714 high-speed parallel DMA interface and Model 7771 VAX I/O Driver software package. The 7771 package is written in VAX assembly language and runs with the VMS operating system. Software and the hardware of the Graphic 7 are both compatible with the DR11-B interface option in the VAX-11/780. Graphic 7 is an intelligent, interactive computer display terminal featuring two programmable microprocessors and directed beam refreshed graphic display with high resolution images. Model 7764 FORTRAN Support Program is \$1500; Model 771 VAX I/O Driver is \$3,000 and Model 5714 DMA interface is \$3,000. Sanders Associates, Inc., Daniel Webster Highway, Nashua, N.H. 03061. Circle 272

NEW KEYBOARDS New sheet keyboards, featuring tactile switches, can be used in designing measuring and control devices, sales terminals and industrial terminals in dust-filled work areas. A covering sheet gives maximum protection from dust, oil, water and other materials that can damage a standard keyboard. The sheet is sealed to the based plate. The keys have a plate spring/actuator construction that permits a rhythmical snap touch. A precious metal coated multi-point contact system is used for reliability and long life. Low profile keyboard. The surface



sheet is available in a variety of indicator designs, including multi-color, full words and special characters. Fujitsu America, Inc., Component Sales Division, 910 Sherwood DR-23, Lake Bluff, IL 60044. Circle 131

FREE CONVERSION DESIGNER'S HANDBOOK. A new 32-page data conversion designer's handbook presents a condensation of over 1000 pages of tutorial engineering information. It is a plain language discussion of design concepts, basic parameters and selection criteria for data acquisition and signal conditioning products. The handbook should be a valuable tool



for signal processing circuit and systems designers. It reflects the state-of-the-art of today's data conversion technology. Procedures are described for determining parameter tradeoffs relative to resolution, accuracy, linearity, offset, temperature coefficient and how these parameters affect high-resolution, highspeed analog-to-digital and digital-toanalog signal translation. Other discussions are on "Theory and Practice" as well as "Selectable Guides" for: D/A Converters, A/D Converters, Sample-Hold Circuits and Ancilliary Devices (MUX, AMP, FILTER MOD-ULES). Other sections discuss Power Supplies, A/D Subsystem Modules and Related Analogic Products. The 32-page Analogic Design Engineer's Handbook and Selection Guide is FREE. Analogic Corp., Audubon Rd., Wakefield, MA 01880. Circle 117

NEW INDICATOR LIGHTS A new line of straight and right-angled solder pin indicator lights has been introduced by Genisco. The C-Series offers three types of illumination - incandescent, LED and neon in a variety of lens styles. All have $.040 \pm .001$ inch diameter brass tin plated terminals with .401 inch straight or .318 inch right angle pins. The indicators, which fit into .290 diameter holes are available in amber, blue, green, red, white or yellow. Housings are anodized aluminum with high-dielectric molded nylon headers. C-Series indicator lamps boast a long life reliability ranging from 1,000 to 60,000 hours. CE and CJ Incandescent Lamp Series have

voltage ratings from 1.35 to 28 VDC. The CW and CY LED Series operate at 1.7 VDC at 10 mA. LEDs with ratings from 4-6 VDC to 18-30 VDC are equipped with built-in resistors. The CS and CT Series of neon lamps are designed to operate on 90 VDC or 65 V AC with a 100K resistor in series. **Genisco Technology Corp.**, Eldema Division, 18435 Susana Rd., Compton, CA 90221. **Circle 271**

LOW COST WINCHESTER BACKUP

This backup for Winchester combines high reliability, large capacity, and low cost. A standard video cassette - with a total capacity of 100 million bytes, can transfer ten-megabytes of data from an eight-inch hard disk in less than ten minutes. In operation, the "MIRROR" (by Corvus) interfaces data signals on the Corvus disk to a customer-supplied video cassette recorder of the VHS, Beta, or U-Matic format. If larger data capacity is required, reel-toreel videotape recorders can be used. Besides serving as a cost effective backup, the MIRROR is suggested as an archival storage device for large data bases. The backup cassette uses the

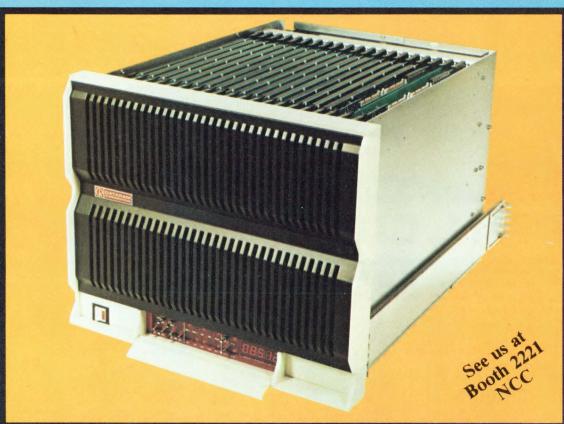


same Z-80 microprocessor and Corvus interface bus as the Corvus disk. The Mirror interfaces to a wide variety of host computers; such as, the Apple, TRS-80 (Model I and Model II,) S-100, and LSI-11. Data format employed in the MIRROR is compatible with the standard NTSC signal. (A version for the European PAL or Secam format is also available.) This means that existing or future video storage devices such as the video disk, the now underdevelopment longitudinal video cartridge, or long-distance video transmission links - will be compatible without modification. \$790. Delivery, 30 days ARO. A complete system with video cassette recorder can be assembled for under \$1500. Corvus Systems, 900 S. Winchester Blvd., San Jose, CA 95128 Circle 132

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The only company to offer both core and semiconductor BULK MEMORY systems for minicomputer users, Dataram today has hundreds of BULK CORE and BULK SEMI users throughout the world, in use in applications that range from process control and data acquisition to disk swapping and main memory expansion. Utilizing capacities from 256KB to 16 MB, and featuring –

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PRINTRONIX+TEKTRONIX the perfect match!

Now Tektronix Graphic CRT's can be happily wedded to your Printronix printer/plotter - P150, P300 or P600. TRILOG's efficient little matchmaker,

the Graphics Adapter Board - GAB for short - plugs right into the spare card slot in your Printronix unit. In seconds you'll get hard copies of the images from one or two

Tektronix Graphic CRT's while retaining all the Printronix normal printing/plotting functions. And GAB's special switch-selectable mode reduces the image size to fit on 81/2" x 11" paper - for a beautiful reflection of their love's affection! Contact your Printronix/TRILOG distributor or call TRILOG direct at (714) 549-4079. 17391 Murphy Avenue, Irvine, CA 92714 **Circle 42 on Reader Inquiry Card**

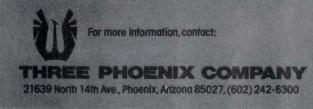


WHO'S THE WORLD'S LARGEST MANUFACTURER OF FLOPPY DISK **TEST AND CERTIFICATION EQUIPMENT?**

Three Phoenix Company. Yes, we offer a full line of precision equipment for the TESTING and CERTIFICATION of Floppy Disks. You'll find manufacturers, OEM suppliers and end-users alike, all rely on Three Phoenix equipment ... for increased production, higher yield and lower cost.

- MINI DISK CERTIFIER (5" DISKS)
- STANDARD DISK CERTIFIER (8" DISKS)
 DUAL SIDED DISK CERTIFIER
 DISK INITIALIZER (IBM FORMATTING)

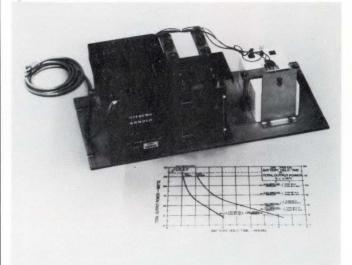
"At Three Phoenix, we specialize in test and disk certification equipment"



New Products

"TEA An 8080/8085 Co-Resident Editor Assembler," By Dr. Christopher A. Titus. Microcomputers are programmed in assembly language rather than machine language which is difficult to use. Assembly language is a series of short sequences of alphanumeric characters, called mnemonics, to represent a specific sequence of operations that the microcomputer can use. The process of writing mnemonics on paper, then translating them into appropriate machine language can be tedious and error-prone. Editors and assemblers are used to speed up the process. An editor is a program that manipulates characters stored in memory and the assembler translates the strings of characters into machine-executable values. This book describes Tychon's Editor-Assembler (TEA) to generate assembly language programs for the 8080 and 8085 microprocessors. TEA is used to create, modify, and assemble source programs. 272 pp. \$8.95. Group Technology, Ltd., P.O. Box 87, Check, VA 24072. Circle 164

BATTERY CAPACITY DOUBLED. The UPS-2708B on-line uninterruptible DC power system is an ideal battery backup supply for volatile MOS memory and refresh logic including add-on memory. It also has TWICE the battery

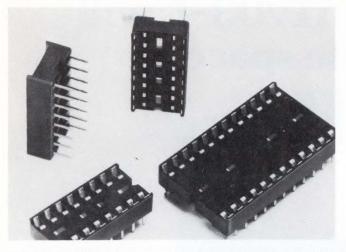


capacity as the earlier UPS-2708A! A battery backup DC power buss that is electrically independent of the main DC power buss means that MOS memory and refresh logic power will not be affected by an AC power outage. In a system that has separate "DC power off" switch for overnight or standby system shutdown, the 2708B can still provide power for memory and refresh logic only. \$445 (1-9). \$365 (100's). Delivery, stock to eight weeks. Stevens-Arnold, Inc., 7 Elkins St., South Boston, MA 02127. Circle 159

21-COLUMN ALPHANUMERIC PRINTER will print 21 columns alphanumeric information on standard 3-7/16" wide plain paper tape. Unique bar matrix impact print mechanism. Can produce multiple copies, and prints in two colors. Snap-in ribbon cartridge eliminates ribbon handling and permits fast, easy ribbon replacement. The PR0533 package measures $12-1/2'' \ge 6-1/2'' \ge 6-7/8''$; contains a power supply, and ASCII compatible interface controller and performs all printer functions. Continuous print speed is 90 lpm with rapid line feed control that slews paper up to 10 lps. \$495.00. OEM discounts available. Delivery, 8 to 10 weeks ARO. SODECO Div., Landis & Gyr, Inc., 4 Westchester Plaza, Elmsford, N.Y. 10523. Circle 161

Circle 43 on Reader Inquiry Card

NEW DIP SOCKETS. Available with straight solder tails for clinching or with retention tails for superior board retention without clinching in pc board holes from .033" to .039" dia., these new sockets are designed for automatic machine insertion. They present a large target area with tapered lead-in ramps for easier DIP insertion and an anti-



overstress wall protects contacts from damage by oversize or bent DIP leads. The self-extinguishing, 94 V-O glassfilled polyester housings have a closed bottom to prevent solder wicking and flux contamination of the solder area. The dual-wiping contacts are available in either phosphor bronze or beryllium copper with selectively plated-gold or tin plated contact area. Supplied in 8 through 40position sizes, these AMP DIPLOMATE sockets are endto-end stackable and extend only .175" above the pc board. AMP Inc., PO 3608, Harrisburg, PA 17105.

Circle 155

EIGHT-INCH WINCHESTER DISK supplies up to 20MB while occupying only 0.39 cu ft. Series 7000 drives have unformatted capacities of 4 MB (\$2100) in single-disk version, 12 MB (\$2300) in double-platter model and 20 MB (\$2650) in three-disk unit. Two drives can be mountd



side-by-side in a standard 18" rack. Track-to-track time is 12 msec. Average head movement time is 50 msec, with a 100-msec worst-case maximum. A 3600-rpm disk rotation gives an average latency time of 83 msec. Delivery is three months ARO. Kennedy Co., 1600 S. Shamrock Ave., Monrovia, CA 91001. Circle 255



even includes both positive indexing and anti-overwrapping mechanisms – features usually found only in industrial tools costing five times as much. Pistol grip design and rugged ABS construction assure performance and durability. In stock at local electronic retailers or directly from

OK Machine & Tool Corporation 3455 Conner St., Bronx, N.Y. 10475 U.S.A. Tel. (212) 994-6600 Telex 125091

[^]Minimum billings \$25.00, add shipping charge \$2.00 New York State residents add applicable tax

This Dual Floppy/LSI-11 does everything the 11V03-L will do in half the space...



and gives you RX02 software/media compatibility, too!

The MF-211 Dual Floppy/LSI-11/2 system, featuring the low-cost CRDS Double Density Controller, is functionally identical to the DEC 11V03-L, but uses only 10¹/₂" of rack space!

PLUS:

- KD11HA, DEC LSI-11/2 central processor
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- Upgradable to LSI-11/23

• Unique CRDS controller with all interface, bootstrap loader and formatter electronics on one dual-height PC card, with complete RX02 software media/compatibility

... And for RX02 plug-replacement: The FD-211 is a compact, low-cost, highly reliable plug-replacement for RX02 applications in 51/4" low-profile chassis.



- Complete PDP-11, LSI-11 compatibility
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Now available with double-sided floppies!

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4 Tech Circle, Natick, MA 01760 Tel. (617) 655-1800 TWX (710) 386-0523



New Products

EMULATOR This new module allows users to test and change programs before commiting them to PROMs, thus speeding up product development. The unit 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



boundry. ROSI (ROm SImulation) can emulate any 4 or 8 bit PROM or ROM starting with 32x8 up to 4Kx8 organizations. Either standard IM 1010 socket adapters or ROSI special socket adapters can be made to emulate the necessary PROM or ROM pinout. Although standard RAM access time for ROSI is 300ns, faster RAMs can be used for bipolar PROM emulation. Powerful EDITING FUNCTIONS give ROSI ability to quickly debug programs. The editing functions available with ROSI and the IM1010 PROM programmer include: MOVE, LIST, VERIFY, IN-SERT, DELETE, SEARCH, CHECK-SUM, FILL, and INVERT. The price of the IM ROSI is \$595. Price of the IM1010 mainframe is \$1995. PROM programming personality modules for the IM1010 are \$350 (to \$500). Delivery, 2 weeks ARO. International Microsystems, Inc., 11554 "C" Avenue, Auburn, CA 95603. Circle 129

NEW 180 CPS MATRIX PRINTER A new M-120 dot matrix printer from Dataproducts provides crisp, easy-to-read print using a 7x7 half-dot matrix font in standard or expanded characters. The print speed is 180 characters per second in a bidirectional, logic-seeking mode. Work throughput ranges

from 75 lpm for full 132-character lines, to 200 lpm with 40-character lines. Average throughput is 120 lpm. An operator-replaceable head is good for more than 200 million characters; and long-life ribbons come in clean, easy to load cassettes. The M-120 includes a built-in self-test feature. An optional LED diagnostic display shows printing cycle at the time printer went off-line, allowing operator correctable conditions to be handled without a service call. Delivery for the M-120 will begin in the first quarter of 1980 with 30 day delivery ARO. OEM pricing can go as low as \$1,350. Dataproducts Corporation, 6200 Canoga Ave., Woodland Hills, CA 91365. Circle 273

HIGH SPEED DMA INTERFACE National Instruments' new GPIB11-2 DMA interfaces from the PDP-11 to the IEEE Std. 488-1978 bus (also referred to as the GPIB, or HP-IB). The GPIB11-2 provides transfer rates up to 500 kbytes/s for three-state operation; up to 250 kbytes/s for open collector operation. The option for three-state or open collector operation is switch selectable. Handshake speed is software programmable. High speed operation is provided by circuitry which automatically holds the UNIBUS for a burst of 16 bytes before releasing it to higher priority after each byte

transfer. The GPIB11-2 plugs into any hex wide SPC slot and provides hardware for implementing Talker, Listener and Controller functions. A fourmeter cable with a GPIB connector of the outboard end allows user to connect as many as 14 instruments on a single interface. Available from stock at \$1,995 including software and cable. National Instruments, 8900 Shoal Creek Blvd, Austin, TX 78758. Circle 200

PRINTER CONTROLLER LINE TRANSMITS KATAKANA LETTERS The MDB Systems Line Printer Controller for use with IBM Series/1 computers now has an added capability of transmitting 8-bit Japanese Industry Standard (JIS) code to all models of Printronix line printers as well as the Dataproducts model 2530. This enables printing of Japanese Katakana business language in addition to conventional ASCII and EBCDIC graphics. The MDB controller translates the EBDIC codes used by the IBM Series/1 computer to the JIS codes which are output to the line printer. In addition, the controller has the full graphics capability available with Printronix line printers. This modified printer controller is priced at \$1,995; delivery, 30 days ARO. MDB SYSTEMS, Inc. 1995 N. Batavia Street, Orange, CA 92665. Circle 198



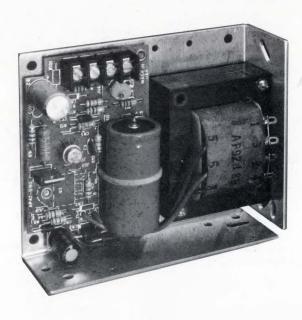
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PRICE BREAKTHROUGH!

ON OPEN FRAME LINEARS

SINGLE OUTPUT – IC REGULATED Industry Standard Thin Profile OEM Economy DC Power Supply @ \$19.90* 5 Year Warranty

- Universal 103-130V/206-260VAC 47-63Hz Input
- Full Power Rated to 50°C
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- Reverse Polarity Protection
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- U.L. Recognized Glass Epoxy Circuit Boards
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- · Series or Parallel Operation
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ADTECH POWER

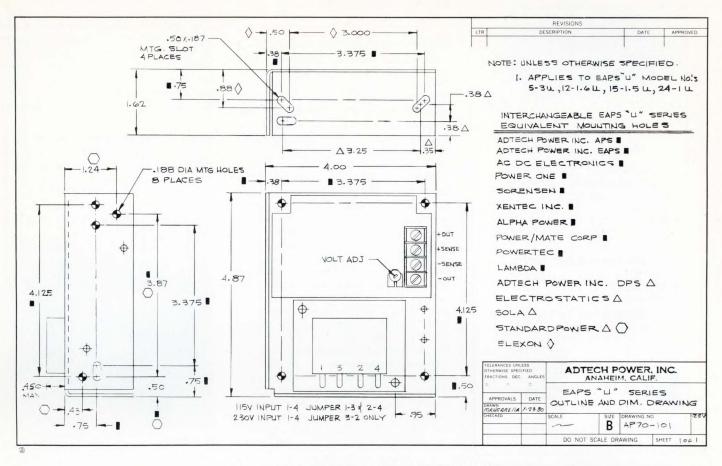
Thinner profile with interchangeability offered in four models will meet the requirements of most needs within a wide variety of applications. IC Regulation, simplified circuitry and top quality components assure long-term reliability.

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

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

MODEL NUMBER	RATING		REGULATION		RIPPLE	ALL MODEL PRICING BY QUANTITY				
	VDC	AMPS	LINE	LOAD	(PK/PK)	1-49	50-99	*100-249	250-499	
EAPS 5-3U	5	3.0	± 0.05%	± 0.10%	5mV	\$23.25	\$21.00	\$19.90	\$19.50	
EAPS 12-1.6U	12	1.6	± 0.05%	± 0.10%	5mV	 Production orders must be for 50 or more pieces with a firm delivery schedule Minimum shipment is 25 pieces, bulk packed to one address 				
EAPS 15-1.5U	15	1.5	± 0.05%	± 0.10%	5mV	3) A one to 49 piece "Prototype" order will be accepted one time only per customer 0 Optional overvoltage protection is available on factory orders over 50 pieces at a price of \$1.50/unit regardless of quantity. Add suffix "OV" to model number.				
EAPS 24-1U	24	1.0	± 0.05%	± 0.10%	5mV	 Optional solder/fast on tabs are available on factory orders over 50 pieces at a cost of \$1,00 per unit in any quantity. Add suffix: "ST" to model number. 				

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



EAPS "U" SERIES SPECIFICATIONS

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

Line Regulation: ±0.05% for ±10% line change. Load Regulation: $\pm 0.1\%$ for $\pm 50\%$ 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.

Texas, Dallas

Texas, Houston

Washington, D.C.

Phone: (214) 387-2489

Phone: (713) 988-0991

Phone: (202) 363-9417

Washington, Seattle

Phone: (206) 455-3460 Washington, Spokane Phone: (206) 455-3460

Wisconsin, Milwaukee

Phone: (414) 527-1500

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

Weight: 2 lbs.

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

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Phone: (813) 536-8536

Phone: (305) 752-7520 Georgia, Atlanta Phone: (404) 233-6679 Illinois, Chicago Phone: (312) 437-2700 Indiana, Indianapolis Phone: (317) 844-2800 lowa, Cedar Rapids Phone: (319) 362-9177 Kansas, Kansas City Phone: (913) 381-0004 Kansas, Wichita Phone: (316) 684-4141 Massachusetts, Boston Phone: (617) 245-0250 Michigan, Detroit Phone: (313) 576-4706 Minnesota, Minneapolis Phone: (612) 861-3343 Missouri, St. Louis Phone: (314) 569-1220 New Mexico, Albuquerque Phone: (505) 294-8408 New Mexico, Las Cruces Phone: (505) 524-0126 New Jersey, Dover Phone: (516) 487-3966 New York, Albany Phone: (518) 456-6667 New York, Buffalo Phone: (715) 632-7880

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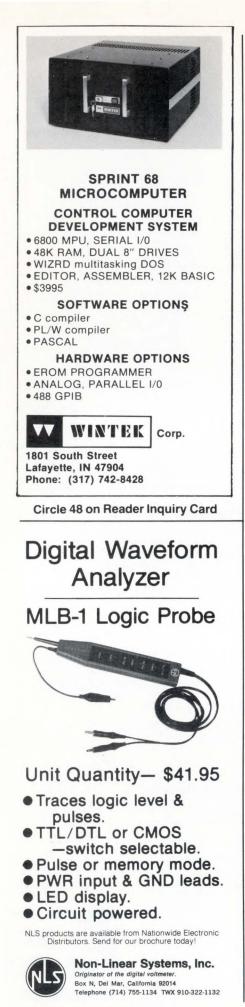
Mexico, Mexico City Phone: 575-58-95 or 575-62-97 Israel, Tel Aviv Phone: (03) 615469 or 622429



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

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

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Circle 81 on Reader Inquiry Card

New Products

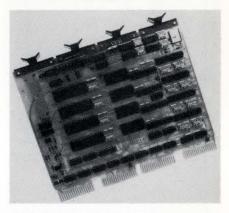
SPECIAL AMPLIFIER A high speed sample and hold amplifier has been introduced by Analogic Corp. Intended for high resolution and high throughput applications, the MP271 features linearity of 0.003% and low feedthrough of typically 0.001% at 500 kHz. This 2" x 2" module (aperture uncertainty of 0.2ns, acquisition time of 1.0µs to 0.005%, low pedestal variation of ±0.002% max., ±0.003% linearity) is designed for use in data acquisition systems with sampling rates up to 300 kHz and resolutions up to 16 bits. The low hold mode feedthrough increases system throughput by allowing A/D conversion time to overlap the multiplexer switching time without degrading system accuracy. The low droop rate of $2\mu V/\mu s$ guarantees a high accuracy even when using the MP271 with a slower speed, moderate cost A/D. The MP271 also has an internal pedestal offset adjustment, with provisions for making additional input offset voltage adjustments. The MP271 is packaged in a shielded metal case and is immediately available. Analogic Corporation. Audobon Rd., Wakefield, MA 01880. Circle 190

WP SYSTEM USED FOR PRINTING. The latest Wang System 25 Word Processor and printer has independent video-display workstations, 40-cps printer, wide-carriage printer, Typesetter 48, and telecommunications interfacing. Addition of the phototypesetter 48 to the system permits producttion of final, polished drafts from individual WP stations. The system can turn out letters, pamphlets, lists and booklets. It gives the end user the luxury of having his own small printing plant. Wang Laboratories, Inc., One Industrial Ave., Lowell, MA 01851. Circle 72

ADD-ON/ADD-IN MEMORIES. "If you're looking for a way to get more from your minicomputer without putting too much more into it, our family of ADD-ON/ADD-IN mini-memories adds up to the right answer for you," says Dataram. "Including our new, expanded family of ADD-ON/ADD-IN systems that's ready to go to work for your minicomputer: Data General, DEC, Interdata and Varian." Dataram Corp., Princeton-Hightstown Rd., Cranbury, NJ 88512. Circle 110

CATALOG OF μ P SYSTEM SUPPORT CARDS. Catalog describes this company's newly developed BOSS (BUS Oriented System Support) line of μ P system support cards. The cards, designed for the STD BUS, measure 4¹/₂" x 6¹/₂" with standard 56 pin connectors. Features, applications, operating procedures and data are detailed in catalog. Easy to understand language is geared to technicians, engineers and manufacturers. Technical data sheets are also available for each card. Micro Link Corporation, 624 S. Range Line Rd., Carmel, IN 46032. Circle 71

PDP-8 CONTROLLER. This Multiple Serial Line Controller for PDP-8 is equivalent to four (4) KL8J asynchronus line controllers on one single QUAD P.C. board. The QUADART does not multiplex any data or control functions. It plugs directly into the

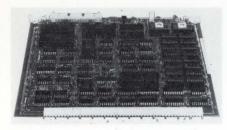


OMNIBUS occupying one slot and functions as four independent KLJ's. Each of the four channels has independent DEVICE CODE selection for the transmitter and receiver; 13 BAUD RATE selections; plus UART control DIP switches. Boards are available off the shelf. They install in minutes, says the company and provide immediate improvement to any operating system. A distribution panel and a full complement of cables are available. \$725.00 OEM Discounts. Computer Exension Systems, Inc, 17511 El Camino Real, Houston, TX 77058. Circle 111

NEW SB CONTROLLER This new single-board 3211 disk controller interfaces any PDP-11 series computer and up to four SMD or SMD-compatible drives in any mix of capacities. Emulating the DEC RM-02 controller, Ball's 3211 controller provides compatible formats and interchangeable media without modification to the software disk driver of the host computer operating system. The host-resident controller mounts in a single SPC slot. Direct access to memory for all read/write block transfer is accomplished using the Non-Processor Request (NPR) DEC Unibus facility. Requiring only one Unibus load, the controller may be strapped to any arbitrary interrupt priority level (BR5 standard), interrupt vector address (254 standard) and device register address (776700 standard). The 3211

handles data rates from 806K bytes to 1.2 megabytes per second. A 2048byte data buffer memory reduces the required data transfer rate with the host. 32-bit ECC detects single burst errors up to 22 bits in length and corrects burst errors of up to 11 bits per sector. Sector interleaving allows slower computers to use high speed disk technology by decreasing the system I/O bandwidth required for data transfers. The host computer can read one sector, perform some processing, then read the next sector without waiting for a complete disk rotation. \$3950. OEM quantity discounts available. Delivery of production quantities, 45 days ARO. Ball Computer Products, 860 East Arques Ave., Sunnyvale, CA 94086. Circle 265

NEW SLAVE PROCESSOR. A four channel communications controller has been introduced by Xycom, Inc., formerly Process Computer Systems, Inc., of Saline. First in a planned series of intelligent, Z80 based, peripheral controllers, the Xycom 1861A has up to 16K of private memory. It also has the capability to address all memory and I/O in a Xycom Flexibus II system to which it is added. As a multiprocessor it is ideal for systems requiring distributed computer power. As an intelligent serial communications controller, the 1861A provides four independent serial channels which may be configured by onboard jumpers to synchronous or asynchronous operation with internal or external clocks. Internal clock rates are program selected.



Data rates up to 500,000 bps may be achieved. Full signal flexibility and modem control is provided for the four channels through independent single channel adapters. These interface standard TTL signals, output from the 1861A to 20ma/PCS party lines, EIA 232C, 422 or 423 signals. In the RacPac series, recently introduced by PCS, back panel mounting is provided for these adapters. \$595. Delivery, 45 days, ARO. Additional random access memory in 1K, 4K or 8K units available at \$50 per K. The company also announced a new accessory for use with the 1861A, the 1899A Multiprocessor Debug Tool, which allows debugging multiple CPUs simultaneously. This permits synchronized or independent examination and alteration of memory locations in

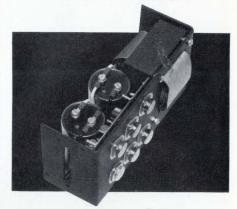
a designated processor anywhere in the system. Break points may be set, cleared, and coordinated from a local console, or from the development system console. \$1,095. Allow 45 days ARO on delivery. PCS manufactures several complete lines of microcomputer hardware for process control, material handling control, machine control and source data acquisition to meet the needs of volume end users, technically independent design and systems houses, and OEMs. Xycom, Inc. (Formerly PCS,) 750 North Maple Rd., Saline, MI 48176. Circle 78

WINCHESTER/FLOPPY SYSTEM. "Data Warehouse" is a highly intelligent, DMA, Winchester/floppy disk system from Remex Division of Ex-Cello-O Corporation. It is available in three configurations and at a reduced price. The Data Warehouse system can be incorporated into a wide variety of low cost micro and mini computer based systems. It extends significantly the capability of small units by use of the unique Data Warehouse system command techniques. Data Warehouse is offered three ways: a 20-Mbyte Winchester disk drive with two dual heads is \$6,350 in OEM quantities; the same system but without Marksman® Winchester disk drive for \$3,775 in OEM quantities; and an "unbundled" version which would include the intelligent controller/formatter and one or two Remex dual head/double density disk drives, for \$2,610 in OEM quantities. Using a technique called channelcommand control which transfers data and command "packets" via DMA to and from the host computer, Data Warehouse reduces the amount of communication necessary between host computer and system. Remex, Div. of Ex-Cell-O; PO Box C-19533; 1733 Alton St., Irvine, CA 92713. Circle 112

ADDRESSABLE I/O SYSTEMS. Serial and parallel configurations. SERIAL ADDRESSABLE RACK (PB 16S1); Communication with multiple input/ output stations. 32 station address capability per serial loop. Up to 16 power I/O modules per station. Switch selectable baud rate. Firmware includes message protocol, event counter, self test, watch dog timer. Plug in modules provide choice of: 20 Ma Current Loop; RS 422 Balanced Differential Drivers and Receivers; Optically Coupled Drivers and Receivers; RS 232. PARALLEL ADDRESSABLE RACK (PB 16P1): Bidirectional Communication with input or output modules. 64 station address capability; up to 16 Power Input/Output modules per station; 50 Conductor Daisy-Chain cable connects all racks to host controller; On-board station address select switch. Opto 22, 15272 Relay Circle, Huntington Beach, CA 92649.Circle 113

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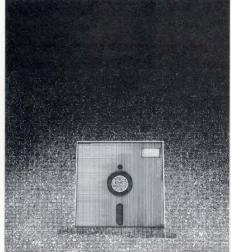
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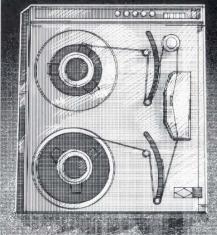
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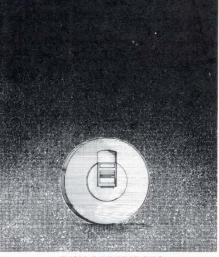


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THERE ARE A LOT OF ALTERNATIVES TO THE DISK BACK-UP PROBLEM.







FLOPPY DISKS Storage capacity: limited. Handling problems. Low cost. REEL-TO-REEL TAPE DRIVES Low performance: 36 megabyte capacity. High performance: 90-100 megabyte capacity. Large, bulky, high cost drives. Cost: very expensive, up to 20 times that of floppy disks.

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

HERE'S THE SOLUTION.

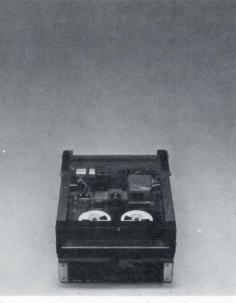
Storage capacity: 75 megabytes formatted (144 Mbytes unformatted).

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

Preformatted tape, allows unlimited record replacement.

Built-in error detection/ correction capabilities.





Fully-buffered I/O channel, permits asynchronous data transfers. Serpentine recording, eliminates wasted rewind times. List price, including Controller, \$2,150.00.

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

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



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COL-INS-CO., Inc. Orlando, FL 305/423-7615



New Products

COMPATIBLE DISK EMULATION The BC-205 Bulk Core System is compatible with DEC RF15/RS09 Fixed Head Disk System. It is also software compatible with standard operating systems and RF-15 diagnostics used on the DEC's older PDP-15. Packaged in a 15-3/4" high chassis which can hold eight 256KB Bulk Core modules, the BC-205 has a maximum capacity of one mega-word (1,024K x 18). Minimum configuration available is 256K x 18 and the BC-205 can be expanded in increments of 256K words by adding additional modules. The BC-205 provides write-protect capability so that individual 32K word segments can be write-protected. An "off-line" tester is integral to the BC-205 and offered as a standard feature. \$23,675 in minimum configuration of 256K words. A half-megaword (512K x 18) version is \$32,975. A full mega-word (1,024K x 18) system is \$48,095. F.O.B. delivery in ninety days ARO. One-year warranty. Dataram Corp. Princeton-Hightstown Rd., Cranbury, NJ 08512. Circle 267

LINE PRINTER CHOICES Model 1210 horizontal font-line printers is available in four configurations: 1000 lpm, 64 character set; 1200 lpm, 48 cs; 750 lpm, 96 cs; 600 lpm, 128 cs. Interchangeable links allow convenient factory replacement of character sets. Standard features on all four microprocessor-controlled models are paper skip speed of 40 ips, a paper puller, and vacuum system. In addition to time saving full line buffering, each printer accepts 6-part forms from 3.5 to 19.5" wide. Motorized upper and lower tractor insures precise print alignment. Data Printer Corp., 99 Middlesex St., Malden, MA 02148. Circle 263

NEW TAPE FOR AUTO-INSERTION A new tape holds and protects radiallead and stand-up axial-lead components used in automatic insertion systems during printed circuit board assembly. Scotch brand YR237 radial lead tape, features high performance adhesive designed to "lock and hold" component lead wires to a flexible fiberboard carrier. The result, says 3M, is reliable, long-term holding power which prevents lead wire "flotation." Mounting radial lead components on the flexible fiberboard carrier permits fan-folding of large numbers of the components for presentation directly to programmed, automatic insertion machines. The YR237 tape is available in 1/2'' or 3/4'' widths. The standard length is 360 yds. 3M PO Box 33600, St. Paul, MN 55133. Circle 262

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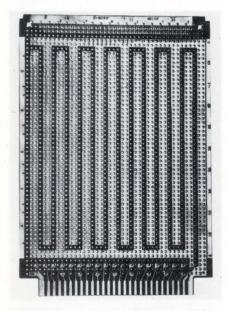
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8 x 8 BIT MULTIPLIER. On-chip I/O registers speed up operation, (45ns) reduce system overhead, and simplify interface to 8-bit microprocessor systems. High speed and versatility make the MPY-8HUJ multiplier well-suited to digital video signal processing, digital filtering, and other applications where it is an advantage to operate with unsigned magnitude notation. The 40-pin ceramic DIP MPY-8HUJ is a high speed TTL, parallel array multiplier. It accepts 8-bit inputs and provides a 16bit double precision product. Main internal multiplier array logic achieves a speed-power performance index of less than 0.8 pJ per equivalent gate. A single +5-V power supply is required. Two versions are available: MPY-8HUJ and MPY-8HUJ-1 is guaranteed to operate at 65 nsec max across the temperature range. \$48 in 100 quantities. \$56 for the MPY-8HUJ-1. TRW LSI Products, 2525 E. El Segundo Blvd., El Segundo, CA 90245. Circle 70

THREE NEW PLUGBOARDS. Designated the 4610 Series, these boards permit convenient interface design and system-expansion using wrapped-wire or soldered interconnections. They are plug compatible with Pro-Log 7801,2, 3 and Mostek MD-SBC-1 or other STD bus μ Cs. The boards measure 4.5" x 6.5" x 0.062, and have 0.042" holes on a 0.1" grid. Fifty-six card-edge contacts, (28 each side) on 0.125" centers supply STD bus input/output. Model 4610 is designed for soldered interconnections. Columns of three-



hole solder pads are interspersed between ground and power busses. They mount up to 20 16-pin DIPs or a combination of DIPs and discrete devices. Model 4610-2 boards are for wrapped wiring. They have interleaved power

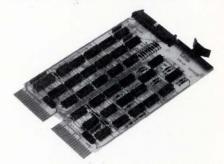
and ground busses positioned to accommodate DIP sockets with 0.3'', 0.6'', or 0.9'' lead spacing. Card edge connector pin two on the 4610 and 4610-2 boards, is connected to the logic power bus while pin four is connected to the digital ground bus. These boards also have 72 0.1" square tinned pads at the top for mounting ribbon-cable I/O connectors. Model 4610-1 boards are unclad, except for the card-edge connector, to allow total freedom in component mounting. Boards are made from FR4 epoxy-glass composite material (C.E.M.) with twoounce copper cladding. Etched circuits are hot-tin plated while card-edge connectors are nickel plated and goldflashed. Card ejectors, 56 contact cardedge receptacles and wiring tools are available as accessories. Pricing in the 1-4 quantity is \$18.95 on Model 4610 and Model 4610-2. Model 4610-1 is \$15.95. Vector Electronic Co., 12460 Gladstone Ave., Sylmar, CA 91342.

Circle 63

INCREASED CONFIGURATIONS ON DISK SYSTEM. This highly intelligent, DMA, Winchester/floppy disk system is now available in three configurations and at a reduced price. The new product from the Remex Division of Ex-Cell-O Corporation makes it possible to incorporate the Data Warehouse system TM system into a wide variety of low cost micro and mini computer based systems. It extends significantly the capability of these small units by use of the unique Data Warehouse system command techniques. The three Data Warehouse offerings: 1) For fast entry into the market place, the designer can select complete system including a 20-Mbyte Winchester disk drive, two dual head, double density flexible disk drives, micro processor based, DMA controller/formatter, plus power supply and cabling contained in a rack mountable chassis. \$6,350 in OEM quantities. 2) A packaged system as described in 1) but without the Marksran® Winchester disk drive. Allows system designer the option to purchase Marksman drive directly. \$3,775 in OEM quantities. 3) Lowest cost is available through an "unbundled" version of the system including the intelligent controller/formatter and one or two Remex dual head/double density disk drives. \$2,610 in OEM quantities for the two drive configurations. Delivery on all three is 30 days ARO. Using a technique called channel-command control which transfers data and command "packets" via DMA to and from the host computer, Data Warehouse systems reduce the amount of communication necessary between host computer and system. System capabilities: Transfer of data without regard for physical boundaries; packet chaining in non-contiguous memory;

off-line copy; system trouble shooting using maintenance packets. **Remex**, Div. of Ex-Cell-O Corp., 1733 Alton St., Irvine, CA 92713. **Circle 75**

LINE PRINTER CONTROLLER. Completely compatible with all models of the LSI 11 and PDP 11/03 Computers. The LPCL11 Controller provides a parallel interface to a large variety of line printers. On board DIP switches allow easy selection of Ad-



dress and Vector locations. Features: Address selection through ten-position DIP switch. The vector address is selected via a six-position DIP switch providing a choice of 000 to 370 (octal). Operation and programming are the same as LP-11 and LS-11. Transparent to the host computers' diagnostics, drivers, and operating systems. Comes complete with a 10 foot cable. \$375. OEM discounts. Computer Extension Services, Inc., 17511 El Camino Real, Houston, TX 77058. Circle 77

BAC-HASP DATA CONVERTER. New converter communicates with host mainframe via IBM HASP multi-learning RJE work station binary synchronous protocol. It performs all errorchecking and correction functions, translates EBCDIC to ASCII and ASCII to EBCDIC, and interfaces with user attached devices in serial asynchronous or byte parallel formats. The BAC-HASP converter operates a wide variety of peripheral equipment at high telecommunications data rates. The BAC-HASP offers error-free operation by using IBM binary synchronous protocol with CRC-16 error checking. It allows user to attach peripheral devices equipped only with asynchronous ASCII RS-232-C or byte parallel interface (generally supplied as standard equipment by the peripheral vendor). The BAC-HASP and attached devices emulate an IBM 360/370 HASP RJE work station. An EIA RS-232-C CRT/keyboard or printer/keyboard may be used as an operator's console. Other features: transmission blocks of 400 to 500 bytes standard, modem-specified data rates up to 9600 Hz., switched or dedicated lines, and optional modem eliminator configuration for local attachment. KMW Systems Corp., 8307 Highway 71 West, Austin, TX 78735. Circle 74

Want to improve your memory? BASF has a small suggestion.

The 6108 uses a ball bearing, friction-free head positioner traveling in a spiral cam... resulting in less susceptibility to vibration or uneven wear.

Main capstan features a double ball race for more accurate and friction-free operation.

THE NEW BASF 6108 IS ONLY 2.1" HIGH. THREE-6108 DRIVES FIT IN THE SAME VERTICAL SPACE AS TWO OF OUR COMPETITION'S.

Consumes only ²/₃ as much power as the competition, and generates less heat.

Industry-standard interface, power plugs and mounting points.

Activity light in door is standard.

Larger capacity than the competition: 40 tracks vs. 35 tracks at single or double recording density. .5 megabyte unformatted capacity.

Track-to-track access time of 12 msec; more than three times faster than the competition.

Program-controllable door interlock and Shugart-sized faceplate options. Built to tight production specs for improved reliability (10,000 hours MTBF) and less sensitivity to vibration.

Available now! The New BASF Double-sided 5.25" Floppy Disk Drive.

The new BASF 6108 is not only the smallest 5.25" floppy disk drive available... t also offers many big advantages in terms of capacity, reliability, and accuracy. BASF s America's only producer of both 5.25" loppy disk drives and 5.25" floppy disk nedia. The 6108 is available for immediate delivery at competitive prices. For comolete information, send in the coupon now, or call Dave Edwards at 617-271-4168.

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Please send me complete information and specifications on the new BASF 6108 5.25" Double-sided Floppy Disk Drive.

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Address_____ City_____

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NEW APPLICATIONS PACKS PLUS COST REDUCTIONS. SD Systems has a totally new range of application packages consisting of four business modules, inventory control, and the



first two vertical market packages for accounting and property management. This manufacturer of small business computers and S-100 bus microprocessor boards, also announces a cost reduction in its entry level computer, the SD-100, to \$6995. The SD-100 has 32 Kbytes of memory expandable to 64 Kbytes, uses a Z-80 microprocessor, and comes standard with two 1/2 Mbyte single sided, double density Shugart floppy disk drives. A 12" visual display with full alpha/numeric keyboard including numeric key pad is also contained in this compact desk top unit. Another member of the family, the SD-200, now sells for \$8995. It offers the same simplicity of design as the SD-100, but has increased expandability and versatility. The SD-200 has two 1 Mbyte, double sided, double density floppy disk drives; operates at 4 MHz; and includes 64 Kbytes of memory expandable to 256 Kbytes. Shipments of the SD-200 commenced in August 1979. The system is being installed in a variety of configurations, including multi-user applications. SD Systems, 3401 W. Kingsley Rd., Garland, TX. 75041. Circle 76

ELECTRICAL POLARIZATION SYSTEM A system developed by 3M for providing positive electrical polarization of electrical flat cable sockets and headers with .100" by .100" spacing has been chosen as a standard by the Air Force for its pending specification MIL-C-83503. The proposed specification deals with dual-in-line packages, printed-circuit boards, sockets and headers that utilize insulation-displacement flat cable systems. The 3M polarization system features keys in the header that must be aligned with matching grooves in the socket before the connectors can be mated. Location of the keys near the ends of the header prevent partial mismating that could occur with a polarization system utilizing only a "center bump" for alignment. According to 3M, the design was incorporated into 3M sockets and headers two years ago to improve mechanical simplicity, convenience and dependability of its line without changing proven electrical reliability. Following publication of the military specification, manufacturers may begin qualification tests. Further details from 3M Electronic Products Div., Department EP9-46, PO Box 33600, St. Paul, MN 55133. Circle 205

ENCODING SYSTEM FOR COM-PUTER GRAPHICS. Display of computer graphics or alphanumeric information on standard commercial color television monitors. This RGB to NTSC color encoder, designated the CCE-850, is designed to encode high resolution RGB colorgraphic computer displays regardless of scan rates. The unit is self-contained. It is 1-3/4" x



 $17'' \ge 8''$. A table top unit, it has provisions for rack mounting if required. A color reference test pattern allows proper NTSC color monitor alignment. The CCE-850 Encoder can be used with any graphics system when NTSC

MORE LSI-11 PRODUCTS FROM ANDROMEDA

MEMORY MEM11

 $32K \times 16$ — Fast enough for 11/23CPU's — 18 bit addressing standard — 1K word increments — first and last address switch selectable byte parity and 22 bit addressing optional — dual width card — fully socketed memory array

8 X 4 CARD CAGE 8LCC

Replacement for MLSI-BPA84 bifurcated, tapered entry, gold plated connectors — color coded card guides — choice of power connector — optional BCV compatible expansion connectors on backpanel — optional termination resistors

PARALLEL I/O

64 TTL I/O lines — inputs and outputs individually selectable — dual width card — user kludge area same connector pinout as 1664 TTL

SOFTWARE

VEDIT — Video text editor for use with VT52, VT100, ADM-3A, and Hazeltine 1500 series DPS — Document Processing System — formats, justifies output to any RT-11 device — takes advantage of most daisy wheel

printers

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Circle 51 on Reader Inquiry Card

DOUBLE DENSITY

An original, not a copy — controls up to 4 regular and 4 mini floppy disk drives — single and double headed — dual width card — 25% more storage and 2.46 times faster than DEC RXV21 — RT-11 compatible handler software available

Contact us for more information on these and other fine LSI-11 products



14701 Arminta St. #J Panorama City, CA 91402 Phone: (213) 781-6000 TWX: (910) 495-1135 video is required for video taping and/ or distribution. \$1,595. Delivery 30 days. Lenco, Inc., 300 N. Maryland St., Jackson, MO 63755. Circle 73

NEW POWER-SWITCHING SERIES. Acme Electric has introduced its AC/DC modular switching units. The AMS Series has 39 models, with voltages from 2 VDC to 28 VDC. It handles power needs from 100 W to 625 W. The input and output conducted EMI or each model is within the limits of MIL-STD-461A, Method CE-03 (Notice 3). Other performance characteristics include .05% line and load regulation and built-in overvoltage and overcurrent protection. Among the standard features are universal 115/230 VAC input, logic shutdown, component recognition under UL Standard 478, and parallel or series wiring capabilities to increase current. or voltage. Acme Electric Corp., 20 Water Street, Cuba, NY 14727.

Circle 235

(713) 227-2195

SUPPORT FOR 1802 PROCESSOR Complete hardware and software support for RCA's 1802 processor is now available for use with GenRad/Futuredata's universal development systems and networks. Program execution and in-circuit emulation uses the GenRad/ Future-data 2300 Series system in conjunction with RCAs COSMAC Micromonitor. Software development features a sophisticated file manager, CRT-based editor, 1802 relocatable macro assembler and linkage editor. A complete set of debug commands includes single step, program trace, memory and register set, and breakpoint analysis. Debug displays include disassembled program flow, multi-window hex and ASCII memory modes. Prices for development system packages start at \$10,650. Support software only for the 1802 is \$600. GenRad/Futuredata, 5730 Buckingham Pkwy., Culver City, CA 90230. Circle 264

NEW MASS STORAGE DEVICE Teradyne has signed its eighth consecutive agreement with Tri-Data to purchase mass storage devices for automatic test equipment systems. Special significance of this, agreement is the introduction of Tri-Data's FlexiFile 43, a microprocessor controlled flexible disk system. The new disk system is completely compatible with existing hardware and software developed for the Cartrifile Magnetic Tape System. FlexiFile 43 delivers 1.5 million bytes of storage on three eight inch drives controlled by an Intel 8085. A Zilog Z80 functions as the applications processor. Tri-Data, 505 East Middlefield Rd., Mountain View, CA 94043. Circle 206

NEW! 300 LPM PRINTER WITH SWITCHABLE SERIAL/PARALLEL INTERFACE BS232C 20 MA 20 MA Program Centronics® Dataproducts® DEC® LA-180 LOCAL DATA Bell Code Sounder (Ontional) Serial/Parallel

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• Teletype Print Mechanism • SP40 Serial/Parallel Interface 300 Lines Per Minute 1024 Character Expandable Buffer 80-Column, 80-Column Forms • RS232C plus 20 MA Access, 132-Column • X-ON/X-OFF or DC Control • Nationwide Full Service • Plug Compatible Parallel Connector: • Acoustic Enclosure Centronics® Dataproducts® For Regional Reps. call (408) 377-7001 (612) 884-0202 (301) 770-6556 (213) 641-1840 (414) 784-3663 (301) 299-5514 (602) 994-1285 (513) 435-2772 (516) 360-0940 (206) 883-7792 (214) 387-2855 DEC®LA-180 LOCAL DATA 2701 TOLEDO ST. TORRANCE, CA 90503 (213) 320-7126

Circle 52 on Reader Inquiry Card

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Marc Savage & Co., Inc. has been retained by a major European aerospace manufacturer to recruit ATE engineers who have substantial experience with avionic hardware. The selected candidates will spend 1, 2 or 3 years (candidate's choice) with their families, in the heart of Europe, living and working in a large metropolitan city, with all expenses paid for housing, transportation and food.

Applicants' experience should include:

- 1) Autopilot and/or stability augmentation systems
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- 3) Debugging applications programs and resolving conflicts
- arising from interfacing LRU's, ATE and application programs 4) Familiarity with and/or ability to program in ATLAS

Take advantage of this unusual opportunity and enjoy all the cultural benefits of the European experience. Return home with a wealth of unforgettable memories.

Send resume in confidence to:



Circle 53 on Reader Inquiry Card

TWO NEW STATIC RAMs The CMOS 4K Static RAM, MB8404E, is organized into 4096 words by 1 bit. The MB8414E has 1024 words by 4 bits. These RAMs feature address access time of 250ns maximum and cycle time of 370ns maximum. Operating power dissipation is 17mW/MHz maximum and standby power is 275uW maximum. The MB8404E 18-pin dualin-line package is a plug-in replacement for the industry standard 6504. The MB8414E is replacement for the industry standard 6514. Fabricated with a CMOS silicon gate process, the units are designed for use in microprocessor systems where low power dissipation and high performance are required. **Fujitsu Microelectronics, Inc.** 2945 Oakmead Village Ct., Santa Clara, CA 95051. **Circle 261**

FLOPPY DISK DRIVES WITH DOU-BLE TRACK DENSITY New minifloppy disk drives will read/write 96 tracks per inch, doubling current track density. Prototypes in single- and double-sided versions of the new drive have been successfully field-tested by Micro

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the OSB11-A Bus Repeater. It is the functional equivalent of DEC's* DB11-A, and is designed to drive at least 19 bus loads and a fifty foot extension of bus cable. In a test environment it has supported 45 loads and more.

The repeater's simplicity of design is visually apparent. This is made possible by a specially designed integrated circuit. Resultant advantages are the speed (about 80 nsec MSYNC to return SSYNC); the reliability inherent in only 34 operational circuit components; ease of installation and a price of \$1250.

The OSB11-A is only one of several products available from Datafusion Corporation which are designed to enhance the capabilities of your PDP11 system. Among these are switching devices for automatic bus reconfiguration, a bus splitter and a cable tester.

We also have some ideas for the application of our products which might not have occurred to you. If you can't get the performance that

you would like from your PDP11 system, maybe we can help. Telephone our Marketing Manager at (213) 887-9523 or write to Datafusion Corporation, 21031 Ventura Boulevard, Woodland Hills, California 91364.



Peripherals. When combined with double data density and double-sided read/ write features, the new unit can store nearly 1 MB of data on a 5-1/4" floppy. Mechanical components of the drive will be the same as the company's current single- and double-sided, doubledensity models that read/write 48 tpi.



The new floppy drives will be plugcompatible with existing systems. Furthermore, diskettes previously recorded on the standard 48 tpi format can be played back on the 96-tpi device. Two models available: Model 91 will read/ write approximately 480 KB of data on a single side of a 5-1/4" disk; Model 92 will read/write about 960 KB on both sides. Track-to-track access time is 5 milliseconds, (five times faster than competitive models, says the company.) Head assembly for the doublesided 92 incorporates a fixed bottom head with a gimbaled top head. In conjunction with a precision chassis design, this assembly provides more than 3 million in-contact passes of the media over a single track. Models 91 and 92 accommodate FM, MFM, or M²FM encoding. Single units for evaluation by OEM's are \$450 for the 91 and \$550 for the 92. Micro Peripherals, Inc., 9754 Deering Ave., Chatsworth, CA 91311. Circle 133

ASYNCHRONOUS TO SYNCHRO-NOUS 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. 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., 155 Main St., Danbury, CT 06810 Circle 127

*TRADEMARK OF DIGITAL EQUIPMENT CORPORATION

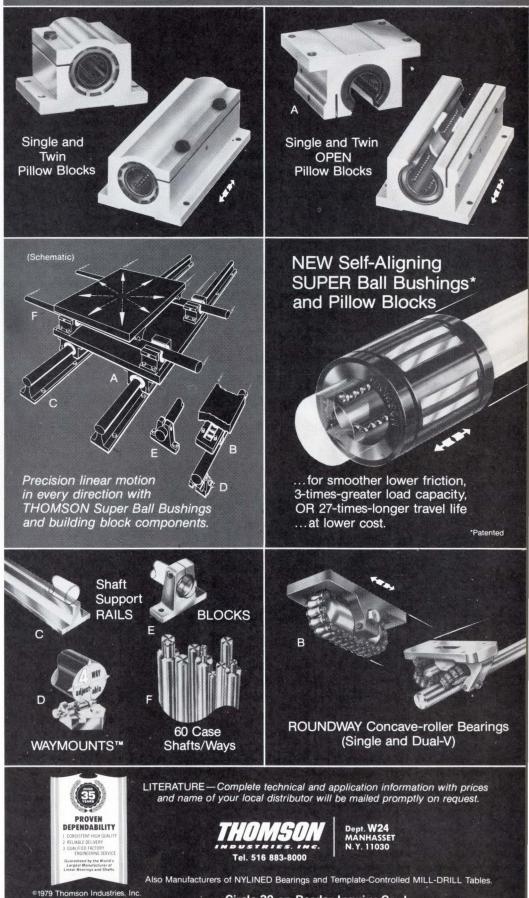
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CIRCUIT BOARD SWITCH DATA SHEET A four page data sheet on its printed circuit board switch is available from Stanford. Featured are complete electrical and physical characteristics, material specifications and dimensional data in both metrics and inches. Ordering information, list of output codes, options, truth tables, and mounting information are clearly presented. Strip Pak by Stanford is designed to mount directly to a PC board by hand or wave soldering. It is available in a wide variety of 10 and 16 position models. BCD and decimal codes offered. Stanford Applied Engineering, 340 Martin Avenue, Santa Clara, CA 95050. Circle 270

BULK CORE REPLACEMENT FOR DATA GENERAL NOVADISC. Dataram's BC-301 BULK CORE system offers Data General users an all-electronic replacement for the Data General 4019 Controller and Novadisc. BULK CORE is completely hardware and software transparent to the full range of Data General minicomputers. Heart of the system is Dataram's 128K x 17 BULK CORE module. A maximum of eight DR-128 modules are packaged in a 15-3/4" chassis which also contains the necessary BULK CORE Interface (BCI) module, power supply, and fan assembly. The BC-301 system also includes a BULK CORE Controller (BCC) module which plugs into the host Data General minicomputer. The BCI module provides both the drive capability required by the maximum configuration, and the "off-line" tester. The BCC module, packaged on a 15" x 15" PC board, contains the logic necessary for Novadisc emulation. DATARAM CORPORATION, Princeton-Hightstown Rd., Cranbury, NJ 08512. Circle 188

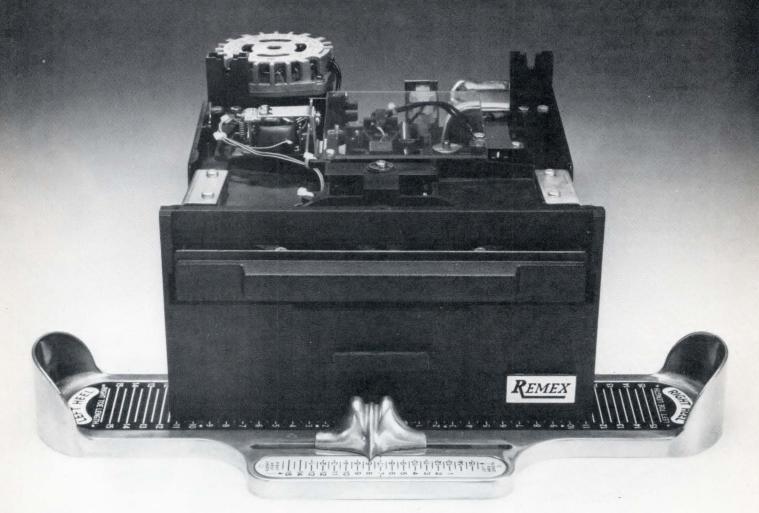
CP/M SOFTWARE SURVEY. A software consulting firm in Southern California, has completed a survey of software packages for micro-computers using the CP/M operating system. Questionnaires were sent to 84 vendors; data on 264 programs were received. The survey contains a general section on topics such as classification. description, price, and number of copies sold as well as a configuration section which covers memory, disk, terminal and printer requirements. A survey directory has been prepared. It shows all programs classified by type and gives names and addresses of vendors. One can read off the vendors of mailing list systems, medical office systems, payroll packages, etc. The directtory is available for \$2.00 (or \$1.00 plus a self-addressed stamped envelope) from The Small Systems Group, Box 5429, Santa Monica, CA 90405. Circle 194

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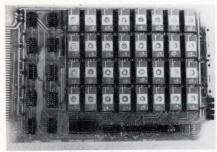
So remember this: If the Shugart fits, Remex fits, too.

Call today for more details or to get your order rolling. Ex-Cell-O Corporation, Remex Division, 1733 East Alton Street, Irvine, CA 92713. (714) 957-0039 TWX: 910-595-1715

Ex-Cell-O Corporation REMEX DIVISION DATA WAREHOUSE

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ROM LOADER The RL 990-1 Rom Loader Card (for the TI 990) was designed to allow rapid reloading of a stand alone 990 processor. A 16K word program loads in less than one second. The Loader has the capacity of 64K words. A "watchdog timer" circuit allows automatic loading and reloading

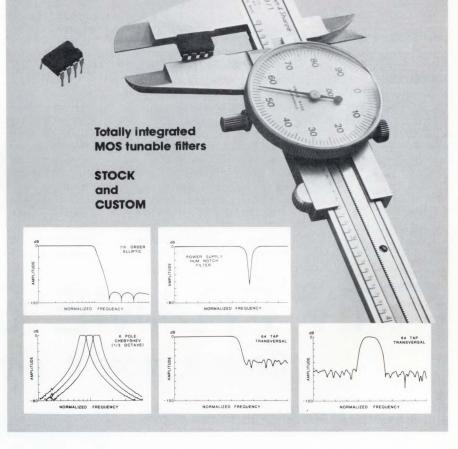


of the program. Other features: a software readable hexadecimal switch, and four software programmable status LED's. The RL 990-1 has been successfully field tested by the company for more than a year. \$350 each. Delivery is stock to two weeks. National Data Corp., One National Data Plaza, Corporate Square, Atlanta, GA Circle 128

NEW SOFTWARE. Sybex has a new Cross-Assembler written in Microsoft BASIC. Generating a 6502 object code, this assembler runs directly on an CP/M computer (Z-80 or 8080based.) The 8" diskette format with documentation is \$65. The company is also distributing two 8080 simulators written by Dan McCreary. The simulators are designed for either the APPLE II or the KIM 1. The cassettes are \$19.95 each. Sybex is also releasing its newest publication "Programming The Z800" written by Richard Mateosian. The 320 p. paper back (133 illustrations) is \$15.95. Sybex, 2344 Sixth St., Berkeley, CA 94710. Circle 257

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NEW GRAPHICS FUNCTIONS FOR PRINTER allows dot matrix type printers in IBM Series/1 systems to perform various types of graphics printing such as bar codes, block characters, extended highlighting and plotting. The new controller will also operate Printronix printers having a Quality Micro Systems interface, as well as Trilog printers. Similar printers which have graphics printing capability, can also be connected to this MDB controller to perform a variety of functions not available with IBM's Series/1 printers. The primary applications are for label printing, plotting, and printing of UPC bar codes. \$1,995. Delivery, 30 days ARO. MDB Systems, Inc., 1995 N. Batavia St., Orange, CA 92665. Circle 162

NEW ADD-IN MEMORY FOR IBM 303X provides users up to four times greater memory density and significantly improved reliability. The new add-in memory, STOR/3000, is also available for certain models of presently installed IBM 370/158 and 168 systems, with future upgradeability to IBM 303X systems. The add-in memory boards plug directly into the IBM storage backplane to use as much of the existing IBM circuitry and signals as possible. This approach, says the company, eliminates the need for complex interface logic. failure-prone interconnect cables and redundant logic and power supplies. STOR/3000 utilitizes 64K MOS RAM storage devices, compared to IBM's 16K storage modules, to provide up to four times greater storage capacity in memory boards of identical size. The new add-in memory uses standard IBM MST compatible logic which eliminates the need for complex "translation" circuitry necessary when logic other than MST is used. STOR/3000 systems

are available for 40 percent less than IBM's current prices and carry a full year's warranty. Delivery, 30 to 60 days ARO. Cambridge Memories, Inc., 360 Second Ave., Waltham, MA 02154. Circle 163

SOLID-STATE THICK FILM THERMAL PRINT-HEADS. The first such device claimed to incorporate all required circuitry mounted directly on the substrate. 32-bit, I²L drive circuits, plus shift registers and diode arrays, are provided in 40-pin flat pak chip-carriers. Mounted directly to the printhead substrate adjacent to the printing element. Thermal printheads can be supplied with single element print widths of up to 10". Line speeds of 2 ms can be achieved, and dot densities have been increased to 8 dots per mm. Both graphics and alphanumeric readouts can be achieved from this same head. New construction technique eliminates external drivers, diode matrices, shift registers, and their associated cabling. A minimum MDLBF of 100 X 10⁶ is guaranteed. R-Ohm Corp., PO Box 19515, Irvine, CA 92713. Circle 154

ENHANCEMENTS TO QCM (Quantitative Computer Management) programs, the VM option and Superspi, will enable users to improve their DP equipment's costeffectiveness and throughput. The VM option permits QCM to support MVS under VM, solving the job accounting problem. It provides correct measurements of CPU utilization by task and corrects CPU times used by the MVS System Resource Manager. Superspi notifies operator/ systems programmers of system or job-related problems through an on line console or TSO terminal and logs, in hardcopy, all problems. **Memorex Corp.**, San Tomas at Central Expy., Santa Clara, CA 95052. **Circle 251**

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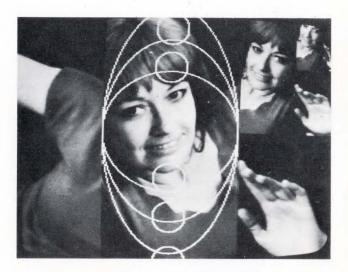
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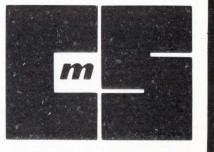
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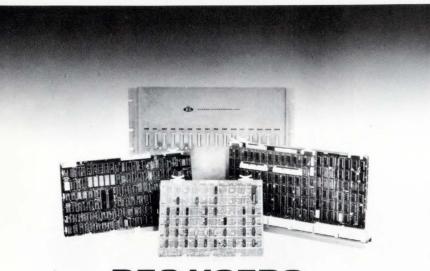
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SHARING UNIT REDUCES COSTS International Data Sciences' new Model 6101 Sharing Unit is designed to allow combinations of up to four modems or data terminals to share a common communications device. Its use can simplify and/or expand a data communications system by decreasing the number of computer ports, modems, and transmission lines required. The IDS Model 6101 operates at data rates up to 19,200 bps in syn-

chronous or asynchronous modes. For synchronous operation, a common transmit timing signal is derived from the common side interface, distributed channel, or from the optional internal clock. Features include front panel LEDs to indicate status of TD, RD, RTS, CTS, DCD, DSR, and DTR on the common side; and monitor the activity of the four distributed channels. An RTS/CTS time delay is provided when the Sharing Unit interconnects a common data terminal to distributed data terminal equipment. This delay can be selected on a channel-by-channel basis for either 5, 50, 150, or 200



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milliseconds. \$650. Delivery, 30 days ARO. International Data Sciences, Inc., 7 Wellington Rd., Lincoln, RI, 02865. Circle 204

FREE BOOKLET This new eight-page illustrated brochure describes Incor, a line of rare-earth cobalt magnet materials. The mineral is useful for engineers with dynamic, electronic-instruments, or mechanical-design projects. The brochure is a design guide that illustrates the unique characteristics and capabilities of the powerful rare earth materials. Incor allows engineers to design: high performance motors that are smaller, lighter and more powerful; microwave tubes that can handle higher capacities; magnetic drives and couplings that can be made smaller and operated at higher torque levels; more compact electronic devices; and, virtually any application where permanent magnets are used to significantly reduce size and weight of the finished product. An outstanding capability stressed in the booklet is Incor's maximum energy product. The energy product is a measure of the potential energy of the material, and the graph in this design guide shows Incor measured in mega-gauss oersted units. Careful design of the magnetic circuit allows the engineer to utilize the maximum potential energy to design smaller and lighter products. For a free copy of "Incor", contact Indiana General, Magnet Products, 405 Elm St., Valparaiso, IN 46383. Circle 266

INTELLIGENT PROGRAMMER Microbar's EPRO-101 is a low cost programmer for use with EPROMs. The neat microprocessor-based, single board construction is designed for expansion to handle 40-pin devices. The EPRO-101 operates as a peripheral to a host computer, development system or a terminal via the built-in RS232. It can also be used in stand-alone configuration. Upload/download programs are available for some development systems or can be developed as required. EPRO Model 101 \$1595 each, Personality Modules \$90 each, Microbar Systems, Inc., 1120 San Antonio Rd., Palo Alto, CA 94303. Circle 202

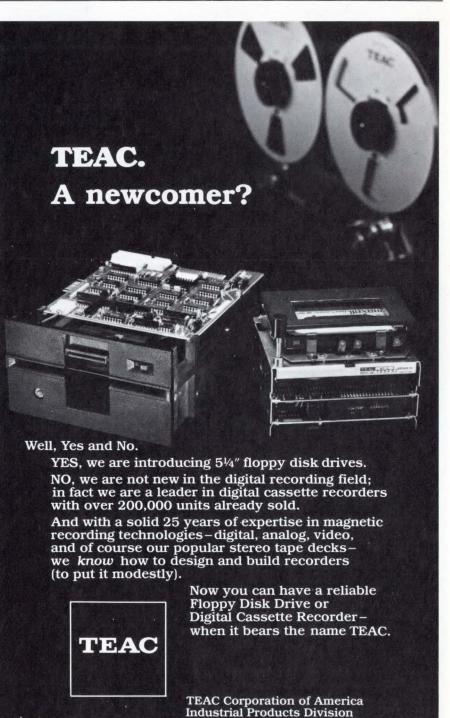
AN INTELLIGENT COMMUNICA-TIONS CONTROLLER A new highperformance intelligent communications controller is available for Perkin-Elmer's family of 32-bit systems including Models 7/32, 8/32, and the MOS-based 3220 and 3240. The new controller, DIOS (DMA I/O Subsystem) provides direct memory access (DMA) facilities between main memory and hardware communications adapters. With the DIOS, data transfers take place without processor intervention, improving system

throughput capabilities while minimizing processor degradation. The DIOS enhances the company's recently announced software package, Reliance, which includes data management and transaction processing software using ANSI'74 COBOL. Reliance supports up to 128 terminal users, assuring data integrity through unique automatic record locking, on-line transaction rollback, and system wide recovery features. Two versions of the DIOS are available. The first, \$6,000 enhances a Reliance software environment by accommodating asynchronous protocols. The second version, \$7,500, is designed for customers with concurrent data communications requirements. This version accommodates asynchronous, character synchronous, and bit-protocols such as SDLC, HDLC, and ADCCP which require zero-bit insertion/deletion. Automatic flag insertion/deletion is also provided. Delivery is 60-90 days ARO. Perkin-Elmer, 2 Crescent Pl., Oceanport, NJ 07757. Circle 269

BUBBLE-MEMORY GUIDE A recently published 16-page booklet, "Bubble Memory Devices" is available from Fujitsu. It is a primer for electronic engineers who need to understand the bubble memory device and how it works. The guide explains the principle of magnetic-bubble memory and the technology developed by Fujitsu. Chapters in the booklet include an explanation of bubble memory, the nature of magnetic bubbles, and how to use them for memory. Also discussed is loop organization and peripheral circuitry. A second booklet covering interfacing and application notes is currently being prepared. Contact George Neeno, Fujitsu America, Inc., Component Sales Division, 910 Sherwood Dr., 23, Lake Bluff, IL 60044. Circle 209

NEW MAGNETIC TAPE-STORAGE SYSTEM System Industries' new product is a 6250-bits/inch magnetic tape storage system for PDP-11/70 minicomputers. The new system, named Omega, has three units: a tape transport, a formatter, and a tape adapter. Major features include high reliability, fast speed, large capacity storage, and easy interfacing without change to DEC hardware or software. The tape transport operates at a speed of 75 in/s and is controlled by the formatter. The system can record data at 6250 bpi in Group Code Recording mode, or at 1600 bpi in Phase Encoded Recording mode, and is switchable and programmable between modes. When recording at 6250 bpi, a standard 2400-ft. reel of tape can store approximately 100-180 megabytes of data, depending on the block size being written. The Omega system's intelligent tape adapter physically interfaces the tape transport and formatter to the PDP-11/70. It uses the latest bitslice microprocessor technology to emulate DEC's TU45 unit, a slower and lower capacity tape system. Up to four tape transports can operate from a single tape adapter. Initial shipments of the new system are scheduled for the first quarter of 1980. The enduser, single-unit price is expected to be below \$35,000. For further information contact Chris Ibbott, System Industries, PO Box 9025, 525 Oakmead Pkwy., Sunnyvale, CA 94086. Circle 195





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lation and maintenance. Quick, easy address change is a time saving feature. Delivery, two weeks ARO. Datasystems

Corporation., 8716 Production Ave., San Diego, CA 92121. Circle 158 "DBUG: AN 8080 INTERPRETIVE DEBUGGER," Titus and Titus, describes DBUG, a software debugging package for 8080-based microcomputers. It describes operation of the program and how it can be applied to program development and testing. Complete with documented hexadecimal and octal listings. 112p. No. 21536. \$4.95. Blacksburg, Howard W. Sams & Co., Inc., 4300 West 62nd St., Indian-

apolis, IN 46168.

a printer up to 3,000 feet from the computer. The DLP-II provides interface for Dataproducts, Centronics, DEC

LA-180 and printers emulating any of these interfaces on one board. A self-test capability further simplifies instal-

LINE PRINTER CONTROLLER FOR DEC COMPUTERS. DLP-II Line Printer Controller features on-board long lines option at a reduced price as compared to an external module. The long lines option is switch selectable requiring no change of boards. With this option, data may be sent to

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"PROGRAMMING THE Z80" This book by Rodnay Zaks is designed as a progressive, step by step course. It covers essential aspects of programming, as well as advantages and disadvantages of Z80. Some of the basic concepts; Z80 Hardware Organization; Basic Programming Techniques; The Z80 Instruction Set; Addressing Techniques; and six other subject titles. 450 pp. Sybex; 2020 Milvia St., Berkeley, CA 94704. Circle 152

Circle 160

"PLANNING AND CREATING SUCCESSFUL ENGI-NEERED DESIGNS" by Sidney Francis Love. 272 pages; 55 illustrations; 6×9. Engineering designer and consultant Sydney Love explains techniques of establishing and maintaining an engineering design effort. Mr. Love shows how to calculate the worth of a design feature, explains project objectives and determines design requirements. Guidelines on determining project targets help to establish valid time and cost estimations. A chapter is included on using the PERT/CPM control technique. Tips are provided for evaluating design alternatives. The book also tells how to achieve optimum design by utilizing tradeoffs during the course of the design process. A special section on group decision making will enhance a design team's ability to choose between technical alternatives. 272 pp. \$17.95. Van Nostrand Reinhold; 135 W 50th St.; New York, NY 10020. Circle 156

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TWO SYSTEMS AIDS a processor speedup modification for DEC PDP11/70 and an automatic overtemperature protection power shutdown system for all DEC computers. The Model C-XX Overtemperature Protection System: operates automatically; Produces a loud audible alarm when sensor detects the first temperature limit of 79°F; Provides optional control for external customer alarm or standby air conditioning actuation. Provides automatic total power shutdown at the second overtemperature limit of 83. Installs in a few minutes with no tools nor special skills required. Fully compatible with all DEC standard equipment and systems. \$749. The Model B-11 PDP11/70 CPU Speedup System: Features 12-15% speedup of PDP11/ 70 CPU Instruction Throughput Rate, easy plug-in and removal of the modified CPU timing module, speedup hardware that is available in four tailored packages. Software sources that are included to test and demonstrate the speedup. The B-11 CPU speedup system is suggested whereever an overall cost effective speedup of a PDP11/70 minicomputer system is desired. A 15% CPU speedup will result in a 12-15% speedup in the execution of computerbound jobs and a noticeable improvement in overall system throughput in heavily loaded systems. \$489. Related and supported services available at varying prices. Nassau Systems, PO Box 19329, Cincinati, OH 45219.

Circle 153

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VECTOR REFRESH TERMINAL. This terminal uses "State-of-The-Art" technology designed for high performance graphics applications such as simulation, data analysis, and nesting (2D part placement). Vector Automation's



standard 21" model (Graphics 80) offers a firmware processor with 32K bytes of memory expandable to 256K bytes, full ASCII keyboard – 95 keys, RS-232 serial interface, and a built-in diagnostic panel. Terminal features 4096 × 4096 resolution, and a 66,000 short vector capacity. Optional peripherals include light pen, data tablet, hard copy and plotters. Host software meeting the core standards published by ACM/Siggraph is available. \$24,500 each. OEM prices available. Delivery 60 days ARO. Vector Automation, Village of Cross Keys, Baltimore, MD 21210. Circle 157





LaVezzi Machine Works, Inc. 900 North Larch Ave. • Elmhurst, III. 60126 (312) 832-8990

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DCS/80 Multibus® Development/ Control System \$3595

The DCS/80 is a low cost, industrial quality rack-mountable Multibus* compatible development/control system. This compact unit was designed for high reliability, easy maintenance and includes dual 8" floppy disks, DCS8010A CPU, 5-slot (optional 9-slot) backplane and power supply. A 16k byte system costs \$3595.

MULTIBUS HARDWARE – DCS designs and manufactures a complete line of Multibus compatible boards including the DCS8010A CPU that can contain up to 4k RAM, 16k PROM/ROM, 48 Bits parallel I/O, and 2 serial I/O ports. Other boards include intelligent disk controller with serial port, IEEE-488, DCS8020-4, RAM, I/O, 8086 and more.

SOFTWARE – The DCS/80 is CP/M** compatible and the software available includes Fortran, Pascal, Process Control Basic, "C" Programming Language, cross-assemblers and a PL/M* compatible compiler.

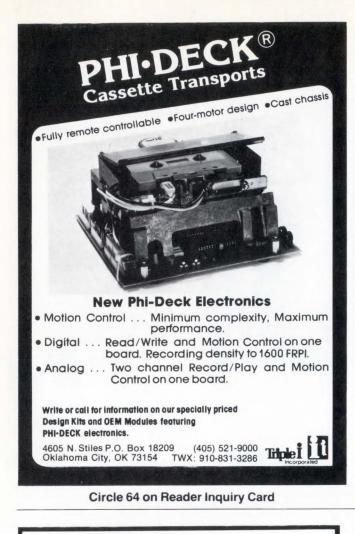
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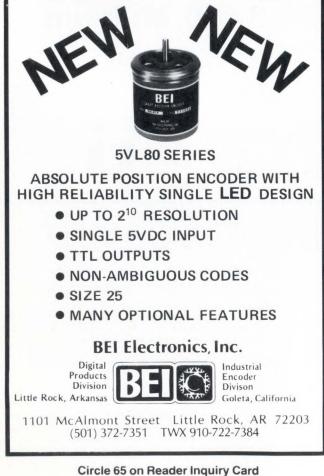
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DUAL-CHANNEL WAVEFORM RECORDER uses a master/slave approach. The master unit offers full-performance dual-channel recording, providing an 8-bit word per sample with a maximum 2048 words/channel memory capacity at up to 5 MHz; the slave is a master-dependent dual-channel recorder. The master can be used alone or teamed with up to three slave units, providing up to eight

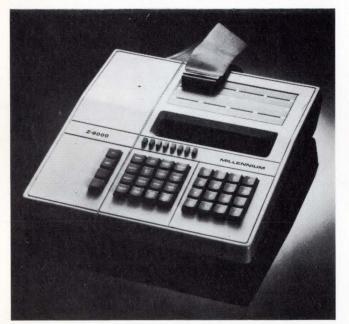


channels of synchronous recording. Designed for highspeed, high-resolution transient event, signal capture, the Model 2805 master unit costs \$5250; the slave unit costs \$4200. Gould Inc., Biomation Div., 4600 Old Ironsides Dr., Santa Clara, CA 95050. Circle 253

INTELLIGENT ANALOG PERIPHERAL mates with Multibus backplane. Features include a fully-developed 8085A-based single-board computer complete with DMA, data acquisition system and an architecture that allows parallel processing relative to the 8085A and the Multibus bus master. DMA capability lets users transfer data at up to 125Khz without CPU intervention. The IAP operates: as a slave device on Multibus to perform high speed intelligent data acquisition; as a low-end, Multibus controlled data acquisition system capable of serial or parallel I/O; or a remote data acquisition system utilizing the IAP modem control feature for long distance TTY data transmission. Other features include 16K of dual-ported RAM, a complete vectored interrupt system, two independently programmable timers, serial I/O interface with current loop, RS232C drivers and modem control, software programmable baud rate generator and four PROM sockets that accept 2708-, 2716-, or 2732-type PROMs. Data Translation, Inc., 4 Strathmore Rd., Natick, MA 01760. Circle 245

INTERFACE PRODUCTS FOR DATA GENERAL computers include. a programmed I/O line printer controller as well as a data channel (DMA) controller with optional programmed interval time real-time clock for interfacing most line printers; other peripheral device controllers including paper tape reader, paper tape punch, card reader and incremental plotter; multiple input/output board to interface a teletype or RS232 device with options for a second serial device controller, a real-time clock, and for modem control of either or both devices; a 4- or 8-channel asynchronous communication multiplexor, a general purpose interface module to provide logic functions to the DG bus plus space for up to 105 14- or 16-pin ICs of user designed logic; an expansion chassis; a bus terminator module; board extender; and 4- or 8-channel communication panels. MDB Systems, Inc., 1995 N. Batavia St., Orange, CA 92665. Circle 244

TRAINING AID and 8- and 16-bit universal prototyping instrument, the MicroSystem Designer-Series 1000 evaluates MPU-based systems. Currently supporting the Z80A, 8088, 8086 and Z8000, the Designer will support, in the future, the M68000, 8085, 8048 and M6809. Uses for the device include trial circuit development, software debug and hardware/software integration. Features include hardware breakpoint, register, memory examinations, single-step mode to allow program analysis and debug and a code execution timer function. By adding various personality modes and an up/down link to a host computer, a design group can add support for all popular microprocessors to an other-



wise dedicated development system. Price: \$1300 to \$1650, depending on the personality modules selected. Millennium Systems, Inc., 19020 Pruneridge Ave., Cupertino, CA 95014. Circle 252



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Designers' Notebook

64K ROM Expands Program Beyond 4K

Few duplicate program memory bytes in 64K ROM make interface with μ C simple and expand program memory beyond the 4K limit. The hardware and software described herein have been tested and run successfully.

Industry standard 8048 family of single chip micros are designed to work with maximum 4K Bytes of program memory. For most applications, 4K Bytes limit is sufficient. For some applications — like large vocabulary talking instruments, language translators, etc. — where program memory plus the data Bytes (for voice storage or look up table, etc.) exceeds 4K Bytes, it is economical to combine program memory and data Bytes on one large ROM; e.g., MK36000 8Kx8 ROM and interface it with ROMless μ C like the 8035.

At a cost of few duplicate program memory bytes, the interface described here lets you: (a) access data byte from any location in the ROM, (b) jump out and jump back beyond the 4K byte limit and hence, increase program memory byte beyond 4K, (c) get rid of two 8 BIT latch chips and a few gates which would be required otherwise to switch proper address locations when program instruction is being fetched, (d) lower battery consumption.

Interface shown in Fig 1 takes advantage of on chip latches for addresses of MK 36000 (Mostek) 8K x 8 ROM. Upper 5 address lines of ROM are connected to port 2 of the micro. Notice that bus is connected to both lower 8 address lines of ROM and 8

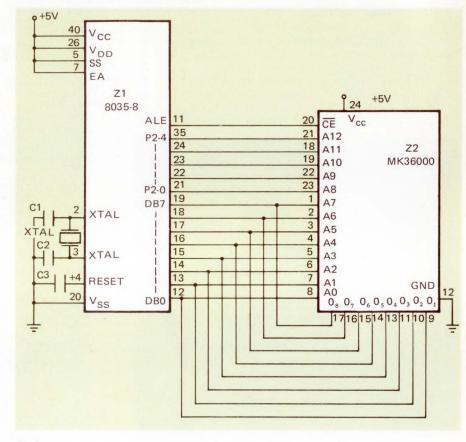


Fig 1.

output lines of the ROM. There is a chance of BUS contention especially at low temperatures and with ROM with faster access time. This could be minimized by either using slower ROM and/or some delay in the ALE \overline{CE} line. Of all the address lines only A12 is required to be set to zero when program instruction is to be fetched (as-

suming program is mostly located in the lower 4K bytes). After the power reset address A1 goes to high and program instruction is fetched from location 1000H instead of 0000H. Sample program in **Fig 2** shows how the program is directed to JUMP to location 000CH where the main program is located.

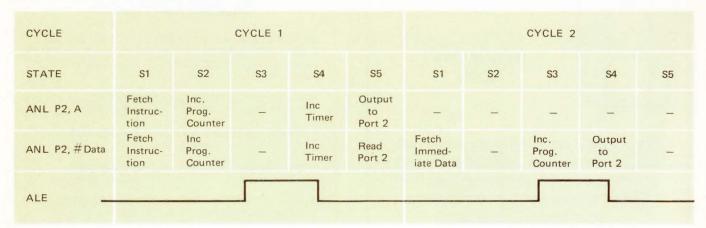


Fig 2 Instruction timing diagram.

ASM48 :F1:ART. SRC

ISIS-II MCS-48/UPI-41 MACRO ASSEMBLER, V2.0 PAGE 1 SAMPLE PROGRAM FOR "FEW DUPLICATE PROGRAM MEMORY BYTES......."

LOC OBJ	SE0 SE	SOURCE S	TATEMENT
	1 \$TITLE	SAMPLE	PROGRAM FOR "FEW DUPLICATE PROGRAM MEMORY BYTES"
011B	3	EXINT0	EQU 011BH ; EXT. INT ROUTINE
0145	4	TMINTØ	
1000	5	EXINT1	
1020	6	TMINT1	
1000	7	ORG	1000H : UPPER 4K BYTES
1000 0409	9 10	JMP	JMP4K AND ØFFH ; JUMP TO 1009H LOC TO SKIP INT LOCATIONS
1002 00	11	NOP	
1003 040C	12	JMP	EXINT1 AND ØFFH ; EXT. INT ROUTINE LOCATED AT 100CH
1005 00	13	NOP	
1006 00	14	NOP	
1007 0420	15	JMP	TMINT1 AND OFFH ; TIMER INT ROUTINE LOCATED AT 1020H
	16 JMP4K:		P2,#00H ; FORCE ADREESS BIT 12 TO 101
100B 00	17	NOP	; TO JMP TO LOWER 4K BYTES AT 000CH
0000	18	000	;
0000	19 20	ORG	000H
0000 040C 0002 00	20 21	JMP	STARTO
0002 00 0003 241B		JMP	EXINT0 SEXTERNAL INTERRUPT ROUTINE LOCATED AT 011BH
0005 00	23	NOP	EANING FEATERAILE INTERACT ROOTINE COUNTED IN STIDI
0005 00	24	NOP	
	25	JMP	TMINTØ , TIMER INTERRUPT ROUTINE LOCATED AT 0145H
0009 00	26	NOP	
	. 27	NOP	
000E 00	28	NOP	
000C 09	29 START0: 30	IN	A, P1 ; START MAIN PROGRAM AT THIS LOCATION
045B	30	ORG	45BH
	32		
045B 8E00	33	MOV	R6, #00H ; 00H OR 0EFH TO FORCE BIT 4 OF PORT 2 TO 101 LATER IN THE PROGRAM
	34		;
9450 FA	35	MOY	A, R2 ; UPPER EIGHT BIT ADDRESS
045E 3A	36	OUTL	P2, A ; ADDRESS THE ROM
145F	37 DUPCOD		\$ + 1000H ; START ADDRESS FOR THE DUPLICATE CODES
045F 81	38	MOVX	R. OR1 ; DUPLICATE THIS CODE AT \$ + 1000H . GET THE DATA BYTE
0460 2E	39	XCH	A, R6 ; DUPLICATE THIS CODE AT \$ + 1000H . SAVE THE DATA BYTE AND CLEAR ACC.
0461 3A	40	OUTL	P2, A ; DUPLICATE THIS CODE AT \$ + 1000H . RESET UPPER ADDRESS BITS TO 101
0462 2E	41	XCH	A, R6 ; RECOVER THE DATA BYTE
145F	42 43	ORG	; DUPCOD ; DUPLICATE CODE TO FETCH DATA BYTE FROM ADDRESS ABOVE ØFFFH
145F 81	44	DB	81H / HEX CODE FOR (MOVX A) 0R1/
145F 81 1460 2E	45	08	2EH ; HEX CODE FOR XXCH A, R64
1460 22 1461 3A	46	DB	3AH ; HEX CODE FOR YOUTL P2. AY TO FORCE NEXT INST. TO BE FETCHED FROM 462H
	47)
	48	END	
USER SYMBOLS			
DUPCOD 145F	EXINTO 011B E	XINT1 10	30C JMP4K 1009 STARTO 000C TMINTO 0145 TMINT1 1020

ASSEMBLY COMPLETE, NO ERRORS

Designers' Notebook

The first instruction to be executed after reset is JMP 09H (at line 10) which actually jumps to 1009H since the A12 is not changed yet. Instruction at 1009 is ANL P2. #00H. which resets A12 to zero. But this zero is not latched inside ROM until after the next single byte single cycle instruction is already fetched (in this case it is NOP). Refer to the instruction timing

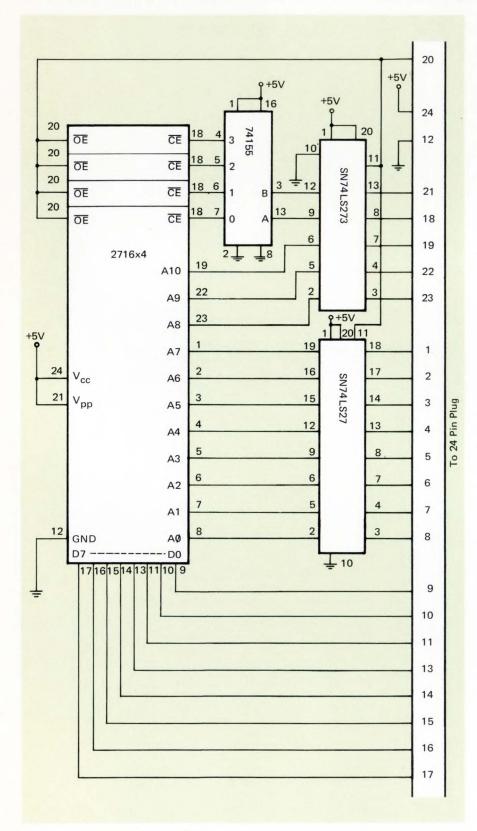


Fig 3 Four 2716s to emulate MK36000.

diagram. Therefore, after executing NOP, the next instruction fetched is from 000CH instead of 100CH. The main program then is started at location 000CH. In place of NOP instruction any other single byte single cycle instruction can be used. If external interupt and timer interupt are enabled then those routines will have to be duplicated at 011BH and 100CH and timer interrupt routine at 0145H and 1020H.

Jump from lower 4K to upper 4K or vice versa can also be achieved by using OUTL P2, A instruction as illustrated in fetching data bytes from anywhere in 8K bytes. R2 contains upper 8 BIT address (only 5 BIT address in this case) and R1 contains lower 8 BIT of the address of data byte to be fetched. R6 contains 00. First higher address is latched on to P2. See line 36 of program sample. Although this is dual cycle instruction, it is executed in first cycle. In the second cycle, address for next instructions is latched in ROM which could be for upper 4K Byte of ROM if BIT 4 in R2 was '1'. (Refer to instruction timing diagram). In that case it is necessary to duplicate following three codes at 145FH, 1460H & 1461H. Hence, after fetching the data byte by executing MOV X A, @ R1 (on line 44) the data Byte is saved and accumulator is cleared (XCH A, R6 at line 45); '00' is then latched on P2 (OUTL P2, A at line 46). After this instruction next instruction is fetched from location 0462H (line 41) and program proceeds as normal. When data Byte to be fetched is from lower 4K Byte of ROM; program follows from line 36 through line 41, which occurs in the same instruction cycle as from upper 4K. Fig 3 shows adapter circuit to emulate MK36000 using four 2716 EPROMs. The 24-pin plug on the cable from the adaptor board goes to 24 pin socket for MK36000 and runs program from the adaptor board. The adaptor circuit is self explanatory and is handy to check production PCB before mask ROM is ready.

Vijay B. Tandon, American District Telegraph Co., One World Trade Center, New York, NY 10048.

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