

Microsystems

Volume 4/Number 6

June 1983

**Plotting
isn't
always
subversive!
Hitch your
micro to a
plotter or
graphics
printer**

Graphics for More Microcomputers

David Freese provides a substantial plotting package of subroutines to drive a graphics printer. Steve Leibson reviews the Hewlett-Packard Graphic Language as a means of communicating with a wide range of plotters. Kalle Gehring and John Moore, of Eastern Michigan University, show how graphics capability can speed data collection and analysis in a chemical laboratory. Joseph Long reviews GrafTalk, a business-oriented package for the production of pie, bar, and line plot graphics.

Hardware Review

Tom Ceska reviews the J.E.S. Super Compuprism graphics board.

System Enhancements

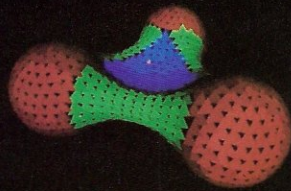
Richard Conn describes ZCPR2, his powerful and flexible replacement for the CP/M command processor. John Potochnak describes a type-ahead buffer that prevents loss of characters during disk I/O. Bradford Thompson shows how to customize your keyboard to generate the codes needed by your word processor.

WordStar and the Heath / Zenith H-19 Terminal

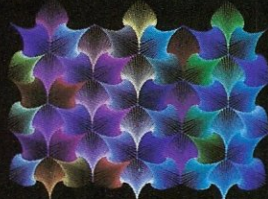
Norman Dresner and Bill Machrone show how to modify WordStar to use all the power of your H-19 keyboard.



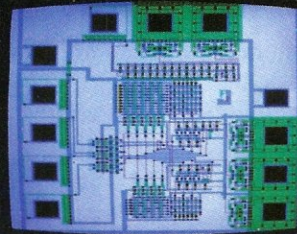
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"Three Atoms" Courtesy of Greg Abram, University of North Carolina at Chapel Hill



"Aurora" By Richard Katz, Vectrix Corporation



"Integrated Circuit Design" Courtesy of Floyd J. James, University of North Carolina at Chapel Hill



"In The Beginning" By Richard Katz, Vectrix Corporation

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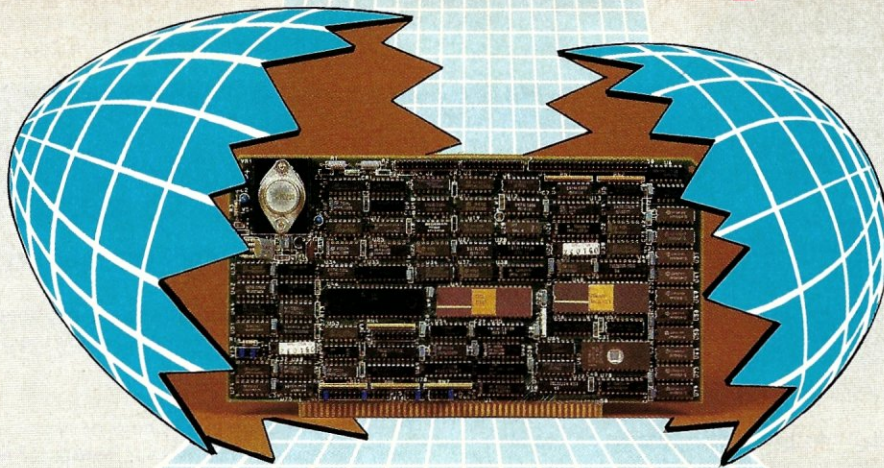
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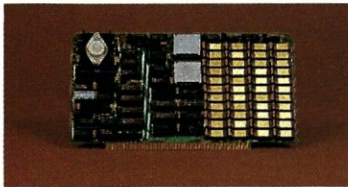
A Third Generation is Born

SBC 300

(Pictured above)

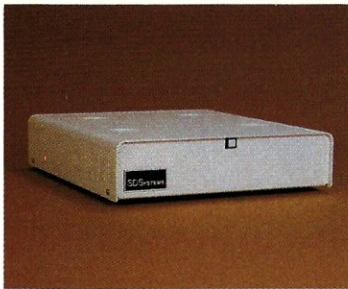
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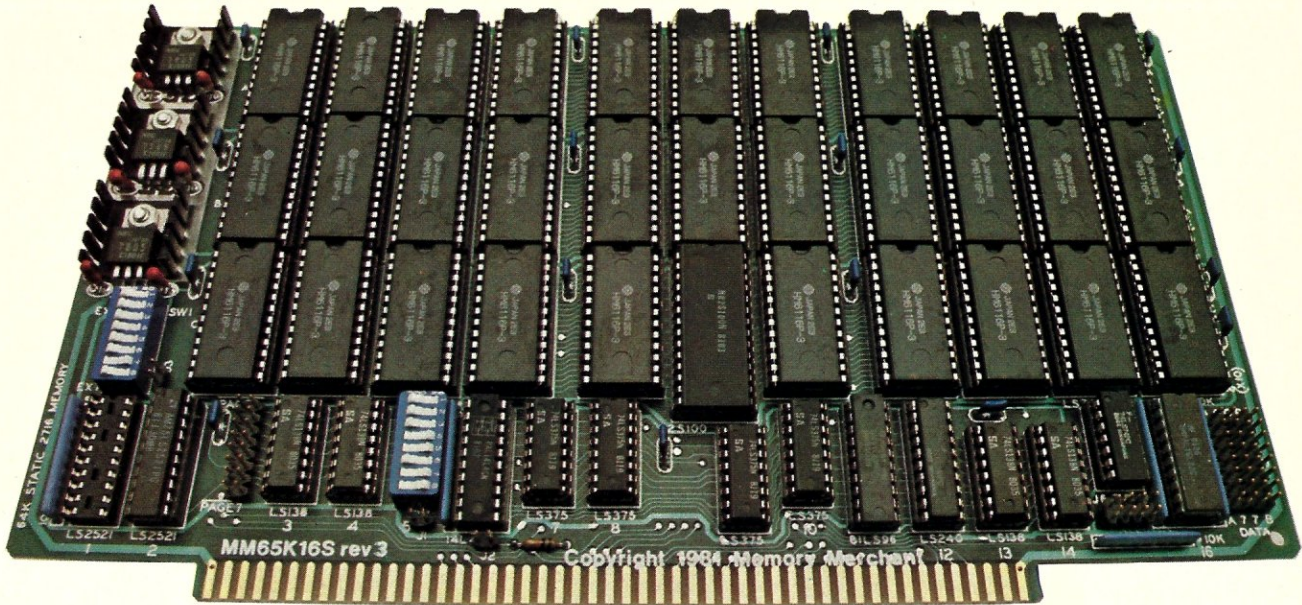
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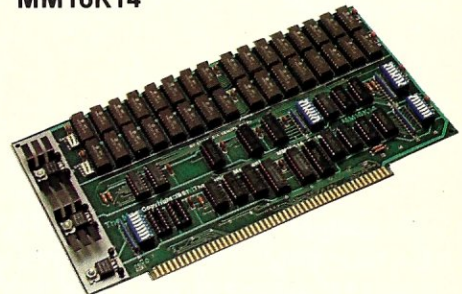
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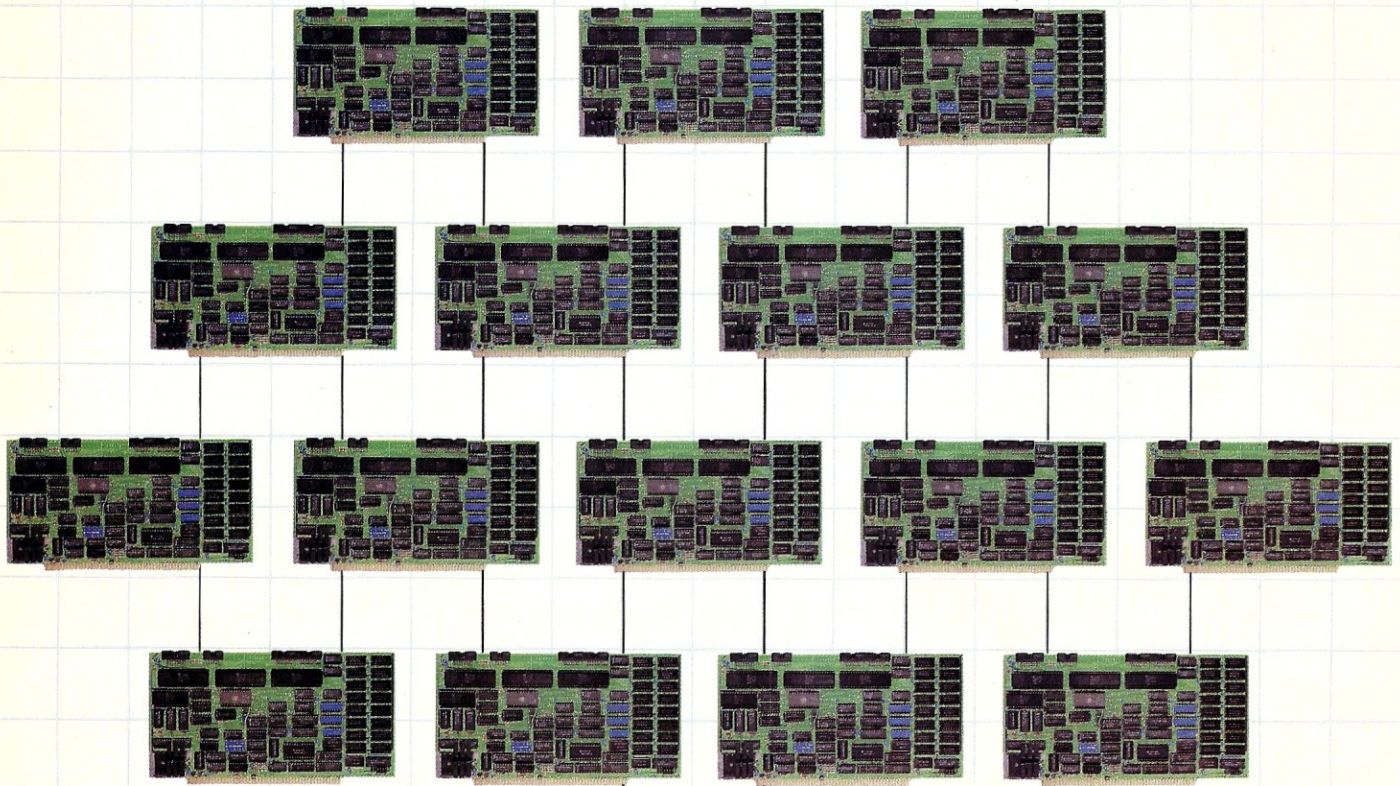
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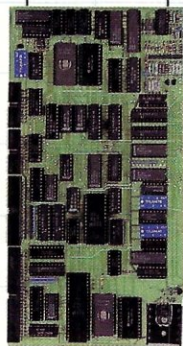
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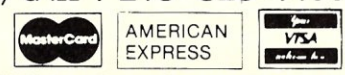
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CIRCLE 4 ON READER SERVICE CARD

Editor's Page

by Sol Libes

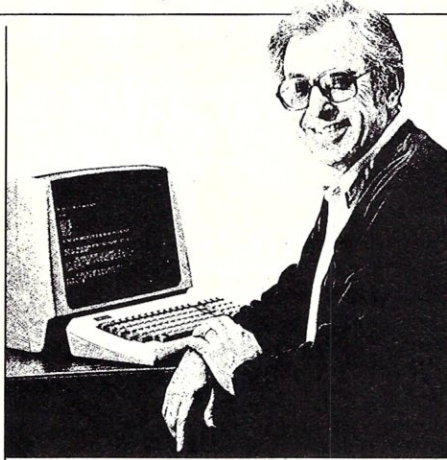
Graphics is becoming of increasing importance in the micro field. The Apple Lisa is the most current example of the trends in the improved graphics interface of micros. The hardware has improved tremendously in recent years, and software to take advantage of this improved hardware is now starting to appear.

Tektronix was the early leader in CRT graphics technology, introducing the storage tube with vectorgraphics type displays in the early 1970s and making computer graphics widely accessible to engineers doing CAD/CAM work. In the mid '70s, Ramtek introduced graphics terminals that used raster scan technology (essentially the same as that used in TVs), significantly increasing the capabilities of CRT graphics while reducing the cost. The raster scan technology was based on using a large memory system to store a memory image of the display in the form of dots, and displaying the dots on the raster scan. Some of the high-resolution graphics required as much as a megabyte of memory. Further, the same color technology used in color TV could be used for CRT graphics.

Color for micros

The next most significant event occurred in the late '70s with the introduction of the Apple computer, which included raster color graphics capability in which the user had access to the screen bit-map in memory. This made it possible to create excellent real-time graphics that extended far beyond the alphanumeric limitations of standard CRT displays for under \$2000. This led to the development of some excellent games and business-oriented graphics.

In the very late '70s, IBM introduced the 3279 color graphics terminal using raster scanning. With the blessing of IBM, business color graphics began to take hold. In 1980, NEC introduced the first personal computer with



a separate microprocessor dedicated to supporting high-density color graphics. This is the current state of the art in CRT graphics developed for personal computers.

Graphics software in the '60s and even up into the mid '70s was a very custom thing, as there was no such thing as a standard interface. Tektronix realized that, to sell their graphics displays, they needed some software to that was user friendly and easy to get at. They created a subroutine library linkable to Fortran called the Plot-10 Software, which in effect became the first standard graphics package. Then a company called ISSCO (Integrated Systems and Software Co., San Diego CA) introduced the first variable bus subroutine library and subsequently introduced the first interactive graphing package, called "Telegraph." These were mainframe products in the \$20-30,000 range.

Soon afterwards, Precision Visuals brought out a package at roughly one-third the price. There are now similar packages for micros (VisiPlot was the first micro-level product in the \$300-400 range. GSS4 from Graphics el product) in the \$300-400 range. GSS4 from Graphics Software Systems is the first subroutine library in the micro world that has minicomputer capabilities. The functionality of the 16-bit micro packages now being introduced is bringing capabilities previously available

only on mainframes to the micro level.

Graphics standards development have moved very slowly. The Calcomp plotter represented, in effect, the first standard graphics device developed in the early '70s. The Tektronix Plot-10 software became the standard for a graphics subroutine library. In the early '70s, the ACM put together a Special Interest Group for graphics, which published a very comprehensive report in 1979. This served as the point of departure for the ANSI committee, which was formed in 1979. Today the X3H3 ANSI committee is diligently working to finish up a graphics standard that was started nearly 10 years ago.

Standardization

There are three significant areas of graphics standardization. First is American National Standards Institute work, which is addressing the source and object code level. Along with the ANSI work is an ISO activity which is moving with a European graphics standard called Graphics Kernel System (GKS), which is moving toward adoption by countries internationally. The third area of standardization is called "Videx." In the U.S., ANSI is working with NAPLPS (North American Presentation Level Protocol Syntax), which is really the Telidon work from Canada with AT&T's endorsement.

Today, when writing an application program using graphics that requires the drawing of lines, solid areas, etc., one can do this through a software interface such as GKS, which provides the function primitives to draw lines, fill areas, create polygons, windows, viewport transformations, etc. These functions are contained in subroutines that form a linkable library.

A universal interface?

The software interface that will be coming to the market soon is termed the "virtual device interface" and contains hardware



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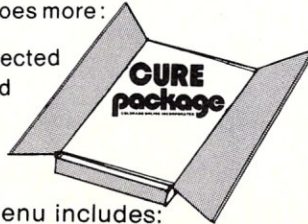
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Editor's Page

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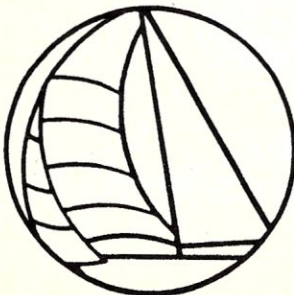
protocols that allow a graphics software package to talk to a specific piece of graphics hardware. This standard is currently being worked on by the ANSI committee. When this standard is finished and adopted, it is expected that manufacturers of graphics devices and IC graphics controllers will conform to the standard simplifying interfacing. Digital Research has already introduced a graphics virtual device interface extension to CP/M, called GSX, that conforms to the proposed ANSI standard. There is no doubt that we will see similar products from other companies. This should create a broader market for applications software packages using graphics. Companies that do not conform to the standard will find that they alone are supporting their graphics interfaces, thereby reducing the amount of software available for their systems.

Microsystems plans to include reviews of these packages in future issues. 

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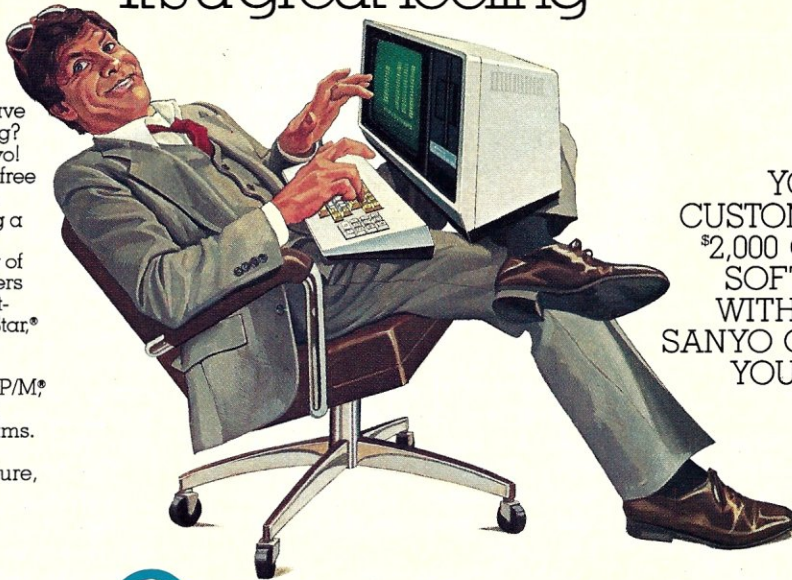
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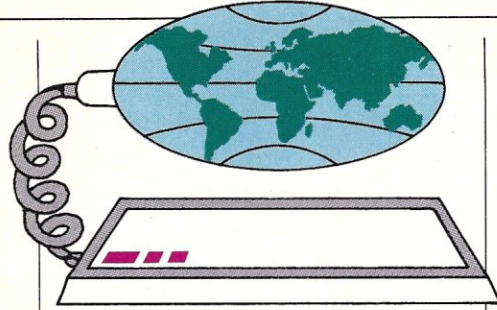
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CIRCLE 77 ON READER SERVICE CARD

News & Views

by Sol Libes



Random rumors

Steve Wozniak, creator of the Apple II, is rumored to be working independently on a project using a new video graphics display technology which will eliminate most of the video support circuitry. . . . Rumors are getting more rampant that American Bell will soon market a micro-computer system using the 32-bit BellMac 32 microprocessor. . . . It looks like the American National Standards Institute (ANSI) standard for microdisks is floundering and there will be no standard adopted this year, leaving the battle to be fought in the marketplace. . . . Data General is promising, at last, to enter the personal computer market later this year with a 32-bit system. . . . And Prime Computer is also expected to enter the personal computer market with a desktop workstation using either the 8086 or 80186. . . . Osborne Computer is expected to introduce two new systems this year (one of which will most likely be out by the time this appears in print). One is expected to be a lower-cost, more compact, and lighter version of the current Osborne One with a larger screen. The second is expected to be a dual processor (Z80/8088) unit with color display, IBM compatibility, and hard disk option. . . . Coleco is also expected to introduce a Z80-based microsystem this summer.

Low-cost CP/M systems hit market

Spectra Video Inc., NY NY, a manufacturer of electronic game units, has announced a Z80-based system with "CP/M compatibility" that carries a list price of \$299.95. Called the SV-318, it is backed by 14 hardware peripheral products and 100 entertainment and software programs. It has 32K of ROM (expandable to 96K, contains Microsoft Basic and word processor), 32K of RAM

(expandable), TV modulator, 71-key ASCII keyboard (with 52 graphics characters), user-definable keys and color capability. There is also a built-in joystick, plug-in cartridge slot, 256 x 192 pixel graphics, and lots more.

And Personal Micro Computers Inc., 475 Ellis St., Mt. View CA, showed their Micro-Mate computer at the recent West Coast Computer Faire with a special show price of \$695. The unit included CP/M Plus (version 3.0) with a bank-switched 128K RAM, a 400K SDDD disk, and Basic, spreadsheet, spelling checker, and utilities programs. Just add a standard terminal and printer for a complete system.

Supermicroprocessors: A status report

National Semiconductor demonstrated their 16032 system recently at a UNIX conference, running a port of UNIX done by Human Comput Resources Corp., of Toronto. Further, they have been accepting orders for the chip set, promising production quantities this summer. They have been shipping sample quantities for several months. Thus we can expect to see initial shipments of 16032-based systems before year-end.

NS is expected to start shipping their "Mesa" system this fall. The Mesa, an 8-user system, is expected to contain the 16082 memory management unit with a 32-bit-wide virtual memory. NS is promising to start sampling its floating point co-processor chip this month.

The 16032 is reported to re-

ally be a 32-bit processor with 16-bit I/O. The 32032, which NC says it will begin sampling in the fourth quarter of this year, is reported to be an upgrade of the 16032 with true 32-bit I/O. Further, NS claims that it will be possible to build a fault-tolerant transaction system by running two 32032s in parallel and comparing results on alternate memory cycles to detect soft errors. NS says the 32032 will be 1.8 times faster than the 16032.

The Motorola 68000 although doing many operations 32-bits at a time has an internal 16-bit-wide data path, and hence the redesign task to move up to a 32-bit version (68020) is a more difficult undertaking for Motorola vis-a-vis National. The 68020 is being promised for April '84 (samples) and August '84 (production). This will be Motorola's true 32-bit micro operating at 16 MHz. It will do 32-bit multiply/divide, use 150,000 transistors, consume 1.5 watts, and have approximately 100 pins.

The Motorola 68881 floating point co-processor production schedule has slipped: Motorola is now promising samples in July '84 and production quantities in December '84. It will contain eight 80-bit registers, have all the addressing modes of 68020, be compatible with the IEEE floating point standard plus some additional functions.

The Motorola 68010, their 16-bit micro with virtual memory facilities, is now being sampled and production is expected this summer. The maximum clock speed will be 16 MHz.

A crimp was thrown into Intel's 286 project and 32-bit upgrade when a large group of engineers up and left their Portland OR operation to form a UNIX systems house based on Intel's technology. However, Intel is already shipping limited production quantities of the 80286.

The NS 16032 will compete



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with the Motorola 68010 while the 32032 will compete with the Motorola 68020. Samples of both the 16032 and 68010 became available at about the same time, with NS promising earlier production quantities. It appears that NS may be sampling and producing the 32032 well ahead of Motorola's 68020. Thus, although National was very late entering the supermicro marketplace, it appears that they now have a good opportunity of garnering enough of it for it to be worthwhile for them.

Tandy finally goes CP/M

The last major CP/M holdout has finally knuckled under . . . Tandy has finally decided to sell CP/M for their new Model 12 system. They have decided to offer the new CP/M Plus (version 3) as an option, as they will include their own TRSDOS with the

unit. However, be forewarned that the CP/M Plus implementation will limit the CP/M TPA (Transient Program Area) to only 48K because of the bank-switching hardware used. Thus, one of the primary advantages of CP/M Plus is immediately lost! On most other CP/M Plus systems, TPAs as large as 62K can be attained.

Competition heats up in the DOS world

Digital Research and SoftTech Microsystems have both dropped the price of the Disk Operating Systems for the IBM-PC. DR's CP/M-86 has been available from IBM for \$250 and SM's p-System was \$600, while PC-DOS (Microsoft's MS-DOS with minor changes) was offered for only \$40. Reportedly, only about 3% of the PCs have been sold with CP/M-86 and less than 1% with the p-System. IBM also

held up supplying these packages so that PC-DOS had the field to itself for several months, giving it another advantage over its competition.

DR therefore decided to take marketing matters into its own hands and market an improved version of CP/M-86 for the PC themselves; they are making it available for only \$60. SM and IBM announced that they will make the p-System available for \$50 for the runtime system.

Microsoft has also released version 2 of MS-DOS, which IBM is now furnishing with the new upgraded version of the PC called the PC-XT. Microsoft claims that version 2 has features to make it an upgrade path to their XENIX multiuser system. Further, they have already disclosed that the next version of MS-DOS will provide an even closer link to XENIX. Considering that IBM is continuing to give strong backing to PC-DOS, does this

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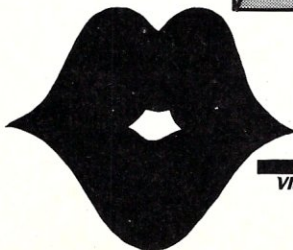
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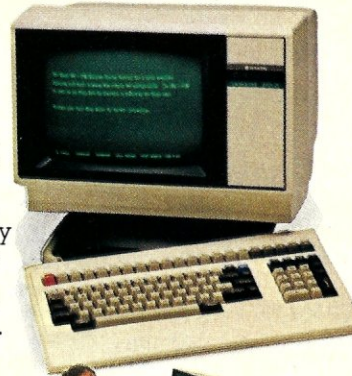
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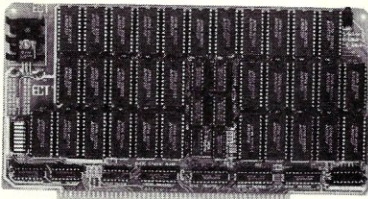
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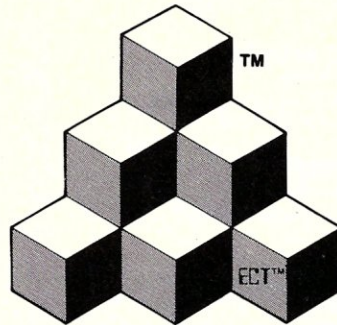


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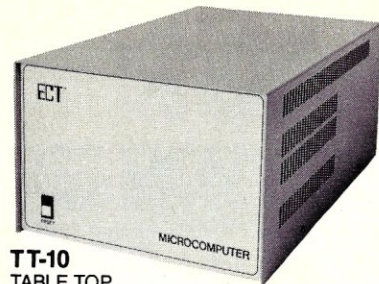


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mean that they are also planning to introduce a XENIX system? Of course IBM could drop always introduce their own implementation of PC-DOS and sever their connection with Microsoft.

Where is the iAPX432?

It is over two years now since Intel introduced their iAPX432 32-bit microprocessor chip set; as yet no commercial product has been introduced using it.

Many of the pioneering users who started product development projects using the 432 have since cancelled the projects or put them on hold due to performance limitations that have shown up with the 432. First of all, Intel was a year late in delivering samples, and then some users claimed that the samples delivered operated at only 20% of their rated speed.

Further, the unique architec-

ture of the 432 meant that companies were starting from ground zero in software development, and software development tools and support chips have been slow in becoming available. The complex architecture also means that software development is more complex and expensive, and few companies have been willing to make the investment.

Intel is currently starting production on the third revision of the 432 chip set, which they hope will finally meet their original performance claims. Also, the bus interface and memory control ICs are expected to finally become available, and it is expected that we will soon see 432-based systems being introduced.

UNIX update

The implementation of UNIX on 68000-based micros appears to be split evenly between two different implementations: Xenix from Microsoft, Bellevue WA, and UniPlus+ from Unisoft, Berkeley CA. There are a few vendors who have done their own 68000 ports, but it is likely that they will switch to either Xenix or UniPlus+ to achieve some level of compatibility and a wider market base, since there already is some software available for these systems. UniPlus+ was the first port to reach the market and implements the Berkeley version of UNIX, which accounts for its popularity. Xenix, on the other hand, is an implementation of the Bell Labs version of UNIX and comes from one of the largest micro software houses in operation today (namely Microsoft).

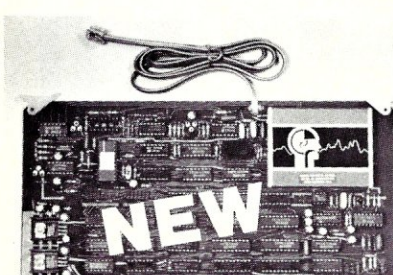
The 8086 and Z8000-based micros appear to be going with Xenix. The only other alternative here is Coherent from Mark Williams Co., Chicago, and they have not been aggressive in getting their product out.

National Semiconductor has already demonstrated their UNIX implementation and one done by Human Computing Resources, Toronto Canada.



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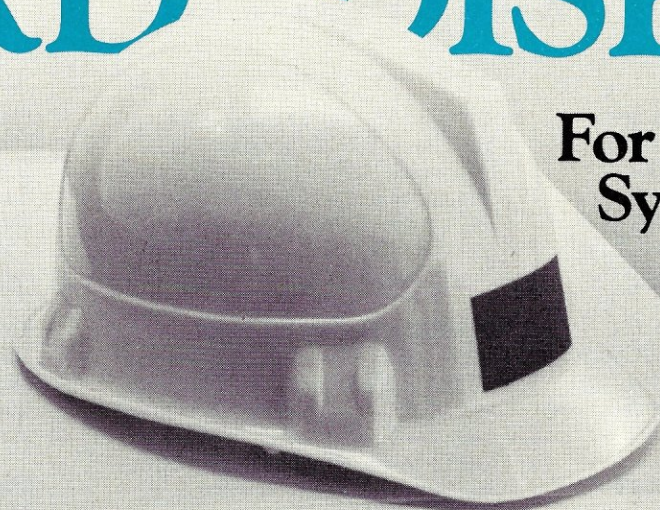


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The initial results do not indicate that this implementation is any faster than the 68000, 8086 and Z8000 implementations, despite the claim by National Semiconductor that this micro has been specifically designed to support UNIX. The initial demonstrations of the product, however, are still considered prototypes, and tuning should improve its performance.

Intel introduces text co-processor chip

Intel has announced an IC (82730) to operate in conjunction with its 8086 16-bit micro that provides word-processing display functions such as proportional character spacing, smooth scroll, display of superscripts and subscripts, variable fonts, and allows users to define their own character sets and provide complete correspondence between display and printed copy. The unit can also

be used in conjunction with Intel's new 82720 graphics co-processor, allowing mixing of text and graphics on the screen. IC samples are now being supplied to OEMs, and production is expected this fall.

Random news bits

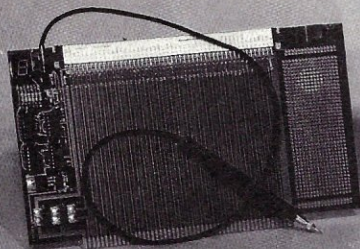
The IEEE 796 Bus (Multibus) Standard has been adopted by the IEEE and is now an official standard. Also, the IEEE expects to shortly adopt the Binary Floating Point Arithmetic (IEEE 754) and Assembly Language Mnemonics (IEEE 694) standards For those into country and western music, check out the record entitled "Basic Ain't the Language of Love." It tells the story of a woman involved with a personal computer addict Toshiba has announced a floppy disk system in development that packs 3MB on a 3.5" floppy Zilog has announced

that they will shortly introduce the Z80H, an 8MHz version of the Z80 Hidisk, San Diego CA, has announced that they now have available CP/M for the Digital Equipment LSI-11. They call it the Z-11 Do you know which is the largest number of CP/M-based systems in current use? I bet you'll never guess. Look below to see if you are right.

News bit answer

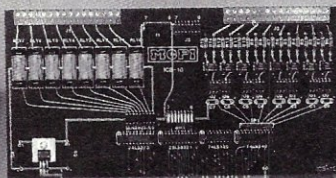
The largest number of systems running CP/M are the Apple II computers. Microsoft alone has equipped one third of them with their Z80 softcard running CP/M. Add to that Z80 cards from two other suppliers, and I estimate that about 40% of the Apple IIs in current use are running CP/M. Since Apple has already shipped over 800,000 Apple IIs, that means that there are about 400,000 Apple II CP/M-based systems!

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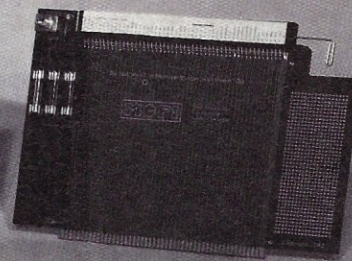
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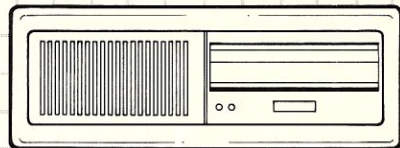
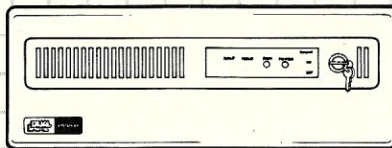
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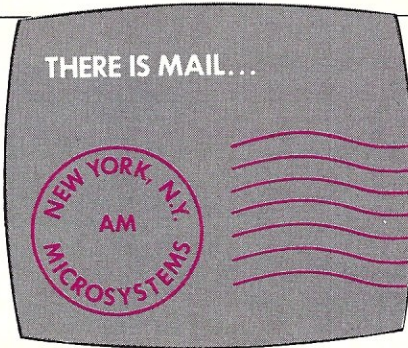
CIRCLE 35 ON READER SERVICE CARD

Letters to the Editor

Dear Editor,

I strongly disagree with the experience F.B. Laughlin reported on his interactions with the people at Lexisoft, Inc. who produce Spellbinder. I have had my S-100 based system since 1979 and Spellbinder word processing software since then (it was first known as Autospell). In that time, I have written several journal articles, collaborated on two plays, two chapters in books, and a test manual. All of this was done using my word processing software.

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Ronald E. Olson, Ph.D.
Univ. of Illinois at Chicago
Office of the Dean
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Post Office Box 6998
Chicago, Illinois 60680

Dear Editor,

Computerists who are still using disk controllers based on the Western Digital FD1771 chip can increase the CP/M

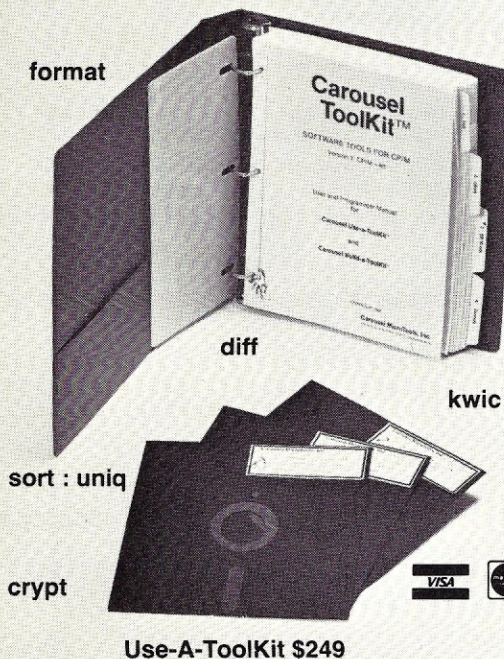
file capacity of their 8-inch single-density single-sided disks from 241K to 354K by formatting each of the non-system tracks (track 2 through track 76) into two 2432-byte sectors. The deblocking algorithm provided by Digital Research must be changed in order to handle these sectors, whose length is equivalent to 19 128-byte logical sectors; as listed in Appendix G of the "CP/M System Alteration Guide,"

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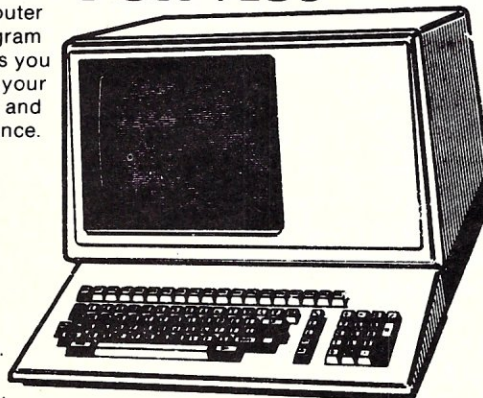
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Letters to the Editor continued . . .

formation and disk-controller command details, refer to the Western Digital data sheets on the FD1771 (March, 1977) and the Track Format Manual published by Shugart Associates (July, 1976).

What prompts me to write this letter is the article entitled "Triple-Density Floppy Disk Storage" that appears in the February 1983 issue of *Microsystems*. Boards such as the Tarbell single-density controller, the Versafloppy I, the Cromemco 4FDC, and the Digital Research of Texas Big Board are not nearly as obsolete as they might seem at first glance. The fact of the matter is that not only can no existing double-density disk controller yield three times the capacity of a standard formatted single-density disk, but no existing double-density disk controller can yield even twice the capacity of a single-density disk that has been optimally formatted for use with the FD1771.

Robert Lurie
8 Tingley Road
Morristown, NJ 07960

Dear Editor,

My copy of *Microsystems* often arrives in rather shabby condition, with pages bent or torn. Out of all the magazines I receive by mail, I must say that yours comes in the worst condition of the lot. I don't mean to imply that I've *never* received others in the same condition, but that this was/is rare (rather remarkable considering the Post Office!). I must also say that the magazines are not beyond use, by any means, but I haven't been called a perfectionist for nothing! At any rate, I thought it something you should know about.

Thomas C. Smith
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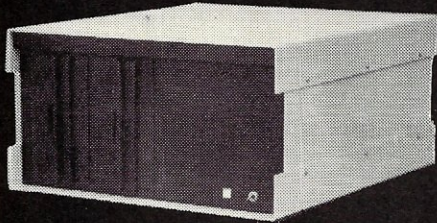
—Editor



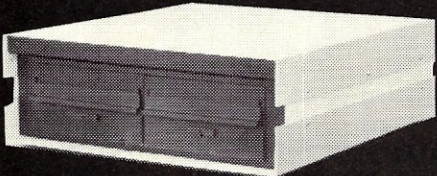
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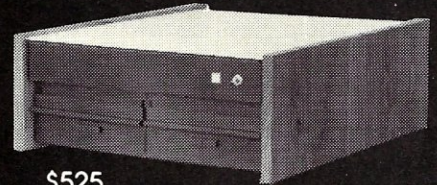
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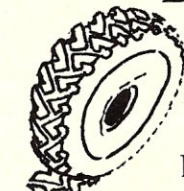


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CIRCLE 266 ON READER SERVICE CARD

The CP/M Bus

Relocating modules and their use in overlaying programs, segmented programs, overlay management, and system extensions

by Anthony Skjellum

This month's CP/M Bus column is a discussion of program overlays. Included in the discussion is the use of relocatable modules to create such overlays. Also discussed are programs which are segmented because of their size. We have previously mentioned another type of relocatable program. This is the type of program which relocates itself under CP/M's BDOS (Basic Disk Operating System) for the purpose of extending the environment for other software. These system extensions will be discussed further in this installment.

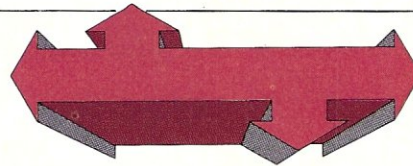
The initial discussion on relocatable code was given in the February 1983 column. Readers are encouraged to refer to this previous column before proceeding. System extensions were also introduced there.

Page relocatable code

For the purposes of the following discussion, all relocatable code will be of the page relocatable variety. As mentioned previously, such code is capable of relocation at page boundaries (XX00 hexadecimal) via a simple relocating subroutine. For 8086/88 code, no such relocation step is needed, but the concepts which follow will still be of interest.

Programs and overlays

A program overlay is a segment of code stored on disk that is conditionally brought in for execution, depending on the needs of the main program. Overlays can be used to permit large programs to run in segments or prevent programs with many diverse functions from requiring unduly large amounts of memory. We will distinguish between programs which execute segments in a sequential fashion from those which call up overlays as needed. Each will be discussed in turn.



Segmented programs

As mentioned above, a segmented program is one that is divided into several parts. The parts are executed serially. At the completion of a segment, the next one is loaded and replaces its predecessor in memory. Shared variables are provided through memory locations selected by the programmer, and some segments may share larger amounts of information via temporary files.

The mechanism of segmentation is quite straightforward. The initial .COM file includes both the first segment and a segment loader module. When a segment completes its task, it relinquishes control to the segment loader. The loader then loads the next segment into the area previously occupied by the

former segment. Finally, the loader gives control to the new segment. The final segment does not call the loader, but instead returns control to CP/M via a warm boot request.

A familiar program that operates in a segmented fashion is the BDS C compiler. The two phases of compilation (parsing and code generation) are divided between the CC1 and CC2 programs respectively. If CC1 is executed in the default mode, it loads CC2 after it has completed. However, CC2 is not loaded by CC1 if CC1 discovers a fatal error in the source file under compilation. Furthermore, CC1 passes all information to CC2 via memory when the compiler runs in the segmented mode. Only when the programs are executed separately is a temporary file created by CC1. (This turns out to be undesirable, since optimization ('-o') cannot be performed when the compile steps are executed separately.)

Programs with overlays

A program that uses overlays will have to be modular so that its functions may be conveniently divided into overlays. Conceivably, programs could be constructed which use more than one overlay simultaneously. Then such overlays would have to be page relocated after loading for execution at the address chosen by the program. Consequently, such overlays would have to be relocatable object modules.

It is also conceivable that overlays would refer to other overlays. This could open the way for primary, secondary, and possibly tertiary overlays. For example, the main program itself could request primary overlays. These primary overlays would in turn request secondary overlays. (A typical primary overlay would be a CRT

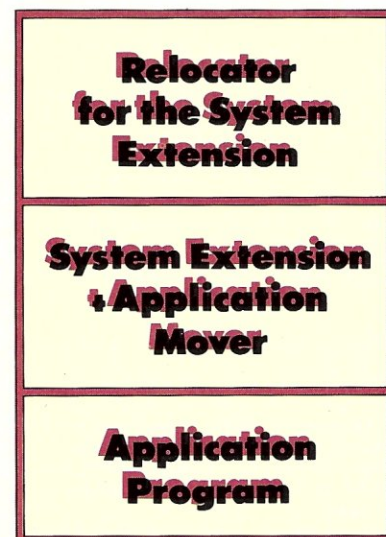


Figure 1. System extensions can be made to load transparently with the application program by arranging them in a special binary module.

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management package, while a typical secondary overlay routine could be the low-level CRT routines for a specific terminal.) Each overlay would contain a list of the overlays which it in turn references. These overlays would be loaded at once so that the overlay which requested them may function immediately.

In order to house the overlays used by a program, an overlay file would be needed. An overlay file would consist of a list of overlays and their sector addresses (and lengths) within the file. Such a directory would be referenced for the purpose of finding overlays. A copy could be optionally kept resident in memory to minimize the access time for acquiring a given overlay.

Overlays will consist not only of executable subprograms. Many programs will find it useful to provide on-line information via text overlays. Such

overlays would be stored in their own text overlay file with a directory of sector addresses and lengths (the same way as for code overlays). Reference to a given overlay would be through that directory.

Once overlays are loaded and used in a program's execution, a method for efficient deletion of these overlays must be available. A least-recently-used (LRU) technique could be applied to such overlays. Such a technique would need to be carefully constructed and would require that the calling subroutines work through a counting procedure so that a running usage count on each overlay could be maintained. Such a system is likely to be complicated and not necessary in most applications. However, it will be universally advisable to delegate all overlay handling to a central overlay manager. Centralization of the overlaying process would increase efficien-

cy and permit portability of the overlay manager to other programs.

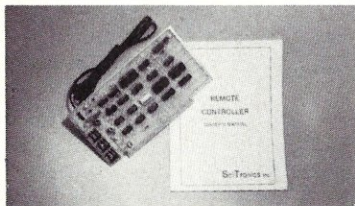
The overlay manager would provide a command structure for handling overlays. Specific requests for overlay deletion would also be supported. This would allow explicit removal of overlays once they are no longer needed. This could almost completely remove the need for an LRU system for overlay deletion if used properly by the programmer.

A well-known software system that uses overlays is the WordStar text processor. The menu-driven commands used by WordStar are particularly suited to overlays. Furthermore, Word Star uses text overlays to provide users with on-line help and other information about the editor's operation.

In the above paragraphs, we have outlined the possibilities for using overlays in certain types of programs. Now we

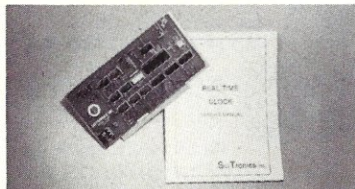
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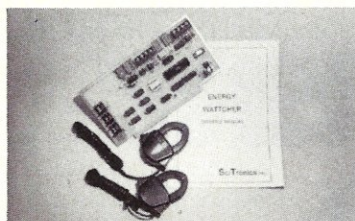
REMOTE CONTROLLER—Innovative Features:

- * Complete 256 address control—not just 16
- * No ultrasonic link—prevents erratic operation
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- * Hardware driven—requires minimal software
- * Complete line of industrial switches available—to 5.5KW



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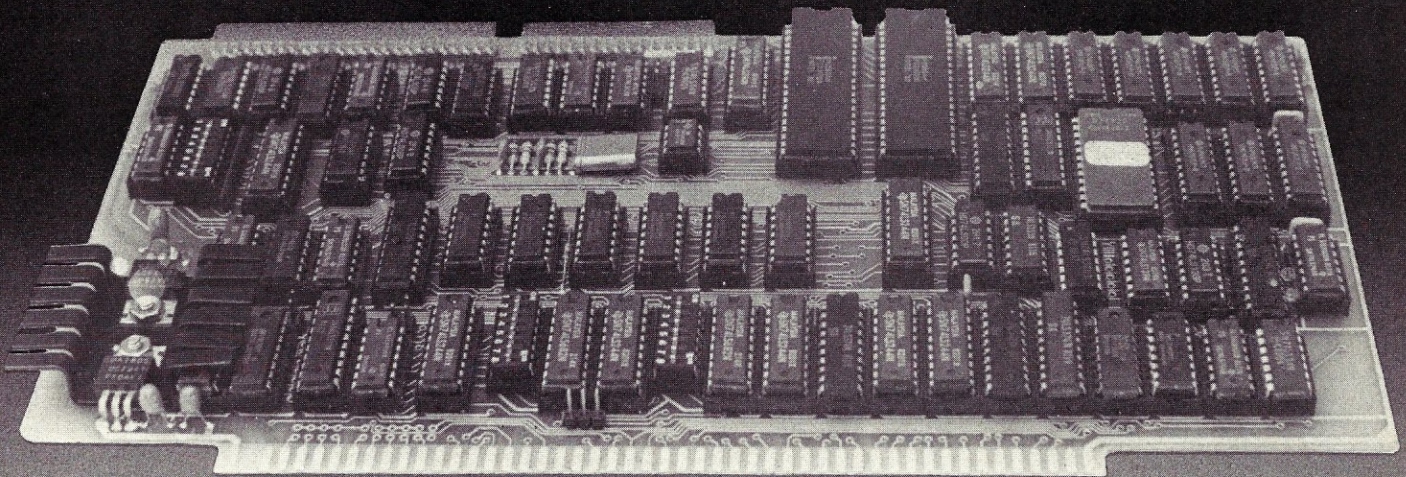


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- * Single and 3 phase operation

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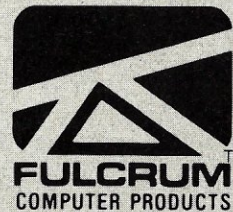
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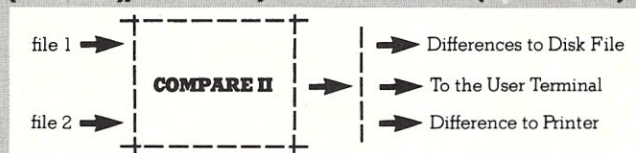
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CIRCLE 15 ON READER SERVICE CARD

CP/M Bus continued . . .

turn to a discussion of system extensions.

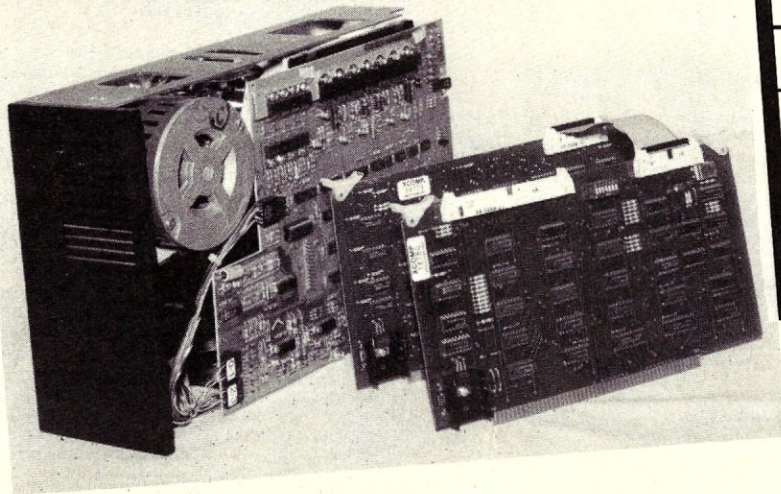
System extensions

A system extension is a program that relocates itself beneath BDOS, intercepts BIOS and BDOS CALLs and extends the capabilities of the operating system by interpreting these calls in new or more general ways. The method for implanting system extensions was mentioned previously. System extensions could also be made accessible to application software through a RST calling mechanism.

System extensions can simplify and enhance the CP/M environment for specific tasks. For example, a graphics manager could be brought in below CP/M for the benefit of a Basic interpreter in which graphics are to be created via PRINT commands. Instead of modifying the BIOS to handle the specific application (which is undesirable), a system extension is provided to do so. Many such extensions are possible, and several could co-exist at once. Furthermore, system extensions need not be loaded explicitly by the operator, but can be made to load transparently with the application program. This is done by arranging a special binary module (see Figure 1 on page 24).

The relocater gets control from CP/M, installs the system extension and then gives control to the application mover. The application mover (really part of the system extension) moves the application program down to the start of the transient program area (TPA) and then relinquishes control to the application program. The application program executes as if run as a normal transient program.

The above concept can be generalized to relocate several system extensions for a given application program. The overhead for several relocations would be at most a few seconds. This time is not significant compared to the length of time a typical application program is used during a single execution. □



10 MEGABYTE S-100 PACKAGE \$1295⁰⁰

"THE WINCHESTER DEAL OF THE YEAR"

If your data storage needs have outgrown your floppy-based S-100 system, Jade now gives you the opportunity to add a fast, reliable hard disk package to your system at a bargain price.

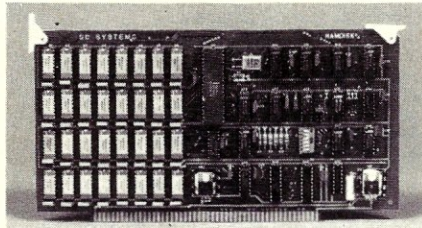
If purchased separately, the components of this package would cost you well over \$3000.00; our special purchase now allows us to give you a special price of only \$1295.00 CALL NOW... These units will not be on the shelf for long at this price!

- Shugart SA1004 8-inch 10MB Winchester
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- Cables and Manuals Included
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For Cabinet & Power Supply Please Add \$200.00

MSH-991000 w/SD Boot Prom - \$1295.00
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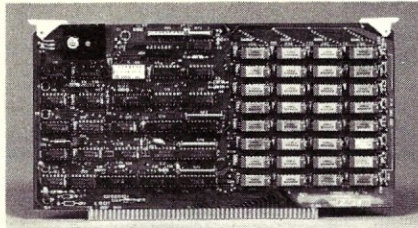


RAM DISC

The RAM Disc from SD Systems is a "solid-state disk drive" for IEEE696/S-100 systems. It allows programs to execute from high speed RAM, circumventing the mechanical problems and speed limitations of floppy disk drives. RAM Disc increases system performance substantially in disk intensive applications. 256K storage per board. "Install" programs available for CP/M & MP/M
MEM-66256A RAM DISK \$799.95

ROM DISC

SD Systems ROM Disc is a 128K EPROM/ROM board which is similar in concept to the RAM Disc. Like the RAM Disc it allows execution of software at high speed directly from memory, without the use of disk drives. The ROM Disc is non volatile memory ideally suited for use with the new CP/M Plus, now available in EPROM
MEM-12850A ROM DISC Board \$295.00
CP/M Plus On EPROM:
SFC-55009059E Unbanked RS232 \$400.00
SFC-55009057E Banked RS232 \$400.00



EXPANDORAM III

SD Systems new ExpandoRAM III is a high density S-100 memory board utilizing the new 64K x 1 dynamic RAM chips. It allows memory sizes of 64K, 128K or 256K all on a single S-100 board. The ExpandoRAM III marks a new generation of highly reliable and versatile dynamic RAM boards suitable for expanding current S-100 systems, or for use in new multi-user systems.
MEM-65064A 64K \$495.00
MEM-65128A 128K \$595.00
MEM-65192A 192K \$675.00
MEM-65256A 256K \$755.00

VERSAFLOPPY II

SD Systems' Versafloppy II is a reliable field-proven S-100 double-density floppy disk controller. For full software compatibility it can also read and write standard IBM 3740 single density format. The Versafloppy II controls single or double sided drives in single or double density format, 5 1/4" or 8" in any combination and up to 4 drives simultaneously. The Versafloppy II is faster, more stable and more tolerant of bit shift and "jitter" than most other controllers. All control and diagnostic firmware is included
IOD-1160A Versafloppy II \$359.95

SBC 200

SD Systems' SBC-200 is an S-100 bus compatible single board computer based on the 4MHz Z80A CPU. It contains a synchronous/asynchronous serial port with software programmable baud rates, a parallel I/O port, a four channel counter timer and 1K on-board RAM. Up to 8K of firmware may be added to the board's 4 EPROM sockets. The SBC 200 is the ideal heart of a system composed of the other boards in the SD product line, or can stand alone in process control applications.
CPC-30200A SBC-200 \$399.95

CP/M 3.0 PLUS

SD Systems' implementation of Digital Research's CP/M 3.0 Plus is a unique combination of hardware and software that optimizes the powerful new features of CP/M Plus. CP/M Plus requires 192K of memory for optimum performance, making it an ideal match for the 256K ExpandoRAM III
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S-100 DISK CONTROLLERS

DOUBLE D - Jade

High reliability double density disk controller with on-board Z-80A, auxiliary printer port, IEEE S-100 can function in multi-user interrupt driven bus.

IOD-1200B Bare board & hdwr man	\$59.95
IOD-1200K Kit w/hdwr & sftwr man	\$299.95
IOD-1200A A & T w/hdwr & sftwr man	\$325.95
SFC-59002001F CP/M 2.2 with Double D	\$99.95

DISK 1 - CompuPro

8" or 5 1/4" DMA disk controller, single or double density, single or double sided, 10MHz.

IOD-1810A A & T	\$449.95
IOD-1810C CSC	\$554.95

2422 DISK CONTROLLER - C.C.S.

5 1/4" or 8" double density disk controller with on-board boot loader ROM. FREE CP/M 2.2 and manual set.

IOD-1300A A & T with CP/M 2.2	\$399.95
-------------------------------	----------

WINCHESTER Disk Controller Monitor Dynamics

This S-100 hard disk controller board was designed to interface most 5 1/4" and 8" Winchester disks to your S-100 system. The controller will support either one or two drives, and with the INSTALL program provided, its easy to add an existing floppy-based system

IOD-5000A Controller	\$489.95
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Must Be Ordered With One Of

The Following Data Separator Boards:

IOD-5050A 5 1/4" Data Separator	\$75.00
IOD-5080A 8" Data Separator	\$75.00

See 1983 Jade Catalog For Further Information
Concerning This Board

LETTER QUALITY PRINTERS

LETTER QUALITY PRINTER - COMREX

Uses standard daisy wheels and ribbon cartridges, 16 CPS bi-directional printing, semi-automatic paper loader (single sheet or fan fold), 10/12/15 pitch, up to 16" paper, built-in noise suppression cover.

PRD-11001 Centronics parallel	\$899.95
PRD-11002 RS-232C serial model	\$969.95
PRA-11000 Tractor Option	\$119.95

380Z by Data Terminals & Communications

Based on the same quality mechanism as the Comrex printer the 380Z contains electronic enhancements that allow it to print at speeds up to 32 CPS. Other features include a 48K buffer, proportional spacing, and Diablo 1640/1650/630 compatible protocol. Comes with printwheel, ribbon and users manual. Serial, parallel, and IEEE 488 interfaces standard.

PRD-11300 380Z printer	\$1295.00
PRA-11000 Tractor option	\$169.95
PRA-12000 Cut Sheet Feeder	\$699.95

Printers From Jade

OKIDATA 82 10" 120 CPS	CALL
OKIDATA 92 10" 160 CPS With Graphics	CALL
OKIDATA 93 15" 160 CPS With Graphics	CALL
OKIDATA 83 15" 120 CPS	CALL
OKIDATA 84 15" 200 CPS With Graphics	CALL
OKIDATA 2350 15" 350 CPS	CALL
OKIDATA 2410 15" 350 CPS	CALL
DAISYWRITER 2000 48K Daisywheel	\$1395.00
GEMINI 10 100 CPS with Graphics	\$349.95
GEMINI 15 15" with Graphics	\$499.95

S-100 I/O BOARDS

I/O-4 - SSM Microcomputer

2 serial I/O ports plus 2 parallel I/O ports.

IOI-1010B Bare board w/manual	\$35.95
IOI-1010K Kit with Manual	\$179.95
IOI-1010A A & T	\$249.95

I/O-5 - SSM Microcomputer

Two serial & 3 parallel ports, 110-19.2K Baud

IOI-1015A A & T	\$289.95
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INTERFACER 4 - CompuPro

3 serial, 1 parallel, 1 Centronics parallel.

IOI-1840A A & T	\$314.95
IOI-1830C CSC	\$414.95

INTERFACER 2 - CompuPro

3 parallel, 1 serial and interrupt timer.

IOI-1820A Interfacer 2, A & T	\$289.95
IOI-1820C Interfacer 2, CSC	\$359.00

200-hour burn-in, 2 year limited warranty, special order.

INTERFACER 3 - CompuPro

5 or 8 channel serial I/O board for interrupt driven multi-user systems up to 250K baud.

IOI-1830A Interfacer 3/5 A & T	\$558.00
IOI-1831A Interfacer 3/8 A & T	\$628.00
IOI-1830C Interfacer 3/5 CSC	\$628.00
IOI-1831C Interfacer 3/8 CSC	\$748.00

MPX-1 - CompuPro

Multi-user I/O multiplexer and interrupt controller with on-board 8085A-2 CPU and 4K or 16K of RAM.

IOI-1880A MPX-1, 16K RAM, A & T	\$584.00
IOI-1880C MPX-1, 16K RAM, CSC	\$674.00

S-100 EPROM BOARDS

PB-1 - SSM Microcomputer

2708, 2716 EPROM board with on-board programmer.

MEM-99510K Kit with manual	\$154.95
MEM-99510A A & T with manual	\$219.95

PROM-100 - SD Systems

2708, 2716, 2732 EPROM programmer with software.

MEM-99520K Kit with software	\$189.95
MEM-99520A A & T with software	\$249.95

32K PROM/RAM BOARD

The 32K S-100 PROM/RAM board can hold up to 16 each 2716 style EPROMs, 6116 style RAMs, or 8 each style EPROMs. This board was designed to fit into holder S-100 systems as well as the newer IEEE-696 machines. Uses 5 volt only EPROM/RAMs, allows operation as a 2K to 32K board, meets IEEE-696 S-100 proposed standard, addressable as two 16K blocks on any 64K page, supports Cromemco as well as Northstar bank select, perfect for MP/M systems.

MEM-99153B Bare board & manual	\$49.95
MEM-99153K Kit with No RAM	\$89.95
MEM-99153A A & T with No RAM	\$139.95
MEM-16153K Kit with 16K RAM	\$129.95
MEM-16153A A & T with 16K RAM	\$179.95
MEM-32153K Kit with 32K RAM	\$179.95
MEM-32153A A & T with 32K RAM	\$229.95

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DUAL DISK SUB-SYSTEMS

Disk Sub-Systems - Jade

Handsome metal cabinet with proportionally balanced air flow system, rugged dual drive power supply, power cable kit, power switch, line cord, fuse holder, cooling fan, never-mar rubber feet, all necessary hardware to mount 2-8" disk drives, power supply, and fan, does not include signal cable.

Dual 8" Sub-Assembly Cabinet

END-000420 Bare cabinet	\$49.95
END-000421 Cabinet kit	\$199.95
END-000431 A & T	\$249.95

8" Sub-Systems - Single Sided, Double Density

END-000423 Kit w/2 Siemens FD100-8Ds	\$650.00
END-000424 A & T w/2 Siemens FD100-8Ds	\$695.00
END-000433 Kit w/2 Shugart SA-801Rs	\$999.95
END-000434 A & T w/2 Shugart SA-801Rs	\$1195.00

8" Sub-Systems - Double-Sided Double-Density

END-000426 Kit w/2 Qume DT-8s	\$1224.95
END-000427 A & T w/2 Qume D-8s	\$1424.95
END-000436 Kit w/2 Shugart SA-851Rs	\$1274.95
END-000437 A & T w/2 Shugart SA-851Rs	\$1474.95

8" SLIMLINE SUB-SYSTEMS

Dual Slimline Sub-systems - Jade

Handsome vertical cabinet with scratch resistant baked enamel finish, proportionally balanced air flow system, quiet cooling fan, rugged dual drive power supply, power cables, power switch, line cord, fuse holder, cooling fan, all necessary hardware to mount 2-8" slimline disk drives, does not include signal cable.

Dual 8" Slimline Cabinet

END-000820 Bare cabinet	\$59.95
END-000822 A & T w/o drives	\$179.95

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END-000824 A & T w/2 SS DD	\$949.95
END-000833 Kit w/2 DS DD	\$1149.95
END-000834 A & T w/2 DS DD	\$1179.95

S-100 CPU BOARDS

THE BIG Z - Jade

2 or 4 MHz switachable Z-80 CPU board with serial I/O, accommodates 2708, 2716, or 2732 EPROM, baud rates from 75 to 9600.

CPU 30201B Bare board w/manual	\$35.00
CPU-30201K Kit with Manual	\$149.95
CPU-30201A A & T with Manual	\$199.95

2810 Z-80 CPU - C.C.S.

2 or 4 MHz Z-80 CPU with serial I/O port & on board monitor PROM, front panel compatible.

CPU-30400A A & T with PROM	\$289.95
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CPU-Z CompuPro

2 or 4 MHz Z80A CPU, 24 bit addressing.

CPU-30500A 2/4 MHz A & T	\$279.95
CPU-30500C 3/6 MHz CSC	\$374.95

8085/8088 - CompuPro

Both 8 & 16 bit CPUs, standard 8 bit S-100 bus, up to 8 MHz, accesses 16 Megabytes of memory.

CPU-20510A 6 MHz A & T	\$398.95
CPU-20510C 6/8 MHz CSC	\$497.95

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MSM-551002 \$294.95 ea 2 for \$269.95 ea

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MSM-660551 \$299.95 ea 2 for \$239.95

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END-000216 Single cab w/power supply \$69.95
END-000226 Dual cab w/power supply \$94.95

S-100 MOTHERBOARDS

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Silent, simple and on sale - a better motherboard.

6 Slot (5 1/4" x 8 5/8")

MBS-061B Bare board \$22.95
MBS-061K Kit \$39.95
MBS-061A A & T \$69.95

12 Slot (9 1/4" x 8 5/8")

MBS-121B Bare board \$34.95
MBS-121K Kit \$69.95
MBS-121A A & T \$109.95

18 Slot (14 1/2" x 8 5/8")

MBS-181B Bare board \$54.95
MBS-181K Kit \$99.95
MBS-181A A & T \$149.95

8" DISK DRIVES

Siemens FDD 100-8 Single-sided double-density
MSF-201120 \$274.95 ea 2 for \$249.95 ea

Shugart SA801R Single-sided double-density
MSF-10801R \$394.95 ea 2 for \$389.95 ea

Shugart SA851R Double-sided double-density
MSF-10851R \$554.95 ea 2 for \$529.95 ea

Qume DT-8 Double-sided double-density
MSF-750080 \$554.95 ea 2 for \$529.95

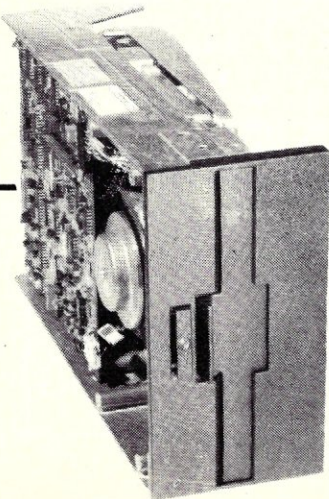
Tandon TM848-1 Single-sided double-den thin-line
MSF-558481 \$379.95 ea 2 for \$369.95 ea

Tandon TM848-2 Double-sided double-den thin-line
MSF-558482 \$494.95 ea 2 for \$484.95

HALF-HEIGHT 8 INCH - NEC

The FD1165 is a double sided, double-density 8-inch floppy disk drive which uses a high speed steel-band head positioning mechanism and a direct drive D.C. spindle motor. One of the most reliable 8-inch drives available.

MSF-851164 FD1164 single sided \$389.95
MSF-851165 FD1165 double sided \$475.00



MODEMS

SMART BUY in MODEMS - Signalman

1200 and/or 300 baud, direct connect, automatic answer or originate selection, auto-answer/auto-dial on deluxe models. 9v battery allows total portability, full one year warranty.

IOM-5600A 300 baud direct connect \$89.95
IOM-5610A 300 baud Deluxe \$149.95
IOM-5620A 1200/300 baud Deluxe \$369.95
IOM-5650A 300 baud for Osborne \$119.95
IOM-5630A 300 baud card for IBM \$269.95

SMARTMODEM - Hayes

Sophisticated direct-connect auto-answer/auto-dial modem, touch-tone or pulse dialing. RS-232C interface, programmable.

IOM-5500A Smartmodem 1200 \$574.95
IOM-5400A Smartmodem 300 \$224.95
IOM-1500A Hayes Chronograph \$218.95
IOM-1100A Micromodem 100 \$368.95
IOM-2010A Micromodem II w/term prgm \$329.95
IOM-2012A Terminal program for MMII \$89.95

1200 BAUD SMART CAT - Novation

103/212 Smart Cat & 103 Smart Cat, 1200 & 300 baud, built-in dialer, auto re-dial if busy, auto answer/disconnect, direct connect, LED readout displays mode, analog/digital loop-back self tests, usable with multi-line phones.

IOM-5241A 300 baud 103 Smart Cat \$229.95
IOM-5251A 1200 baud 212/103 Smart Cat \$549.95

J-CAT™ MODEM - Novation

1/5 the size of ordinary modems, Bell 103, manual or auto-answer, automatic answer/originate, direct connect, built-in self-test, two LEDs and audio beeps provide status information.

IOM-5261A Novation \$149.95

NEW! CP/M PLUS 3.0

CP/M 3.0 is Digital Research's latest version of the industry standard disk operating system. It features many performance improvements, such as intelligent record buffering, improved directory handling, "HELP" facility, time date stamping of files and many more improvements. AND A TREMENDOUS INCREASE IN SPEED!!! It is fully CP/M 2.2 compatible and requires no changes to your existing application software. Available only to Versal floppy II owners with SBC-200 CPU's

SFC-55009059F Unbanked, RS232 \$250.00
SFC-55009058F Unbanked, VDB8024 \$250.00
SFC-55009057F Banked, RS232 \$250.00
SFC-55009056F Banked, VDB8024 \$250.00
SFC-55009057D Manual \$50.00

CPU 8086/87 - CompuPro

CPU 8086/87, based around Intel's highest performance 8086 sixteen bit processor, also includes sockets for their 8087 math co-processor, and 80130 Operating System Firmware component.

CPU-70520A CPU 8086/87 A & T \$699.00
CPU-70520C CPU 8086/87 \$764.00

S-100 MAIN FRAMES AND DISK CABINETS ON SALE

S-100 MEMORY BOARDS

64K STATIC RAM - Jade

Uses new 2K x 8 static RAMs, fully supports IEEE 696 24 bit extended addressing, 200ns RAMs, lower 32K or entire board phantomable, 2716 EPROMs may be subbed for RAMs, any 2K segment of upper 8K may be disabled, low power typically less than 500ma.

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CIRCLE 16 ON READER SERVICE CARD

A General-Purpose Graphic Plotting Package

A plotting interface—written for Basic, Pascal/Z, and JRT Pascal to drive a BASE2/IDS-560 printer—that can be easily modified for other printers and other languages

by David H. Freese, Jr.

There are many excellent dot matrix graphic printers that are underused simply because there is inadequate software available to extend high-level languages with plot functions. Those of us who first learned programming on a mainframe computer (with Fortran and directly callable PLOT functions) may yearn for those good old days when we need graphic output now. Well, yearn no longer—contained herein is all you need to provide yourself with a substantial plotting package.

Functions provided

The subroutines contained in this group of assembly-level programs provide the interface between a Basic, Pascal/Z, or JRT Pascal program and the BASE2/IDS-560 graphics printers. These subroutines are designed to be called from Basic, using function calls similar to those found in Fortran, and from Pascal using external procedures. The functions provided include:

- a. pixel plotting
- b. data point plotting
- c. line plotting
- d. circle plotting
- e. axis plotting
- f. initialization of plot map, and
- g. transfer of plot map to the printer

The assembly code is designed to execute under CP/M. Conditional assembly is provided to allow these subroutines to operate under various conditions. These include Pascal/Basic linkage, BASE2/IDS560 printer drivers, and relocation for the CDR Systems, Heath/Zenith, and Lifeboat Associates versions of CP/M. The routines can be easily modified for different operating systems by redefining the equates associated with the memory allocation. These routines have been successfully transferred to a TRS-80 Model I.

Linkage to other languages

While these subroutines are shown with linkage to Basic and Pascal, it is quite easy to extend them to other high-level languages. The entrance code for each subroutine and the passing of parameters from the high-level language is specified in the listings. It

David H. Freese, Jr., Clermont Computer Consultants, R.D. 1—Box 316, Cape May Court House, NJ 08210

is only necessary to rewrite these to provide the recognition of multiple parameters from the language in question. For example, the subroutines could have been written to use the CALL function in Microsoft's MBasic. This would also have been compatible with Microsoft's Fortran compiler. However, those who still use OBasic would then be unable to use the subroutines without considerable rewriting. (Microsoft sometimes refers to their earlier version (4.5) of Basic as OBasic, as opposed to the current version (5.4) which they refer to as MBasic.)

It is easy to provide the interface to printers other than the BASE2 or the IDS560. The subroutine that transfers the plot image to the printer will have to be modified to reflect the specific requirements of your printer.

Background

The BASE2 and IDS-560 graphic printers can be operated in an alphanumeric mode or a graphic mode. In either mode the printer can be configured to print in several horizontal and vertical densities. Horizontal densities are specified in characters/line (or dots/line), and vertical densities are specified in half-dots/inch. For a complete description of the BASE2 or IDS-560, refer to the respective manuals.

The selection of 14 half-dots/inch vertical density for the BASE2 printer will guarantee a uniform distribution of dots in the vertical direction without overlap or interline spaces. The selection of 96 characters/line (or 576 dots/line) guarantees the same dot density in the horizontal direction. The graphic routines are based on this selection of horizontal and vertical dot densities.

The vertical and horizontal density is fixed at 84 dots/inch in the IDS560, and no special setup codes are needed to insure proper graphics output.

When operating in the graphics mode, the printer accepts data in the form of ASCII characters, each of which represent seven vertical dots. Each successive character contains the next horizontal position of seven vertical dots. Each dot is printed or skipped, depending on the value of its corresponding bit in the ASCII character. The uppermost dot is specified by bit 0, and the lowermost dot by bit 6. Bit 7 is not used by the printer and can be either 1 or 0. The BASE2 prints the line of graphics when all 576 ASCII characters have been received. Printing commences when the ETX DC4 sequence is received by the IDS-560. The printer remains busy until that line has been printed, and will then accept another line of characters. For example, the following sequence would print the equivalent of the letter K:


```

1 0 0 1
1 0 1 0
1 1 0 0
1 0 1 0
1 0 0 1
0 0 0 0
0 0 0 0
| | | |
| | | --- char(n+3): &H11, or &H91
| | ----- char(n+2): &H0A, or &H8A
| ----- char(n+1): &H04, or &H84
----- char(n+0): &H1F, or &H9F

```

The BASE2 graphics printer is not an x - y plotter, since a reverse line feed cannot be implemented on this machine. The IDS-560 does have the capability to reverse line feed and/or to move the print head to an absolute vertical and horizontal position on the paper. Graphics output would be slow using absolute print head movement.

Two methods of creating the graphics image are available:

- a. compute the status of each bit as it is printed, or
- b. create an image of the entire plot area and transfer it to the printer when it is complete.

Method (a) minimizes the memory requirements, but requires that any equation being plotted be evaluated for each and every dot in the plot space. For a plot 300 x 300 pixels in area, this means 90,000 evaluations of an equation, possibly using floating point arithmetic and transcendental functions. The result is an extremely slow plotting routine.

Method (b) minimizes the plotting time, but requires a significant amount of memory to store the image. A plot area 300 x 300 will require 11,250 bytes, an area 400 x 400 will require 20,000 bytes. Reducing the area results in both a smaller printed plot and reduction in the resolution of the plot. It is necessary to find a compromise that has sufficient resolution/size and a moderate memory requirement.

The second method has been selected for this application. The subroutines have been written in a manner that will allow a change in the desired plot area by a change in one variable—the number of lines/plot. A selection of 43 lines/plot results in a plot area 301 x 301 and occupies 11,438 bytes of memory, while a selection of 59 lines/plot results in a plot area 413 x 413 and occupies 21,476 bytes of memory. The choice of a plot area of 413 x 413 will be approximately 5" per side on the IDS-560.

Passing parameters from the high-level language

With the exception of the initialization and transfer functions, the plot functions all require multiple integer parameters to be passed by the high-level language. A language such as Pascal or Fortran maintains multiple parameter lists on a stack. Whether the stack contains the actual value or a pointer to the storage location of the parameter is a function both of the function Declaration and the specific compiler/interpreter implementation. In order to maintain compatibility with as many versions of Basic as possible, the USR function will be used to gain access to the plot functions. The older versions of Basic allow only a single parameter to be passed via the USR function call. It will be necessary to subvert this limitation by using additional Basic functions normally used during random disk input/output.

Linkage to Pascal/Z

Parameters are passed by Pascal/Z on the stack. The stack is organized in the following way for integer/byte values:

```

p1 (2 bytes): integer,
p2 (2 bytes): integer,
.
.
pi (1 byte): byte/boolean,
.
.
pn (1/2 bytes)
return address ; stack pointer

```

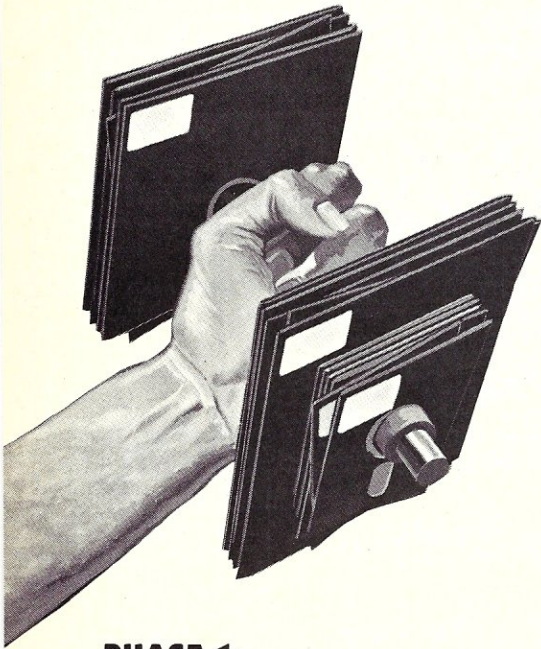
The Pascal program must declare the plotting subroutines to be external and designate the proper number of passed parameters. Each subroutine removes its allocated parameters and restores the return address to the stack. No check is made for improper procedure calls.

Linkage to JRT Pascal

JRT Pascal uses two stacks, one to pass parameters and one to contain global variables. Both functions are needed to support the graphics plotting package. JRT Pascal treats the disk as an extension of memory. When an external procedure or function is declared, it is handled as follows: During the compile process, a list of external procedures is made a part of the program intermediate file. During execution, the interpreter loads the required external procedure the first time it is invoked. That procedure may then either remain in memory or be purged, depending on the dynamic memory requirements of the program. In this manner the disk is treated as an extension of memory. Each procedure in the plotting package could have been separately assembled and linked, but

To create the graphics image, we may either compute the status of each bit as it is printed (slow), or create an image of the entire plot area by using a method that minimizes plotting time but requires a significant amount of memory.

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For more information about MicroShell, see the following reviews:
Christopher Kern, BYTE, December, 1982
Alan R. Miller, Interface Age, July, 1982
David Fiedler, Microsystems, January, 1983

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CIRCLE 19 ON READER SERVICE CARD

Graphic Plotting Package continued . . .

I chose to keep the entire package in a single external file. This decision forces the external plotting procedures to be entered with a fixed parameter list.

JRT Pascal places data in the parameter stack in the following manner:

value parameters: present on the stack,

```
integer: 2 bytes
boolean: 2 bytes
char: 1 byte
set: 16 bytes
```

reference parameters: address of the variable
address: 2 bytes

The external plotting procedure is declared in the following manner:

```
procedure JPLOT(cmd: char; p1,p2,p3,p4,p5,p6,p7: integer); extern;
```

The data stack after the procedure call JPLOT will be:

The data stack after the procedure call JPLOT will be

```
xx      (DE) -> current stack address
0F00    16 bit integer = length of stack = 15
p7L,p7H 16 bit integer = p7
p6L,p6H 16 bit integer = p6
p5L,p5H 16 bit integer = p5
p4L,p4H 16 bit integer = p4
p3L,p3H 16 bit integer = p3
p2L,p2H 16 bit integer = p2
p1L,p1H 16 bit integer = p1
'X'     8 bit ASCII character
        a,A,p,P,l,L,d,D,c,C,i,I,t,T
.
.
.
image   (HL + 6) -> address of first global variable
```

Linkage to a Basic program

Parameters are passed in an ordered list, which is contained in a string variable passed by Basic. Each of the parameters in the string is created by the use of MKIS(a) and concatenated to the next parameter. The following Basic calling procedure is recommended:

```
100 DEF USR1=&HXXXX
110 DEF FNPL0T(X1,Y1,X2,Y2)=
      LEN(USR1(MKIS(X1)+MKIS(Y1)+MKIS(X2)+MKIS(Y2)))
.
.
.
1000 ZZ=FNPL0T(A,B,C,D) ' execute the funtion
```

(Note: The use of the LEN() function prevents Basic from assigning an additional string variable to string space. This reduces string clutter and subsequent time loss when Basic collects garbage and reallocates string space.)

Description of subroutines

Axis is a subroutine that plots the x,y axis pair and tick marks at required locations. A grid consisting of single points spaced at the major tick marks is optional. The calling routine is set up as follows:

When called by Basic:

```
DEF USRK = &Hkkkk
DEF FNAXIS(X0,Y0,XA,YA,XB,YB,GRID) =
      LEN(USRK(MKIS(X0) + MKIS(Y0) + MKIS(XA)
      + MKIS(YA) + MKIS(XB) + MKIS(YB) + MKIS(GRID)))
ZZ=FNAXIS(0,0,5,5,10,10,1) : ' execute Axis
```

```
*****
;
; GENERAL PURPOSE GRAPHICS PRINTER PLOTTING PACKAGE
;
; Plotting Subroutines/Procedures
; compatible with the following high level languages:
;
; . BASIC,
; . PASCAL/Z,
; . and JRT PASCAL
;
; which support the following printers
;
; . BASE-2
; . IDS-560
;
; 10 February 1983
;
; Ver: 2.2
;
; Courtesy: Clermont Computer Consultants
;            RD 1 Box 316
;            Cape May Court House, NJ 08210
;            (609) 263 7511
;
; *****
;
; .Z80
;
; EQUATES FOR ALL SUBROUTINES
;
; TRUE EQU 1
; FALSE EQU 0
;
; LIFEFT EQU FALSE
; ZENITH EQU FALSE
; CDR EQU TRUE
;
; BASE2 EQU FALSE
; IDS560 EQU TRUE
;
; BASIC EQU FALSE
; PAS.Z EQU FALSE
; PAS.J EQU TRUE
;
; IF LIFEFT
; EQU 4200H
; ENDIF
;
; IF NOT LIFEFT
; EQU 0000H
; ENDIF
;
; BDOS EQU BASE+5
;
; =====
; Change LINES equate to produce a plot area of a given size
;
; LINES = int(#dots/7) + 1
;
; LINES EQU 59 ; produces 413 x 413 image
;
; =====
```


Graphic Plotting Package continued . . .

Seven parameters are passed:

X0, Y0: intersection of axis
 XA, YA: minor tick interval
 XB, YB: major tick interval
 GRID: 0 suppress grid marks
 1 plot grid marks at major tick intervals

When called by Pascal/Z:

Declaration:

```
procedure axis(x0,y0,xa,ya,xb,yb: integer grid: boolean); external;
```

Invoking:

```
axis(0,0,2,2,10,10,true);
```

When called by JRT Pascal:

Declaration:

```
procedure jplot(cmd:char;p1,p2,p3,p4,p5,p6,p7:integer); extern;
```

Invoking:

```
jplot('a',0,0,2,2,10,10,1);
```

Line is a subroutine that plots a line between the pair of ordered points (x1,y1) to (x2,y2). The calling routine is set up as follows:

When called by Basic:

```
DEF USRi = &Hiiii
DEF FNLN(x1,y1,x2,y2) = LEN(USRi(MKIS(x1) + MKIS(y1) +
                          MKIS(x2) + MKIS(y2)))
ZZ=FNLN(5,10,100,110) : ' execute Line
```

When called by Pascal/Z:

Declaration:

```
procedure line(x1,y1,x2,y2: integer); external;
```

Invoking:

```
line(5,10,100,110);
```

When called by JRT Pascal:

Declaration:

```
procedure jplot(cmd:char; p1,p2,p3,p4,p5,p6,p7: integer); extern;
```

Invoking:

```
jplot('L',5,10,100,110,0,0,0);
```

Point is a subroutine that plots a square centered at the point x,y. The calling routine is set up as follows:

When called by Basic:

```
DEF USRn=&Hnnnn
DEF FNPOINT(X,Y)=LEN(USRn(MKIS(X)+MKIS(Y))
ZZ=FNPOINT(50,100) : ' execute Point
```

When called by Pascal/Z:

Declaration:

```
procedure point(x,y: integer); external;
```

Invoking:

```
point(50,100);
```

When called by JRT Pascal:

Declaration:

```
procedure jplot(cmd:char; p1,p2,p3,p4,p5,p6,p7: integer); extern;
```

Invoking:

```
jplot('d',50,100,0,0,0,0,0);
```

```
;
; DOTS          ; number of vertical dots in plot
; NLINES       ; number of lines in image area
; LENGTH       ; number of horizontal dots in plot
;
; IF
;   BASE2
;   (576-LENGTH)/2 ; fill for left margin
;   EQU          576-LENGTH-FILL1; 576 dots per line in 96 char/line mode
;   ENDIF
;
; IF
;   IDS560
;   EQU         126          ; 1.5 inch left margin
;   ENDIF
;
; AREA         NLINES*LENGTH ; number of bytes for plot area
;
; IF
;   LIFEFT
;   EQU        ODF00H        ; lower bound of CP/M (48K ORG 4200H)
;   ENDIF
;
; IF
;   NOT LIFEFT
;   EQU        ODC00H        ; lower bound of ORG 0 versions
;   ENDIF
;
; IF
;   BASIC
;   EQU        TMEM-AREA-06EAH ; leave room for prog + plot area
;   EQU        (BOTTOM AND 0FF00H) ; and start at next lowest page boundary
;   ENDIF
;
; IF2
;   IF
;     .PRINTX/ PASCAL-Z version/
;     ENDIF
;   IF
;     .PRINTX/ JRT PASCAL version/
;     ENDIF
;   IF
;     BASIC
;     .PRINTX/ BASIC version/
;     ENDIF
;   IF
;     BASE2
;     .PRINTX/ For BASE-2 printer/
;     ENDIF
;   IF
;     IDS560
;     .PRINTX/ For IDS-560 printer/
;     ENDIF
;   ENDIF
;
; IF
;   BASIC
;   *****
;   Subroutine to link the parameters passed from BASIC
;
; DTLNK:
;
;
```


Graphic Plotting Package continued . . .

Plot is a subroutine that sets the pixel specified by *x,y*. The calling routine is set up as follows:

When called by Basic:

```
DEF FNUSRi=&Hiili
DEF FNPLOT(X,Y)=LEN(USRi(MKIS(X) + MKIS(Y)))
ZZ=FNPLOT(2,5) : ' execute Plot
```

When called by Pascal/Z:

Declaration:

```
procedure plot(x,y: integer); external;
```

Invoking:

```
plot(2,5);
```

When called by JRT Pascal:

Declaration:

```
procedure jplot(cmd: char; p1,p2,p3,p4,p5,p6,p7: integer); extern;
```

Invoking:

```
jplot('p',2,5,0,0,0,0,0);
```

Init is a subroutine which clears the plot memory.

Callable from Basic by:

```
DEF USRq=&Hqqqqq
DEF FNCLRPLT = USRi
ZZ=FNCLRPLT ' execute clear plot
```

When called by Pascal/Z:

Declaration:

```
procedure init; external;
```

Invoking:

```
init;
```

When called by JRT Pascal:

Declaration:

```
procedure jplot(cmd: char; p1,p2,p3,p4,p5,p6,p7: integer); extern;
```

Invoking:

```
jplot('i',0,0,0,0,0,0,0);
```

XFR is a subroutine that transfers the plot memory to the line printer.

Callable from Basic by:

```
DEF USRm=&Hmmm
DEF FNXFR = USRi
ZZ=FNXFR 'execute transfer
```

When called by Pascal/Z:

Declaration:

```
procedure xfrplt; external;
```

Invoking:

```
xfrplt;
```

When called by JRT Pascal:

Declaration:

```
procedure jplot(cmd: char; p1,p2,p3,p4,p5,p6,p7: integer); extern;
```

Invoking:

```
jplot('t',0,0,0,0,0,0,0);
```

Circle is a subroutine that plots a circle of radius *r*, centered at location *x,y*. The calling routine is:

When called by Basic:

```
DEF USRk = &Hkkkk
DEF FNCIRCLE(X,Y,R) = LEN(USRk(MKIS(X) + MKIS(Y) + MKIS(R)))
.
.
ZZ=FNCIRCLE(25,25,10)
```

```
LD A,(DE) ; fetch # bytes
SLA B ; 2*(# parameters)
CP JR NZ,STERR ; are they =?
INC DE,HL ; no, an error in BASIC
EX E,(HL) ; point to string address
LD HL ;
INC D,(HL) ; HL points to first byte in string
EX DE,HL ;
LD DE,P1 ; transfer 2*(# param's) bytes of data
LD A,(HL),A
LD HL
INC HL
INC DE
DUNZ
RET

;
;
; ***** PAS.J *****
; ***** PARAMETER LINKAGE ROUTINE FOR JRT PASCAL *****
;
; All calls to plot functions must be via this parameter linkage
; routine. JRT PASCAL expects each external .INT file to contain
; a single unique function or procedure. All of the plot procedures
; must be treated as a single entity with one entry parameter acting
; as a pointer to the desired sub-procedure.
;
; JPLLOT:
; entry code
;
; DEFB 95,06,00 ; int vmcode
; DEFB 92 ; lpn vmcode
; DEFB 00 ; mode vmcode
;
; hl = base
; de = current
; bc = tos
;
; BC,6
; HL,BC ; HL = IMAGE address
; (IMGPTR),HL ; store for later use
;
; EX DE,HL
; DEC HL
; DEC HL ; point to length
; LD A,(HL) ; get length
; CP 0FH ; see if correct
; JP NZ,JERR ; bad procedure call
; LD D,(HL) ; do each parameter in reverse order
; DEC HL
; LD E,(HL)
; LD (P7),DE ; DE = parameter 7
; DEC HL
; D,(HL)
; DEC HL
; E,(HL)
; LD (P6),DE ; DE = parameter 6
; LD HL
; LD D,(HL)
; DEC HL
; LD E,(HL)
; LD (P5),DE ; DE = parameter 5
; LD HL
; LD D,(HL)
; DEC HL
```


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The Translators provide Z-8000 source code from Intel 8080 or Zilog Z-80 source code. This source code expansion is from 2% to 11%. The Translator outputs a worksheet and a Z-8000 source file. The worksheets show each line of 8080/Z-80 code, with notes to help the programmer to optimize performance, and further lower code expansion. It even comments lines it adds! The Z-8000 source code used by these packages are the unique 2500AD syntax using Zilog mnemonics, designed to make the transition from Z-80 code writing to Z-8000 easy.

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```

POP     DE
INC     DE                ; DE = second address of IMAGE
LD      BC,AREA-1
LD      (HL),0           ; set all bytes to 00
LDIR
;
;
IF      PAS.Z
XOR     A                ; flag valid subroutine call
ENDIF
;
RET
;
;*****
;
; Plot Subroutine:
;
PLOT:   IF      PAS.Z    ; USR entry point
;
ENTRY   PLOT
POP     BC              ; fetch return address
POP     HL              ; fetch y: integer
LD      (P2),HL
POP     HL              ; fetch x: integer
LD      (P1),HL
PUSH   BC              ; restore return address
ENDIF
;
IF      BASIC
;
LD      B,2            ; transfer data from string buffer
CALL   DTLNK          ; and test/limit to boundaries
ENDIF
;
LD      HL,(P1)
CALL   TEST
BIT    7,B            ; if out-of-bounds
JP     NZ,SETRET     ; do not plot point
LD      (STARTX+2),HL
LD      HL,(P2)
CALL   YTEST
BIT    7,B            ; if out-of-bounds
JP     NZ,SETRET     ; do not plot point
LD      (STARTY+2),HL
JP     SET1
;
SET0:   LD      HL,(STARTX+2) ; entry point for subr call
CALL   TEST          ; when point may be outside boundaries
BIT    7,B            ; if out-of-bounds
RET    NZ            ; do not plot point
LD      (STARTX+2),HL
LD      HL,(STARTY+2)
CALL   TEST          ; if out-of-bounds
BIT    7,B            ; do not plot point
RET    NZ
LD      (STARTY+2),HL
;
SET1:   LD      B,0      ; entry point for subr call
LD      HL,(STARTY+2)  ; when point is within boundaries
;
; Determine address and bit number of pixel
;
; ADDR = LENGTH*(INT(Y/8) + X
; BIT  = 2^(8 - (Y MOD 8))
;
LD      DE,8
OR      A
DIV8:   SBC     HL,DE

```

```

JR      C,DONDIV
INC     B
JR      DIV8
DONDIV: ADD     HL,DE
LD      C,L
INC     B
LD      DE,LENGTH
LD      HL,(IMGPTR)
OR      A                ; clear carry
SBC     HL,DE            ; HL = IMAGE - LENGTH
SMULT:  ADD     HL,DE
DJNZ   SMULT
LD      DE,(STARTX+2)
ADD     HL,DE            ; HL = ADDR
LD      B,C
INC     B
LD      DE,TABLE-1
FINDT:  INC     DE
DJNZ   FINDT
LD      A,(DE)          ; A has proper bit set
OR      (HL)
LD      (HL),A
;
SETRET: IF      PAS.Z
;
XOR     A                ; flag valid subroutine call
ENDIF
;
RET
;
TABLE:  DEFB    80H      ; bit position table
        DEFB    40H
        DEFB    20H
        DEFB    10H
        DEFB    08H
        DEFB    04H
        DEFB    02H
        DEFB    01H
;
;*****
;
; Point Subroutine:
;
POINT:  IF      PAS.Z    ; CALL entry point
;
ENTRY   POINT
POP     BC              ; fetch return address
POP     HL              ; fetch y: integer
LD      (P2),HL
POP     HL              ; fetch x: integer
LD      (P1),HL
PUSH   BC              ; restore return address
ENDIF
;
IF      BASIC
;
LD      B,2
CALL   DTLNK
ENDIF
;
LD      HL,(P1)
CALL   TEST
LD      (P1),HL
LD      HL,(P2)
CALL   YTEST
LD      (P2),HL
LD      HL,(P1)

```



```

DEC HL
LD (STARTX+2),HL
LD HL,(P2)
DEC HL
LD (STARTX+2),HL
CALL SET0
LD HL,(P1)
LD (STARTX+2),HL
CALL SET0
LD HL,(P1)
INC HL
LD (STARTX+2),HL
CALL SET0
LD HL,(P2)
LD (STARTX+2),HL
CALL SET0
LD HL,(P2)
INC HL
LD (STARTX+2),HL
CALL SET0
LD HL,(P1)
LD (STARTX+2),HL
CALL SET0
LD HL,(P1)
DEC HL
LD (STARTX+2),HL
CALL SET0
LD HL,(P2)
LD (STARTX+2),HL
CALL SET0
;
IF PAS.Z
;
XOR A ; flag valid subroutine call
ENDIF
;
RET
;
;*****
;
; Line Subroutine:
;
LINE:
IF PAS.Z ; CALL entry point
;
ENTRY LINE
POP EC ; fetch return address
POP HL ; fetch y2: integer
LD (P4),HL
POP HL ; fetch x2: integer
LD (P3),HL
POP HL ; fetch y1: integer
LD (P2),HL
POP HL ; fetch x1: integer
LD (P1),HL
PUSH BC ; restore return address
ENDIF
;
IF BASIC
LD B,4 ; 4 parameters in the CALL list
CALL DTLNK ; fetch the values P1, P2, P3, P4
ENDIF
;
LD HL,(P1) ; test for boundary conditions & transfer
CALL TEST ; to working storage
LD (STARTX+2),HL ; X1 <-- P1
LD HL,(P2)

```

```

CALL YTEST
LD (STARTY+2),HL ; Y1 <-- P2
LD HL,(P3)
CALL TEST
LD (ENDX+2),HL ; X2 <-- P3
LD HL,(P4)
CALL YTEST
LD (ENDY+2),HL ; Y2 <-- P4
LD HL,(ENDX+2) ; test for ENDX = STARTX
LD BC,(STARTX+2)
OR A ; 0-->carry
SBC HL,BC
JR NZ,LINE1 ; ENDS<>STARTX
LD HL,(ENDY+2) ; same for ENDY, STARTY
OR A
LD BC,(STARTY+2)
SBC HL,BC
JP Z,SET1 ; co-resident points, just plot single point
;
; LINE1:
LD HL,(ENDX+2) ; evaluate 32 bit fixed point
LD DE,(STARTX+2) ; numbers: DIRX & DIRY
OR A
SBC HL,DE
LD (DIRX),HL ; DIRX <- ENDX - STARTX; fractional part
BIT 7,H ; extend sign of .DIRX to integer part
JR Z,X0
LD HL,-1
JR X1
LD HL,0
LD (DIRX+2),HL ; do same for DIRY
LD HL,(ENDY+2)
LD DE,(STARTY+2)
OR A
SBC HL,DE
LD (DIRY),HL
BIT 7,H
JR Z,Y0
LD HL,-1
JR Y1
LD HL,0
LD (DIRY+2),HL
LD HL,(DIRX) ; HL <- .DIRX
LD DE,(DIRY) ; DE <- .DIRY
LD A,H
AND 80H
LD B,A ; B <- sgn(.DIRX)
LD A,D
AND 80H
LD C,A ; C <- sgn(.DIRY)
SHLFT: SLA L ; multiply HL, DE by 2
RL H ; until sign change occurs
SLA E ; on one or the other
RL D
LD A,H
AND 80H
CP B
JR NZ,DSHLFT
LD A,D
AND 80H
CP C
JR NZ,DSHLFT
JR SHLFT
DSHLFT: LD (DIRX),HL ; restore .DIRX & .DIRY with one equal
LD (DIRY),DE ; to 1/2 & the other less (magnitudes)
LD HL,8000H ; HL <- 1/2
LD (STARTX),HL ; round up STARTX, STARTY by 1/2
LD (STARTY),HL
NXTBL: CALL SET1
OR A

```



```

LD HL, (ENDX+2)
LD DE, (STARTX+2)
SBC HL, DE
JR Z, NXTBL2 ;STARTX = ENDX
NXTBL1: LD HL, (STARTX)
LD DE, (DIRX)
ADD HL, DE ;.STARTX = .STARTX + .DIRX
LD (STARTX), HL
LD HL, (STARTX+2)
LD DE, (DIRX+2)
ADC HL, DE ;STARTX. = STARTX. + DIRX. + .CY
LD (STARTX+2), HL
LD HL, (STARTY)
LD DE, (DIRY)
ADD HL, DE ;.STARTY = .STARTY + .DIRY
LD (STARTY), HL
LD HL, (STARTY+2)
LD DE, (DIRY+2)
ADC HL, DE ;STARTY. = STARTY. + DIRY. + .CY
LD (STARTY+2), HL
JR NXTBL
NXTBL2: OR A
LD HL, (ENDY+2)
LD DE, (STARTY+2)
SBC HL, DE
JR NZ, NXTBL1 ;STARTY. <> ENDY.
;
IF PAS.Z
;
XOR A ; flag valid subroutine call
ENDIF
;
RET
;
; *****
;
; CIRCLE Subroutine:
;
CIRCLE: IF PAS.Z
;
ENTRY CIRCLE
POP BC ; R VALUE
POP HL ; Y VALUE
LD (P3), HL ; Y VALUE
POP HL ; X VALUE
LD (P2), HL ; X VALUE
POP HL
LD (P1), HL
PUSH BC
PUSH IX
PUSH IY
ENDIF
;
IF BASIC
;
LD B, 3
CALL DTLNK
ENDIF
;
LD HL, (P1)
CALL TEST
LD (P1), HL
LD HL, (P2)
CALL YTEST
LD (P2), HL
LD IX, SINTBL

```

```

LD IY, COSTBL
LD B, 45
CIRC0: PUSH BC ; SAVE COUNTER
LD D, (IX+1) ; SIN->(DE)
LD E, (IX)
LD BC, (P3) ; R->(BC)
CALL MULT ; PROD->RSIN
LD (RSIN), DE
LD D, (IY+1)
LD E, (IY)
LD BC, (P3)
CALL MULT ; PROD->RCOS
LD (RCOS), DE ;X->HL
LD HL, (P1)
ADD HL, DE ; X+RCOS ,Y+RSIN
CALL CIRC1
LD DE, (RSIN)
ADD HL, DE
CALL CIRC2
; X+RSIN, Y+RCOS
LD DE, (RSIN)
ADD HL, DE
CALL CIRC1
LD DE, (RCOS)
ADD HL, DE
CALL CIRC2
; X-RSIN, Y+RCOS
LD DE, (RSIN)
OR A
SBC HL, DE
CALL CIRC1
LD DE, (RCOS)
ADD HL, DE
CALL CIRC2
; X-RCOS, Y+RSIN
LD DE, (RCOS)
OR A
SBC HL, DE
CALL CIRC1
LD DE, (RSIN)
ADD HL, DE
CALL CIRC2
; X-RCOS, Y-RSIN
LD DE, (RCOS)
OR A
SBC HL, DE
CALL CIRC1
LD DE, (RSIN)
OR A
SBC HL, DE
CALL CIRC2
; X-RSIN, Y-RCOS
LD DE, (RSIN)
OR A
SBC HL, DE
CALL CIRC1
LD DE, (RCOS)
OR A
SBC HL, DE
CALL CIRC2
; X+RCOS, Y-RSIN
LD DE, (RCOS)
ADD HL, DE
CALL CIRC1
LD DE, (RSIN)
OR A
SBC HL, DE

```




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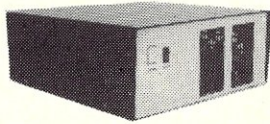
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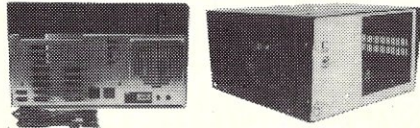
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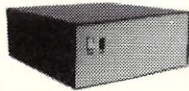


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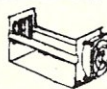
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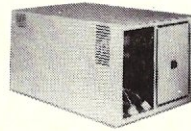
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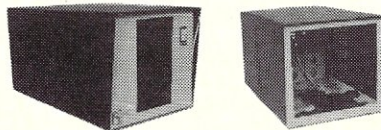
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```

CALL    CIRC2
; X+RSIN, Y-RCOS
LD      DE,(RSIN)
ADD     HL,DE
CALL    CIRC1
LD      DE,(RCOS)
OR      A
SBC     HL,DE
CALL    CIRC2
;
INC     IX
INC     IX
INC     IY
INC     IY
POP     BC
DEC     B
JP      NZ,CIRC0
;
LD      HL,(P1)      ; X+R, Y
LD      DE,(P3)
ADD     HL,DE
CALL    CIRC1
CALL    CIRC2
; X-R, Y
LD      DE,(P3)
OR      A
SBC     HL,DE
CALL    CIRC1
CALL    CIRC2
; X, Y+R
CALL    CIRC1
LD      DE,(P3)
ADD     HL,DE
CALL    CIRC2
; X, Y-R
CALL    CIRC1
LD      DE,(P3)
OR      A
SBC     HL,DE
CALL    CIRC2
;
IF      PAS.2
;
POP     IY
POP     IX
XOR     A
ENDIF
;
RET
;
CIRC1: LD      (STARTX+2),HL
LD      HL,(P2)
RET
;
CIRC2: LD      (STARTY+2),HL
CALL    SET0
LD      HL,(P1)
RET
;
RSIN:  DFW  0
RCOS:  DFW  0
;
;
MULT:  from ELECTRONICS/Feb 24, 1982 Designer's Casebook
;      article by Jerry L. Goodrich
;      performs a 2-byte by 2-byte integer multiply
;      (BC)*(DE)-->(DE),(HL)
;
MULT:
LD      A,E          ;load lowest-order byte of multiplier
PUSH    DE           ;save highest-order byte multiplier
CALL    BMULT       ;do 1-byte multiply
EX      (SP),HL     ;save lowest-order bytes product,get multiplier
PUSH    AF          ;store highest-order byte of first product
LD      A,H         ;load highest-order byte of multiplier
CALL    BMULT       ;do second 1-byte multiply
LD      D,A         ;position highest-order byte of product
POP     AF          ;get highest-order byte of first product
ADD     A,H         ;update third byte of product
LD      E,A         ;and put in E
JP      NC,NC1      ;don't incr D if no carry
INC     D           ;incr D if carry
;
NC1:   LD      H,L    ;relocate lowest-order bytes of sec. prod.
LD      L,0
POP     BC          ;get lowest-order bytes of sec. prod.
ADD     HL,BC       ;get final product lowest-order 2 bytes
JR      NC,NC2     ;done if no carry
INC     DE         ;otherwise update highest-order 2 bytes
;
NC2:   BIT     7,H    ;round up if frac part => .5
RET     Z
INC     DE
RET
;
; BMULT performs a 1-byte by 2-byte multiply
; (A)*(BC)-->(A),(BC)
;
BMULT: LD      HL,0    ;zero partial product
LD      DE,7         ;D=0,E=bit counter
ADD     A,A         ;get first multiplier bit
;
LOOP1: JP      NC,ZERO   ;zero-skip
ADD     HL,BC       ;one-add multiplicand
ADC     A,D         ;add carry to third byte of product
;
ZERO:  ADD     HL,HL   ;shift product left
ADC     A,A
DEC     E          ;decrement bit counter
JR      NZ,LOOP1    ;loop until done
RET     NC         ;done if no carry
ADD     HL,BC       ;otherwise do last add
ADC     A,D
RET
;
; COSTBL and SINTBL are tables of cosine and sine values
; specified as 16-bit fractions. Each table is 45 units
; (degrees) long.
;
COSTBL: DFW  65526    ;1 DEG
DFW  65496    ;2
DFW  65446    ;3
DFW  65376    ;4
DFW  65287    ;5
DFW  65177    ;6
DFW  65048    ;7
DFW  64898    ;8
DFW  64729    ;9
DFW  64540    ;10
DFW  64332    ;11
DFW  64104    ;12
DFW  63856    ;13
DFW  63589    ;14
DFW  63303    ;15
DFW  62997    ;16
DFW  62672    ;17
DFW  62328    ;18

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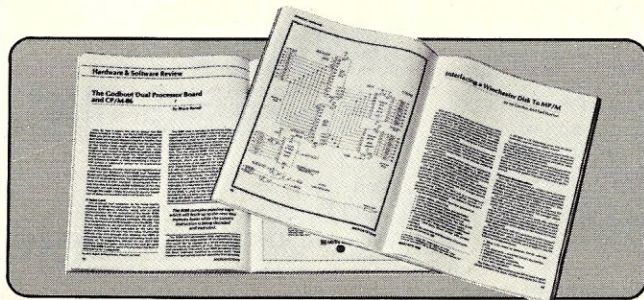
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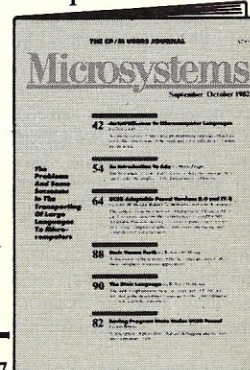
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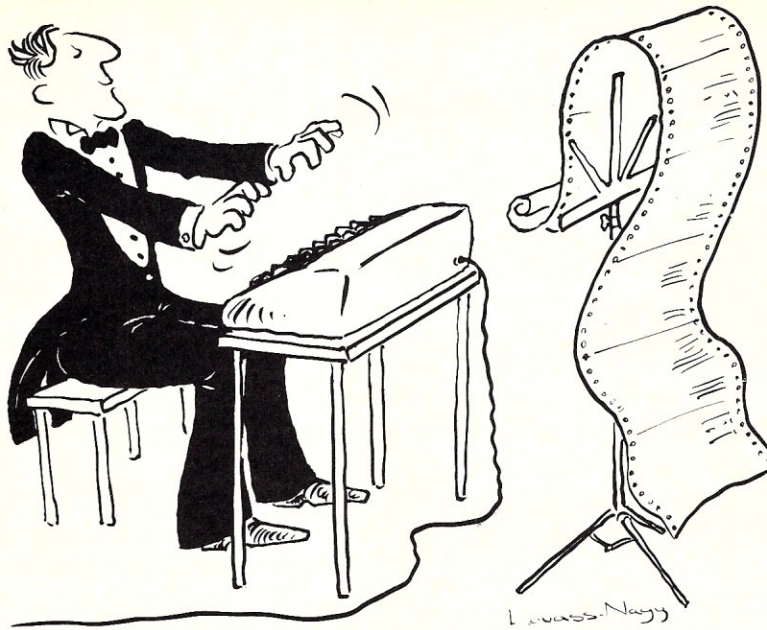
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CIRCLE 201 ON READER SERVICE CARD


```

LD      IY, STARTY+2
LD      HL, (P3)          ; fetch X tick minor
LD      (TM), HL
LD      A, L
OR      H
JR      Z, XTMAJ          ; skip if Xt minor=0
LD      HL, (P1)
LD      (TAXIS), HL
LD      HL, (P2)
LD      (CAXIS), HL
CALL    TICK              ; fill in tick marks
CALL    MINOR
XTMAJ:  LD      HL, (P5)          ; fetch X tick major
LD      (TM), HL
LD      A, L
OR      H
JR      Z, YTMIN          ; skip if Xt major =0
LD      HL, (P1)
LD      (TAXIS), HL
LD      HL, (P2)
LD      (CAXIS), HL
CALL    TICK              ; fill in tick marks
LD      (XGRID), HL
CALL    MAJOR
YTMIN:  LD      IX, STARTY+2      ; same as above, but rotate axis
LD      IY, STARTX+2
LD      HL, (P4)          ; fetch Y tick minor
LD      (TM), HL
LD      A, L
OR      H
JR      Z, YTMAJ          ; skip if Y tick minor=0
LD      HL, (P2)
LD      (TAXIS), HL
LD      HL, (P1)
LD      (CAXIS), HL
CALL    TICK              ; fill in tick marks
CALL    MINOR
YTMAJ:  LD      HL, (P6)          ; fetch Y tick major
LD      (TM), HL
LD      A, L
OR      H
RET     Z                  ; all done no Y tick major
LD      HL, (P2)
LD      (TAXIS), HL
LD      HL, (P1)
LD      (CAXIS), HL
CALL    TICK              ; fill in tick marks
LD      (YGRID), HL
CALL    MAJOR
CALL    GRID
;
;
IF      PAS.Z
;
POP     IY                  ; restore IX, IY
POP     IX
XOR     A                  ; indicate valid external procedure call
ENDIF
;
RET
;
TICK:  LD      HL, DOTS-1      ; find largest value for tick mark
LD      DE, (TAXIS)
OR      A
SBC     HL, DE
LD      DE, (TM)
TICK0: SBC     HL, DE
JR      NC, TICK0
ADD     HL, DE
LD      DE, DOTS-1
EX      DE, HL
OR      A
SBC     HL, DE          ; HL = highest value for tick mark
RET
; MINOR: LD      (IX+0), L      ; plot minor tick marks on indicated axis
LD      (IX+1), H
LD      HL, (CAXIS)
DEC     HL
LD      (IY+0), L
LD      (IY+1), H
CALL    SETO
LD      HL, (CAXIS)
INC     HL
LD      (IY+0), L
LD      (IY+1), H
CALL    SETO
LD      L, (IX+0)
LD      H, (IX+1)
LD      DE, (TM)
OR      A
SBC     HL, DE
JR      NC, MINOR
RET
; MAJOR: LD      (IX+0), L      ; plot major tick marks on indicated axis
LD      (IX+1), H
LD      HL, (CAXIS)
DEC     HL
DEC     HL
DEC     HL
LD      (IY+0), L
LD      (IY+1), H
CALL    SETO
LD      HL, (CAXIS)
DEC     HL
DEC     HL
LD      (IY+0), L
LD      (IY+1), H
CALL    SETO
LD      HL, (CAXIS)
DEC     HL
LD      (IY+0), L
LD      (IY+1), H
CALL    SETO
LD      HL, (CAXIS)
INC     HL
LD      (IY+0), L
LD      (IY+1), H
CALL    SETO
LD      HL, (CAXIS)
INC     HL
LD      (IY+0), L
LD      (IY+1), H
CALL    SETO
LD      L, (IX+0)
LD      H, (IX+1)
LD      DE, (TM)
OR      A
SBC     HL, DE
JR      NC, MAJOR
RET

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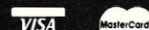
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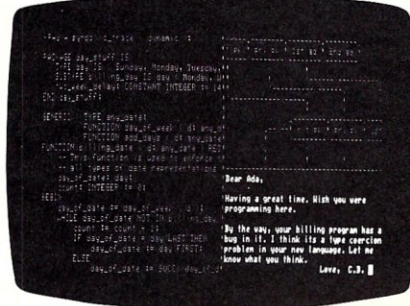
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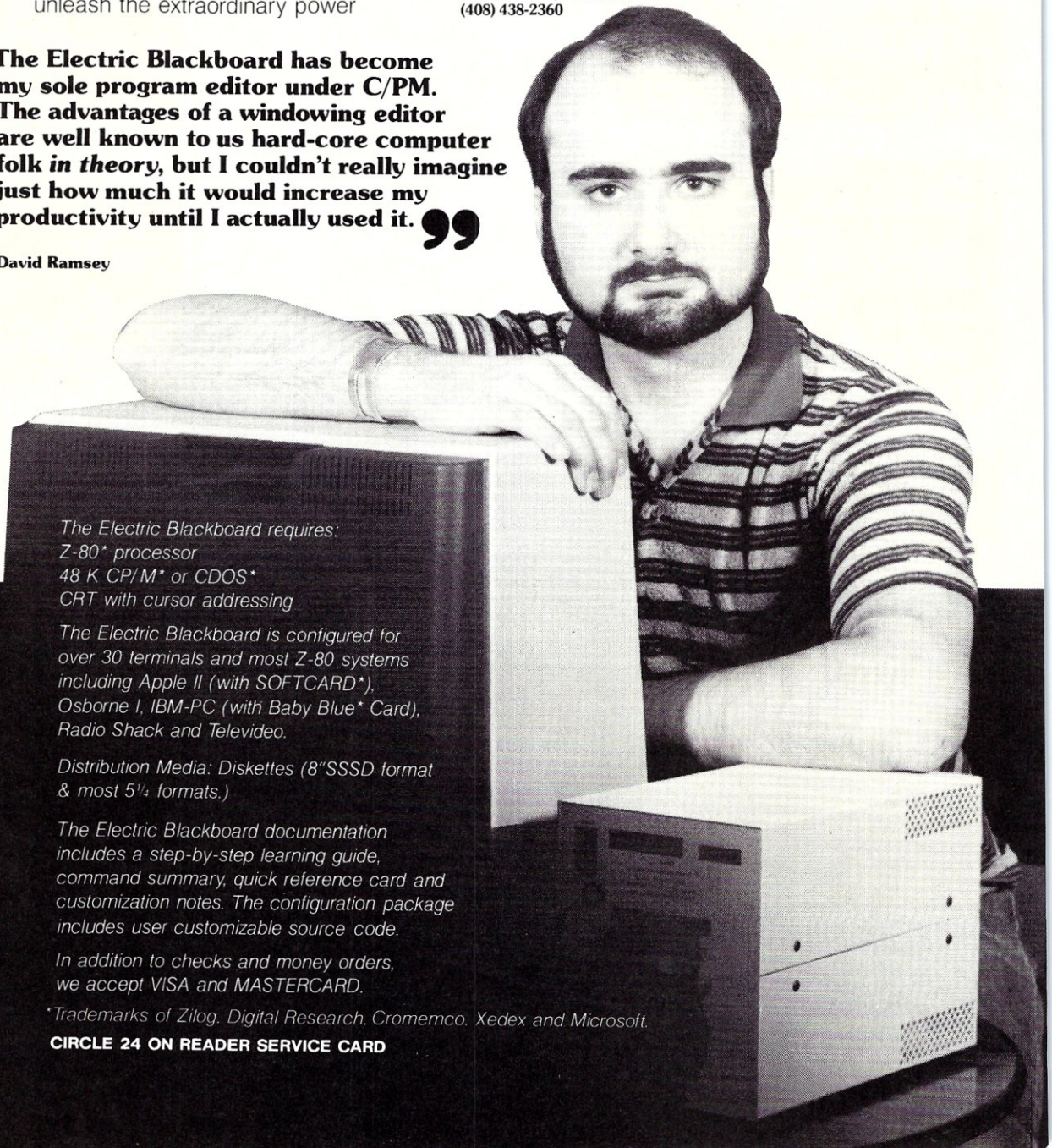
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CIRCLE 24 ON READER SERVICE CARD




```

;
GRID: LD HL,(P7) ; plot x, y grid marks if required
LD A,H
OR L
RET Z ; no grid required
LD HL,(P5)
LD A,H
OR L
RET Z ; impossible x grid
LD HL,(P6) ;
LD A,H ;
OR L ;
RET Z ; impossible y grid
LD HL,(XGRID) ; put grid marks at intersections of
LD (STARTX+2),HL ; axis major tick marks
GRID0: LD HL,(YGRID)
LD (STARTY+2),HL
GRID1: CALL SET1
LD HL,(STARTY+2)
LD DE,(P6)
OR A
SBC HL,DE
JR NC,GRID1
LD HL,(STARTX+2)
LD DE,(P5)
OR A
SBC HL,DE
JR NC,GRID0
RET

;
;*****
;
; LINE PRINTER DRIVER
;
PRNTR: PUSH AF
PUSH BC
PUSH DE
LD E,A
LD C,5
CALL BDOS
;
IF BASE2
;
DELAY: LD B,32
DJNZ DELAY ; give BASE2 some more time
ENDIF
;
POP DE
POP BC
POP AF
RET
;
;*****
;
; XFRPLT: transfer image-to-printer subroutine
;
XFRPLT: IF PAS.Z ; CALL & USR entry point, no parameters
;
ENTRY XFRPLT
PUSH IX ; save IX, IY for PAS.Z/Z
PUSH IY
ENDIF
;
IF BASE2
;
LD A,27 ; set up PRNTR for:
CALL PRNTR ; 96 characters/inch
LD A,50 ; 14 vertical half-dots/inch
CALL PRNTR
LD A,27
CALL PRNTR
LD A,98
CALL PRNTR
LD A,14
CALL PRNTR
ENDIF
IF IDS560
LD A,03 ; send ETX character
CALL PRNTR
ENDIF
;
; row: continuous sequence of memory locations of length LENGTH
; line: continuous sequence of graphic characters of length LENGTH
; shift: number of 16 bit left shifts required to recover graphic
; character from 16 bit word formed from location
; plot+i (IX)->H, and plot+i+LENGTH (IY)->L
LD IX,(IMGPTR) ; IX = IMAGE
LD IY,(IMGPTR)
LD DE,LENGTH
ADD IY,DE ; IY = IMAGE + LENGTH
LD C,LINES ; transfer this number of print lines
LD D,7 ; # shifts in first group
XFR0: LD
XFR1: IF BASE2
LD A,27 ; set up for graphics
CALL PRNTR
LD A,99
CALL PRNTR
ENDIF
PUSH BC ; save line counter
LD B,FILL1 ; & fill left margin with blanks
LD A,128
CALL PRNTR
XFR10: DJNZ XFR10
LD BC,LENGTH ; transfer the graphics characters
LD H,(IX+0)
LD L,(IY+0)
CALL ROTL
;
IF BASE2
CALL PRINTER
ENDIF
IF IDS560
PUSH AF
CALL PRNTR
POP AF
CP 03 ; was ETX sent?
CALL Z,PRNTR ; yes, must be sent twice
ENDIF
INC IX ; increment image pointers
INC IY
DEC BC ; decrement character counter
LD A,C
OR B
JR NZ,XFR2 ; do entire line of graphic characters
IF BASE2

```



```

;
XFR20: LD      B,FILL2      ; fill right margin with blanks
LD      A,128
CALL    PRNTR
DJNZ    XFR20
LD      A,10              ; terminate with line feed
CALL    PRNTR
ENDIF

IF      IDS560
;
LD      A,03              ; send line terminator sequence
CALL    PRNTR
LD      A,14
CALL    PRNTR
ENDIF

;
DEC     D                  ; do one less shift on next line
LD      A,D                ; test for D=6, special case
CP      6
JR      NZ,XFR21
LD      BC,-LENGTH        ; if D=6 then repeat row for next line
ADD     IX,BC
ADD     IY,BC
XFR21: POP     BC          ; decrement line counter
DEC     C                  ; all lines done, exit from loop
JR      Z,XFRDN           ; shifts 7 --> 0 done?
LD      A,D
CP      -1
JR      NZ,XFR1          ; no, do next shift
JR      XFR0              ; yes, next row, line, shifts 7-->0

XFRDN: IF      BASE2
;
LD      A,27              ; reset printer to normal
CALL    PRNTR
LD      A,98
CALL    PRNTR
LD      A,24
CALL    PRNTR
ENDIF

;
IF      IDS560
;
LD      A,03
CALL    PRNTR
LD      A,14
CALL    PRNTR
LD      A,03
CALL    PRNTR
LD      A,02              ; return to NORMAL mode
CALL    PRNTR
ENDIF

;
IF      PAS.Z
;
POP     IY                ; restore IX, IY for PAS.Z
POP     IX
ENDIF

;
RET

;
ROTLO: PUSH    DE          ; save DE, BC
PUSH    BC
XOR     A                ; test for case 0
CP      D
JR      Z,ROTLO1
LD      A,D              ; test for case 7
CP      7
JR      NZ,ROTLO

SRL     H                  ; if D=7, then one shift right
JR      ROTLO1
ROTLO: SLA     L
RL      H                  ; 16 bit rotate D bits to left
DEC     D
JR      NZ,ROTLO
ROTLO1: XOR     A          ; reverse bit order for PRNTR
LD      B,7
ROTLO2: SRL     H
RLA
DJNZ    ROTLO2
POP     BC                  ; restore BC, DE
POP     DE
RET                          ; & return graphic char in Accum

;*****
;
; working storage locations
;
STARTX: DEFW  0             ; X1, 16 bit integer, 16 bit fraction
DEFW  0
STARTY: DEFW  0             ; Y1, same
DEFW  0
ENDX:   DEFW  0             ; X2, same
DEFW  0
ENDY:   DEFW  0             ; Y2, same
DEFW  0
DIRX:   DEFW  0             ; (X2 - X1)/256, same format as X1
DEFW  0
DIRY:   DEFW  0             ; (Y2 - Y1)/256, same
DEFW  0

;
; passed parameters storage
;
P1:     DEFW  0             ; memory reserved for passing up to
P2:     DEFW  0             ; eight parameters from BASIC via
P3:     DEFW  0             ; CALL subr (P1,P2,P3,P4,P5,P6,P7,P8)
P4:     DEFW  0
P5:     DEFW  0
P6:     DEFW  0
P7:     DEFW  0
P8:     DEFW  0

;
TM:     DEFW  0             ; reserved for AXIS routine temp storage
TAXIS:  DEFW  0
CAXIS:  DEFW  0

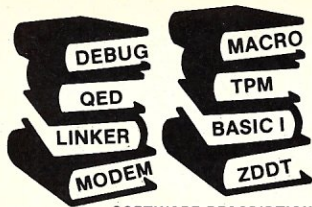
;
XGRID:  DEFW  0
YGRID:  DEFW  0

;
IMGPTR: DEFW  IMAGE
IMAGE   EQU  $

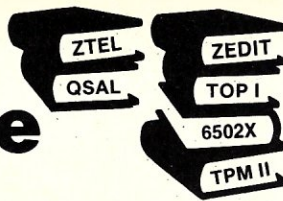
;
IF      PAS.Z
;
DEFS    AREA
ENDIF

;
END

```

Z80 Software



SOFTWARE DESCRIPTIONS

TPM (TPM I) - \$80 A Z80 only operating system which is capable of running CP/M programs. Includes many features not found in CP/M such as independent disk directory partitioning for up to 255 user partitions, space, time and version commands, date and time, create FCB, chain program, direct disk I/O, abbreviated commands and more! Available for North Star (either single or double density), TRS-80 Model I (offset 4200H) or II, Versafloppy I, Tarbell I, or Osborne I.

TPM-II - \$125 An expanded version of TPM which is fully CP/M 2.2 compatible but still retains the extra features our customers have come to depend on. This version is super FAST. Extended density capability allows over 600K per side on an 8" disk. Available preconfigured for Versafloppy II (8" or 5"), Epson QX-10, or TRS-80 Model II.

CONFIGURATOR I

This package provides all the necessary programs for customizing TPM for a floppy controller which we do not support. We suggest ordering this on single density (8SD).

Includes: TPM-II (\$125), Sample BIOS (BIOS) SOURCE (\$FREE), MACRO II (\$100), LINKER (\$80), DEBUG I (\$80), QED (\$150), ZEDIT (\$50), TOP I (\$80) BASIC I (\$50) and BASIC II (\$100)

\$815 Value NOW \$250

CONFIGURATOR II

Includes: TPM-II (\$125), Sample BIOS (BIOS) SOURCE (\$FREE), MACRO II (\$100), MACRO III (\$150), LINKER (\$80), DEBUG I (\$80), DEBUG II (\$100), QDAL (\$200), QED (\$150), ZTEL (\$80), TOP II (\$100), BUSINESS BASIC (\$200) and MODEM SOURCE (\$40) and DISASSEMBLER (\$80)

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This package is only for the TRS-80 Model I. Note: These are the ONLY CDL programs available for the Model I. It includes: TPM I (\$80), BUSINESS BASIC (\$200), MACRO I (\$80), DEBUG I (\$80), ZDDT (\$40), ZTEL (\$80), TOP I (\$80) and MODEM (\$40)

\$680 Value NOW \$680

MODEL II PROGRAMMER

This package is only for the TRS-80 Model II. It includes: TPM-II (\$125), BUSINESS BASIC (\$200), MACRO II (\$100), MACRO III (\$150), LINKER (\$80), DEBUG I (\$80), DEBUG II (\$100), QED (\$150), ZTEL (\$80), TOP II (\$100), ZDDT (\$40), ZAPPLE SOURCE (\$80), MODEM (\$40), MODEM SOURCE (\$40) and DISASSEMBLER (\$80)

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ACCOUNTING PACKAGE - \$300, Written in Business Basic. Includes General Ledger, Accounts Receivable/Payable, and Payroll. Set up for Hazeltine 1500 terminal. Minor modifications needed for other terminals. Provided in unprotected source form.

MACRO I - \$80, A Z80/8080 assembler which uses CDL/TDL mnemonics. Handles MACROS and generates relocatable code. Includes 14 conditionals, 16 listing controls, 54 pseudo-ops, 11 arithmetic/logical ops, local and global symbols, linkable module generation, and more!

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MACRO III - \$150, An enhanced version of Macro II. Internal buffers have been increased to achieve a significant improvement in speed of assembly. Additional features include line numbers, cross reference, compressed PRN files, form feeds, page parity, additional pseudo-ops, internal setting of time and date, and expanded assembly-time data entry.

6502X - \$150, A 6502 cross assembler. Runs on the Z80 but assembles 6502 instructions into 6502 object code! Similar features as our Macro assemblers.

DEVELOPER I

Includes: MACRO I (\$80), DEBUG I (\$80), ZEDIT (\$50), TOP I (\$80), BASIC I (\$50) and BASIC II (\$100)

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COMBO

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LINKER - \$80, A linking loader for handling the linkable modules created by the above assemblers.

DEBUG I - \$80, A tool for debugging Z80 or 8080 code. Disassembles to CDL/TDL mnemonics compatible with above assemblers. Traces code even through ROM. Commands include Calculate, Display, Examine, Fill, Goto, List, Mode, Open File, Put, Set Wait, Trace, and Search.

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QED - \$150, A screen editor which is both FAST and easy to learn. Commands include block delete, copy, and move to a named file or within text, repeat previous command, change, locate, find at start of line, and numerous cursor and window movement functions. Works with any CRT having clear screen, addressable cursor, clear to end of line, and clear to end of screen.

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When ordering software specify which disk format you would like.

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8XD	8" CDL Extended Density (1024 bytes/8 sector/77 tracks = 616K)
5SD	5.25" Single Density (TRS80 Model I, Versafloppy I, Tarbell I)
5EP	5.25" Epson Double Density
5PC	5.25" IBM PC Double Density
5XE	5.25" Xerox 820 Single Density
5OS	5.25" Osborne Single Density
5ZA	5.25" Z80 Apple (Softcard compatible)

TPM INFO When ordering TPM I or II, in addition to Disk Format, please specify one of the following codes:

CODE	DESCRIPTION
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NSSD/Z	North Star Single Density for Zapple I/O
NSDD/H	North Star Double Density for Horizon I/O
NSDD/Z	North Star Double Density for Zapple I/O
TRS80-I	TRS-80 Model I (4200H Offset)
TRS80-II	TRS-80 Model II
VI8	Versafloppy I 8"
VI5	Versafloppy I 5.25"
TPM-II:	
VII8	Versafloppy II 8" (XD)
VII5	Versafloppy II 5.25"
TRS80-II	TRS-80 Model II (XD)

Prices and Specifications subject to change without notice. TPM, Z80, CP/M, TRS80 are trademarks of CDL, Zilog, DRI and Tandy respectively.

ZTEL - \$80, An extensive text editing language and editor modelled after DEC's TECO.

ZEDIT - \$50, A mini text editor. Character/line oriented. Works well with hardcopy terminals and is easy to use. Includes macro command capability.

TOP I - \$80, A Text Output Processor for formatting manuals, documents, etc. Interprets commands which are entered into the text by an editor. Commands include justify, page number, heading, subheading, centering, and more.

TOP II - \$100, A superset of TOP I. Adds: embedded control characters in the file, page at a time printing, selected portion printing, include/merge files, form feed/CRLF option for paging, instant start up, and final page ejection.

ZDDT - \$40, This is the disk version of our famous Zapple monitor. It will also load hex and relocatable files.

ZAPPLE SOURCE - \$80, This is the source to the SMB ROM version of our famous Zapple monitor. It can be used to create your own custom version or as an example of the features of our assemblers. Must be assembled using one of our assemblers.

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MODEM SOURCE - \$40, For making your own custom version. Requires one of our Macro Assemblers.

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Includes: 6502X (\$150), MACRO II (\$100), MACRO III (\$150), QDAL (\$200), QED (\$150), LINKER (\$80), DEBUG I (\$80), DEBUG II (\$100), ZDDT (\$40) and BUSINESS BASIC (\$200)

VALUE: \$1250 \$325

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Utility City	Pie Writer/Standard	150 108	Supertext 40/80	175 126	Sol/Sys. Inc.		VisiTrend/Plot
Apple Mechanic	• Double Vision	150 108	Form Letter Module		Executive Secretary	250 169	VisiDex
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HP-GL: Add Graphics to Any Computer System

by Steve Leibson

Generally, when we think about computer languages, it is the traditional ones that come to mind. Such names as Basic, Pascal, Forth, and Assembler are commonplace in the pages of *Microsystems*. HP-GL (Hewlett-Packard Graphic Language) was developed by the Hewlett-Packard company to control its line of computer plotters (Hewlett-Packard, 16399 W. Bernardo Drive, San Diego, CA 92127-1899). Any programming language that can output ASCII characters can drive an HP-GL plotter. This article shows you how to use HP-GL to add sophisticated graphic capability to your system.

The first plotter to use HP-GL appeared in 1977. It was the Hewlett-Packard 9872 plotter. Since then HP has introduced a wide range of plotters and other graphic output devices that accept HP-GL commands. Plotters are now available—from the 7470A (\$1,575), which plots on 8½" x 11" paper or transparency film, to the 7585B plotter (about \$22,900) with a 36" bed. Nicolet Zeta plotters are also compatible with HP-GL (Nicolet Zeta Corp., P.O. Box 4003, Concord, CA 94524), and are available with EIA RS-232C and IEEE-488 (GPIB, HP-IB interfaces). Most microcomputers are sold with one or the other of these standard interfaces, making high-quality graphics just a connection away.

An I/O language

HP-GL is an interface language, as opposed to a programming language. You control the peripheral through characters sent to the device. Most printers have primitive interface languages involving escape sequences to activate special features such as underlining and special character sets. Any programming language that can send characters out a serial or IEEE-488 port may be used to control an HP-GL peripheral.

The syntax for HP-GL commands is very simple. A syntax diagram is shown in Figure 1. The command starts with a two-letter instruction mnemonic such as "PA" for Plot Absolute. Any needed command parameters follow the instruction mnemonic. Parameters are separated by commas or spaces (spaces are ignored on the 9872 plotter). The command ends with a termination character that may be either a semicolon, a line feed, or both (the line feed can be used only on the HP-IB interface). One exceptional terminator is needed for the label command: an ASCII ETX character (CHRS(3)). This special terminator allows semicolons and line feeds to appear in the label string of the label command.

Steve Leibson, 4040 Greenbriar Blvd., Boulder, CO 80803



The Hewlett-Packard 7585 drafting plotter, which takes 36½" x 48½" paper

HP-GL has been developed over the past eight years. The syntax diagram in Figure 1 is for the newer 9490A plotter; Figure 2 illustrates the more restrictive HP-GL syntax of the 9872.

Parameters may take one of four formats: integer, scaled decimal, decimal or label. A number in integer format is between -32768 and +32767. If the parameter must be an integer, the plotter truncates any fractional part of the parameter that may have been included. A number in scaled decimal format is between -32768.0000 and +32767.9999, with an optional decimal point and fraction. Scaled decimal format is used when user-unit scaling is active. It applies to all HP-GL instruction parameters that are interpreted as user units. Decimal format numbers are of the range -128.000 to +127.9999 (with decimal point and fraction optional). Label fields may contain any ASCII text.

Hewlett-Packard has incorporated a sophisticated graphics extension to the Basic interpreters in its computers. This extension, called AGL (A Graphics Language), translates statements written in HP extended Basic into one or more HP-GL commands. You don't need AGL extensions to run HP-GL plotters, however. HP-GL commands can be generated on non-HP computers with PRINT statements.

I am going to present two programs using HP-GL written on an IBM PC in Microsoft Basic. The first, a very simple program, draws a circle, and the second, with just a little more complexity, plots some data in a very fancy manner. These programs will illustrate some of the more useful HP-GL commands and how to generate them.

Drawing a circle

Listing 1 is the circle-drawing program, adapted from a program fragment in the 7470A Interfacing and Programming manual. Figure 3 is the circle drawn by this program. Most of the statements in Listing 1 are plain vanilla Basic. We will look closely at those lines peculiar to IBM's version of Microsoft Basic and the lines that output HP-GL commands.

Line 1100 connects the IBM serial port (COM1:) to file #1 so that we can print to it. The extra parameters of the OPEN statement configure the port for 9600-baud operation, with no parity, eight bits per character, one-stop bit, 10-second timeouts on the Clear-to-Send and Data-Set-Ready lines, and an automatic line feed generation with every carriage return. These are the parameters that work with my 7470A. Some Basics do not require line 1100 (such as North Star's). You can print to the 7470A at 9600 baud only if you have implemented either the hardware or software handshake—otherwise the data will be sent too quickly and the plotter will lose some of the commands.

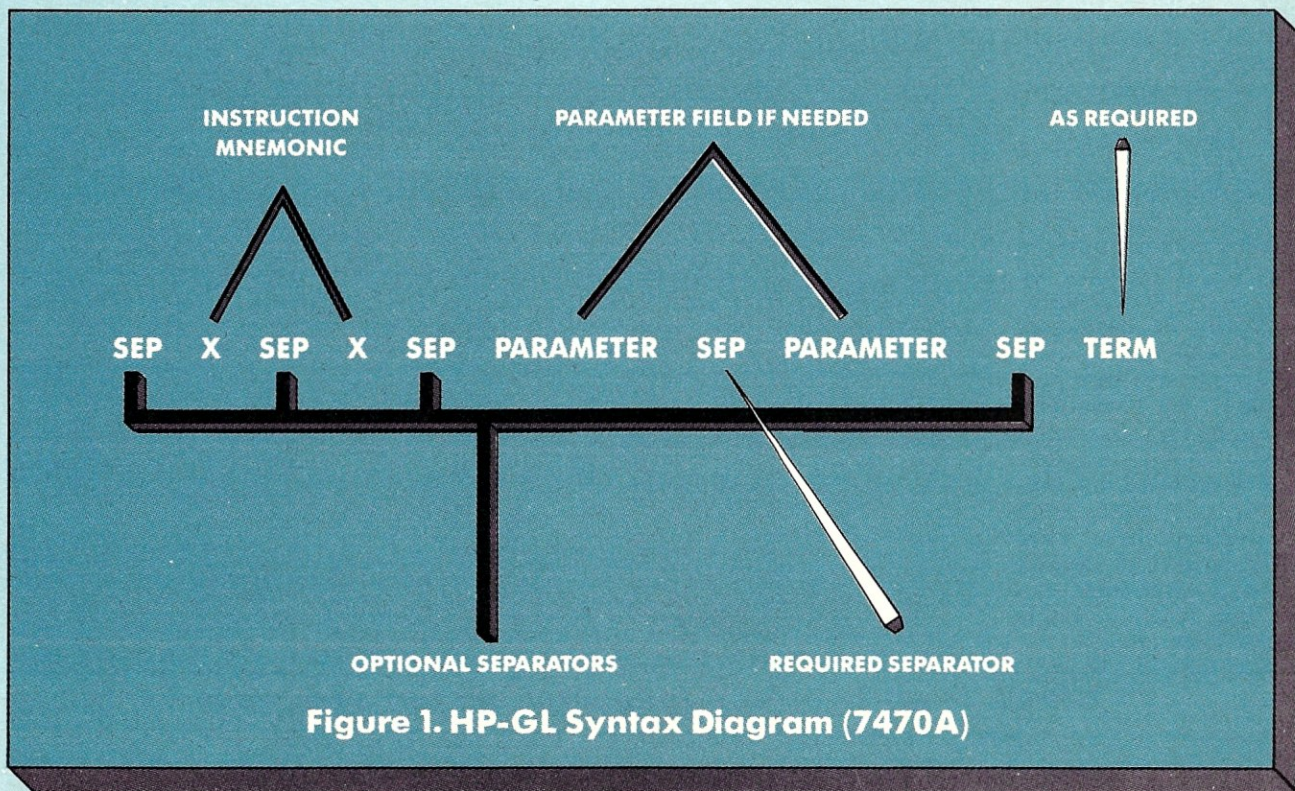
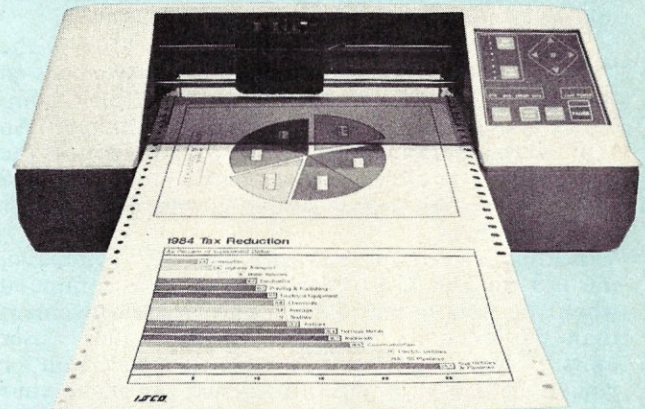
The plotter is initialized on line 1130. Here we encounter our first HP-GL command. It is "IN", the INITIALIZE plotter command that has no parameters. This places the plotter in its initial power-on state and returns all plotter internal parameters to their defaults. It is a very good idea to send the "IN" com-

mand to the plotter at the beginning of each run to place it in a known state. No telling what the last program did to it.

A semicolon terminator separates the "IN" command from the second command. This is the "IP" or Input P1 and P2. The lower left corner of the plot is called P1 and the upper right is P2; they define the area for scaling. The "IP" command sets the absolute positions of these two points on the paper, defining the plotting rectangle. All lines drawn by the plotter will fall in this area when AGL is being used. Otherwise, P1 and P2 do not restrict pen motion. The parameters of the "IP" command are in "plotter units," which are 0.025 mm. An 8½" x 11" sheet of paper is approximately 7,560 by 10,300 plotter units.

In our circle program, we set up the lower left and upper right points at 2000,1000 and 8000,7000 respectively. This gives us a square area to plot on. As

The Nicolet Zeta 8: An 8-pen desktop plotter





The HP 7470A graphics plotter—a fast low-inertia plotting system designed for the low-cost plotter market

we shall soon see, a square plotting area simplifies the scaling of the plot.

The next HP-GL command on line 1130 is the "SP" or Select Pen command. There are two pens on the 7470A. You pick up the first with an "SP1" command and the other with an "SP2" command. An "SP" with a parameter of 0 or no parameter puts the pen away. The plotter knows which pen it has and replaces it in the proper holder. Larger HP plotters have eight pens.

Scaling is accomplished with the "SC" command, the last on line 1130. You use the scale command when you wish to plot data in units more convenient than plotter units. Scaled units are called "user units." Thus the plotter will make the conversion for you. A little distributed intelligence can make your job much easier. Here we scale the square plotting area so that it is two user units by two user units. Since we are going to plot a circle with a radius of 1, it should conveniently fit in the center of our square plotting area.

I have included a semicolon at the end of the scale command as a terminator. Since this is the last command in the PRINT statement, the line feed that will automatically be output at the completion of the statement will also terminate the command when the HP-IB is being used. Double termination is allowed by HP-GL syntax: Better safe than sorry. Line 1130 also shows that several HP-GL commands can be sent with a single PRINT statement.

The main body of the circle-drawing program is the FOR/NEXT loop found from line 1190 through 1250. We draw a circle by computing the endpoints of 60-line segments and plotting them. The actual plotting command, Plot Absolute (PA) is spread over three program lines: 1220 through 1240. Line 1220 outputs the instruction mnemonic, line 1230 outputs an endpoint to plot to, and line 1240 tells the plotter to put the pen down ("PD") when it gets to the specified location. This command is on three lines so that the variables *x* and *y* could be sent with the PRINT USING syntax, and to illustrate that a single HP-GL command need not be sent with a single PRINT statement.

The first time that the "PA" command is output, the plotter has not put the pen down (pen up is the power-up default). Thus the plotter will first move to the desired point and then put the pen down because the "PD" follows the coordinate parameters. This is equivalent to a MOVE statement in some graphics-extended Basics. For all subsequent "PA" commands, the plotter will draw a line from where it was to where it ends up. This is equivalent to a DRAW statement in some Basics.

I had to put a fudge factor in the FOR/NEXT parameter because the plotter didn't draw the last line segment of the circle. When loop counter *T* reached $2*PI$, the loop was satisfied and the last "PA" wasn't sent. By telling the loop counter to go just a bit farther, the problem went away.

To demonstrate the labeling capabilities of the 7470A, I printed some text in the circle. Line 1270 is the character SIZE command. The parameters define the width and height of the label characters in cen-

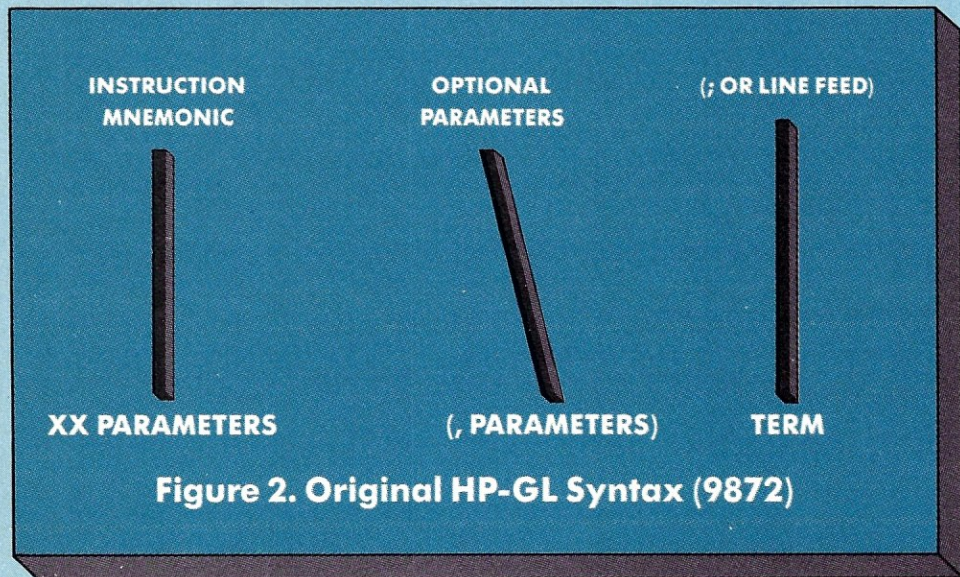


Figure 2. Original HP-GL Syntax (9872)

HP-GL is an interface language, as opposed to a programming language. You control the peripheral through characters sent to the device.

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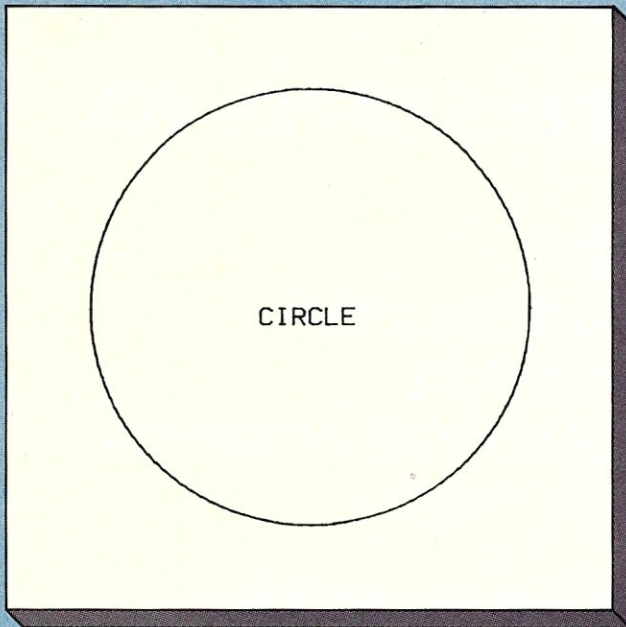


Figure 3. Circle drawn by the program in Listing 1.

timeters. Line 1280 moves the pen to location 0,0 after first lifting the pen up (PU). Remember, we left the pen down after plotting the circle. (Yes, I did forget to do this the first time!)

Line 1290 is a very useful command, the Character Plot ("CP") command. It allows you to place the pen at a location based on the size of the characters you are about to plot. Here we back up three character spaces and down half a space to center the label. Line 1300 is the LaBel command ("LB") which tells the plotter to print all subsequent characters until an ETX is received. The ETX is sent using the CHR\$(3). Finally, we put the pen away with "SP0" so it won't dry out.

A square deal

Earlier I mentioned that it was easier to deal with a square plotting area. Suppose we had left out the "IP" command and used the plotter's default, which is rectangular. Listing 2 shows the only change we will make to the program, the deletion of the "IP" command in line 1130. When this is done, we get the drawing of Figure 4. The circle is now an ellipse. This happened because the plotter-unit scales for x and y are equal, but the user units are not. Thus one user unit in the x direction is larger than one user unit in the y direction. Sometimes, this can be used to intentionally stretch or distort a plot.

Plotting data

Listing 3 is a program for plotting data. It uses more HP-GL commands and therefore more features of the 7470A. Figure 5 is a plot produced by this program. Line 1140 again initializes the plotter, selects a

pen, and sets up a plotting area.

Line 1150 sets up our scales. The x axis is going to represent months and is therefore scaled into 12 user units. The y axis is scaled for our data. If the maximum and minimum limits on the data are unknown, it is a fairly simple matter to write the program to determine these and use variables for the scaling parameters. Line 1160 draws the axes and then raises the pen.

On line 1200, we again find a Size command to set the label character size, along with a Tick Length command ("TL") which sets the size of the tick marks on the axes. Tick marks are specified as a percentage of the horizontal and vertical size of the plotting area. The first Tick Length parameter specifies the length of the mark above the x axis and to the right of the y axis, while the second parameter specifies the length below and to the left. A grid can be drawn using tick marks of 100% length.

Ticks are drawn by using the Plot Absolute command to position the pen, and the X Tick ("XT") and Y Tick ("YT") commands to draw the ticks. Since the pen was left up, the Tick commands will draw a tick mark and then return the pen to the up position. Also, since the pen is in the general vicinity, we use the Character Plot and LaBel commands to label the ticks at the same time. The x axis is ticked and labeled by lines 1210 through 1270, while lines 1330 through 1380 do the y axis. Lines 1280 and 1390-1400 label the axes.

At the line 1410, we finally get through with the gingerbread and plot some data. We are going to plot three sets of data and take advantage of another 7470A feature to do this. Lines 1450 through 1480 set the Line Type ("LT"). Instead of a solid line, each set of data is plotted with a unique dash pattern,

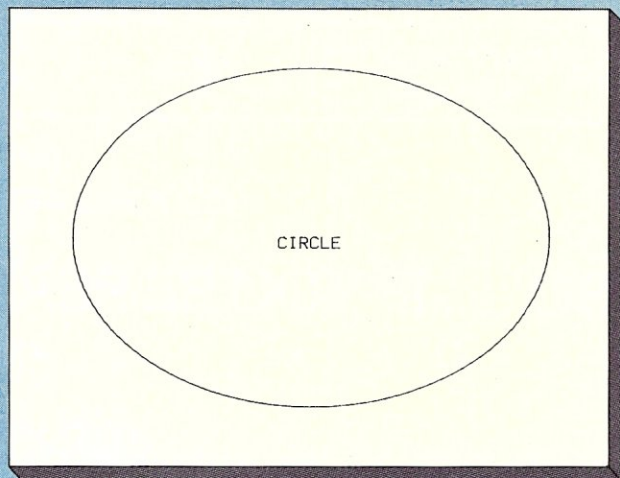


Figure 4. Circle in Figure 3 redrawn using the plotter's default, which makes a user unit on the x axis larger than one on the y axis.

HP-GL commands can also be generated on non-HP computers by using PRINT statements.

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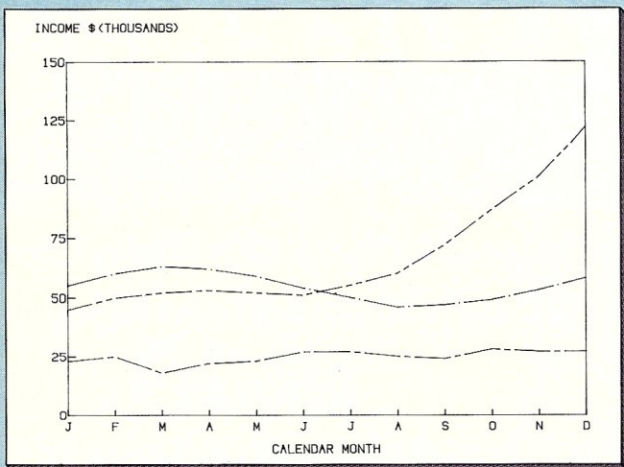


Figure 5. Plot produced by the program given in Listing 3.

line types 4 through 6. These line types are preprogrammed. There are 6 of them. The first parameter of the "LT" command specifies the line type, while the second specifies the pattern repeat length as a percentage of the diagonal distance between P1 and P2. Lines 1490 through 1550 plot the data. Again I have spread one HP-GL Plot Absolute command over three Basic PRINT statements.

One more note. As I developed the programs in the

listings, the plots would frequently go awry. The best indication that things were not going as they should be was a flashing error light on the 7470A control panel. When this happened, I would note where in the plot the error occurred and would then redirect the PRINT statements from the suspect program lines to my screen. Then I could see what the computer was actually sending to the plotter.

Usually, the problem was caused by the automatic formatting of the numeric parameters by the PRINT statement. For example, when a number becomes small enough, the PRINT statement switches from fixed-point format to floating point, which gives the plotter indigestion. That is the reason you find PRINT USING statements for numeric output in my programs.

Because of HP-GL's ASCII orientation, this type of troubleshooting is easy to do. Simply print the offending output and compare it to the syntax diagram of Figure 1 to find your problem.

Some final words

I hope that these two simple programs have shown how simple it is to produce very fine graphic output with your computer and HP-GL. There are many commands we haven't covered. The 7470A has 42 HP-GL commands for plotting, and the RS-232C version adds 14 escape sequences to control the interface. Larger HP plotters have even more commands. If you want or need graphics, HP-GL may just be your ticket. □

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 CIRCLE 32 ON READER SERVICE CARD

Listing 1

```

1000 REM *****
1010 REM
1020 REM DRAW A CIRCLE USING HP-GL COMMANDS
1030 REM
1040 REM   ADAPTED FROM HP BASIC TO IBM/MICROSOFT BASIC BY
1050 REM   STEVE LEIBSON   JANUARY 30, 1983
1060 REM
1070 REM *****
1080 REM
1090 REM FIRST, CONNECT BASIC TO THE SERIAL PORT
1100 OPEN "COM1:9600,N,8,1,CS10000,DS10000,LF" AS #1
1110 REM
1120 REM INITIALIZE PLOTTER, SET LOWER LEFT, UPPER RIGHT AND SCALE
1130 PRINT #1,"IN;IP2000,1000,8000,7000;SP1;SC -2,2,-2,2;"
1140 REM
1150 REM NOW DRAW THE CIRCLE
1160 REM
1170 DEFSNG X,Y
1180 PI=3.1416
1190 FOR T=0 TO 2*PI+.1 STEP PI/60
1200   X=COS(T)
1210   Y=SIN(T)
1220 PRINT #1,"PA";
1230 PRINT #1,USING "###.###";X;Y;
1240 PRINT #1,"PD"
1250 NEXT T
1260 REM NOW FOR A NICE LABEL
1270 PRINT #1,"SI.19 .27;"
1280 PRINT #1,"PA PU 0 0;"
1290 PRINT #1,"CP -3 -.5;"
1300 PRINT #1,"LBCIRCLE",CHR$(3);
1310 PRINT #1,"SP0;"
1320 END

```

Listing 2

```

1130 PRINT #1,"IN;SP1;SC -2,2,-2,2;"

```

Listing 3

```

1000 REM *****
1010 REM
1020 REM MAKE A PLOT USING HP-GL COMMANDS
1030 REM
1040 REM   ADAPTED FROM HP BASIC TO IBM/MICROSOFT BASIC BY
1050 REM   STEVE LEIBSON   JANUARY 30, 1983
1060 REM
1070 REM *****
1080 REM
1090 REM FIRST, CONNECT BASIC TO THE SERIAL PORT
1100 OPEN "COM1:9600,N,8,1,CS10000,DS10000,LF" AS #1
1110 REM

```

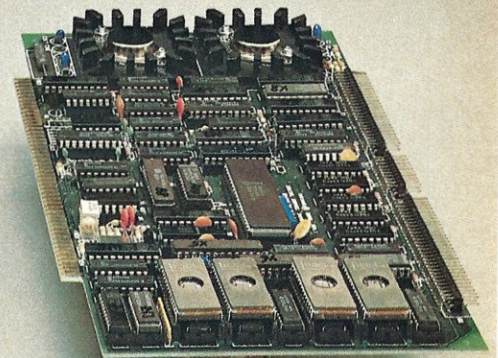
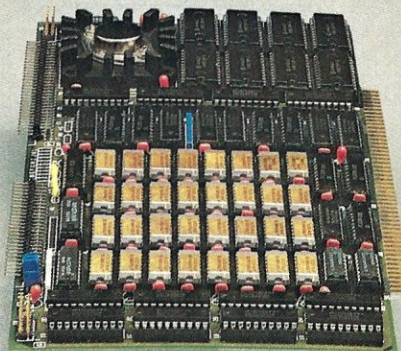
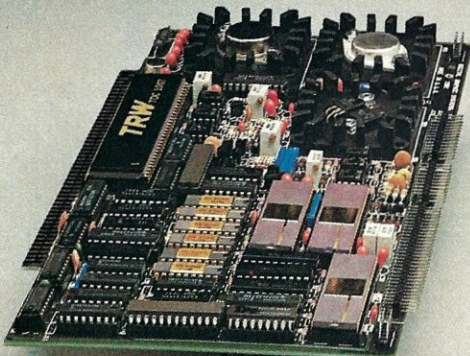
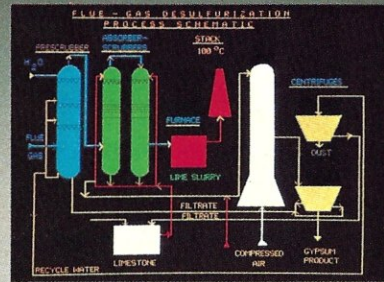
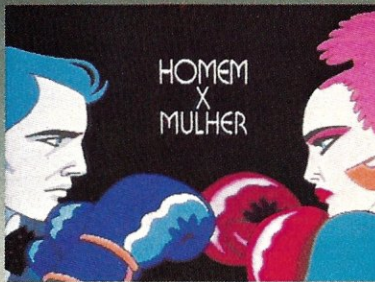
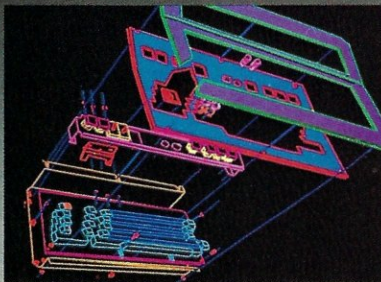
```

1120 REM INITIALIZE THE PLOTTER AND DRAW THE AXES
1130 REM
1140 PRINT #1,"IN;SP1;IP1250,750,9250,6250;"
1150 PRINT #1,"SC1,12,0,150;"
1160 PRINT #1,"PA 1,0 PD 12,0 12,150 1,150 1,0 PU;"
1170 REM
1180 REM LABEL THE X-AXIS
1190 REM
1200 PRINT #1,"SI.2,.3;TL1.5,0;"
1210 FOR X=1 TO 12
1220   PRINT #1,"PA ";
1230   PRINT #1,USING "###";X;0;
1240   PRINT #1," XT;"
1250   READ A$
1260   PRINT #1,"CP-.33,-1;LB";A$;CHR$(3)
1270 NEXT X
1280 PRINT #1,"PA6.5,0;CP-7,-2.5;LBCALENDAR MONTH";CHR$(3)
1290 DATA "J","F","M","A","M","J","J","A","S","O","N","D"
1300 REM
1310 REM AND NOW THE Y-AXIS
1320 REM
1330 FOR Y=0 TO 150 STEP 25
1340   PRINT #1,"PA 1,"Y,"YT;"
1350   PRINT #1,"CP-4,-.25;LB";
1360   PRINT #1,USING "####";Y;
1370   PRINT #1,CHR$(3)
1380 NEXT Y
1390 PRINT #1,"PA1,150;CP-4,2;LBINCOME $";CHR$(3);CP -9,-1;"
1400 PRINT #1,"LB(THOUSANDS)";CHR$(3)
1410 REM FINALLY, PLOT SOME DATA
1420 REM
1430 PRINT #1,"LT3;"
1440 FOR P=4 TO 6
1450   PRINT #1,"LT";
1460   PRINT #1,USING "###";P;
1470   PRINT #1,"8;"
1480   PRINT #1,"PU"
1490   FOR X=1 TO 12
1500     READ Y
1510     PRINT #1,"PA";
1520     PRINT #1,USING "####";X;Y;
1530     PRINT #1,"PD"
1540   NEXT X
1550 NEXT P
1560 PRINT #1,"SP;"
1570 DATA 55,60,63,62,59,54,50,46,47,49,53,58
1580 DATA 23,25,18,22,23,27,27,25,24,28,27,27
1590 DATA 45,50,52,53,52,51,55,60,72,87,101,122
1600 END

```


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What You See Is What You Get.

CIRCLE 249 ON READER SERVICE CARD

A Laboratory Application of Microcomputer Graphics

by Kalle B. Gehring and John W. Moore

In the summer of 1980 we developed a Pascal graphics and instrument interface program for one of our Z80/S-100 based microcomputers. The computer interfaces to a stopped-flow spectrophotometer and replaces a storage oscilloscope and polaroid camera. A TV monitor connected to a set of Cambridge Development Laboratory (CDL) graphics boards displays kinetic traces, experimental parameters, and the results of analysis.

The stopped-flow interface (Figure 1) shows the value of having a computer graphics system connected to a laboratory instrument. Although data points can be read by the computer without the graphics system, the user has no way of knowing whether the data is valid. The graphical representation of the kinetic traces allows users to evaluate the experiment

as it progresses and to correct experimental errors before they are saved for analysis. In our stopped-flow interface it is also necessary to see the kinetic trace in order to decide what part of the trace should be used for the analysis. Our system uses a lightpen to read the endpoints used in analysis from the TV screen.

Besides simply replacing an oscilloscope, the interface program provides permanent storage of the kinetic traces that can later be recalled on the TV monitor. A second program performs a least-squares analysis on the traces to find the kinetic rate constants. Previously kinetic traces were digitized by hand from a polaroid photograph and entered into a hand-held calculator for analysis. The computer interface not only provides greater throughput, but digitizes the kinetic traces more accurately and can statistically combine the results of several hours of data collection.

A stopped-flow spectrophotometer measures the rate of a chemical reaction from the rate of disap-

Kalle B. Gehring and John W. Moore, Chemistry Dept., Eastern Michigan University, Ypsilanti, MI 48197

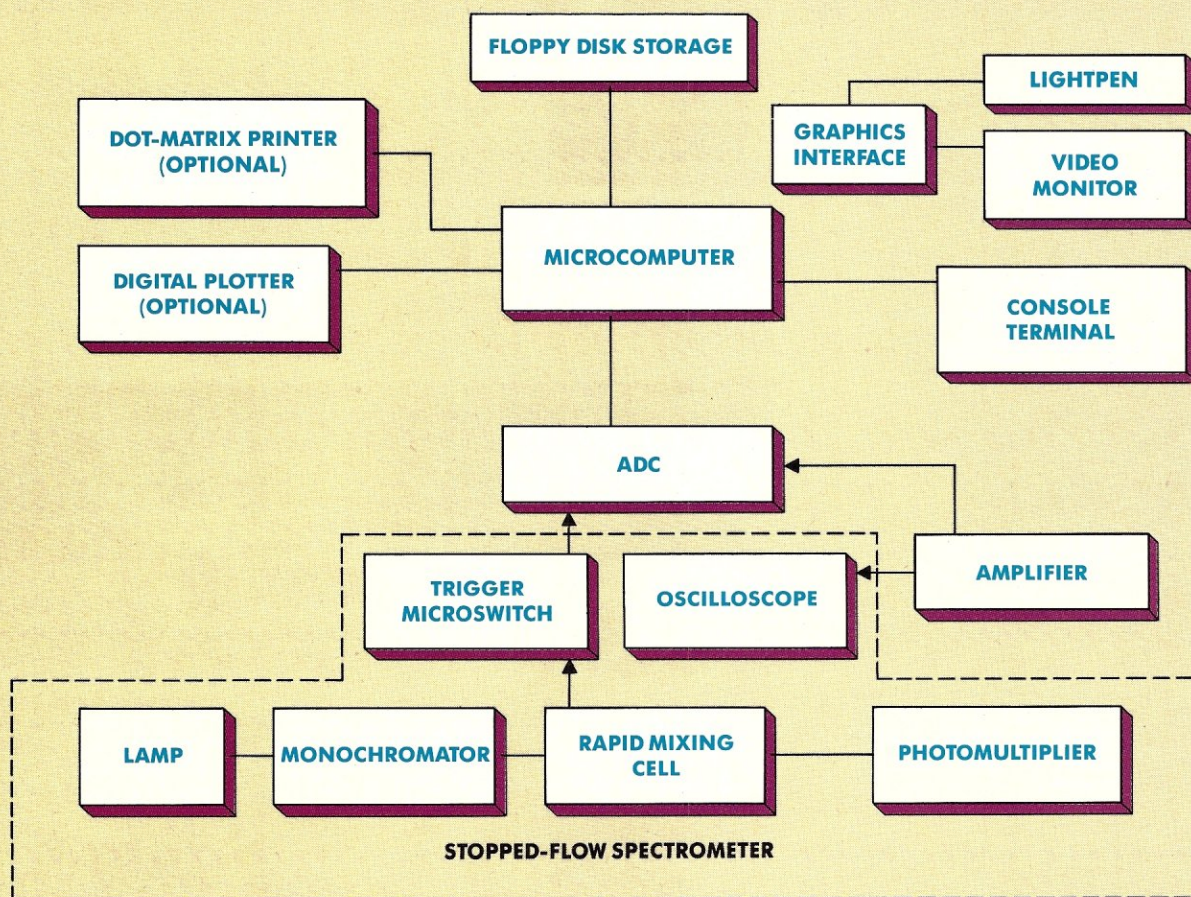


Figure 1. Block diagram of a microcomputer-interfaced stopped-flow spectrophotometer.

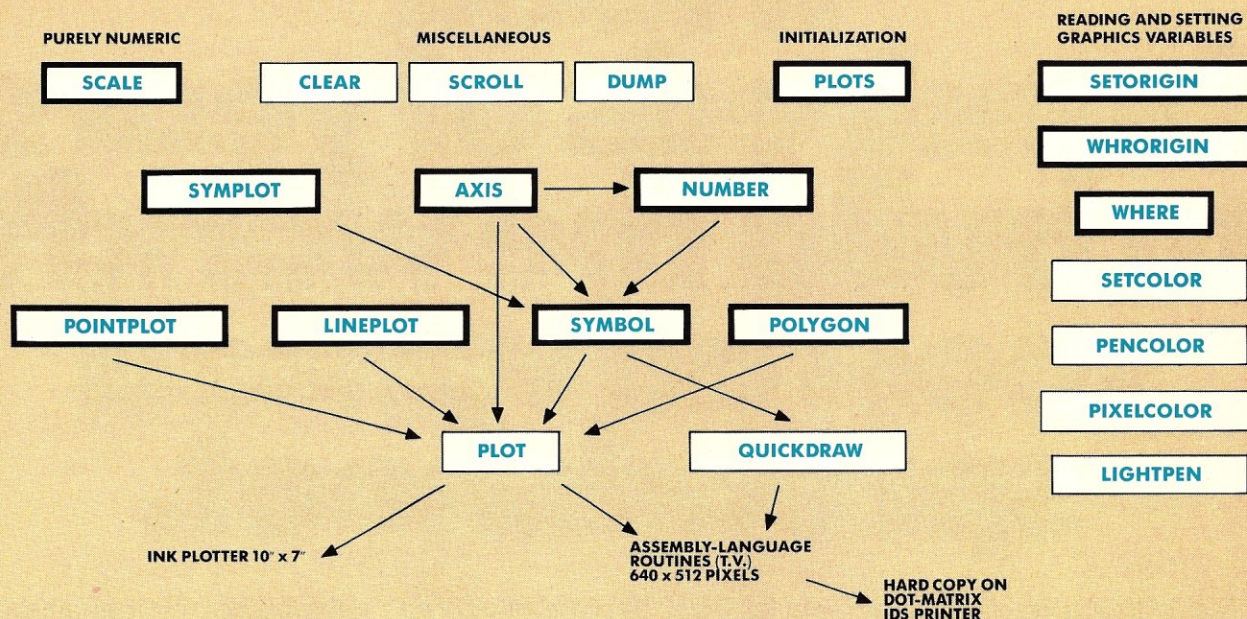


Figure 2. Flowchart of the graphics subroutines. Boldface routines use both the TV graphics boards and the plotter. Except for QUICKDRAW, all the functions draw lines by calling PLOT, which allows programs to preview plots on the TV monitor before plotting. This software is available for a nominal fee through the USUS library. The figure was drawn by a HIPLLOT ink plotter.

pearance or appearance of a colored reactant. In the stopped-flow apparatus, two solutions flow through a Y-shaped tube, where they mix and start to react. At the bottom of the Y tube is an observation cell and a photomultiplier tube. The time course of the reaction is studied by abruptly stopping the flow, so that instead of flowing out of the tube the solutions react in the observation cell. Our spectrophotometer, a Beckman DU monochromator, is connected to a linear-log photometer that provides a 10V signal that reflects the intensity of light passing through the reacting solution. This voltage signal is digitized by a multi-channel Tecmar analog-to-digital (ADC) board connected to the S-100 bus of the Z80. When the flowing solutions are stopped, the stopped-flow apparatus closes a circuit to signal the computer to start the kinetic trace. The ADC board polls this circuit and starts converting the photometer signal when the circuit is closed.

Our system was developed using UCSD Adaptable Pascal II.0 (see the November 1982 *Microsystems* for a description of implementing UCSD Pascal on our system). UCSD Pascal provides an editor, linker, and Z80 assembler as well as the Pascal compiler and p-machine. The graphics software is in a UCSD Pascal Unit that allows the graphics subroutines to be compiled separately from the interface programs. This allowed the graphics subroutines to be written before the interface program and allows the graphics system to be used by other application

programs. A set of Z80 assembler routines are associated with the Graphics Unit for the low-level control of the graphics boards. The two interface programs, Data Collection and Data Analysis, are both Pascal programs that call procedures in the Graphics Unit. The Data Collection program also calls an assembly-language routine to do the time-critical analog-to-digital conversions.

The Graphics Unit was developed along the lines of the Fortran Calcomp plotting routines. The software was originally written for a Houston Instruments digital plotter and was later upgraded for the TV boards. Programs can switch easily between the plotter and TV monitor because output from the Graphics Unit is funnelled through one subroutine, PLOT. PLOT chooses to draw on the plotter or to call an assembly-language subroutine to draw on the TV monitor. The stopped-flow interface does not use the plotter because of the availability of hard copy of the TV screen on a dot-matrix printer. Both the Data Collection and Analysis programs allow the experimenter to save a picture of the kinetic trace by calling (through the Graphics Unit) the assembly-language subroutine that scans the graphics boards memory and prints it on an Integral Data Systems (IDS) 445 printer. Figure 2 shows a flowchart of the Pascal subroutines in the Graphics Unit. The higher-level subroutines draw graphs and text, while the lower-level routines draw lines, clear the screen, and read variables from the graphics boards.

Graphical representation of the kinetic traces allows users to evaluate the experiment as it progresses and correct experimental errors before they are saved for analysis.

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1981

1534

1540 Adi ultimo Feb

194	Pro & danno // A doni uarij, per da tratto in resto, per saldo di quello d'...
195	Pro & danno // A Spese de uiuer di spese fatte, come in esse appar, per saldo 154 d 20 P 14
196	Fitti della possession da Moian // A per fito di quella per l'anno presente, 1541, per saldo de quelli d' 45 d
197	Pro & danno // A Spese diuerse per l'anno presente, come in esse appar, per 399 d 12 P
198	Pro & danno // A Spese de salariadi piu spese fatte l'anno presente, come in per saldo di quelle d' 48 d 12 P
199	Pro de zeccha in monte // A Pro & d lita seguida, come in quello appar, per 150 d P
200	Pro et danno // A Cauedal de mi Alui per utilita seguida de l'anno 1540, per saldo di quello, d' 900 d 22 P

1979

STATEMENT				
	JAN	FEB	MAR	
SALES	1000	1100	121	
COST	300	330	363	
GROSS	700	770	847	
R & D	160	176	194	
MARKETING	200	224	251	
ADMIN.	140	151	163	
TOTAL	500	551	608	
INCOME	200	219	239	
TAXES	80	88	96	
NET	120	131	143	

INCOME STATEMENT	
NET SALES	1000
COST OF GOODS SOLD	300
GROSS PROFIT	700
RESEARCH & DEVELOPMENT	160
MARKETING	200
ADMINISTRATIVE	140
TOTAL OPERATING EXPENSES	500
INCOME BEFORE TAXES	200
INCOME TAXES	80
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Payroll Start Date	4/ 1/83			Fica	6.700%		
Days this period	15			SDI	.8%		
Recalculate YTD Y/N ?	N			User-set decimal places.			
Emp#	Employee name	Status	Gross Salary	Total Deduct	Net Pay	YTD Gross	
34	Adams	M	\$1,100.00	(\$82.50)	\$1,017.50	\$6,200.00	
49	Bequette	S	\$750.00	(\$56.25)	\$693.75	\$5,250.00	
84	Johnson	S	\$850.00	(\$63.75)	\$786.25	\$5,950.00	
92	Jones	M	\$900.00	(\$67.50)	\$832.50	\$6,300.00	
12	Samson	S	\$560.00	(\$42.00)	\$518.00	\$3,920.00	
19	Santos	M	\$650.00	(\$48.75)	\$601.25	\$4,550.00	
45	Smith	S	\$700.00	(\$52.50)	\$647.50	\$4,900.00	
Total # employees		7	Floating \$ signs.		Embedded commas.		
Total Gross Salaries (100's)			\$55.1	Negative numbers in ().			
Total Deductions (100's)			\$-4.1	Numbers in 100s or 1000s.			
Total Net Pay (100's)			\$51.0	Arrange reports numerically or alphabetically, like this			

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CIRCLE 57 ON READER SERVICE CARD

Microcomputer Graphics continued. . .

Both the interface programs are menu-driven in much the same way as UCSD Pascal. At each point in the program the top line of the console presents the available commands, and the user types just the first character to select a command. An inexperienced user is guided through the experimental procedure by the order of the available commands.

The Data Collection program emulates the oscilloscope screen through the CDL graphics boards and presents prompts on the console. In the experimental procedure, the photometer is first calibrated with 0% and 100% transmittance through the reaction cell. After a sweep speed is selected the computer waits for a signal from the stopped-flow apparatus that the reaction is starting and then records 101 conversions of the reaction trace. The 0%, 100%, and kinetic traces as well as the experimental parameters are displayed by the Graphics Unit on the TV monitor (Figure 3). After each kinetic trace the user is given the option of saving the trace as part of a disk file, discarding it, or printing it on an IDS dot-matrix printer connected to the graphic system.

The actual A to D conversions are done by a Tecmar multichannel ADC board with 12-bit resolution. It is controlled and read by a Z80 assembler routine that uses an interrupt timer on a Cromemco TU-ART board to provide accurate timing. A to D conversions are initiated at rates from 5000 hertz to 20 hertz. Since each kinetic trace is sampled at 101 points, reactions occurring in 20 milliseconds to 5 seconds can be studied.

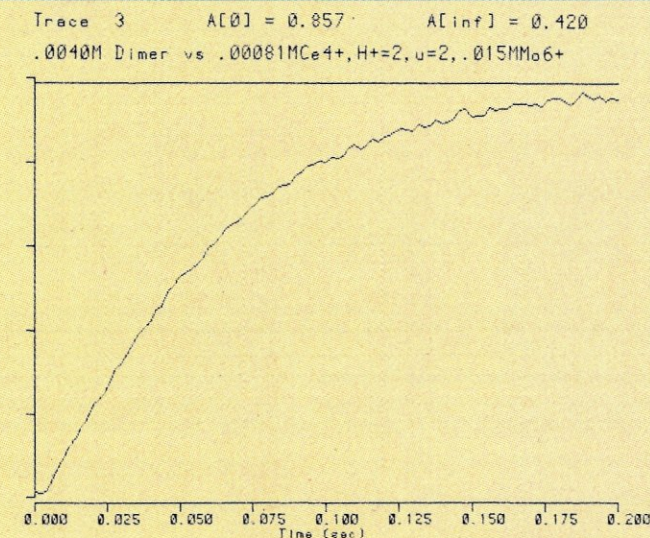


Figure 3. Example kinetic trace from an experiment. The TV screen was "DUMPed" to the dot-matrix printer, a process that takes about 2½ minutes. The axes are absorbance versus time. Two traces are shown: the top one is the final ($t = \infty$) absorbance, and the lower trace is the change in absorbance during the reaction.

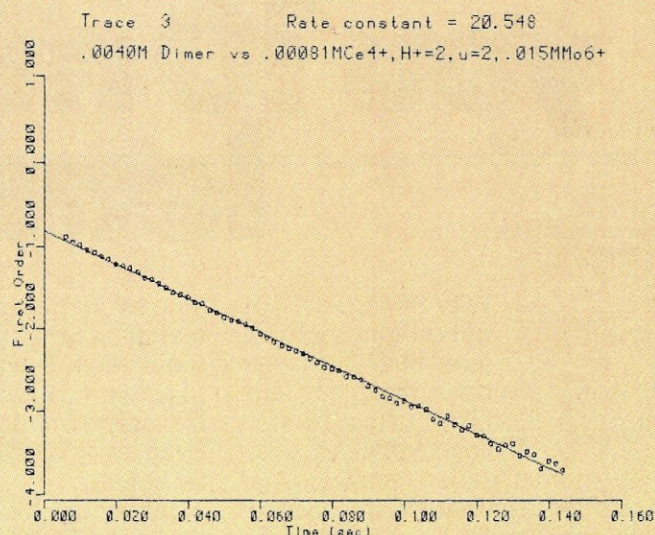


Figure 4. Sample kinetic analysis. The data from the previous figure were analyzed and a rate constant determined; this figure shows the data points and the line of best fit as displayed on the TV monitor. (The second line of text above the trace is a description of the experiment.)

The Analysis program is run after data collection is complete. It reads kinetic traces previously saved as disk files and performs an analysis according to either first- or second-order reaction kinetics. A graph of the data and a line of best fit is displayed on the TV monitor and can be printed. Figure 4 shows a sample graph. At the end of the analysis the kinetic rate constants of several traces can be weighted-averaged and a table of the results saved on disk. In addition to the menu-style input from the console, the Analysis program uses a lightpen connected to the CDL graphics boards to select the section of the kinetic trace to be analyzed.

Our graphics software (with documentation) is available in a variety of disk formats for a small distribution fee through UCSD Pascal User's Group (USUS) library. Write to the USUS library, care of Dr. James Gagne, Datamed Research, 1433 Roscomare Rd., Los Angeles, CA 90024, (213) 472-8825. Anyone interested in obtaining a listing of our two interface programs should write to us.


Our TV graphics hardware consists of a set of three Cambridge Development Laboratory graphics boards. The boards contain all of the graphics memory for 512 x 640 pixels and provide a composite video signal for a TV monitor. The boards are controlled through eight I/O ports that implement a number of powerful hardware functions. For displaying text, a screen-scrolling function and a specialized "byte writing" function are available. For our purposes, we were pleased by the high speed of the boards and special features such as the lightpen that can read a po-

The CDL graphics boards and the Tecmar ADC board have worked without any problems, transforming our Z80/S-100 computer into an advanced digital storage oscilloscope.

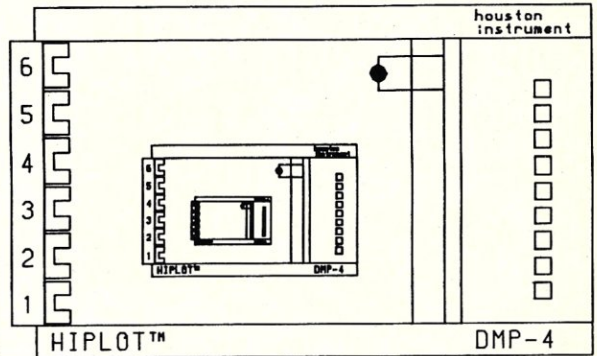
Microcomputer Graphics continued.

sition from the TV monitor. Up to 16 colors are available with the CDL boards, but this entails purchasing three additional boards for the necessary graphics memory.

The Houston Instruments HILOT digital plotter is 10" by 7" flatbed ink plotter. It is connected to the computer through a 4800-baud serial port that sends 11 different ASCII characters to control the pen movements. The plotter has a maximum resolution of 200 steps per inch and a maximum speed of 480 steps per second. Our plotter has worked very well connected to the graphics software, although it is not used by the stopped-flow interface. Figure 2 shows the high quality of drawings possible with this inexpensive plotter.

The stopped-flow spectrophotometer interface has been in operation for more than two years with very good results. The CDL graphics boards and the Tecmar ADC board have worked without any problems and have transformed our Z80/S-100 computer into advanced digital storage oscilloscope. The high-resolution graphics displays the experimental data collected from the ADC board, and, with the lightpen, provides an easy means of entering parameters used in the data analysis. Experiments can be saved on 8" floppy disks for permanent storage, and the graphics boards memory can be printed to give hard-copy graphs of kinetic traces and analyses. To borrow a chemist's term, the rate limiting step in the laboratory is no longer the analysis of the experiments, but preparing and doing the experiments. 

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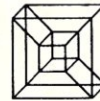


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QCAL includes (at \$295 on 8" SD diskette) user's manual, sample programs, relative object code for the emulated calls, source for fonts (7 alphabets for USA and Western Europe), and source for one sample graphics device driver. Available choices are HILOT(tm), Watanabe(tm), and NEC Spinwriter(tm). Custom fonts and drivers are easily created using supplied documentation.

QCAL was featured in the US exhibit at "Europe Software 82", The Netherlands. It is now in use around the world.

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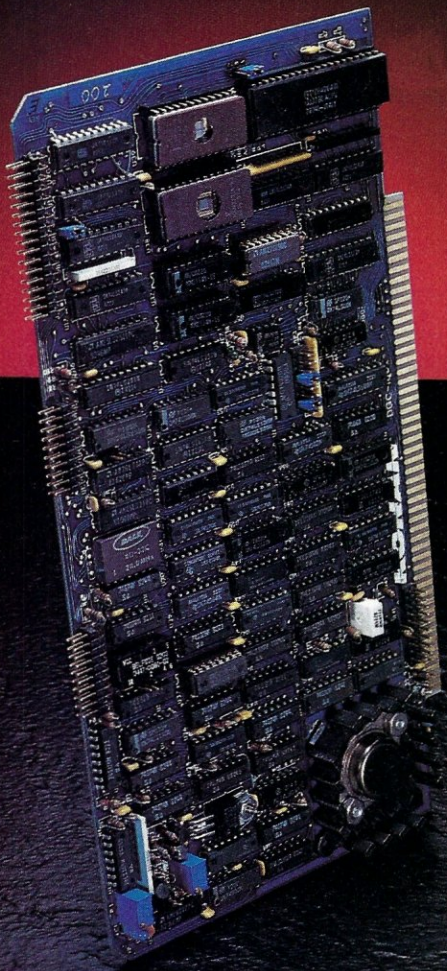


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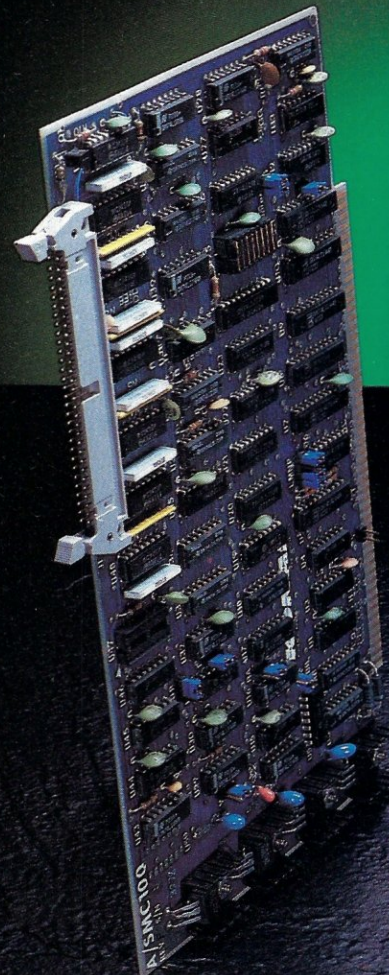
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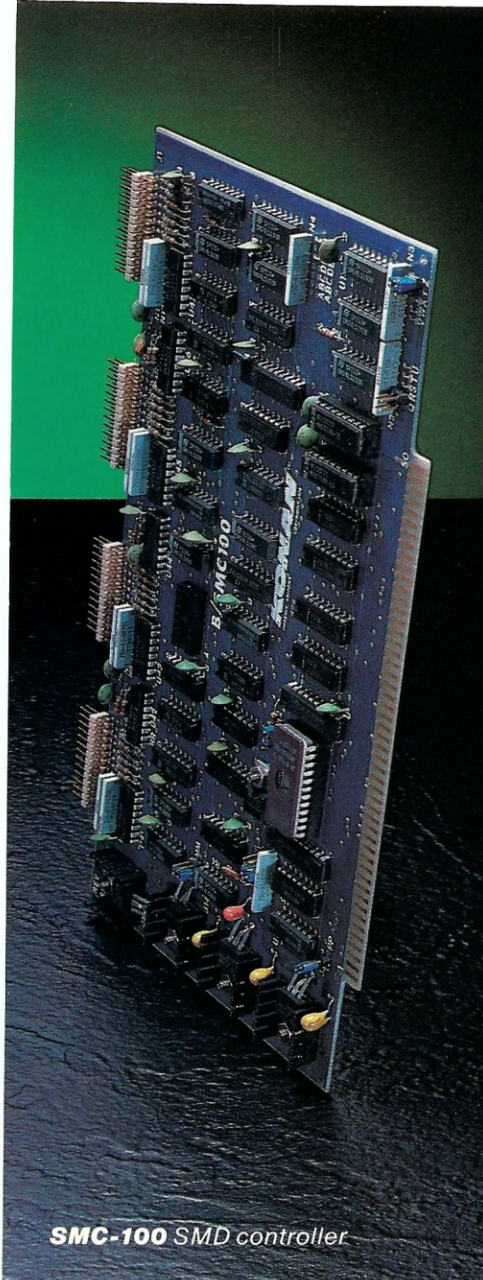
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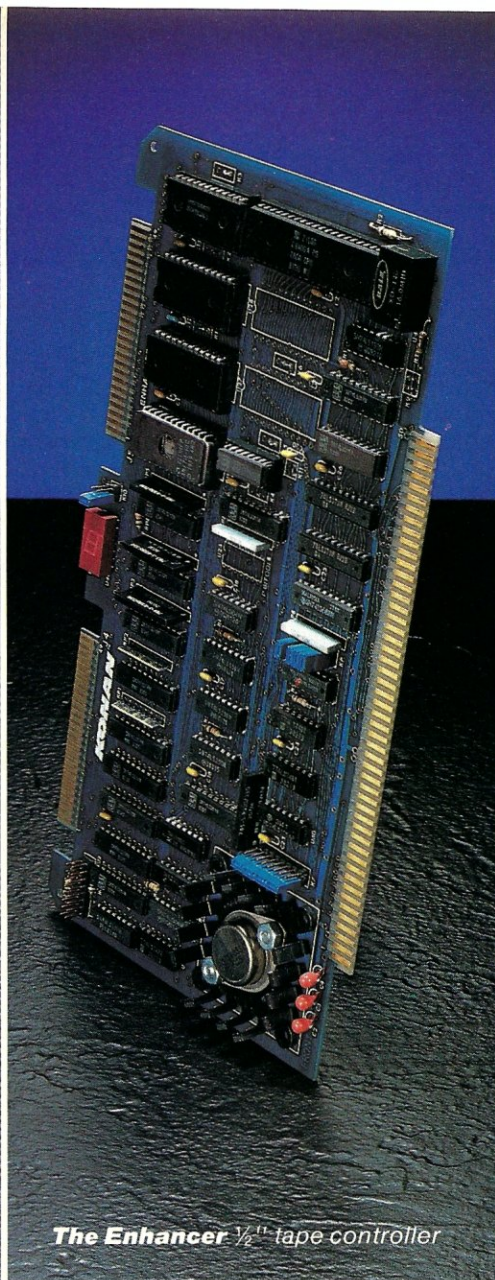
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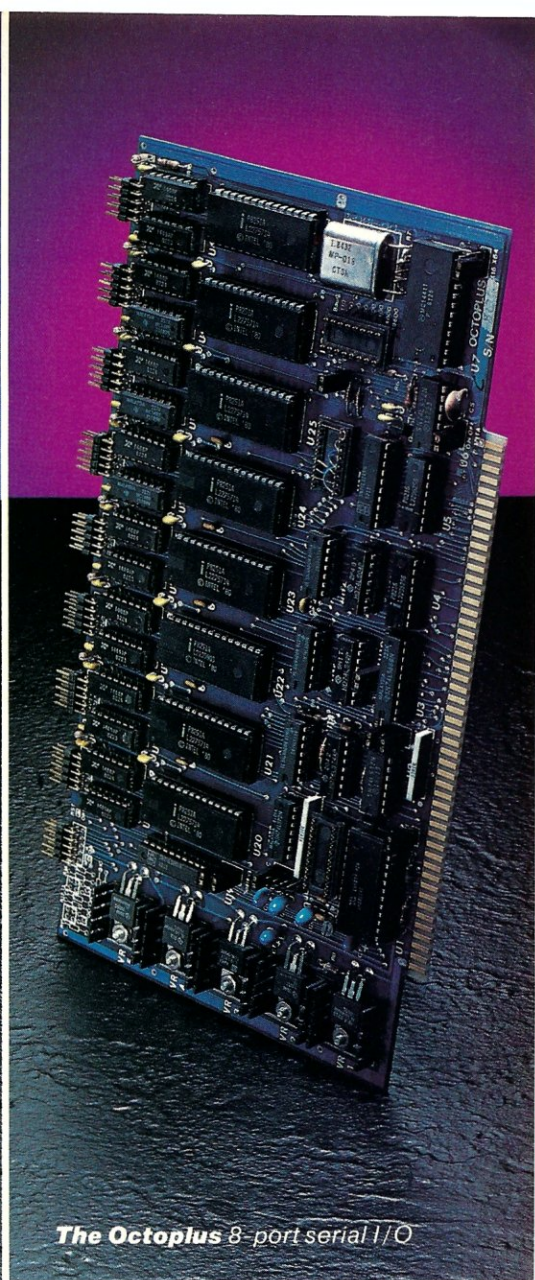
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GrafTalk

A graphics package for producing pie, bar, and line plot graphs

by Joseph W. Long

GrafTalk is a business-oriented graphics package which can be used to produce pie, bar, and line plot graphs. It is intended for a wide range of users: Both people with relatively little computer knowledge and experienced graphics programmers can easily and profitably use GrafTalk. GrafTalk is a superb package: it is easy to install, easy to use, beautifully documented and very powerful. Using its extensive tutorial, it is possible to produce graphs within a few minutes of installing it. Exploring all of the power of GrafTalk will take some time, but it's an enjoyable process because of the very high quality of the documentation and the extreme power of the package.

It should be possible to run GrafTalk on nearly any CP/M-based system that drives a graphics device through a serial or parallel output port. Systems using special graphics boards or memory-mapped graphics may or may not work with GrafTalk. For this type of system it would be a good idea to contact Redding Group, Inc., before you buy. At this time, only seven systems (Altos—all models, Radio Shack Model II, Xerox 820 Superbrain I, North Star Advantage, IBM PC with Baby Blue board, Zilog MCZ-2 plus directions for any Z80 computer with an SIO, 8251 or 2661 chip) are supported in the sense that specific directions are included for them with GrafTalk. My system (Horizon, ADM3 + RG512 Graphics, DMP4) was quite easy to get going, but again, I would suggest contacting Redding Group before you buy to avoid any surprises.

Installation

I installed GrafTalk correctly the first time I attempted it, using the "INSTALL" program which, together with the documentation provided, makes the installation quite straightforward. The installation documentation is adequate, but does not have the high polish of the rest of the package. A person with little or no microcomputer experience might have some problems trying to follow the INSTALL documentation.

The installation program is menu-driven and allows the installation of a console device, up to three graphics devices and, in addition, changing of various default settings (more on these default settings later). GrafTalk supports a number of video terminals and a variety of graphics hardware, including video graphics devices, digital plotters, and printers with graphics capabilities (see Table 1).

The documentation includes an example installation dialog, but it is placed at the end of the installation manual, and I must confess that I didn't find it until I had successfully completed installing my terminal and video graphics. My first attempt at instal-

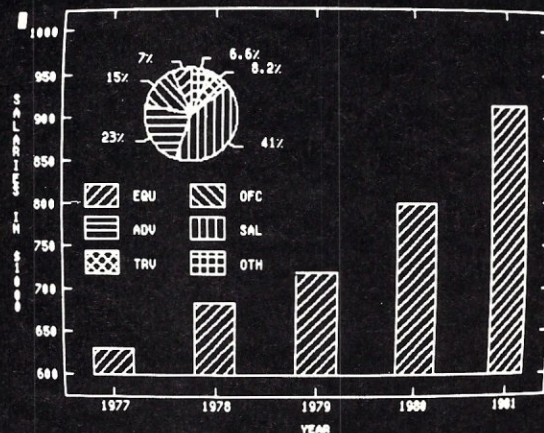
lation led to the sign on prompt and a "FOR HELP TYPE HELP" message, but no keyboard response, so I redid the installation with the same result. The problem is that GrafTalk needs about 10 seconds after the prompt appears to bring itself all the way up. After my third try I went for coffee, and when I returned everything was working. Ten seconds seems like forever when you are bringing up new software! This delay is not mentioned in the documentation.

Structure

GrafTalk operates in two modes. There is a command processor and a text editor. The command processor allows you to run graphics programs created using the text editor. A variety of utility type commands is also available in the command mode for clearing video graphics, clearing the terminal screen, switching plotters, etc. These are all mnemonic two-letter commands that are easy to remember.

There is an extensive HELP file which I found myself gradually relying on more and more—it is often quicker than looking in the manual if you don't need a detailed explanation. A powerful feature included in the command mode is that almost all of the graphics commands used to create graphs are available in the command mode. This means that plots can be made interactively, so it is very easy to quickly explore the graphics commands and what they do. This capability, along with the outstanding tutorials in the manual, make learning GrafTalk a pleasure.

The text editor included with GrafTalk is an excellent piece of software. It is video oriented and has a command/status line across the bottom of the screen. I found it very easy to adapt to (I use WordMaster for most text editing). The editor is a subset of a larger editor called "SCATE" marketed by Redding Group. I intend to look into SCATE further because I am highly pleased with the portion included with GrafTalk. The editor allows two workspaces, so that



A video plot of one of the sample programs from the tutorial.

Joseph W. Long, Dept. of Chemistry, Broome Community College, Binghamton, NY 13902

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HP 7220, 7225, 7221, 7470
CALCOMP 81
GOERZ 281
STROBE 100
WATANABE 4675
IBM XY/750

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(Tektronix 4010 Compatible)

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- * ADM 3A, 3A+, 5
ID-100
MICROANGELO MA512
TAB 132/15-G w/TB600 board
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920, 925, 950
- * VT 100
- * VT 132

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NEC 3510, 3520, 5510, 5520, 7510,
7520
Paper Tiger IDS 460
Epson, MX80, MX100
Diablo 1640, 1650, 630
IDS PRISM

Graphics Printers

Diablo 1640, 1650, 630
NEC

TABLE I
GRAPHICS DEVICES SUPPORTED

*These screens require retrofits from Digital Engineering, Datatype and/or Selanar.

two graphics programs may be worked on at the same time, which I often found to be convenient in developing new programs. Working with the editor is very easy because the program currently in the workspace can be executed using a simple escape command. After the program is executed you are automatically returned to the edit mode, ready to continue development. If you go to the command mode and then re-enter the editor, the program in the work space is still there, ready to go.

You can use SCATE as a text editor for non-graphics work: I was able to write a Basic program, leave GrafTalk, and load and run the program using Microsoft Basic. You cannot use the editor without loading GrafTalk first, but I think of this capability as a nice little "free bonus." Also, GrafTalk can read files created with other text editors, which could be very helpful if you have large data files, since they may not have to be retyped.

Using GrafTalk

Producing graphs with GrafTalk is child's play. All

plotting parameters have default values, so that a graph can be produced with very few commands. Many of the default settings will of course not produce the graph that you want, but you do have a firm place to start in learning to get exactly what you are after. I think that this feature is one which makes GrafTalk such a beautiful package.

To produce a graph, GrafTalk needs some data, which can be entered in the immediate (i.e., command) mode (see Listing 1) or put in a disk file via the text editor. The command "PIE R2" will produce a pie graph of the data in row 2 of the data (Figure 1). The commands "BAR R2 R1" and "PLOT C2 C3 VS C1" produce the plots in Figures 2 and 3.

From this simple start, GrafTalk will do as much for you as you are willing to learn. Everything can be changed, in nearly any way you might like. Titles, axis names, tick mark names, and any other alphanumeric labeling in any position are easy to add. The size of the plot may be changed and positioned anywhere on the plotting surface. The automatic scaling of data can be defeated and the number and position

Intended for a wide range of users, GrafTalk is a superb package: easy to install, easy to use, beautifully documented, and very powerful.

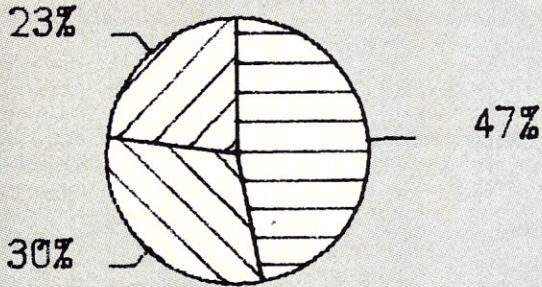


FIGURE 1

Note: The plots in Figures 1-3 were done using GrafTalk's "REGION" command, which controls the size and position of a graph on the plotting surface, and the "TEXT" command for lettering.

of tick marks can be specified. The sequence of shading patterns and the patterns themselves can be varied. Even the size and aspect ratios of alphanumeric text can be changed. Colors are supported for devices with that capability, and color sequences may be varied or defeated. The list is endless.

As I mentioned above, this is a very powerful package indeed. All of the above graphing parameters and many more are available and easy to use because of the tutorial examples, most of which are illustrated, and the reference documentation, where each command is thoroughly explained. One could really learn to use the package by ordering the manual only and carefully going through the tutorial and reference sections.

An especially useful feature of GrafTalk is that a plot may be rapidly developed using a video graphics device; then, when everything is just the way you want it, hard copy may be run on a plotter or graphics printer. Having available a fast video graphics display is of great help in quickly developing a plot. I would hate to have to do all of my plotting development using just the digital plotter, although most GrafTalk users seem to do it that way.

If you do have only a digital plotter, there is the one out that GrafTalk provides. You can set the plotting area to be quite small during the development process, and when the graph is correct you can reset the plot size. Because of the area effect, cutting the plot size to one third speeds up plotting by a factor of almost 10.

GrafTalk provides several ways to control the size and position of a graph on the plotting surface. The "REGION" command causes a cursor to appear on the graphics device, which can be moved to the position you want to be the lower left limit. You then move the cursor to the upper right limit, and all subsequent plotting will be done in that area. There is

even a hi-low speed feature for this movement. A similar mode, "JOYSTICK", allows you to position titles, legends, and other text where you want, if the default locations are not right.

GrafTalk has other even more powerful ways of setting plot sizes: there are three graphics coordinate systems: NORMALIZED, WORLD, and USER. There are also USER and WORLD WINDOWS which I won't attempt to explain further here, as they are somewhat complicated. The manual has an explanation in this section entitled "Notes to the hopelessly confused," which is encouraging since this material is covered in a section labeled "Advanced Plotting Methods," and many users of GrafTalk will probably never have need of these commands. Still, they are there for those who want them.

Data files may contain up to three ignored characters. This means that dollar signs, commas, and % signs (these are the default characters and can be changed) will be ignored: \$23,000 and 14.05% are read as 23000 and 14.05 by GrafTalk (see Listing 2). It should be possible to use many existing data files without modifying them to be readable by GrafTalk. GrafTalk has a "MARKER" command that allows data files to be broken up into sections; a program can access data in any desired section. Data files may contain up to 20 rows (35 rows in version 2.0, released in April 1983) and an "unlimited" number of columns. With more than 20 (35) rows, however, data can be plotted only as columns.

Another highly useful feature is a marker that allows you to mark a beginning and endpoint in a program you are developing—only the program state-

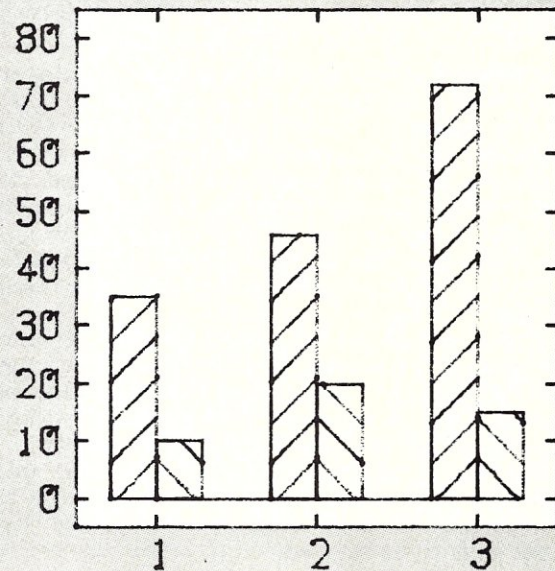


FIGURE 2

GrafTalk's text editor allows two workspaces, so that two graphics programs may be worked on at the same time. This is a convenient feature for developing new programs.

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ments positioned inside the limits chosen will be executed. This can really speed up development.

There is one aspect of GrafTalk that takes a little getting used to. A lot of plotting information (titles, for example) is stored in disk files. These files are not cleared when a new plot is run. This means that if you run a plot from a command file, then run another command file without the TITLE instruction, the title from the first file will be drawn on the second plot. The "INITIALIZE" command (which clears all such files) at the beginning of a program will prevent this, as would a "NO TITLE" command in the second plot above. I found this feature rather puzzling and annoying until I figured out what was happening, but after using GrafTalk a lot, I have found that it's very handy.

Scientific plots

Since it is a business-oriented graphics package, I was initially skeptical about whether I would have any real use for GrafTalk beyond playing with it. A little reflection revealed two ways in which the package would be useful within my department (Chemistry). The first use is just for what it was designed. In preparation of our budgets and in other dealings with the college administration, graphical presentation of data for justifying equipment requests and other similar uses will have a great impact and therefore be very helpful to the department. This will be especially advantageous as long as our department alone on the campus has this graphics capability!

My personal interest in graphics is in scientific plotting. Much to my surprise, I have found that it is not difficult to do such work. This is because GrafTalk recognizes data files generated by other software. I was able to write a simple program in Micro-

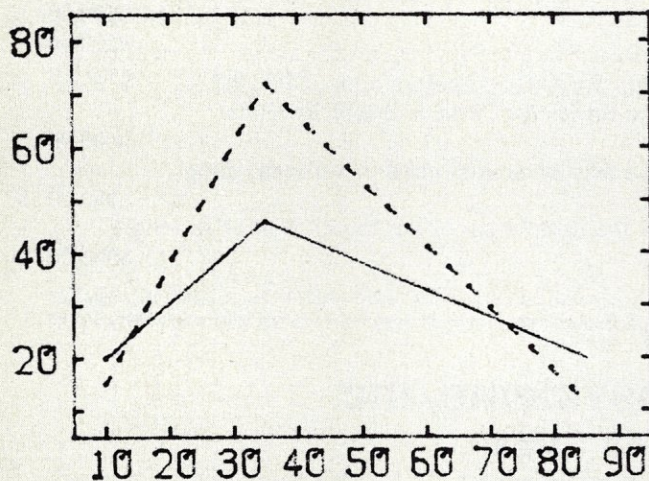
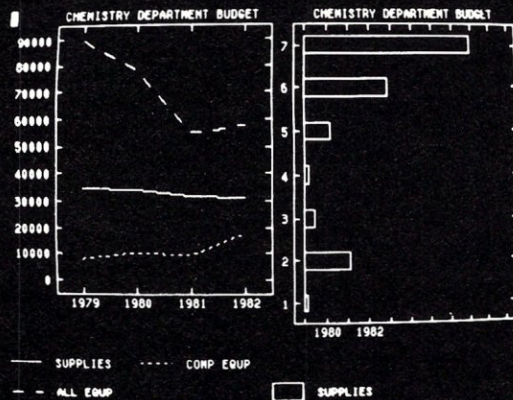


FIGURE 3

Scientific plotting is not difficult to do because GrafTalk recognizes data files generated by other software. Thus data processed for scientific use may be written to a disk file for access by GrafTalk.



A video plot of some of the data from the data file given in Listing 2 (the axes are mislabeled in the left-hand plot).

soft Basic that writes data to a disk file in row column fashion (see Listing 3). A Basic program may take data and process it in ways of interest to physical scientists and engineers: take logs, do curve fits, and so on. The manipulated data may then be written to a disk file for access by GrafTalk. The main disadvantage to this approach is that it is somewhat time-consuming to switch from Basic to GrafTalk and back, but it does work well (see Figure 4).

Comparisons

There is another graphics package called Grafpak (Mycroft Labs, Tallahassee, FL). Despite the similar names, GrafTalk and Grafpak are quite different. GrafTalk is business oriented and is intended for use by applications people who know little about graphics except that they want a plot. Grafpak is a set of Fortran plotting subroutines that are most easily used in scientific plotting and require a good knowledge of Fortran.

The newest versions of Grafpak include programs that generate pie, bar, and line plots automatically, but they are not really in the same league with GrafTalk for business plotting. On the other hand, for scientific plotting, Grafpak is superior, and it also includes a program (EZPLOT.COM) that does interactive scientific plotting. The best solution would be to own both of these packages because of the way they complement one another.

Redding Group also markets "GrafLib," a set of Fortran subroutines that allows you to develop your own graphics software. Although it doesn't say so anywhere, it seems that GrafTalk was written using the routines in the GrafLib package. GrafLib is very different from GrafTalk; it is designed for experienced Fortran programmers only. For example, you cannot use it to quickly patch GrafTalk's capability into Basic programs. I plan to spend some time with GrafLib and review it for *Microsystems*.

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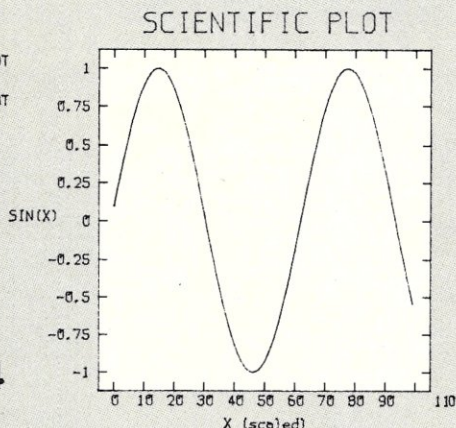


FIGURE 4

Documentation

As I have mentioned above, GrafTalk's documentation is excellent. It comes in a three-ring binder, is well organized and very easy to work with. There is no index, but there is a very complete table of contents that makes commands easy to find. The manual is divided into three sections: the first section includes the user's manual, which contains a brief overview of GrafTalk, and the tutorial, which contains many example programs that are very carefully and clearly explained. The second—the reference section of the manual—deals with each GrafTalk command in detail and cross-referenced to related commands. The final section is on the use of SCATE. The manual is written in clear English; there is no jargon and everything is clearly explained. Nothing is left as an exercise for the reader. GrafTalk's documentation is the best of any software package I have seen.

Bugs

I have found only two bugs in GrafTalk, one of which is that the line continuation character (the ampersand) does not work when it is encountered in a command file. My system hangs up when it finds an ampersand and must be rebooted. This does not occur in the command mode or when a command file is executed from a workspace. Redding Group is aware of the bug and has fixed it in version 2.0.

The other bug is a minor one: There is a command "NUMBER" which you can use to print numbers anywhere on the plotting surface. NUMBER has two arguments: the number to be printed and the number of significant figures (this one is optional). I found that until a number of significant figures is specified the first time, the numbers plotted are wrong. After that, NUMBER works correctly without the optional argument.

Support

I have had only a few occasions to contact Redding Group with problems, but each time they were imme-

diately able to give me the information I needed. One problem was in getting a DMP-4 plotter working with GrafTalk. It seemed that I needed some handshaking between the plotter and my North Star, and I wasn't sure exactly how to get it working. Even though the North Star Horizon is not officially supported as of yet, they were able to tell me exactly what the problem was and how to correct it (they were right, too). I then called Lifeboat Associates, which also distributes GrafTalk. They gave me the same advice, which was a pleasant surprise. Those folks really do know about the software they sell!

As this review was about to be submitted, I ran into an interesting snag with GrafTalk. I have a North Star 18MB hard disk CP/M that just came back from being repaired. For some reason, GrafTalk will not work under North Star hard disk CP/M. (It does work with North Star non-hard-disk CP/M.) Lifeboat Associates cannot help because they do not support the North Star hard disk. North Star can not help because they have never heard of GrafTalk. I am hoping that there is someone out there who has solved this problem and will contact me. The CP/M software bus concept is a good one, but it *does* lead to problems of this sort upon occasion.

Summary

GrafTalk is an excellent business graphics package that does everything right. It is an example of what all computer software ought to be: powerful, very easy to use, and well documented. I have enjoyed everything I have done with GrafTalk. I never had the feeling that I was overwhelmed by how much I had to learn to make the software do useful work, or that I was lost in a mountain of mediocre documentation never able to find that elusive bit of information. This sets GrafTalk apart from other software that is also powerful and useful, but too difficult to use to be of any help to most people. □

GrafTalk Overview	
Purpose:	Business graphics package
Manufacturer:	Redding Group Inc. 609 Main St. Ridgefield, CT 06877 (203) 431-4661
Distributor:	WESTICO 25 Van Zant St. Norwalk, CT 06855 (203) 853-6880
System requirements:	48K CP/M 180K disk drives graphics device
Version 2.0:	\$450
Version 2.0 update:	\$100

GrafTalk is an excellent business graphics package that does everything right. It is an example of what all computer software ought to be.

THE UNKNOWN GIANT

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Massachusetts
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CIRCLE 27 ON READER SERVICE CARD

London
United Kingdom
TLX 86554

Lucerne
Switzerland
TLX 56940

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1983 YUMA GAMES
U.S. Patents
4234496 &
DES 263586

LISTING 1

SMALL DATA TABLE ENTERED WHILE IN COMMAND MODE

```
* @DATA
* 10 20 15
* 35 46 72
* 85 20 11
* @END
```

LISTING 2

SOMEWHAT LARGER DATA FILE ENTERED USING SCATE
Note commas, dollar signs in first row of data.

```
A>TYPE DEPT.EUD
```

THESE FIGURES REPRESENT THE CHEMISTRY DEPARTMENT'S BUDGET FOR THE LAST FOUR YEARS, BROKEN DOWN BY CATEGORIES

	FY1981	FY1982	FY1979	FY1978
TEMP SERVICE	\$2,000	\$2,100	\$1,900	\$1,877
SUPPLIES	35000	34000	32000	31500
EXPENSE	4500	5400	6500	7000
COMPUTER SUPPLIES	3100	2400	2000	2900
COMPUTER EQUIPMENT	8200	10500	9500	17500
EQUIPMENT	89000	78000	55000	57000
TOTAL	151800	132400	106200	118477

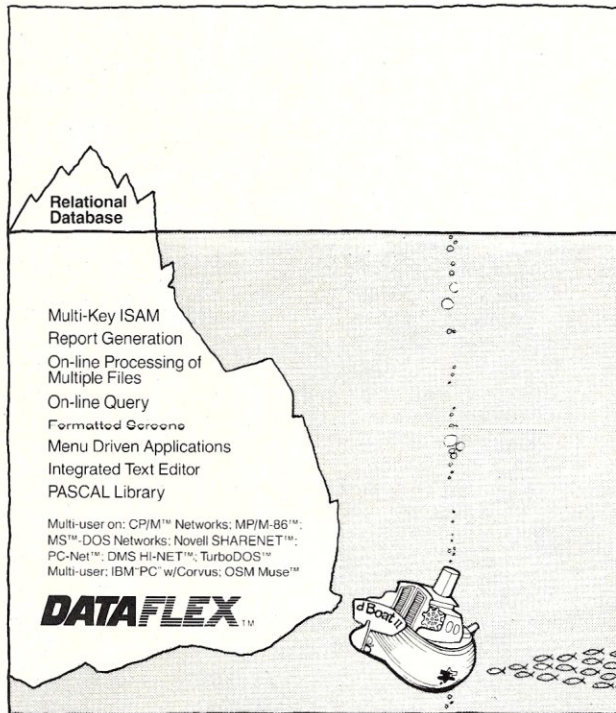
```
A>
```

LISTING 3

BASIC PROGRAM TO GENERATE SIN CURVE DATA AND PLACE IT IN A DISK FILE READABLE BY GRAFTALK

```
PROGRAM TO CREATE A DATA FILE ACCESSABLE FROM GRAFTALK FOR PLOTTING PURPOSES
1000 REM
1010 REM
1020 REM
1030 REM
```

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DATAACCESS
CORPORATION



CIRCLE 215 ON READER SERVICE CARD

GrafTalk continued . . .

```

1040 REM
1080 REM
1090 DIM A(100+2)
1100 FOR J=0 TO 100
1110 A(J,1)=J : A(J,2)=SIN(.1*J)
1120 NEXT J
1130 REM
1140 REM
1150 REM
1160 REM
1170 FOR J=1 TO 100
1180 PRINT A(J,1) , A(J,2)
1190 NEXT J
1200 PRINT
1210 REM
1220 REM
1230 REM
1240 REM
1250 OPEN "0", #1, "DATA"
1260 FOR J=1 TO 100
1270 PRINT #1, A(J,1) , A(J,2) , : REM TRAILING COMMA REQUIRED TO PROPERLY
REM FORMAT DISK FOR GRAFTALK
REM INSERTS A <CR> INTO DISK FILE FOR
REM GRAFTALK
1280
1290 PRINT #1, CHR$(141) :
1300
1310 NEXT J
1320 REM
1330 END
1340 REM
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```

BDS C

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Version 1.5 contains some nifty improvements:

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BDS C's powerful original features include dynamic overlays, full library and run-time package source code (to allow customized run-time environments, such as for execution in ROM), plenty of both utilitarian and recreational sample programs, *and speed*. BDS C takes less time to compile and link programs than any other C compiler around. And the execution speed of that compiled code is typically lightning fast, as the Sieve of Eratosthenes benchmark illustrates. (See the January 1983 BYTE, pg. 303).

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CIRCLE 202 ON READER SERVICE CARD

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Fully configured hard disk development systems, based on CompuPro hardware, are now available from Gifford Computer Systems. The total price with hardware and software? Only \$9990. All you need is an RS-232 terminal to be up and running. Each system is covered by a two year, 24 hour replacement warranty. Systems are available for delivery now.

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- 8 MHz Motorola MC68000™ CPU
- 256K high speed static RAM
- 2.4 Mbyte floppy disk storage
- 21 Mbyte formatted Winchester disk
- 9 serial ports
- Real time clock/calendar
- 20 slot IEEE 696/S-100 motherboard

Upgrades for CompuPro based computers.

- CompuPro™ 68000 CPU (8 MHz) \$ 850.00
- CP/M-68K™ from Digital Research \$ 350.00
- 20 Mbyte Winchester disk subsystem with CBIOS drivers \$3,595.00

Software

- CP/M-68K™ from Digital Research
- C compiler from Digital Research
- 68000 assembler from Digital Research
- Mince visual editor from Mark of the Unicorn

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Please have a representative call me.

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CIRCLE 181 ON READER SERVICE CARD

T/MAKER III - PERHAPS THE FIRST TRULY UNIVERSAL PROGRAM.

Now you can spreadsheet, bar chart and word process from the same program.

You can adapt it to use all your terminal's special keys. You will be operating with it after 10 minutes. We have called it "universal" because it is hardware independent, flexible, integrated, user friendly and powerful. At only \$275* you save hundreds of dollars. By having one universal program, you save hundreds of hours.

HARDWARE INDEPENDENT

Using T/MAKER III's powerful T/MODIFY you can incorporate all your terminal's and printer's special keys and features into your package. Cursor control, video attributes, insert and delete, printer width, font selection, everything.

T/MODIFY isn't like the INSTALL programs where you hope the terminal and printer you have in 2 years is supported by the software manufacturer. With T/MAKER III you have the power to make the decision, and to make it again and again—anytime your hardware configuration changes.

FLEXIBLE

Sometimes word-wrap is good, but for spreadsheet building or program entry it's disastrous. T/MAKER III lets you decide—even in the middle of a document.

Sometimes a "what you see is what you get" word processor is best; other times you want to enter text using maximum width. T/MAKER III will do either.

If you want to stop printing after each page...print a few pages of the file...combine 2 spreadsheets...rearrange the columns in a list...stack bar charts on each other...use one character for bar charts on the screen and a different one on the printer...issue a RESET command to the operating system...change the drive number for text files...T/MAKER III does it all, and lots, lots more.

INTEGRATED

Usually this means that files created by the word processor can be read by the spreadsheet sold by the same manufacturer, but T/MAKER III takes you into real operational integration.

You can instantly bar chart any row or column of your spreadsheet (on screen or printer) then return to the spreadsheet—without leaving T/MAKER III. You can put spreadsheets or bar charts right in the middle of your word processor report—without leaving T/MAKER III.

You can examine, create, rename or erase files, then return to your word processing—without leaving T/MAKER III.

T/MAKER III gives you complete integrated capabilities in one program, so you don't have to use *three*.

USER FRIENDLY

T/MAKER III's plain English breaks the training and memory barrier. It gives you easy to remember commands: ALIGN does all the justifying and margin setting you have specified. COMPUTE does all the spreadsheet calculations you define. SORT sorts a list alphabetically or numerically. TALLY does 2 dimensional tabulations. Others include PRINT, EDIT, COMBINE, ARRANGE, REPLACE, BAR, FIND, KEEP, and lots more that are all easy to understand and remember. And more.

Suppose you leave the editor portion of the program to examine another file. When you return, the cursor will be exactly where you left it. Have you ever looked at a spreadsheet and forgotten the underlying schema? T/MAKER III will show you the spreadsheet data and the underlying formulae at the same time.

You know how the star of word processors bombs out if there isn't room to save the file at the end of an editing session? T/MAKER III tells you about the problem, then lets you examine the directory and erase files until there's room.

POWERFUL

Universal, flexible, integrated, hardware independent, but has it the power to do the job?

Multi-line page headers and footers. Multiple footnotes automatically placed on the correct page. Control of orphan and widow lines. Linkage of multiple files at print time. Global search and replace. Control of page width and length and numbering. Comment lines in text. And more.

Averages, logs and exponentials, trig functions, min, max and mean and percent change. Projection, increases, growth rate, net present value. Rearrange columns, drop or keep all lines containing specified string, match 2 files line-for-line in both directions, sort list by columns, tally and cross tabulate. And more. Bar chart any data row or column, keystroke macro up to 150 characters, or delete blocks of text; a unique DO command takes a command line from a file, and carries out those commands, a WAIT command for push-button demos. And still lots more!

WHAT YOU HAVE TO DO TO GET T/MAKER III*

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J.E.S. Graphics Super Compuprism Graphics Board

by Thomas Ceska

The Super Compuprism from J.E.S. Graphics is an S-100 graphics board, although its S-100 signals do not conform to the recently adopted IEEE-696 specifications. It has a 288 x 192 x 4 matrix display, with each pixel in the 288 x 192 plane capable of being assigned any of 16 grey levels or 16 colors. The board contains 32K of dynamic memory. The cost of the bare board is \$50; the kit version is \$350; and the assembled and tested version is \$395. I purchased the bare board and was able to populate it for about \$150, making the total cost about \$200. The major expense was the 16 150 ns 16K x 1 memory chips (\$40), which have since dropped by half in price.

I will give my impressions of the documentation first, before I go into more detail about my experiences in getting the board working. The kindest thing I can say about the documentation is that it is adequate. The instructions are 19 pages of photocopies stapled together. All of the documentation had been typed at one time, but subsequent revisions are handwritten, with occasional scribbles on at least half of the 19 pages. This documentation describes the assembly of the minimal Compuprism. The Super Compuprism is an enhanced Compuprism with additional integrated circuits piggybacked on existing chips. The documentation for enhancing the Compuprism to Super Compuprism consists of five continuous sheets of dot matrix output, all printed in capitals. The text was not paginated. The documentation was not one to inspire confidence, but, as I said, it was adequate. Undeterred, I ordered the parts.

The instructions call for assembling the board to its minimal Compuprism configuration first, followed by testing before modifying the board. The board has plated-through holes, and parts placement on the board is marked. For the most part, parts placement is unambiguous. A few of the capacitor locations are unclear, and the orientation of the resistor packages is not indicated, but with a little thought the correct locations and orientations can be deduced. I socketed all of the ICs and I did not have any difficulty in assembling the board up to this point. When I plugged the board into my chassis and ap-

plied power I could not get the display to stabilize, nor could I read or write to the board. After a few calls to J.E.S. Graphics, I deduced that the board was using $\phi 1$ (S-100-25) as the system clock. After modifying the board by cutting the trace to pin 25 and adding a jumper from the cut trace to $\phi 2$ (S-100-24), the board worked fine. I should mention that help over the telephone from J.E.S. Graphics was courteous and forthcoming. Although the source of my problem was not pointed out by J.E.S., I was able to deduce what the difficulty was after the helpful discussions.

At this stage the Compuprism board has 16K of memory, and the display resolution is 144 horizontal by 192 vertical elements. The pixels are short horizontal bars rather than dots. The next step in assembly was to expand the Compuprism board from 16K to 32K of memory, add bank select control, and add the 16 grey-level options (switchable from 16 colors). This involves piggybacking a handful of chips to existing ones and adding two handfuls of jumpers. On the 47 original ICs, 16 more were added piggyback. Needless to say, the board began to look like a rat's nest, even though I tried to keep the jumpers neat and short (see Figure 1).

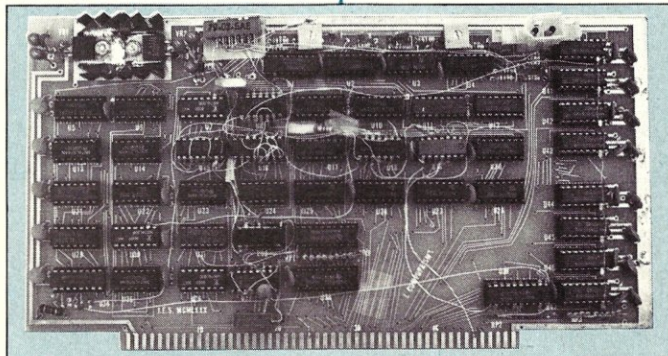


Figure 1. The Super Compuprism, with the bank select and 16 grey-level options installed: 16 integrated circuits are piggybacked on existing chips.

But how does it work? Have a look at Figure 2 for an example. The board works quite well, although there are problems with the stability of the display. More on this later. The programs for manipulating the data are relatively straightforward and are not shown here. The routines to write and read the memory on the board are shown in Listing 1. The pixels are 1 nibble each (4 bits), thus one byte contains 2 pixels. Writing pixels into the 288 x 192 array is simple. The documentation provides a hex dump of a short routine to test the board. Although a few routines illustrating pixel manipulation would have been useful, I found that writing the subroutines I used was not difficult.

Disadvantages

The memory store and fetch times on this board are quite slow, and the documentation claims that memory operates at a quarter the speed of a normal memory board. The Compuprism forces a wait state until the board enters horizontal retrace. Thus the display is stable while its memory is being accessed. The manual also mentions that the Compuprism may not

Thomas Ceska, 934 Stewart Ave., Apt. 12, Ithaca, NY 14850

J.E.S. Graphics continued . . .

be able to perform op-code fetch cycles when used at 4 MHz. Since the memory is slow, it seems unwise to execute a program in its memory. I use the board as a large temporary data matrix for some of my programs.

I mentioned before that I found the display oscillated up and down on occasion. The problem is intermittent, and I traced it to a design flaw in the vertical synchronization circuitry. Horizontal and vertical timing are determined by 74123 one-shots. For horizontal retrace, the accuracy of the one-shot timing is quite good; however, for vertical synchronization, a relatively long time is required before retrace. A small error in the timing of each retrace will result in the vertical displacement of the display lines: thus an oscillation of the display is observed. A digital counter for vertical synchronization may be required for a stable display.

Compuprism does not conform to the proposed IEEE-696 specifications for the S-100 bus. I found that I had to reroute the pin 25 trace to pin 24. The board is not capable of 24-bit addressing or 16-bit data transfer, but it works quite well with older S-100 systems.

The question of reliability and ease of maintenance is of paramount importance to most computer users. The board which I populated operated as advertised and I was quite pleased with it, even though it does have its shortcomings. The board worked well for about eight months, but then one day I was unable to read or write to its memory. Pulling out my logic probe, I probed it to the point where no signal was coming out to the monitor. I traced the problem to a burned-out IC that was underneath a piggy-backed chip. After desoldering, replacing the chip, and resoldering all of the jumpers, the board was working again.

However, recently I find I am having difficulty with memory read and write operations, and I suspect that the same IC has blown again. Thus I fixed the problem, but not the cause of the problem. Since a third of the ICs are buried under other ICs and jumpers, the board is extremely difficult to debug and fix. Because of the large number of ICs on this

board, the amount of power drawn is quite considerable. This may be an underlying factor in the reliability of the board.

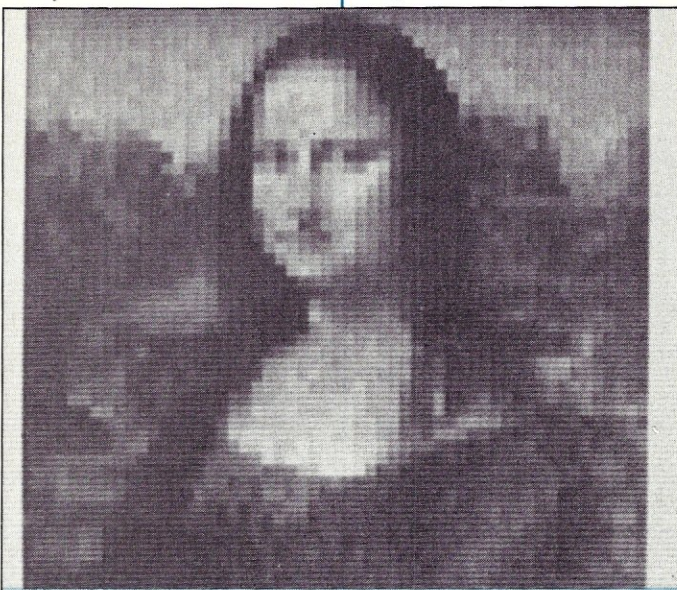


Figure 2. Example of the graphics capability with the Super Compuprism. The data for this Mona Lisa was taken from the book, Digital Image Processing, by R.C. Gonzalez and P. Wintz, Addison-Wesley Publishing Co., New York, 1977. The image has been enlarged by a factor of two. The data set comprised a 64 x 64 matrix, but the display is 128 x 128 in size. The resolution of the board is actually better in both dimensions than the photograph indicates. A total of 15 grey levels are used in the image.

Advantages

The Super Compuprism has a resolution of 288 horizontal by 192 vertical pixels. This is relatively high for microcomputer-based graphics boards. Sixteen different grey levels or colors (switch selectable) can be produced by the board, and each pixel can be independently set. (I haven't used the board in its color mode, so I don't know what the quality of the color display is like.) The graphics display is easy to manipulate, and the subroutines that write to the board are straightforward.

The board is low priced when compared to boards with greater resolution and pixel depth. For example, Scion's MicroAngelo with a 512 by 480 by 1 resolution costs \$1100.

Conclusion

Advantages:

1. Relatively high resolution
2. 16 independent grey levels or colors
3. Simple to program
4. Low cost

Disadvantages:

1. Slow memory
2. Oscillating display
3. Non-IEEE-696/S-100
4. Reliability?

The minimal Compuprism graphics board is probably reliable and definitely easily maintainable. However, with a resolution of 144 by 192, I do not think it is a very useful board. The Super Compuprism is potentially very useful and useable with its 288 by 192 array. I think if J.E.S. redesigned the board to remove the design flaws I mentioned, made room on the board for all ICs, and conformed to the S-100 IEEE-696 specifications, they would have an excellent product. However, in its present configuration, with the reliability and maintenance problems I encountered, I cannot recommend the board to the general user. Hardware hackers may be able to resolve difficulties more easily and should consider this board if they need graphics capability. □

**The board has a resolution of 288 by 192 pixels;
each pixel can be independently set to one
of sixteen grey levels or colors.**

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- XC - Extract columns from a file
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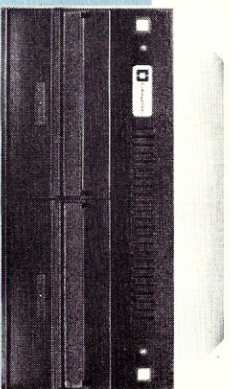
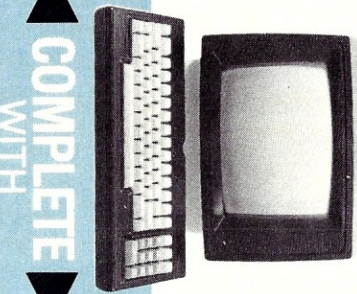
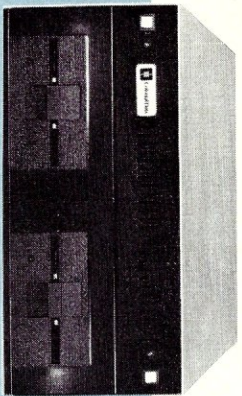
; SOURCE FILE FOR PROM CHIP
; RAM SOURCE ADDRESS = 4000H
; REM FIRST FILL 4000 4FFF FF
;
47C2          ORG      47C2H
;
; PUTS BYTE OF DATA IN C INTO ADDRESS HL
; OF GRAPHIC EXTENDED MEMORY. DESTROYS 'A' REG.
EXMPUT:      MVI     A,0FFH      ;SELECT GRAPHIC MEMORY
; VIA THIS PORT.
47C4 D37F    OUT     7FH        ;PUT BYTE THERE
47C6 71      MOV     M,C         ;BIT 7 = 0
47C7 97      SUB     A           ;RETURN TO NORMAL MEM
47C8 D37F    OUT     7FH
47CA C9      RET
;
; GETS BYTE OF DATA FROM GRAPHIC BOARD EXTENDED MEMORY
; HL = ADDRESS, DATA RETURNED IN C, 'A' REG DESTROYED.
EXMGET:      MVI     A,0FFH      ;BIT 7 = 1
; SELECT GRAPHICS BOARD
47CB 3EFF    OUT     7FH
47CD D37F    MOV     C,M
47CF 4E      MOV     C,M
47D0 97      SUB     A           ;BIT 7=0
47D1 D37F    OUT     7FH
47D3 C9      RET
;
; CLEARS GRAPHICS BOARD SCREEN RAM: 27,648 BYTES
; ENTRY @ SETGB USED FOR BACKGROUND IF BIT 7=1 (E.G.,88H)
CLEARGB:    MVI     A,0FFH      ;FF=BLANK SCREEN
SETGB:      PUSH    H           ;SAVE REGISTERS
            PUSH    D
            PUSH    B
47D9 210000  LXI     H,0000      ;START CLEARING HERE
47DB 110100  LXI     D,0001      ;NEXT LOCATION
47DF 01FF6B  LXI     B,27647     ;ONE LESS TO CLEAR
47E2 D37F    OUT     7FH
47E4 77      MOV     M,A         ;SELECT GRAPHIC MEMORY
47E5 EDB0    DB      0EDH,0B0H   ;CLEAR FIRST LOCATION
47E7 97      SUB     A           ;THEN CLEAR THE REST (WITH LDIR)
47E8 D37F    OUT     7FH      ;BIT 7 = 0
47EA C1      POP     B           ;RETURN TO NORMAL MEMORY
47EB D1      POP     D
47EC E1      POP     H
47ED C9      RET           ;RESTORE REGISTERS
;
; DESELECTS SORCERER 48K, SELECTS GRAPHICS BOARD MEMORY
; PUTS DESIRED DOT ONTO GRAPHICS DISPLAY
; HL = ADDRESS OF DOT, C = INTENSITY
; NOTE: CORRECT NIBBLES IN C ARE PREDETERMINED.
GRDOT:      MVI     A,0FFH      ;BIT 7 = 1
47EE 3EFF    OUT     7FH      ;SELECT GRAPHIC MEMORY
47F0 D37F    OUT     7FH
47F2 7E      MOV     A,M
47F3 A1      ANA     C           ;GET 2 PIXELS
47F4 4F      MOV     C,A         ;SET DESIRED PIXEL
47F5 77      MOV     M,A         ;SAVE THIS INTENSITY
47F6 97      SUB     A           ;PUT BYTE IN MEMORY
47F7 D37F    OUT     7FH      ;BIT 7 = 0
47F9 C9      RET           ;RETURN TO NORMAL MEMORY
;
47FA C300D0  JMP     0D000H      ;DISK BOOT ADDRESS
47FD C3C8E0  JMP     0E0C8H      ;COLD START ADDRESS
;
4800          END
;
1

```

Listing 1. Primitive assembly language routines to read and write to the graphics board, both in a byte mode and in a pixel mode.

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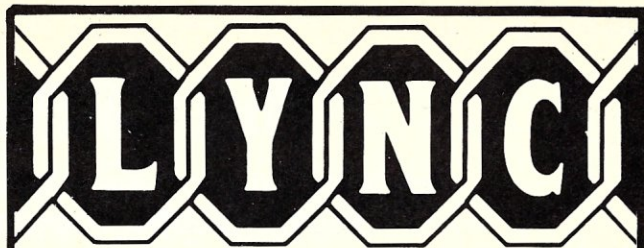
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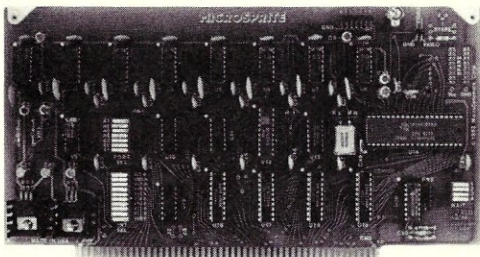
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CIRCLE 154 ON READER SERVICE CARD

The ZCPR2 System

An introduction to a Z80 enhanced replacement,
in the public domain, for the CP/M CCP

by Richard Conn

Welcome to the world of ZCPR2— which you can best become acquainted with via a package of programs now in the public domain known as the ZCPR2 system. It is divided into two parts—ZCPR2 itself and the ZCPR2 utilities. ZCPR2 replaces the Console Command Processor (CCP) of CP/M, which itself performs only two main functions: (1) accepting command lines from either the user or a running SUBMIT command file (\$\$\$SUB) and (2) processing those command lines.

ZCPR2 runs in place of the CP/M 2.2 CCP. It provides functions similar to those provided by the CCP, but also offers many enhancements to those functions (see the section comparing ZCPR2 and the CP/M CCP).

ZCPR2 does not stand alone, but functions as a part of the **ZCPR2 system**, which also includes a set of utility programs. More than 30 such programs make up the ZCPR2 system, with about 15 more files containing on-line documentation that tells you how to use it. The latter are called HLP (Help) files, and one of the ZCPR2 utilities, HELP, can be used to index quickly into these HLP files and read them.

The ZCPR2 system is available through the Special Interest Group in Microcomputers (SIG/M) of the Amateur Computer Group of New Jersey (ACG-NJ), as well as a growing number of Remote CP/M (RCPM) Systems, the Compuserve Timesharing Network, the ARPA Network of the DoD (for the DoD Community only), local computer clubs, and a variety of other sources. It is free of charge (except for copying fees or connect time, or whatever your source of supply charges) and covers 10 8" IBM 3740 floppy disks. The ZCPR2 system is divided among these disks:

- 1 Disk — Source Code to ZCPR2 and some key programs
- 3 Disks — Source Code to the ZCPR2 Utilities
- 1 Disk — COM Files of the ZCPR2 Utilities
- 2 Disks — HLP Files on the ZCPR2 System
- 3 Disks — Manuals on the ZCPR2 System

The ZCPR2 system documentation consists of the following four manuals:

The Installation Manual—How to install the ZCPR2 system on your microcomputer (48 pages).

The Concepts Manual—The basic ideas of what ZCPR2 and the ZCPR2 system is and does (65 pages).

The User's Guide—How to use ZCPR2 itself, all of the ZCPR2 utilities, and all of the ZCPR2 subsystems (140 pages).

Richard Conn, 93 Wedgewood Circle, Eatontown, NJ 07724

The Rationale—Design ideas behind the ZCPR2, including why things were done the way they were, and how some things tick internally to ZCPR2 (20 pages).

Many of the ZCPR2 utilities are written in M80 assembly language (using the Microsoft M80 Assembler) and call routines from SYSLIB 2.6. SYSLIB is a library of more than 130 subroutines written in assembly language. It provides basic support for a variety of functions, including directory access, disk I/O, math, sorting, and number conversion, and can be used on any CP/M 2.2 system. SYSLIB 2.6 is in the public domain and covers another three disks that contain:

- the source code to all of the SYSLIB modules
- on-line documentation on SYSLIB (HLP files)
- SYSLIB itself as a relocatable object file
- the manuals on SYSLIB

The SYSLIB manuals are:

The User's Guide—Tutorial on SYSLIB and how to use it, with many examples (56 pages).

The User and Reference Manual—In-depth documentation on all 130 subroutines within SYSLIB (112 pages)

What does ZCPR2 buy me?

ZCPR2 was designed with one primary purpose in mind: to increase productivity—a goal attained by giving the user an environment responsive to his needs and configurable to his specific desires, while still remaining compatible with CP/M 2.2 and allowing him to run most, if not all, of his CP/M-based software with little or no modification. For instance, WordStar, dBASE II, WordMaster, ASM, BDS C, and most of the commercial software packages run under a ZCPR2 system just as they run under CP/M 2.2—they can't tell the difference.

How does ZCPR2 act more responsively to the user's needs? First, it gives him a number of commands designed to make his job easier. For instance, under CP/M, the ERA command will not erase read-only files. The BDOS traps any attempt to erase such a file and gives an error message, forcing the user to issue a command to change the protection on the file and then reissue the ERA command. In other words, instead of simply helping the user along, CP/M forces the user to bend to it in a manner selected by the person who originally designed it.

ZCPR2 is different in that respect. In the case of ERA, for instance, if the user wishes to erase a read-only file, he just uses the ERASE command instead. It will tell the user that the file is read only, and ask him if he wants to go ahead and erase it. Since the ERASE command accepts a list of files, the command could be:

```
ERASE file1,file2,file3,...
```


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The ZCPR2 System continued. . .

where each "file" could contain wildcards. Alternatively, the ERASE command could be issued with an inspect option,

```
ERASE *.* I
```

in which case all files in the directory are displayed one at a time, and the user is asked in each case if he wants to erase it.

REN, DIR, and TYPE also have transient counterparts under ZCPR2: RENAME, XDIR, and PAGE, respectively. These alternate commands are merely four of the 31 utilities available, all of which are designed to enlarge system capabilities and improve human engineering.

A second way in which ZCPR2 is more responsive is in the way it handles these commands. The user no longer has to be aware that ASM.COM is on drive A in user 0 and XDIR.COM is on drive B in user 4, for instance, because ZCPR2 can be made to search for the COM file when the user issues a command. The user need never concern himself with where his COM files are—he is free to concentrate on the problem at hand. Granted, on small disk systems, this is only a minor problem of remembering to prefix, say, XDIR with A:XDIR, and so on. Under ZCPR2 he does not even have to remember that.

Each command has a number of options. Under the ZCPR2 idea of bending the system to the user, you are not forced to remember these commands and their options. You can always ask for help when you are on-line. This is the third way in which ZCPR2 is more responsive to the user.

Help is obtained in two ways under ZCPR2. The simplest way is to type the name of the command followed by two slashes. For instance, typing:

```
ERASE //
```

will print out one screen full of documentation on the ERASE command, giving you information on what its parameters and options are. This is nice for jogging your memory, but, if you don't feel that this is enough, you can issue the command:

```
HELP or HELP ZCPR2
```

and receive page upon page of documentation on all the commands in the ZCPR2 system. Invoking the "HELP ZCPR2" command calls up a menu of broad topics. By striking one letter, you are indexed into that topic and, frequently, given a menu of subtopics. By striking another letter, you are indexed into that subtopic, where you will usually find the information you want. Of course, you can ask for help relating to the Help subsystem itself and receive information on how to use it.

If productivity is the primary goal of the ZCPR2 system, learning is the secondary one. ZCPR2 is released to the public domain, and anyone can acquire the complete source code to the system and see how it

works internally. I am excited by all of its novel ideas, and feel that as people start using ZCPR2, they will pick up ideas from it and see CP/M in a different light. Key among these is how responsive a system can be to its users, and how this can be accomplished. Having the complete source code to ZCPR2 and SYSLIB allows the user to delve into the way things work. It provides a nice laboratory environment in which one can learn by example and then push on with his own ideas.

ZCPR2 compared to CCP

A dissertation that compares ZCPR2 to CP/M exhaustively lies outside the scope of this article. The reader is invited to read the *Concepts Manual for ZCPR2* and the *Rationale Manual for ZCPR2* for more detail, but here is a brief summary of the main points (see Table 1).

Only two major differences are noted between the memory images of the two systems: ZCPR2 resides in place of the CP/M CCP, and the ZCPR2 BIOS is modified (optionally). ZCPR2 can be implemented in over 4 million different configurations; a minimum configuration has a standard BIOS containing no modifications at all, and a maximum configuration has a modified BIOS which may be 3K or 4K larger than the standard, thereby reducing your Transient Program Area (TPA) correspondingly.

Table 1: CP/M and ZCPR2-based executing memory images

Address	CP/M System	ZCPR2 System
High Memory ->	-----	-----
	BIOS	Modified BIOS
BDOS+0E00H ->	-----	-----
	CP/M 2.2 BDOS	CP/M 2.2 BDOS
CCP +0B00H ->	-----	-----
	CP/M 2.2 CCP	T ZCPR2
CCP Base ->	-----	-----
	Scratch Area	A Scratch Area
100H ->	-----	-----
	CP/M Buffers et al	ZCPR2 Buffers et al
0H ->	-----	-----

Note that, depending on how you want to configure your ZCPR2 system, you may have to sacrifice some of your TPA to make room for some of the advanced features. A second difference lies in the resident commands under ZCPR2, which are:

- DIR can also display system files if needed
- ERA has a verify option that allows you to approve the files before they are erased; ERA also displays the names of all the files it is erasing.
- REN can delete, with your approval, any non-read-only file it is renaming.
- TYPE is a command that pages, stopping the display after filling your screen; it can also be made to

ZCPR2 runs in place of the CP/M 2.2 CCP. It provides functions similar to those of CCP, and also offers many enhancements.

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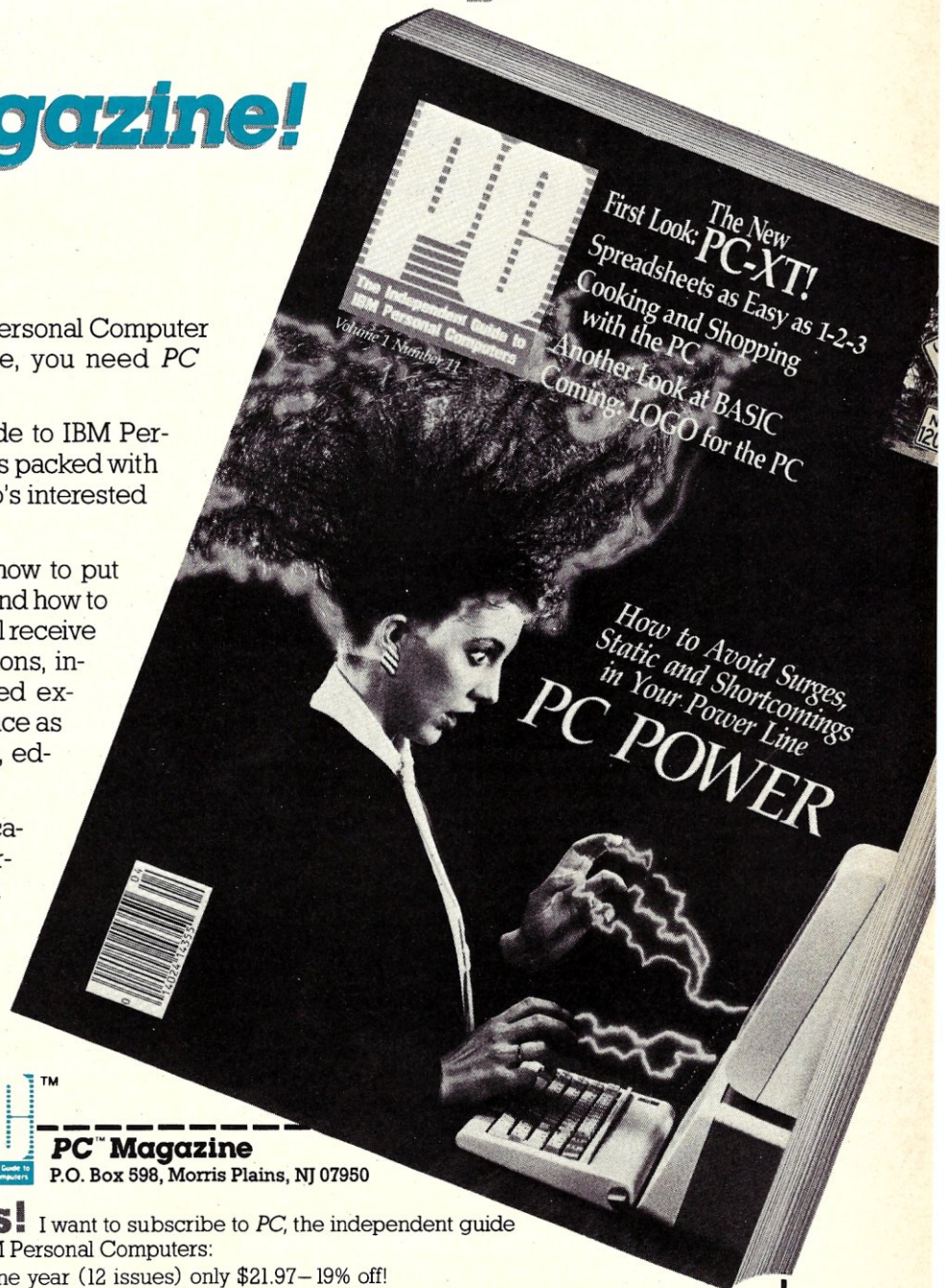
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The ZCPR2 System continued. . .

- print a file without paging (as in normal CP/M).
- LIST is a command like TYPE, but prints the file on the LST: device without paging.
- SAVE accepts both decimal and hexadecimal arguments, and you can specify the number of 128-byte sectors or 256-byte blocks to be saved; the hex argument feature is especially nice since DDT gives all its values in hex.
- GET loads a file anywhere in memory for you.
- GO re-executes the COM file currently residing in the TPA.
- JUMP allows you to call a subroutine at any memory address.

Another important feature of ZCPR2 is the DU form, applicable to all the ZCPR2 resident commands and utilities that are provided as part of the ZCPR2 system. You can use "DU:"—where "D" is a disk letter and "U" is a user number—in all the places where you simply used "D:" before in these three ways:

1. DU can be used to log into a different disk and/or user area. The USER command is no longer needed or available.
2. DU can be used in front of file names and in places where D was used before.
3. DU can prefix commands to indicate to ZCPR2 where to go first to find the COM file.

Examples of these features are given in Table 2. Note that the ZCPR2 prompt tells you what disk and user area you are on.

Table 2. Examples of use of the DU form in ZCPR2

A>1:	A>dir 2:	A>b4:xdir
A1>b2:	A>type c31:read.me	A>6:myprog
B2>c:	A>save 15h b4:image.cpm	A>b:doit
C2>a0:	A>era b2:thatfile	A5>b2:run
A>	A>ren c:file1=file2	C3>a:doit

The last feature of ZCPR2 itself that I want to discuss here is the multiple command line. With CP/M, you had to issue one command, then wait for it to finish before issuing another. Under ZCPR2, you can issue a group of commands on one line and then go off while your system does the work. The following command line is perfectly valid:

```
A>b:;dir a7:*.txt;dir c22:;c7:;era *.com;dir
```

Major features of the ZCPR2 system

ZCPR2 itself, obviously, is a major feature of the ZCPR2 system. To recap, some of its features are:

1. Extensions to the resident commands
2. The use of the DU form
3. COM file search
4. Multiple command line

The ZCPR2 utilities combine in various ways to provide even more features, first among which is the DIR form, used in addition to the DU form by the ZCPR2 utilities.

This allows you to assign names to user areas. For instance, you can assign the name "JEFF" to disk A/user 7, "HELP" to disk A/user 24, "WORK" to disk B/user 0, and "ROOT" to disk A/user 15. Once you have done this, commands like the following are possible:

Command Line	Function
A>cd root	Log into the directory "ROOT"
A15>xdir help:	Display files in "HELP"
A15>erase jeff:myfile	Erase MYFILE from "JEFF"
A15>print work:file1	Print FILE1 in "WORK"

Four ZCPR2 utilities are provided to deal directly with named directories (the DIR form), and the rest of the ZCPR2 utilities (like XDIR) can reference them. CD is used to log into a named directory with password protection; PWD is used to print the name of the current directory or the names of all directories you can reference; MKDIR is used to create named directories; and LD defines a global set of directories (see the manuals for more detail).

The named directory feature once more bends the system to the needs of the user. The main application of this feature is in large disk environments (like hard disks), where the user can divide his work into functional areas and refer to them by name, rather than remembering arbitrary disk and user numbers.

Another major feature of the ZCPR2 system is the path. A path is a specific sequence of directories, disks, and user areas followed by the ZCPR2 system during the search for a file. ZCPR2 itself uses a path when looking for a COM file, and the utilities can be set up to use any number of paths for a variety of purposes. HELP, for instance, can follow its own path when looking for HLP files. A path can also be expressed symbolically in terms of DU and DIR forms, as in the following example:

```
A$ A0 BASE ROOT
```

This path extends from disk A/current user (the user you are now logged into) to disk A/user 0 to the directory named "BASE" to the directory named "ROOT". A command called PATH is available, which allows you to display and alter paths in the ZCPR2 system. You can use PATH to change the sequence of directories through which ZCPR2 looks for COM files.

The multiple command line is a third feature of the ZCPR2 system; I mention it again because it can be used in another way by some of the ZCPR2 utilities. The buffer, which stores the multiple command line, can also be used by one program to chain to another program or group of programs. For instance,

ZCPR2 was designed to increase productivity—a goal attained by giving the user an environment responsive to his needs while remaining compatible with CP/M 2.2.

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"Unicum: a thing unique in its kind, especially an example of writing.
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- bc - binary file compare, display differences in hex
- cat - catenate files (vertically)
- cp - copy one or more files, even between users
- dm - disk mapper, reports free blocks and directory space
- fid - file identification by unique numbers (CRC's)
- hc - horizontal file catenation and column permutation
- ln - create file links (multiple names for one file)
- ls - intelligent directory lister, optional multi-columns
- mv - move (rename) files, even between users
- rm - remove (delete) files, with optional verification
- sc - source file compare, with resynchronization
- sfa - set/reset file attributes, optional verification
- sp - spelling error corrector, with 80,000 word dictionary
- sr - search multiple files for a pattern
- srt - in-memory file sorter, optional duplicate line omission
- tee - pipe fitting (copy input stream to multiple outputs)
- tr - transliterate (translate character codes)
- wc - word counter, counts characters, words, and lines
- wx - word extractor, copies each word to a separate line

Each Unicum understands several flags ("options" or "switches") which control program alternatives. No special "shell" is needed; Unica commands are typed to the standard CP/M command interpreter. The Unica package supports several Unix-like facilities, such as filename user numbers:

```
sc data.bas:2 data.bas:3
(compares files belonging to user 2 and user 3);
Wildcard patterns:
rm -v *tmp*
(types each filename containing the letters TMP and asks whether to delete the file);
I/O redirection:
ls -a >proj.dir
(writes a directory listing of all files to file "proj.dir");
Pipes:
dm b: | sr free >lst:
(creates a map of disk B:, extracts those lines in the map which contain the word "free", and prints them on the listing device).
```

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The ZCPR2 System continued. . .

one of the ZCPR2 subsystems is the MENU system, which presents a menu to the user and runs a command line based on the menu item selected by him. MENU does this by placing that command line into the multiple command line buffer followed by a semicolon and the command "MENU" (this returns control to the MENU program when done).

More than 30 utilities are provided as a part of the ZCPR2 system, divided into the following classes:

1. The I/O subsystem
2. Directory display
3. Disk utility
4. Library utility
5. Menu subsystem
6. File compare progs
7. File copy utility
8. Command file processors
9. Named-directory programs
10. ZCPR2 residents
11. ZCPR2 alternates
12. On-line documentation
13. Miscellaneous

And this is only the beginning—if it has sparked your interest, I recommend the *Concepts* manual.

What are the gotchas?

With any piece of software, there is always something that someone won't like about it. ZCPR2 is no

exception. Although neither the ZCPR2 system nor Mod 0.2, the latest modification to it, contains any known bugs, there are things to watch out for.

The first problem that everyone encounters is that of installation. The system does not come up simply by your typing a command. You (or someone who is knowledgeable in assembly language) have to install ZCPR2. It can be configured in over 4 million ways—and this does not even include the utilities, which also have to be installed.

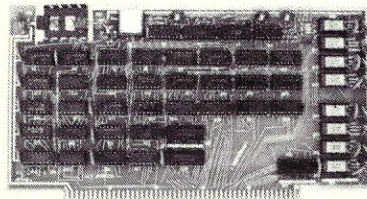
Installing ZCPR2 necessitates reading the *Concepts* and *Installation* manuals in detail, understanding what is discussed, and then writing some assembly language code. ZCPR2 comes as two files, the body and the header. Configuring ZCPR2 involves selecting options and setting values in the header; you need to know 8080 assembly language to do this. You should not need to touch the body. ZCPR2 must then be assembled with the MAC assembler (which is *not* public domain and must be purchased from Digital Research, Inc.).

When you have configured ZCPR2, you may also have to modify the code in the cold boot routine in your BIOS. The extent of this modification depends on what configuration options you have selected.

Finally, you need to install the utilities of the ZCPR2 system that you want to use. This is relatively easy, however, since an installation program, GENINS, is provided.

GENINS permits you to select the principal op-

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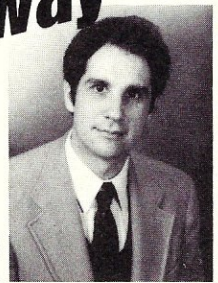
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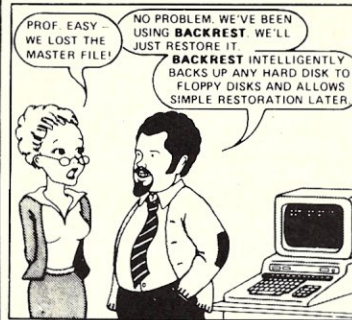
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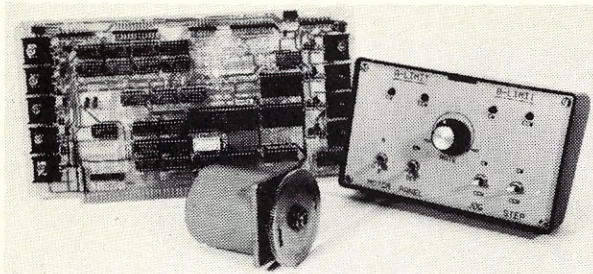
A > DO ASM PROG1; LOAD PROG1; ASM PROG2; LOAD PROG2; DIR

SuperSUB is an enhanced SUBMIT command that will run on any standard CP/M 2.2 system. It runs faster than SUBMIT because it buffers the commands in memory.

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CIRCLE 41 ON READER SERVICE CARD

The ZCPR2 System continued. . .

tions for the utilities, save these options away in a save buffer, and then move through each utility, copying the save buffer into it and setting whatever special options are necessary. GENINS is menu driven, and, once you are familiar with it, it usually takes approximately 15 minutes to install all 31 utility programs.

Installation, then, is the main "gotcha" to the ZCPR2 system. It takes a certain knowledge of assembly language and access to a commercial assembler (MAC) install it.

A second "gotcha" is the overall size. The ZCPR2 system can be fully implemented only on systems with a relatively large disk capacity. As a rule, more than 500K per disk is recommended in order to implement the ZCPR2 system as it was intended to be used. If you have less capacity than this, you will have to configure the system so that some options are left out. This can still give you many good features, but you may not realize the full capability of the ZCPR2 system as described in the manuals. Features such as paths, multiple command lines, and menus cost little and add much to a system. These combine to form a nice ZCPR2 system subset.


A third "gotcha" is that to implement a full ZCPR2 system, you need to modify the cold boot routine in your BIOS. You can implement a "nice" configuration of ZCPR2 without doing this, and you can realize many good features of ZCPR2 without BIOS modification. However, BIOS modification allows several more outstanding features of the ZCPR2

system to come into play.

Finally, a fourth "gotcha" revolves around the issue of support and assistance with the ZCPR2 system. The support you receive will have to come from your local computer club, people you can contact, the company you bought your ZCPR2 system from (if you elected to buy it rather than use the public domain distribution system), or from me (the author) if you can get hold of me and I'm willing to help at the time.

One important point to remember is that we are dealing with public domain here, and not a business. You are not necessarily paying money for this software, and there is no full-time, dedicated support organization to help you, such as you would find in dealing with a company. There are a great many good people who enjoy becoming involved in local computer clubs and helping others in such matters, but they are doing it for no pay and for altruistic reasons. You cannot make demands on them, but you can ask them for help, and they are usually glad to lend a hand.

Closing words

The ZCPR2 system is capable of growth and evolution. As we use it and learn from it, some ideas will be discarded; others will be adopted and expanded upon. It is not a panacea—but neither is any software. It is a good tool, however, that can meet many needs. I hope you investigate it further, read the manuals, and enjoy using it. 

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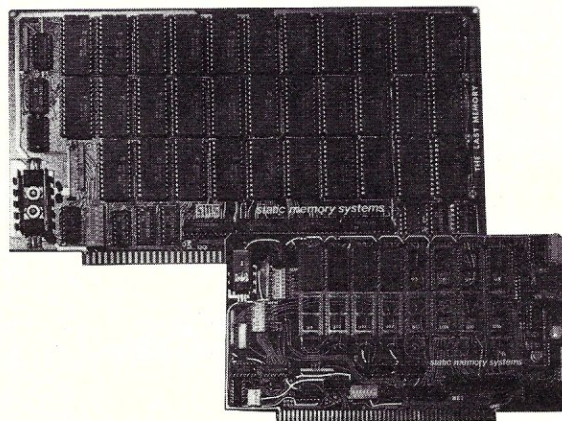
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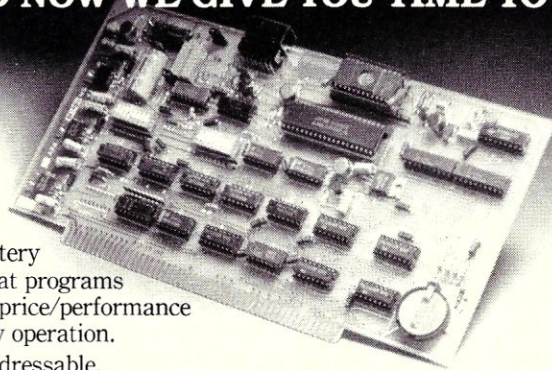
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CIRCLE 171 ON READER SERVICE CARD

Implementing Console Key-Pressed Interrupts

Type console commands and/or program inputs before they are requested

by John M. Potochnak

The first machine I ever used permitted type-ahead. I sorely missed it when I brought up my CP/M-based micro. The result was its implementation under the grudging auspices of CP/M version 2.2. My definition of type-ahead is the ability to type console commands and/or program input before they are requested. To do this you must process console key-pressed interrupts and buffer the typed characters until the next character requestor gets around to eating them.

Processing interrupts

Step 1 is to enable interrupts for your console keyboard. I have both a serial console (connected through a UART) and a video board. My software will handle either. It uses Z80-mode vectored interrupts, so the correct routine is called whenever a key is pressed.

Step 2 is to buffer the characters somewhere. My buffer is 256 bytes long. This may seem excessively long, but you'll see how that can be used to re-do the CP/M SUBMIT facility into one that is not only faster but far more versatile for small (buffer-size) command files.

Step 3 is to rewrite the console status (CONST) and console get character (CONIN) BIOS routines. CONST now checks to see if anything is in the buffer; CONIN sets a character from the buffer instead of from the device.

The next step is to apply the following BDOS patch.

```
SGCCP EQU 0980H ; Where SYSGEN drops the CCP
SGBDOS EQU SGCCP+080EH ; Where SYSGEN drops the BDOS

ORG SGBDOS+014AH ; Prohibit BDOS XON/XOFF
NOP ; PROCESSING
NOP
NOP
```

This will prohibit the BDOS from doing input while it is outputting to the console. This is necessary, otherwise the standard control-S to stop/start console output will eat up your typed-ahead characters. The control-S feature is then duplicated in the BIOS—fortunately, it is trivial.

The code I use to accomplish the preceding functions accompanies this article. It works with the SD SBC-200 CPU board and the SD VDB-8024 video display board.

Immediate mode character processing

There are a few advantages to processing some char-

acters immediately (i.e., at interrupt level). I have implemented these for my VDB-8024 video board. Its keyboard is wired so that the high-order bit of the key character can be set by holding down a super-shift key. This gives me an additional 128 function keys.

My function keys are as follows:

- Clear input buffer and warm boot. This allows you to trap out of looping programs or simply abort something.
- Dummy up an RST instruction. This only works if DDT or my debugger is loaded. When the RST is simulated, the debuggers treat it as if a breakpoint has been hit. This allows you to determine the PC of a looping program or get back into DDT if your breakpoints are not hit.
- Immediately output a status line. My status line consists of the wall clock time, disk statistics, program state, and the current PC. These are useful for timing operations or judging program progress.
- Clear the input buffer. Useful if you make a boo-boo.

Handling XON/XOFF in the BIOS

I use control-S (XOFF) and control-Q (XON) to handle stopping and starting console output. I like this better than the standard method of using only control-S to stop and anything to start. This way you can type as many control-S's or control-Q's as you want and always produce the correct effect. Also, this scheme cooperates with type-ahead in that characters other than control-S and control-Q may always be typed ahead.

There is a "gotcha" with handling your own XON/XOFF. You must be able to disable this processing sometimes. My text editor uses these control characters, so they must be passed while editing.

Originally I had a byte which the text editor changed to zero, saying "don't process control-S and control-Q." The byte was also checked to prevent the BIOS output routine from doing auto-linefeed. Auto-linefeed had to be done by the BIOS because my original terminal was too dumb to linefeed at the end of a line.

I now have my own BIOS entry point, which is called by the text editor. This was necessary when the BIOS was broken into two segments to allow most of it to live in another RAM bank. The warm boot code resets this parameter back to normal. Programs that change it need not worry about the next guy unless they "RET" to the CCP.

Ah, the CCP! Alas, she is still half-duplex. I

John M. Potochnak, 106 Birchwood Terrace, Wayne, NJ 07470


```

F613 ED7332FB 0045 KBINTU: LD (SPSAV),SP : PRESERVE SOMEONE'S STACK
F617 317BF8 0046 LD SP,LOCSTK : OURS
F61A F5 0047 PUSH AF
F61B E5 0048 PUSH HL
F61C DB7C 0049 IN A,(VDAT) : GET CHARACTER
F61E E67F 0050 AND 7FH : LOSE PARITY
F620 FE1E 0051 CP '^'-40H : CONTROL-^ IS THE EQUIVALENT OF SS-BREAK
F622 284E 0052 JR Z,SSWB
F624 1830 0053 JR KBINT : SKIP TO CHARACTER STORE

0055 : *****
0056 : *
0057 : * Here on vectored interrupt caused by VDB-B024 received char *
0058 : *
0059 : *****

F626 ED7332FB 0060 KBINTV: LD (SPSAV),SP : PRESERVE SOMEONE'S STACK
F62A 317BF8 0061 LD SP,LOCSTK : OURS 18-Jul-82 21:29:29
F62D F5 0062 PUSH AF
F62E E5 0063 PUSH HL
F62F DB91 0064 IN A,(VDAT)
F631 EE00 0065 XOR B0H : COMPLEMENT SUPER SHIFT BIT
F633 F256F6 0066 JP P,KBINT : SUPER-SHIFT NOT PRESSED IF NOT SIGN BIT
F636 FEE1 0067 CP B0H+'a' : UPPER CASE LOWER CASE
F638 3086 0068 JR C,NOTLWR
F63A FEFB 0069 CP B0H+'z'+1
F63C 3002 0070 JR NC,NOTLWR
F63E D620 0071 SUB 'a'-'A' : CONVERT TO UPPER CASE
F640 FE00 0072 NOTLWR: CP B0H : SS-BREAK
F642 282E 0073 JR Z,SSWB : YES, WARM BOOT NOW
F644 FE80 0074 CP B0H : SS-BACKSPACE
F646 2840 0075 JR Z,SSDDT : YES, BLINDLY RESTART DDT
F648 FEDE 0076 CP '^'+B0H : SS-^
F64A 285B 0077 JR Z,SSSTAT : YES, INSTANT STATUS
F64C FEDC 0078 CP '^'+B0H : SS-\
F64E 282F 0079 JR Z,SSCLBF : YES, CLEAR INPUT BUFFER
F650 FEAD 0080 CP '-'+'B0H : SS-MINUS?
F652 0002 0081 JR NZ,KBINT
F654 3E5F 0082 LD A,5FH : YES, CHANGE TO UNDERSCORE (NONE ON KEYBOARD)
0083

F656 67 0084 KBINT: LD H,A : PRESERVE THE CHARACTER
F657 3A2FF8 0085 LD A,(CICHR) : SEE IF WE SHOULD DO XON/XOFF
F65A B7 0086 OR A
F65B 7C 0087 LD A,H : GET CHARACTER BACK
F65C 2000 0088 JR Z,NOX : NO
F65E FE13 0089 CP 'S'-40H : CONTROL-S?
F660 2856 0090 JR Z,XOFF : YES, XOFF OUTPUT
F662 FE11 0091 CP 'Q'-40H : CONTROL-Q?
F664 2853 0092 JR Z,XON : YES, XON OUTPUT
F666 CDBEF6 0093 NOX: CALL STCHAR : PUT CHAR IN THE BUFFER
F669 E1 0094 KBIGNR: POP HL : RESTORE EVERYTHING
F66A F1 0095 POP AF
F66B ED7B32FB 0096 LD SP,(SPSAV) : CURRENT PROCESS' STACK
F66F FB 0097 EI : RE-ENABLE INTERRUPTS
F670 ED4D 0099 RETI

0100 : *****
0101 : *
0102 : * Here to handle the function keys *
0103 : *
0104 : *****
0105 : HANDLE WARM BOOT BY SS-BREAK OR CONTROL-^

F672 FD2A32FB 0106 SSWB: LD IY,(SPSAV) : USER'S STACK
F676 21CDF8 0107 LD HL,WBOOT : WHERE WE WANT TO LAND
F679 FD7500 0108 LD (IY),L
F67C FD7401 0109 LD (IY+1),H
0110

F67F AF 0111 SSCLBF: XOR A
F680 32CBF8 0112 LD (KBTAKR),A : NO CHARS IN INPUT BUFFER
F683 32CCF8 0113 LD (KBPUTR),A
F686 18E1 0114 JR KBIGNR : RESTORE REGISTERS AND 'RETURN' TO WARM BOOT
0115

F688 3A39F8 0116 SSDDT: LD A,(CBANK) : SEE WHICH MEMORY BANK IS ON BELOW INT LVL
F68B 3239F8 0117 LD (DDT),A : MAY HAVE TO WAIT TO RESTART DDT
F68E B7 0118 OR A
F68F 20DB 0119 JR NZ,KBIGNR : MUST WAIT TIL OUT OF THE BIOS
F691 ED7330FB 0120 LD (KBTEMP),SP : SAVE OUR STACK
F693 ED7B32FB 0121 LD SP,(SPSAV) : USER'S STACK 18-Jul-82 21:29:29
F699 213000 0122 LD HL,RST7 : WHERE RST7 IS FOR DDT/DEBUG
F69C E5 0123 PUSH HL
F69D ED7332FB 0124 LD (SPSAV),SP : SAVE FOR RETI
F6A1 ED7B30FB 0125 LD SP,(KBTEMP) : OUR STACK
F6A5 18C2 0126 JR KBIGNR
0127

F6A7 3E01 0128 SSSTAT: LD A,1 : FORCE BANK 1
F6A9 D3FF 0129 OUT (MB),A
F6AB 3236F8 0130 LD (XNFFLG),A : IF WE CALL AT IRP LVL, MUST NIX XOFF
F6AE CDDCF8 0131 CALL $STATLN : PRINT A STATUS LINE
F6B1 3A39F8 0132 LD A,(CBANK) : BACK TO WHATEVER
F6B4 D3FF 0133 OUT (MB),A
F6B6 18B1 0134 JR KBIGNR
0135

```

```

F6B8 AF 0136 : SET XON/XOFF FLAG
F6B9 3236F8 0137 XOFF: XOR A
F6BC 18AB 0138 XON: LD (XNFFLG),A : XON/XOFF
0139 JR KBIGNR : AND DUMP CHARACTER
0140

0141 : *****
0142 : *
0143 : * Store character in the type-ahead buffer *
0144 : *
0145 : *****

F6BE F5 0146 STCHAR: PUSH AF : PRESERVE FOR LATER
F6BF 3ACCF8 0147 LD A,(KBPUTR) : INDEX FOR PUTTER (US)
F6C2 F5 0148 PUSH AF : SAVE, WE MAY STORE CHAR HERE
F6C3 21CBF8 0149 LD HL,KBTAKR : ADDRESS OF TAKER INDEX
F6C6 3C 0150 INC A : STEP TO NEXT PUT INDEX
F6C7 BE 0151 CP (HL) : WILL WE PASS TAKER?
F6C8 2003 0152 JR NZ,KBINT0 : NO, OK TO STORE CHAR
F6CA F1 0153 POP AF : DUMP PUTTER INDEX
F6CB F1 0154 POP AF : AND CHARACTER
F6CC C9 0155 RET : AND IGNORE THIS INTERRUPT
F6CD 32CCF8 0156 KBINT0: LD (KBPUTR),A : SAVE INDEX FOR NEXT TIME
F6D0 F1 0157 POP AF : GET INDEX FOR THIS CHAR
F6D1 212FF7 0158 LD HL,KBBUFR : ADDRESS OF THE KB BUFFER
F6D4 85 0159 ADD A,L : COMPUTE LOC FOR CHARACTER
F6D5 6F 0160 LD L,A
F6D6 3001 0161 JR NC,KBINT1
F6D8 24 0162 INC H
F6D9 F1 0163 KBINT1: POP AF : GET THE CHARACTER
F6DA 77 0164 LD (HL),A : SAVE IN THE BUFFER
F6DB C9 0165 RET
0166

0167 : *****
0168 : *
0169 : * This Code used at cold boot time to initialize the UART *
0170 : * and setup the CTC for vectored interrupts on key pressed *
0171 : *
0172 : *****
F6DC 000000 0173 DINIT: DEFB 0,0,0 : GET USART INTO KNOWN STATE
F6DF 40 0174 DEFB 40H : RESET USART
F6E0 4E 0175 DEFB 4EH : 4FH FOR 150, 300 BAUD
F6E1 37 0176 DEFB 37H : DTR TRUE
F6E2 4500 0177 DEFB 45H,13 : CTC0 TO 9600 BAUD
F6E4 00 0178 DEFB IVCTC.AND.0F8H : INT VECTOR FOR CTC
F6E5 C501 0179 DEFB 0C5H,1 : CTC CHANNEL 1 SETUP FOR KB INTS
0180 18-Jul-82 21:29:29
0181 : *****
0182 : *
0183 : * Following code for interrupts from VDB-B024 only, serial *
0184 : * console accessed via the UART is enabled by a program *
0185 : *
0186 : *****

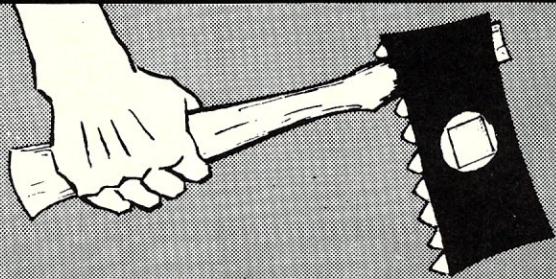
F6E7 3EFC 0187 LD A,IVCTC.SHR,8 : HIGH ORDER ADDRESS OF VECTORS
F6E9 ED47 0188 LD I,A : SET INTERRUPT VECTOR HIGH
F6EB ED5E 0189 IM 2 : SET VECTORED INTERRUPT MODE
F6ED 21DCF6 0190 LD HL,DINIT : USART/CTC SETUP
F6F0 017D06 0191 LD BC,600H+USTS : XFER 6 BYTES
F6F3 EDB3 0192 OTIR
F6F5 017903 0193 LD BC,300H+CTC0 : 3 BYTES
F6F8 EDB3 0194 OTIR
F6FA DB01 0195 IN A,(VDAT) : CLEAR KEY PRESSED ON COLD BOOT
F6FC 017902 0196 LD BC,200H+CTC1
F6FF EDB3 0197 OTIR
0198

0199 : *****
0200 : *
0201 : * This loop goes at the beginning of the CONOUT routine, it *
0202 : * implements XON/XOFF *
0203 : *
0204 : *****
0205 $CONOUT:
F701 3A36F8 0206 LD A,(XNFFLG) : CHECK FOR XON
F704 B7 0207 OR A
F705 28FA 0208 JR Z,$CONOUT
0209

0210 : *****
0211 : *
0212 : * Check for character in the input buffer *
0213 : *
0214 : *****
0215 $CONST: DI : INSURE NO FUNNIES (SS-\)
0216 LD A,(KBTAKR) : INDEX OF TAKER
0217 LD HL,KBPUTR : ADDRESS OF THE PUTTER INDEX
F70E 95 0218 SUB (HL) : SEE IF CHARACTER READY (IE NOT =)
0219 EI
F710 C8 * 0220 RET Z : EQUAL, NOTHING YET
F711 3EFF 0221 LD A,0FFH : ELSE GOT SOMETHING
F713 C9 0222 RET
0223

```


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```

0224 : *****
0225 : +
0226 : +      Read a character from the type-ahead buffer
0227 : +
0228 : *****
0229 $CONIN:
>F714 0230 CALL    $CONST      ; CHECK STATUS
F714 CD07F7 0231 JR      Z,$CONIN  ; NO. WAIT
F717 28FB 0232 LD      A,(KBTAKR) ; INDEX FOR TAKER (US)
F719 3ACBFB 0233 LD      HL,KBBUFR  ; ADDRESS OF THE BUFFER
F71C 212FF7 0234 ADD     A,L        ; COMPUTE CHAR LOCATION
F71F 85 0235 LD      L,A
F720 6F 0236 JR      NC,CONIN0 ;
F721 3001 0237 INC     H
F723 24 0238 CONIN0: LD   A,(KBTAKR) ; BUMP TAKER ADDRESS
F724 3ACBFB 0239 INC     A
F727 3C 0240 DI
F728 F3 0241 LD      (KBTAKR),A ; NO RACES PLS
F729 32CBFB 0242 LD      A,(HL) ; GET THE CHARACTER
F72C 7E 0243 EI
F72D FB 0244 RET
F72E C9 0245

0246 : *****
0247 : +
0248 : +      Data items for type-ahead
0249 : +
0250 : *****
>F72F 0251 KBBUFR: DEFS 256 ; KEYBOARD INPUT BUFFER
>F82F 0252 CICHTR: DEFS 1 ; NON-ZERO FOR SPECIAL CHAR PROCESSING IN BIOS
>F830 0253 KBTEMP: DEFS 2 ; FOR TEMPORARY STACK STORAGE
>F832 0254 SPSAV: DEFS 2 ; SAVE CALLER'S STACK HERE DURING INTERRUPTS
>F834 0255 BANKSV: DEFS 2 ; SAVE STACK DURING BANK SWITCHING
F836 FF 0256 XNFFLG: DEFB 0FFH ; NON-ZERO IF CONSOLE OUTPUT XON'D
F837 00 0257 BANK: DEFB 0 ; MEMORY BANK INTO WHICH TO DO DISK IO
F838 00 0258 CBANK: DEFB 0 ; MEMORY BANK IN CONTROL NOW (FOR DDT RST7)
F839 00 0259 DDT: DEFB 0 ; NON-ZERO TO CAUSE DDT RESTART
F83A 00 0260 UTERM: DEFB 0 ; NON-ZERO TO ACTIVATE PARALLEL TERMINAL
>F83B 0261 DEFS 40H ; LOCAL STACK SPACE FOR INTERRUPTS
>F87B 0262 LOCSTK EQU $
>F87B 0263 DEFS 50H ; FOR BANK SWITCHING (OLD STACK MAY NOT BE
>F8CB 0264 BANKSP EQU $ ; ADDRESSABLE)
F8CB 00 0265 KBTAKR: DEFB 0 ; KEYBOARD INDEX FOR TAKER
F8CC 00 0266 KBPTR: DEFB 0 ; INDEX FOR PUTTER (DEFB TO FORCE ALLOCATION)
0267
0268 : *****
0269 : +
0270 : +      Dummy entries to make assembler happy
0271 : +
0272 : *****
>F8CD 0273 DMAINT:
>F8CD 0274 WBOOT:
>F8CD 0275 $STATLN:
F8CD C9 0276 RET
0277
0278 END

```

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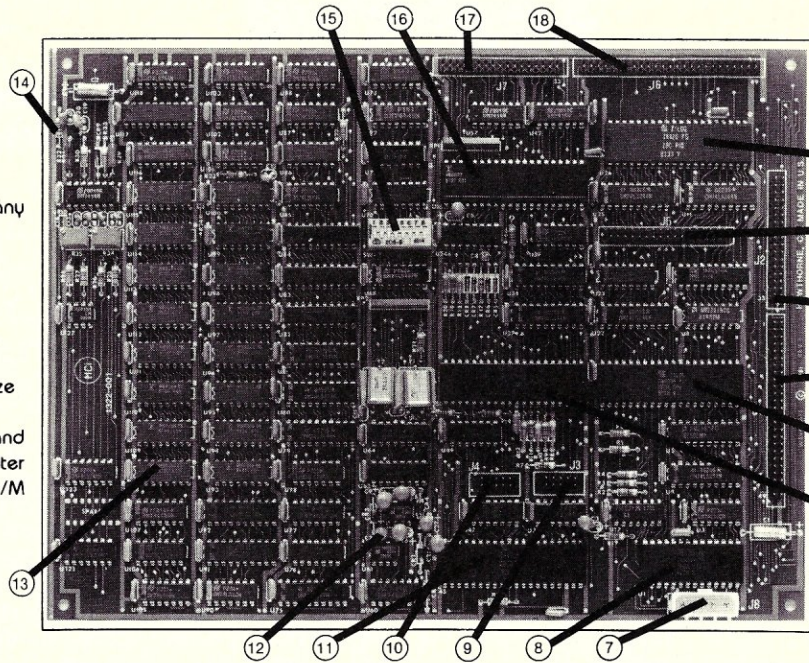
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CIRCLE 209 ON READER SERVICE CARD

Customize Your Word Processor Keyboard

Use a translator and an interrupt handler to generate Escape sequences without losing characters

by H. Bradford Thompson

Does your favorite editor of word processor use all the special keys on your terminal? Or do you wear out your left pinky entering control characters while special-function and cursor-control keys sit idle? And if the latter, have you wondered why? After all, how much can it take to activate those special keys? Why not just detect whatever they send, look it up in a table, and send the processor program what it expects for the action desired?

Of course, if it were that simple more editors would come fully customizable, and I wouldn't have a subject for this article. So I'll first describe the problems and then discuss their solution for WordStar with the Zenith/Heath Z-19/H-19 terminal. The added code is placed in areas that WordStar designated for user installation patches, plus space in the CP/M (Customer-adaptable) Basic Input Output System. The programs have been kept as general as possible and should be adaptable to other editors and terminals.

With the resulting system you can assign to single keys entire sequences of editor instructions and small routines, thus creating your own instructions. As a simple example, chemists commonly want single-number subscripts (as for instance, in H₂O). In WordStar the subscript requires the sequence

`Ctrl-P, V, 2, Ctrl-P, V`

for a total of seven finger-contacts with four different keys. I just typed that subscript 2 with two strokes:

`f1 2.`

My use of the Z-19's keypad and other special keys is summarized in Figure 1.

The problem

The special-function keys of a terminal commonly produce a sequence starting with a nonprinting character. This character is usually the ESC, or Escape, and that character and what follows is called an escape sequence. Counting the keypad at right¹, the Z-19 has 21 special keys. Ten of these send one escape sequence unshifted and a different sequence with the shift depressed. We can thus assign 31 different special functions to these keys. Nineteen of these sequences consist of ESC followed by one character, while 12 consist of the ESC, a question mark, and a third character. For example, the right-arrow key shifted sends ESC C. Unshifted¹, the same key sends ESC ? v.

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We must, then, intercept and identify these sequences and translate them into what we wish the Editor (or word processor, but we'll say Editor for short) to see. For versatility, we will include a way of calling short special programs. This is the task of the Translator, which is the first of the two programs described below.

The Translator alone will work pretty well. However, suppose an escape sequence arrives from the terminal while the Editor is still coping with the previous arrival. The ESC may well get lost, leaving the Editor with only the following letter. The result, while rarely catastrophic, can be pretty annoying. WordStar normally can handle input at typing speed, but can easily be overloaded by using the Z-19 repeat key. Incidentally, this is not a problem unique to my Translator. If you own the full-screen editor VEDIT and a Z-19 terminal, try holding down the REPEAT and either the up or the down arrow. All goes well for a while, but soon after the cursor hits bottom (or top) and VEDIT has to scroll the display, you will find stray letters in your text. These are simply the "followers" of missed Escapes. VEDIT does its best: It checks for incoming characters whenever feasible. It just can't keep up with the REPEAT key.

There is another time when a Translator can lose part of an Escape Sequence: when the Editor takes time for a disk operation. WordStar prints WAIT at the top of the screen. That's good advice. However, loss of an ordinary character or two is pretty innocuous. Loss of part of an escape sequence, plus the possibility of tacking on something else, is much more serious.

You can avoid these problems by using the REPEAT with care (or not all), and by heeding all WAITs or just quitting while your disks whir. However, we set out to use the full capacity of our keyboard, so why quit now? A solution exists in a well-designed interrupt-driven keyboard input handler. Such a handler, written for Lifeboat Associates' BIOS for CP/M and a North Star Horizon computer, is the second program to be described below. Unless your computer doesn't permit user-introduced interrupts, this program ought to suggest what must be done, and may be adaptable directly.

Does the use of ESC to introduce sequences mean you lose the ESC key for its usual purposes? No, you don't have to!

The Translator

WordStar contains a provision for a user-designed keyboard input routine. The Translator fills this role. Whenever WordStar requests an input character, the Translator first checks to see if it has any characters to send to complete some previous request, and if not,

takes in one character from the keyboard. It checks to see if this is an ESC. If it is not, the character is sent along to WordStar. If an ESC is received, the Translator stalls for slightly longer than the time needed for the keyboard to send one more character (for example, 1.3 milliseconds at 9600 baud). If nothing is received in that time, the ESC came from the ESC key and is sent on. If another character is received within this stall period, translation is in order. Those so inclined can follow the process in Listing 1.

Listing 1 includes, besides the Translator, the character translation tables (Tables 1-5), some minor patches, and a patch loader for convenience in loading it all into WordStar. First we will examine a line in Translation Table 1:

80H+'J', XK, 25 .

which translates into

J* CTRL-K CTRL-Y

where J* stands for a character J with the parity bit set to 1. This says to the Translator: "The sequence ESC J (which is generated by the ERASE key) is to be translated as the sequence Ctrl-K, Ctrl-Y (which is WordStar input for 'Delete Marked Block')." The Translator uses Table 1 as follows: To the character following an ESC, a set parity bit is added, and Table 1 is searched for a match. The character sequence following the matched character in the table is then supplied to WordStar. On receiving, for example, an ESC J, the Translator would feed WordStar a Ctrl-K and then a Ctrl-Y. The next character (E*) in Table 1 has a set parity bit: the Translator realizes this is

the start of another sequence, so the present string of output characters is complete.

Possible translations are not restricted to WordStar's single-key instructions. An example is "Delete Word Left", which is not in WordStar's repertoire (although "Delete Word Right" is). I more often want to delete the word I just typed, so a single key-stroke is translated into two commands: "Move Left One Word", then "Delete Word Right".

If more than a simple translation is required, special routines may be written and included. An example is the Table 1 sequence

80H+'S', 0, SPRT, XP, 22, 0, XP, 22.

This translates ESC, S, produced by the key F₁, and handles the single-character subscript. The first 'character' after the S* is a zero byte. The Translator interprets this as meaning that the next byte is the relative address of a special routine. The special routine at relative address SPRT reads one more character from the keyboard, plants that character in the sixth position in the sequence, and then resumes the sequence with the first XP, thus sending WordStar

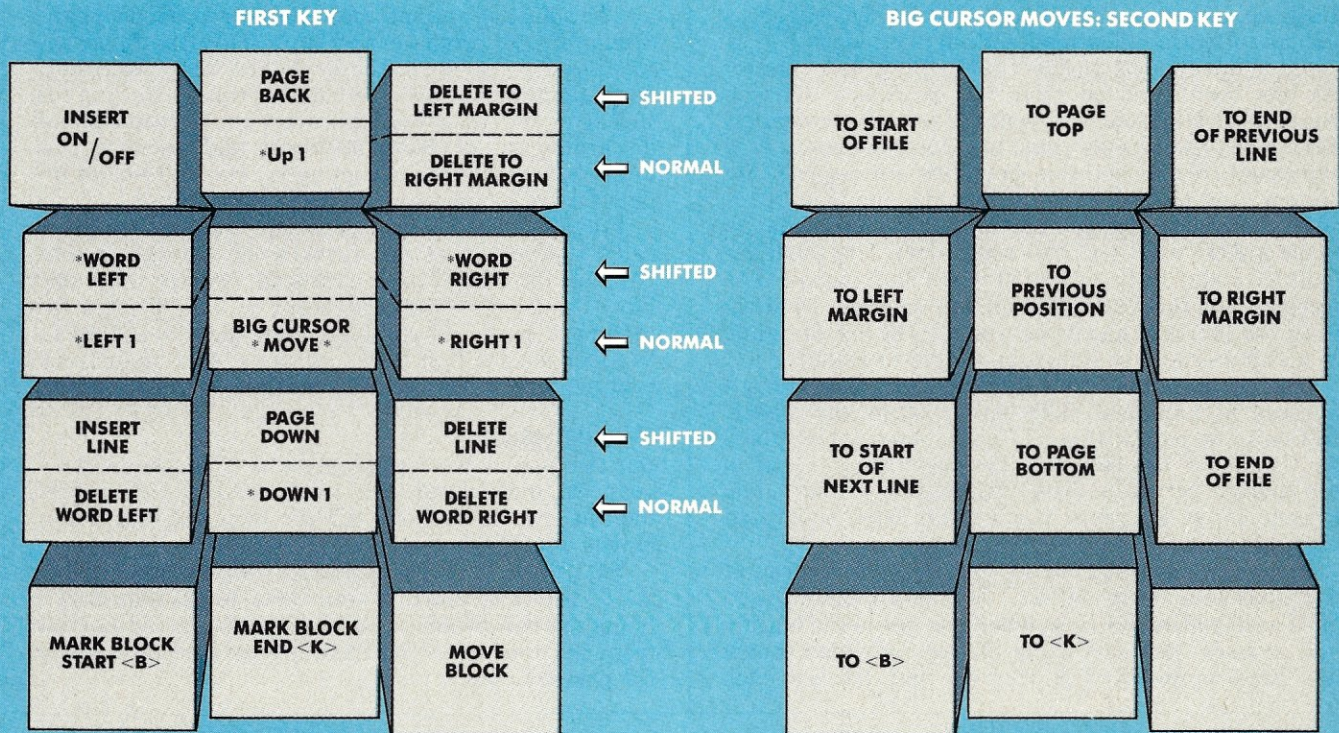
Ctrl-P Ctrl-V n Ctrl-P Ctrl-V

where N is the one-character subscript.

Another special routine leads into secondary tables. For example, the last item in Table 1:

80H+'?', 0, SPRT, TABL2L

handles the Z-19 three-character escape sequences beginning with ESC ?. The special routine reached via SPRT interprets the next byte (TABL2L) as the



*Indicates cursor move

OTHER SPECIAL KEYS:

F₁: subscript
F₂: superscript

WHITE: Done, Save Edit
RED: Abandon Edit

ERASE: Delete Block

Possible use of Z19 keypad

length of the table immediately following, gets one more keyboard-input character, and looks it up. Table 2 contains the third characters of three-character sequences, plus the desired translations.

A more elaborate use of the secondary-table routine is made for two-key sequences beginning with the center ("HOME") key of the keypad. This key plus one of its neighbors is used for large cursor movements (see Figure 1, right side). The two-key combinations are very natural-feeling, and none of these cursor moves are ones with which it is logical to use the repeat key. Table 3 and Table 4 of the Translation Tables check on the "ESC, ?" sent by the second key; Table 5 completes the translation. These cursor moves include two not in WordStar's repertoire that I find very useful: "To End of Previous Line" and "To Start of Next Line".

WordStar provides space for user console-routine patches. The Translator fits nicely into this space. It could, however, be part of the CP/M BIOS (Basic Input-Output System), provided there is no conflicting use of the special keys by other programs.

The keyboard interrupt handler

We noted above that an interrupt-driven keyboard input handler greatly improves Translator operation. I had written interrupt software for larger computers, but this was my first attempt with the Z80 processor. Contrary to much I had read, I found the Z80 interrupt structure easy to work with.

Of course, the computer in use must allow user-designed interrupts. This may involve hardware as well as software adjustment: What is required is that an interrupt request be generated whenever a character has been received from the keyboard. On the North Star Horizon, four types of console-service interrupt request signals come to a common point: It is necessary to connect this point via an appropriate jumper, and to disconnect all but the one type of request desired². The jumper was installed so as to cause a RST 18H (in Z80 code; RST 3 in 8080 assembler code) to be executed when this request was received and the Z80 interrupt was enabled, Mode 0. Both the Horizon hardware and CP/M are designed to make this sort of interrupt simple to install.

The program to service the interrupts thus created is given in Listing 2. The listing shows the USER section to be patched into Lifeboat Associates' BIOS for CP/M for the Horizon. The second serial port in my system serves a NEC Spinwriter printer. The console input interrupt portion has been separated from the rest for easy transplantation.

When an interrupt occurs the incoming character is placed in a "ring buffer." This is a memory area used as a continuous ring: when you get to the bottom you go back and start using the top, provided that it has been emptied. The routine that fetches each

character for program use will zero out the space thus emptied, so the input routine can always tell if the next buffer location is free. When the buffer fills, we just have to throw away input. This is unlikely to be a real loss. Normal typing will never fill up the buffer.

The input routine also watches for ESC characters, and notes when an incoming escape sequence is in progress. Now suppose that we hold down a special key and the repeat key for so long that we fill the buffer. We may find ourselves with too little room for all of a sequence, and a partial sequence is just what we don't want! So in this case we backtrack to the ESC and discard it and all that followed.

In Listing 2 the ring buffer is installed by cleaning out the memory occupied by the once-only code executed on a CP/M "Cold Boot" (i.e., startup from scratch). This saves space but has disadvantages. You may prefer to move the buffer to the unused area following the patch.

When designing any interrupt-driven handler, one must watch out for possible effects of interrupts on parts of the software that are timing-sensitive. An example in my system is the floppy-disk handler, which requires the attention of the Z80 with the interrupts off.³ The Lifeboat BIOS contains code that disables and enables the interrupts accordingly. However, this does not get us off the hook: suppose that the start of an escape sequence is lost while the disk handler is at work, but the end of the sequence comes in after the interrupts have been enabled. In that case we are in trouble.

The solution is to intercept the call to the disk handler, and take proper action after it. What if characters are arriving from the keyboard when we return from handling the disk? We detect this by stalling for slightly more than one character-time, reading and discarding any keyboard interrupt, and repeating this until nothing further is coming in. For 9600-baud input, this will cost us a very few milliseconds.

Finally, how do we intercept that disk-routine call? Lifeboat does not furnish the listing for that part of its BIOS, but a search reveals only one DI . . . EI ("Disable Interrupt" . . . "Enable Interrupt") pair, and right between them is a CALL. We just replace that CALL with a CALL to our own routine, which has the original CALL in its middle.

Conclusion

So, that's it! I have used parts of this system for a year or more, and the final version for several months. As far as I can tell the bugs are out, and it makes WordStar more fun to use.

So if you have WordStar, a North Star, and a Z-19, use it directly. If you have something else, I hope you can profit from my experience and borrow from my routines. You have my permission to copy for personal use.

When an interrupt occurs, the oncoming character is placed in a ring buffer—a memory area used as a continuous ring: when you get to the bottom, you go back and start using the top.


```

;-----
; |                                     |
; |                                     |
; |                                     |
;-----
; Each separate patch (of consecutive locations to be
; overlaid in Wordstar) is preceded by two words, the
; first giving the starting address for the patch and
; the second giving the patch length. When a word
; starting with 00xxH is encountered in place of a
; loading address, loading ceases and a jump is made
; to 0100H.
;
; The loader and patches are then loaded above Wordstar
; proper. A JP CPLOAD is inserted at locations
; 100 - 102, and the patched version is saved.
;
; ORG    CPLOAD
; LD     HL,PATCH1
LDRLUP: LD  E,(HL)      ;Get patch destination
; INC   HL
; LD   D,(HL)
; LD   A,D              ;00xx means all patched
; OR   A              ;if so, then
; JP   Z,100H         ; start patched WS
; INC  HL              ;Get patch length
; LD   C,(HL)
; INC  HL
; LD   B,(HL)
; INC  HL
; LDIR              ;load this patch
; JR   LDRLUP
;
; PATCH 1: Replace JP at 100, displaced to reach loader
;
; PATCH1: DW 0100H      ;First patch destln.
;          DW 3         ;length
;          .PHASE 0100H
;          JP  WSTART   ;Put back overwritten JP.
;          .DEPHASE
;
; PATCH 1A: Initialize Z19 terminal
;
; This goes in std WS terminal-initialization space.
;
; PATCH1A: DW TRMINI    ;Second patch destination
;           DW 5         ;length (for loader)
;           .PHASE TRMINI
;           DB 4         ;length (for WS)
;           DB ESC,'u'   ;Assure unshifted keypad
;           DB ESC,'='   ;Alternate keypad
;           .DEPHASE
;
PAGE 62
;-----
; |                                     |
; |                                     |
; |                                     |
;-----
; This patch enables use of the special keys on the Z19
; for cursor movement and other functions. The precise
; functions assigned are determined by contents of
; the Translation Tables, which this program interprets.
;
; Conventions for patching Wordstar are given in Appendix
; E of the Wordstar User's Guide. See Wordstar 3.0
; USER1 Listing, pages 14, 19.
;
; Method: Each input request is received at UCONI. A
; CALL to BDOS is made, and any normal character is
; passed on. On receipt of an ESC, the next input

```

```

3F00 21 3F14
3F03 5E
3F04 23
3F05 56
3F06 7A
3F07 B7
3F08 CA 0100
3F0B 23
3F0C 4E
3F0D 23
3F0E 46
3F0F 23
3F10 ED B0
3F12 18 EF

```

```

3F14 0100
3F16 0003
0100 C3 2D08

```

```

3F1B 0292
3F1D 0005
0292 04
0293 1B 75
0295 1B 3D

```

```

3F24 02BA
3F26 0006

```

```

02BA C3 02E0
02BD C3 02EB

```

```

3F2E 02E0
3F30 0075

```

```

02E0 2A 02FE
02E3 7E
02E4 B7
02E5 FA D306
02E8 3E FF
02EA C9

```

```

02EB 2A 02FE
02EE 7E
02EF B7
02F0 FA 0300
02F3 23
02F4 28 32
02F6 22 02FE
02F9 E6 7F
02FB 28 03
02FD C9
02FE 7849

```

```

0300 CD 0346
0303 FE 1B
0305 C0

```

```

0306 01 00C0
0309 0B
030A 78
030B B1
030C 20 FB
030E 0E 0B
0310 CD D306
0313 B7
0314 3E 1B
0316 C8
0317 21 7849
031A 01 0038

```

```

; character is read, and sought in List 1.
;
; When an input escape sequence has been identified,
; the first character of the corresponding Wordstar
; sequence is returned. Succeeding Wordstar input
; requests are given the rest of the sequence until
; it is complete.
;
; Special routines can be called in response to ESC
; sequences, either within or in place of output
; character sequences.
;
; PATCH 2: Jumps to console status and input routines
;
; DW UCONI-3      ;Patch destination
; DW 6            ;Patch length
; .PHASE UCONI-3
; JP CISTAT      ;Direct call to BIOS
; JP CIN         ;Character-input routine
; .DEPHASE
;
; PATCH 3: Main Body of Translator
;
; DW CINSET      ;Load in WS MORPAT area
; DW PSEND-$-2   ;Patch length
; .PHASE CINSET
;
; Status check routine
;
; CISTAT: LD HL,(POINTR)
;          LD A,(HL)
;          OR A              ;Char. left?
;          JP M,CONST      ; If not, check via CP/M
;          LD A,OFFH       ; If so, send back sig.
;          RET

```

```

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;
; Routine to service input request from Wordstar
;
; CIN: LD HL,(POINTR) ;Get list pointer
; CINRUN: LD A,(HL) ;Char from last time?
;          OR A
;          JP M,READ1 ; If not, go get one.
;          HL ;Advance pointer
;          INC HL ;Zero -> special routine
;          JR Z,SPROUT
;          LD HL,(POINTR),HL
;          AND 7FH ;Trim parity bit.
;          JR Z,READ1 ;Don't send back nulls!
;          RET ; And give char. to WS
;          DW TABL1 ;Start out at "no char."
;
; Read input
;
; READ1: CALL CHARIN ;Get any waiting char.
;          CP ESC ;Check for ESC
;          RET NZ ; and return if it isn't
;
; Wait to see if this is a sequence. & if so service it
;
; LD BC,ECCOUNT ;Char.-time counter
; ELOOP: DEC BC ;Countdown.
; LD A,B ; Could also be done
; OR C ; with CPI; JP PE,ELOOP
; JR NZ,ELOOP ;(26-cycle loop)
; LD C,11 ;CP/M Console Status
; CALL ; Call
; OR A ;Sequence still coming?
; LD A,ESC ; (Get ESC, in case.)
; RET Z ;No. Return the ESC
; LD HL,TABL1 ;Set up search
; LD BC,TABL1L

```


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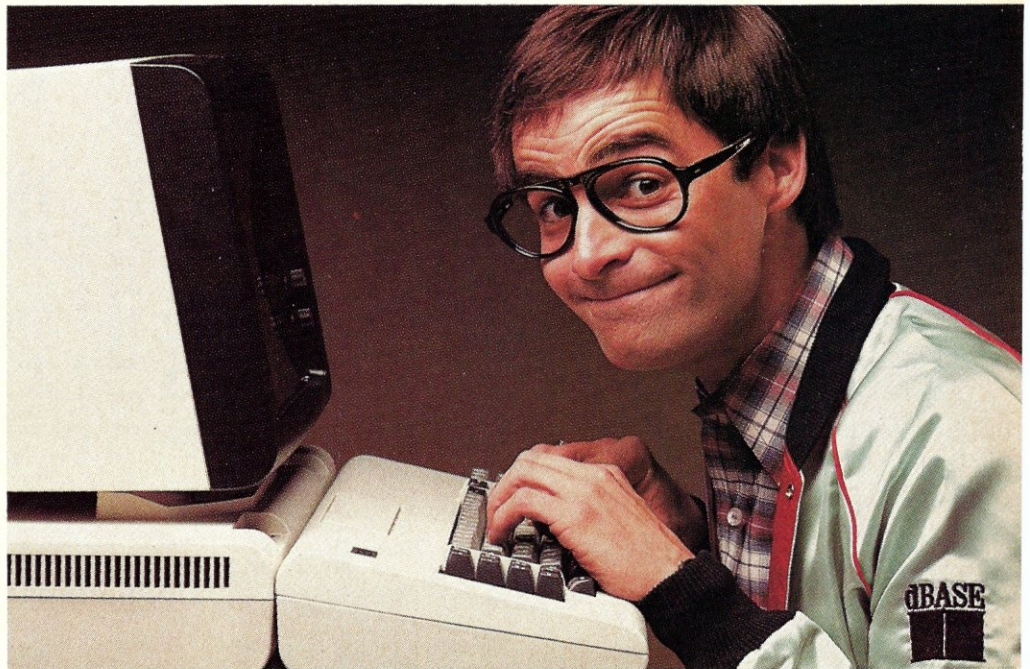
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And we'll make your products part of our Marketing Referral Service. Besides putting you on our referral hotline, we'll publish your program descriptions and contact information in *dBASE II Applied*, a directory now in computer stores world-wide.

Go for it.

But we can't do any of this until we hear from you.

For details, write RunTime Applications Development, Ashton-Tate, 10150 West Jefferson Boulevard, Culver City, CA 90230.

Or better yet, just call (213) 204-5570. And get what you deserve today.



ASHTON · TATE 


```

EC00      ROMTOP EQU 0E800H+400H ;First address past ROM      0060
F400      PARLEN EQU 0F400H      ;No. of locs to set      0004
DA51      LD HL,ROMTOP          0061
DA54      LD D,H
DA55      LD E,L
DA56      LD BC,PARLEN          001B
DA59      LDIR                  ;Set all parity bits
DA5B      LD A,41H
DA5D      OUT (0COH),A          ;Arm parity error check      D7FF
;Action on parity error depends on wiring. See memory      D7AA
;Instructions
;
;Initialize IOBYTE
DA5F      LD A,81H              ;LIST-->LPT, CONSOLE-->CRT
DA61      LD (IOBYTE),A        ; See CP/M Alt. Guide p.16
DA64      XOR A                ;Reset USARTS
DA65      OUT (6),A
;
;Set up ports
DA67      DI                  ;Disable interrupts
DA68      LD A,4EH             ;For 1 stop bit
DA6A      OUT (3),A           ;To first serial port
DA6C      OUT (5),A           ;To second serial port
DA6E      LD A,37H            ;See INTEL 8251 data sheet
DA70      OUT (3),A           ;First port
DA72      OUT (5),A           ;Second port
DA74      IN A,(2)            ;Clear input buffers
DA76      IN A,(4)            ; on both serial ports
DA78      LD A,30H            ;Reset parallel port
DA7A      OUT (6),A           ; PI flag
DA7C      LD A,60H            ; PO flag
DA7E      OUT (6),A
;
;Initialize the H19
DA80      LD HL,H19SET         ;Text for setup
DA83      LD B,H19STL         ;Length of text
DA85      LD C,2              ;Port
H19LUP: IN A,(3)
DA89      AND 1
DA8B      JR Z,H19LUP         ;Wait until ready
DA8D      OUTI                ;Send
DA8F      JR NZ,H19LUP        ;Message done?
DA91      IN A,(2)           ;One last clean-up
DA93      JR C,INSET         ;Set up interrupt
;
;Text for H19 Initialization
;
DA95      H19SET: DB 0,0,0     ;Spare
DA98      DB 1B,1E1          ;Clear screen on boot
DA9A      DB "BIOS version HBT 1.14",0DH,0AH
;
H19STL EQU $-H19SET
;
PAGE 60
;-----
; ||
; || INTERRUPT-DRIVEN CONSOLE INPUT ROUTINE
; ||
;-----
;
;The following are defined to match the system and
; hardware:
0003      INTNO EQU 3         ;No. of interrupt wired for
; console input
0018      CLINKA EQU INTNO*8 ;Interrupt Link Address
0002      CIPORT EQU 2        ;Console Input port
0003      CSPORT EQU 3        ;Console status port
0002      CSMASK EQU 2        ;Input char. ready bit
;
CBAUD EQU 96                ;Input baud rate (In 100Hz units)
Z80MHZ EQU 4                ;Processor clock rate
CHRLEN EQU Z80MHZ*2330/CBAUD ;51-cycle loop, counter
; for 1.2-character wait.
ESC EQU 1BH
;
;The following describe the only DI ..... EI segment in
; the Lifeboat BIOS:
DRQUTN EQU BIOS+4FFH       ;Target of (transplanted) CALL
DCALLA EQU BIOS+4AAH       ;Address of same
;
INPBUF EQU INITO           ;Input buffer origin. If this
; routine follows immediately after the BIOS once-only
; initialization segment. INPBUF can be set to the first
; byte of that segment. Otherwise, substitute
; INPBUF EQU CLINK
; This will provide a 27-byte buffer, which is normally
; more than adequate. Alternatively, the buffer can be
; placed between this patch and USER+1FFH.
;
;Developed and tested on 56K N* Horizon w/two quad dens.
; drives; Lifeboat CP/M; Zenith Z19 terminal.
;
;The following interrupt links are planted on page 0, as
; used in Z80 Mode 0.
CLINK:
.PHASE CLINKA
PUSH AF ;Console Input Interrupt link
PUSH BC
PUSH DE
PUSH HL
JP CONSRV
.DEPHASE
;
LNKLEN EQU $-CLINK
;
BUFLEN EQU INBEND-INPBUF ;Console buffer length
;
PAGE 60
;
;INITIALIZATION:
;
; Must be executed during BIOS initialization. before
; first console input
;
;Plant interrupt link
;
CINSET: LD BC,LNKLEN ;Enter here
LD DE,CLINKA
LD HL,CLINK
LDIR ;Put link in place
;
;Divert CALL to disk routine via handler below.
;
LD HL,LOCALL ;Get CALL to local routine
LD DE,DCALLA ;Put in where disk
LD C,3 ; call was
LDIR
;
INBEND: LD HL,INPBUF ;Clear out input buffer
LD BC,BUFLEN
XOR A
IPBLUP: LD (HL),A ;Clear one byte
CPI ; and count
JP PE,IPBLUP
;
LD (HL),OFFH ;Place Buffer End Marker
IM 0 ;Interrupt Mode 0
EI ;And cock the trigger!
RET ;FINAL return from INIT.
;
DAB1
0018 F5
0019 C5
001A D5
001B E5
001C C3 DAE3
0007
007E
DAB8 01 0007
DABB 11 0018
DABE 21 DAB1
DAC1 ED 80
DAC3 21 DAE0
DAC6 11 D7AA
DAC9 0E 03
DACB ED 80
DACD 21 DA4F
DAD0 01 007E
DAD3 AF
DAD4 77
DAD5 ED A1
DAD7 EA DAD4
DADA 36 FF
DADC ED 46
DADE FB
DADF C9

```


EXTRA**EXTRA**

S-100 World News

MACROTECH International Corporation

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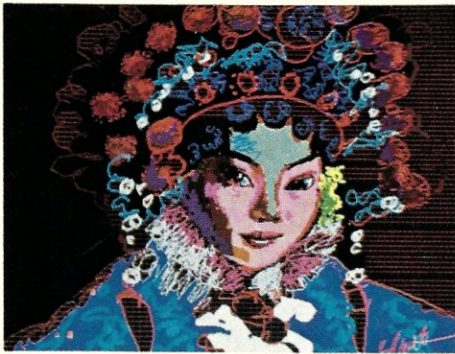


Image achieved by DGS' CAT 1600 Series color video graphic workstation. Picture courtesy of Digital Graphic Systems, Inc. See story below.

GRAPHICS: NOW MAX-IMIZED

CANOGA PARK—March 30, 1983—The decreasing costs and increasing density of memory made possible the present boom in digital graphics. Graphic systems designers are now able to take another major step with the introduction of MAX-M, a one megabyte memory board for \$1983. As large size system memory and multi-megabyte Virtual Disk, MAX-M opens up major new low cost implementations.



Wayne Maw, Director of R&D for RGB Dynamics, Salt Lake City, Utah, reports, "My application is dependent on speed. With the Macrotech dynamic board, I have the needed speed!" The RGB system is a Z80-based, high resolution color directory system for shopping malls, due for April release.

Empirical Research Group of Kent, Washington, creates a state-of-the-art high resolution color video graphics system by integrating their fast 68000 computer, Macrotech system memory, and the color video image processor from Digital Graphic Systems, Inc., Palo Alto, California. Radcliffe Goddard of Digital Graphics states, "High speed image processing requires large system memory to provide instantaneous display frame paging."

The demand for MAX-M by the graphics industry was nearly instantaneous following the initial Macrotech announcement. ■

MAX—256K to 1M S-100 Memory

CANOGA PARK—March 30, 1983—Mike Pelkey, Macrotech International president, today released details of the revolutionary MAX line of S-100 memory boards. Pelkey stated: "IEEE-696 now has a new standard for dynamic memory. The MAX product line offers 256K to 1M, at a price that ranges down to less than \$0.00023 per bit." Pelkey continued, "The MI product line now includes our ultra fast (70 ns) 128K static memory, with battery backup capability, plus the 150 ns dynamic memories—in every 128K step from 256K through 1M (1024K) bytes, and add-on kits to permit field upgrade of sizes."

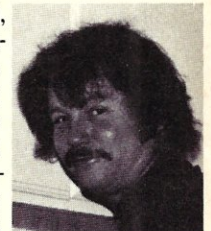
The extreme density of the MAX family is made possible through the use of proprietary PALs (programmable array logic). Also stated as available for add-on to any size MAX is

Macrotech's popular M³ memory mapping architecture. M³ permits the 16-bit address space of an 8-bit processor to be dynamically mapped in 4K pages into as much as 16 megabytes of physical memory.

Parity error detection and 8/16 bit data transfer capabilities are provided as standard on the MAX series memory board. ■

Software for M³ Available

BURBANK—March 30, 1983—"M³ bank switching for 8-bit processors is much more useful with the new creative systems programs," states Dan West of Westcom Systems Inc. MP/M II* disk intensive applications are greatly improved with the new Virtual Disk routines now available through Macrotech OEM's and dealers for their M³ memory boards.



Westcom Systems, as the software consulting firm for Macrotech, has also provided subroutine listings to easily incorporate M³ mapping into the new CP/M 3.0* (CP/M Plus*) Bios module. The advantages of CP/M 3.0* with disk buffering, hashed directories, and user program expansion go hand in hand with Macrotech's flexible "bank switched" memory capabilities.

All Macrotech software and manuals are available through Dan West's Comuserve account #70250,102. Leave comments/questions as E-Mail.

These new techniques can combine the above features with custom needs of the future, such as printer buffering, multi-page display and memory-intensive graphics displays.

The software listings are included in the Macrotech memory board manuals and are optionally available on 8" diskettes. ■

PRICE INDEX

	SIZE	P/N	PRICE
Static Memory	128K	128-ST	\$1232
Dynamic Memory	256K	MAX-256	\$1108
24-bit	384K	MAX-384	1292
Addressing	512K	MAX-512	1647
	768K	MAX-768	1815
	896K	MAX-896	1899
	1M	MAX-M	1983
With 16-bit M ³ Addressing option, add \$91			

	FROM/TO	P/N	PRICE
Upgrade Kits	256K/384K	MKT-2/3	\$ 192
	256K/512K	MKT-2/5	692
	256K/768K	MKT-2/7	876
	256K/896K	MKT-2/8	967
	256K/1M	MKT-2/M	1060
	384K/512K	MKT-3/5	600
	384K/768K	MKT-3/7	784
	384K/896K	MKT-3/8	876
	384K/1M	MKT-3/M	968
	512K/768K	MKT-5/7	284
	512K/896K	MKT-5/8	376
	512K/1M	MKT-5/M	468
	768K/896K	MKT-7/8	192
	768K/1M	MKT-7/M	284
	896K/1M	MKT-8/M	192
M³ option		MKT-M3	121

Software (provided on 8" disk)			
Virtual Disk for MP/M II* and CP/M 2.2,			
CP/M 3.0* Bios modules,			
CP/M memory tests			
			\$ 25
Manuals (sold separately)			
	128/ST		\$ 15
	MAX Technical Manual		15


```

DAE0  CD DB5F      LOCAL: CALL  DRSET      ;To be transplanted
;
;Routine to zero the console input buffer. Used here
; and during disk operations.
;
;
PAGE 60
;CONSOLE INPUT INTERRUPT SERVICE ROUTINE
;
DAE3  21 DA4F      CONSRV: LD   HL, INPBUF      ;Get buffer pointer
DAE4                                INPTR0 EQU  CONSRV+1      ; Address altered: points
;                               ; to first vacant slot
DAE6  01 0000      LD   BC,0          ;Zero ESC SEQ counter
DAE9  CD DB2C      CALL  INGET1      ;Get the waiting char.
DAEC  FE 1B        CP   ESC          ;If it's not an ESC
DAEE  C2 DB0C      JP   NZ,INDONE    ; we're done
DAF1  CD DB16      CALL  INGET2      ;Wait for and get the next
DAF4  FE 3F        CP   '??'        ;if it's a '?'
DAF6  CC DB16      CALL  Z,INGET2    ; wait for, get the last
DAF9  79           INDON1: LD   A,C          ;Compare no. of char. read
DAFA  B8           CP   B            ; vs stored
DAFB  CA DB0C      JP   Z,INDONE    ; If equal. we're done.
DAFE  2A DAE4      ESCZAP: LD  HL,(INPTR0)   ;Otherwise go back,
DB01  AF          ESCZLP: XOR  A          ; and zero out the seq:
DB02  CD DB4D      CALL  MOVPTR      ;
DB05  0D          DEC  C            ;C = No. of char. stored
DB06  C2 DB01      JP   NZ,ESCZLP
DB09  C3 DB0F      JP   INDON2

;
INDONE: LD   (INPTR0),HL ;Reset input pointer
INDON2: POP  HL
DB10  D1          POP  DE
DB11  C1          POP  BC
DB12  F1          POP  AF
DB13  FB          E1
DB14  ED 4D      RET1

;
;SUBROUTINE TO TAKE. STORE ONE INPUT CHARACTER
;
DB16  INGET2:      ;Enter here to time possible 2nd
;                   ;or 3rd entry in an ESC sequence
DB16  11 0061      LD   DE,CHRLN      ;For 1,2-char. time loop
DB19  DB 03      INTRY: IN  A,(CSPORT) ;Read port status
DB1B  E6 02      AND  CSMASK      ;Check in-ready bit
DB1D  20 0D      JR   NZ,INGET1   ; If ready. go get it
DB1F  1B        DEC  DE          ;Count down to time
DB20  7A        LD   A,D          ;Check the countdown
DB21  B3        OR   E            ; (0 only if D and E 0)
DB22  20 F5      JR   NZ, INTRY
DB24  D1        POP  DE          ;Discard calling addr.
DB25  05        DEC  B            ;Is B=1?
DB26  CA DB0C   JP   Z,INDONE    ; Yes. Leave the ESC.
DB29  C3 DAFE   JP   ESCZAP      ; No. Zap the ESC Seq.

;
INGET1: IN  A,(CIPORT) ;Read the waiting char.
DB2E  04        INC  B            ;Count char's read
DB2F  E6 7F     AND  7FH          ;Scrap the parity bit
DB31  57        LD   D,A          ; and store in D
DB32  7E        LD   A,(HL)      ;Is there space in
DB33  B7        OR   A            ; the buffer?
DB34  7A        LD   A,D          ;Retrieve character
DB35  C0        RET  NZ          ;No.
DB36  0C        INC  C            ;Yes. Count char's stored
DB37  CD DB4D   CALL  MOVPTR      ;Store character
DB3A  7A        LD   A,D
DB3B  C9        RET

PAGE 60
;
;CONSOLE INPUT FOR CP/M FROM BUFFER
;
DB3C  21 DA4F      UCONIN: LD  HL, INPBUF      ;Char. waiting in buffer?
DB3D                                INPTR1 EQU  UCONIN+1    ; address changes, is

DB3F  7E        DB3F  7E        UCON1: LD   A,(HL)      ; buffer-unload pointer
DB40  B7        OR   A            ; Set flags
DB41  28 FC      JR   Z,UCON1    ;Wait for char.via int'rpt
DB43  4F        LD   C,A          ;
DB44  AF        XOR  A            ;00 to clear buffer slot
DB45  CD DB4D   CALL  MOVPTR      ;Store, advance HL pointer
DB48  22 DB3D   LD   (INPTR1),HL    ; and store it too.
DB4B  79        LD   A,C
DB4C  C9        RET

;
;MOVPTR: BUFFER POINTER ADVANCE. DATA STORE SUBROUTINE
;
; Used during interrupt to advance INPTR0, store data
; Also when deleting partial ESC seq. which cannot be
; completed because buffer is full
; Used during fetch (above) to advance INPTR1, store
; zeros to replace digits fetched
;
MOVPTR: LD   (HL),A      ;Feed buffer (data or 00)
DB4D  77        INC  HL          ;Move up the pointer
DB4E  23        LD   A,(HL)      ;Look for OFFH
DB4F  7E        LD   A,(HL)      ;
DB50  3C        INC  A            ; at end of buffer
DB51  C0        RET  NZ
DB52  21 DA4F   LD   HL,INPBUF    ;If so, set back to start
DB55  C9        RET

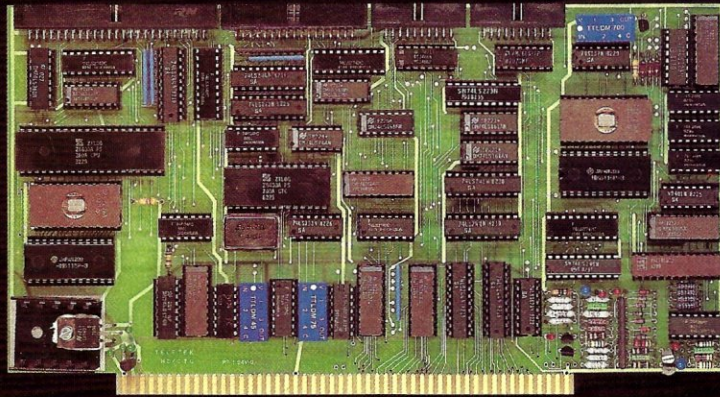
;
;CONSOLE INPUT STATUS FOR CP/M
;
UCSTAT: LD   HL,(INPTR1) ;Check buffer contents
DB56  2A DB3D   LD   A,(HL)
DB59  7E        OR   A
DB5A  B7        RET  Z            ;No key
DB5B  C8        LD   A,OFFH
DB5C  3E FF     LD   A,OFFH
DB5E  C9        RET            ;Key

;
PAGE 60
;
;ROUTINE TO ELIMINATE INTERRUPT INTERFERENCE WITH DISK
;
; (And Vice Versa)
;
;This intercepts BIOS disk-handlers that operate with
; the interrupt off.
;
DRSET: CALL  DROUTN      ;FILLED (See above)
;
;Before enabling interrupt. check for characters waiting
; and coming in. Any found may be the end of an ESC
; sequence. and are discarded. The constant CHRLN
; will cause a wait of 1.3 character periods after last
; character.
;
PUSH  AF
DB62  F5        PUSH  BC
DB63  C5
DB64
DB64  01 0061    E1LOOP: LD   BC,CHRLN      ;Wait 1.3 char. periods:
DB66  DB 03      DELOOP: IN  A,(CSPORT)   ;Load no. of counts
DB69  E6 02      AND  CSMASK      ;Get KB status
DB6B  28 04      JR   Z,DEL2      ; and test for char.
DB6D  DB 02      IN  A,(CIPORT)   ;If so. take care of it
DB6F  18 F3      JR   E1LOOP      ; and check for another
DB71  0B        DEL2: DEC  BC          ;Count down one
DB72  78        LD   A,B
DB73  B1        OR   C            ;Any bit in BC?
DB74  20 F1     JR   NZ,DELOOP   ;If so, count on
DB76  C1        POP  BC
DB77  F1        POP  AF
DB78  C9        RET

;
USRLEN EQU  $-USER
;
END  USER
0179

```


Bored Waiting? Here's The Board You've Been Waiting For.



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TELETEK

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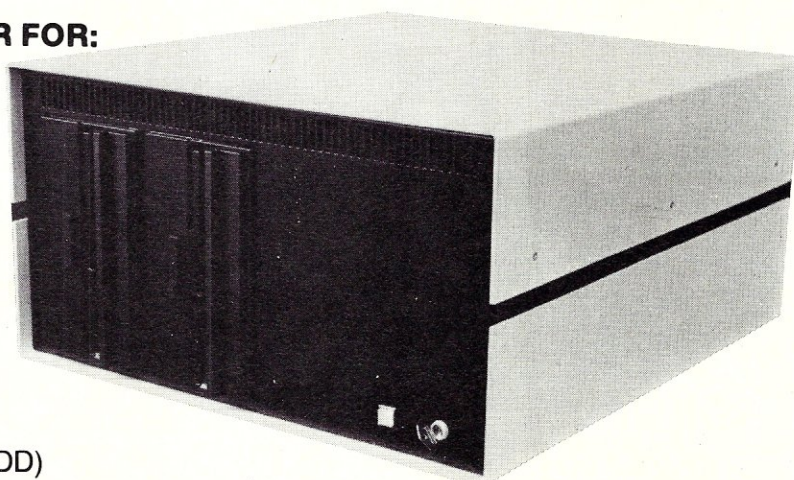
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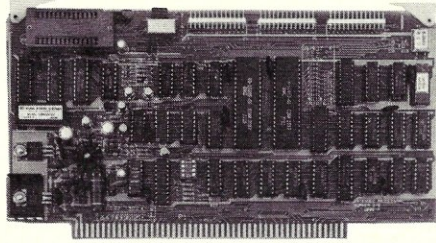
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- Model 953A, programs most 24 pin EPROMS.

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CIRCLE 150 ON READER SERVICE CARD

THE BURNER I/O FOR THE S-100 BUS



- Programming socket is zero insertion force type.
- Programming voltages generated on board.
- Programmer is totally I/O mapped.

I/O Features: (serial)

- 2 fully independent RS-232 serial ports.
- RS-232 data ready supported.
- Each serial port has independent baud rate generators that are software programmable from 50 to 19,200 baud.
- Serial ports may be polled and/or interrupt driven.

I/O features: (parallel)

- Independent 8 bit output, input and status flags.
- All I/O including flags are latched.
- In addition, there are 4 direct sense lines.

Memory management features:

- Controls the S-100 address lines from A16-A23.
- Uses output instruction to load the address.

Quality construction including silk screen, solder mask, sockets and card ejectors.

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- Programs EPROM types 2704 thru 2764 and TMS2508, 2516, 2716
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Memory management may be added to options B or C for \$25.00.
 Shipping, UPS: \$3.00 surface, \$5.00 air

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CIRCLE 142 ON READER SERVICE CARD


```

DB      ESC,'x' ; set terminal for shifted
DB      '6',0  ; keypad
;
DB      0,0,0  ; nulls for later
DB      0
TRMUNI: DRG    029BH ; Terminal Termination String
DB      03     ; # of bytes
DB      ESC,'y6' ; reset to normal keypad
ORG     02BDH ; User Console Input Routine
JMP     OURINP ; go to code extension
ORG     02E0H ; User Patch Area==MORPAT
OURINP: CALL    GETCON ; get console input
CPI     ESC   ; is it an ESC code
RNZ     ; if not, exit
CALL    GETCON ; get next character
CPI     ESC   ; does he really mean it
RZ
SUI     UCA   ; reduce by "A"
JC      INPERR ; if n.g., diagnose
CPI     04   ; upper-limit+1 of acceptable
JNC     INPERR ; diagnose if n.g.
LXI     H,XTAB ; translate it to WS
MOV     E,A
MVI     D,0
DAD     D
MOV     A,M
RET     ; exit smiling

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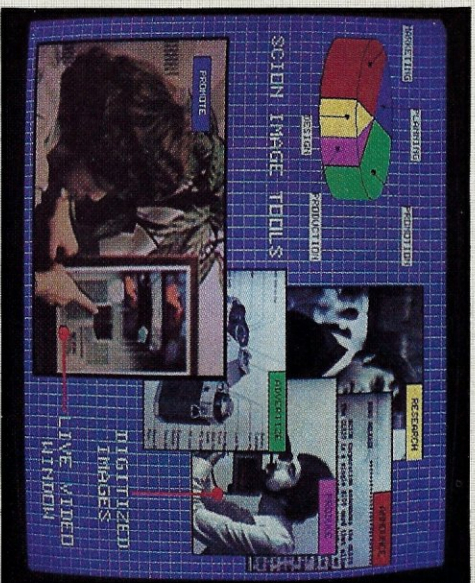
WordStar Arrow Keys for the H-19 Terminal

```

GETCON: MVI     E,OFFH ; we want input
        MVI     C,DIRIO ; naked, no less
        CALL    BDOS
        ORA     A       ; do we have one?
        RNZ     ; yes
        JMP     GETCON ; no, try again
INPERR: MVI     E,BELL
        MVI     C,CONOUT
        CALL    BDOS
        JMP     OURINP
;
; TRANSLATE TABLE ^E ,^X ,^D ,^S
;
XTAB:   DB      05H,18H,04H,13H
        END

```

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More WordStar Mods for the Z-19

Other enhancements for the Heath/Zenith Z-19 CRT terminal

by Bill Machrone

This program modifies WordStar to use the Heath/Zenith Z-19's function keys and the keypad for greater ease in editing. The 25th line is used to explain the use of each of the function keys. The keypad is put into its shifted state and its functions are equivalent to the legends on the keys.

This patch method uses WordStar's normal keyboard entry code and modifies the keycode dispatch tables internal to WordStar. Each dispatch is a four-byte table entry:

- 1: The first stroke of a multicharacter command or a single-character command
- 2: The second stroke of a multicharacter command or a null
- 3, 4: Actual address of the routine in memory, or a displacement into the overlay file.

There are some limitations to this technique, the first being that no key (except Escape) can have two meanings, both as a lead-in character and a one-character instruction. Also, there is a limit to how fast WordStar can look up and dispatch the entries generated by the keyboard. Thus, I've defined the arrow keys on the keypad to mean "move to the limits of the screen or line," equivalent to ^QE, ^QS, ^QD and ^QX. WordStar, without a modified input rou-

tine, cannot handle the two characters generated by the arrow keys at the repeat rate, which would be desirable for character-at-a-time cursor movement.

I don't consider this a drawback, as I prefer not removing my hands from the typing position to do cursor positioning. WordStar's standard "cursor-control diamond" arrangement is fine with me, while the right arrow key is probably the one I use most, returning me to the end of the line after I have backed up to correct errors or insert words. The other keys on the keypad perform the closest analogue to their Z-19 function: "IC" toggles the insert modes, "DC" is the same as pressing "G", "IL" inserts a blank line, and "DL" deletes a line as incontrovertably as "Y". I was not able to implement an equivalent to "home," so that key simply repeats the cursor to top of screen function. The functions performed by the top row of keys are defined under XTAB in the listing.

A quirk in the Z-19's control program makes the keypad a little tricky: If you inadvertently press the control key and one of the keypad functions, the defined function is performed *locally* by the terminal and no transmission is made to WordStar. Thus, if you press control and IC/7, the terminal goes into its local insert mode, and WordStar's insert mode is not toggled on or off. The resulting screen will make you think your system is ready for the scrap heap. Actually, your file isn't affected—you can close it with a ^KX, reset the terminal, and start over.

Bill Machrone, 121 North Avenue, Fanwood, NJ 07023

```

title 'Z19PAT3 Terminal initialization for WordStar 3.XX'
; By:
; Bill Machrone
; 121 North Avenue
; Fanwood, NJ 07023

; Version 1.1 03-Nov-80. Puts indent and find on line 25.
; Arrow keys on keypad move cursor to extremes on screen
; rather than one position.

; Version 2.0 02-Mar-81. New addresses for WS version
; 2.26. Minor corrections to 1.1

; Version 3.0 11-Nov-81. New addresses for WS version
; 3.0. Disable 25th line on Z19 at end of session.

; Attributes for Heath/Zenith Z19 terminal, so that
; function keys defined in WS patch area are explained
; on the 25th line of the screen.
; Code below is intended to be assembled, then
; overlaid onto installed WS.COM with DDT or equivalent.

FALSE equ 0
TRUE equ not FALSE
ESC equ lbH
BDOS equ 0005

REVID macro
db ESC, 'p'
endm

REVOFF macro
db ESC, 'g'
endm

SPACE macro
db ' '
endm

CURSOR macro col, line
db ESC, 'y'
db line + 31, col + 31
endm

LDIR macro
db 0EDH, 0B0H
endm

; Save the bother of Z80.LIB
; save the bother of Z80.LIB

; The extra key dispatches are placed in XTAB and they
; also overlay get/set user place markers 6-9. Anyone
; who tries to keep more than 5 place markers straight at
; one time should probably have his head examined, but
; thanks anyway, MicroPro.

MEMORY equ 3800H ;End of WS.COM; see note below.
TRMUNI equ 029BH ;WS de-initialization routine.
PRGMEM equ 035CH ;WS modified working storage jump.
INISUB equ 02A4H ;Initialization subroutine.
UNISUB equ 02A7H ;De-init subroutine.

```


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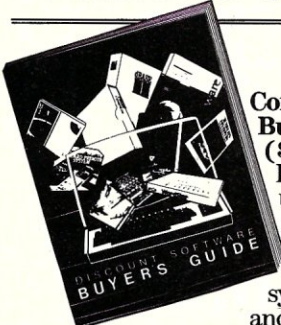
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```

MORPAT equ 02E0H ;Extra room for de-init.
XTAB equ 0649H ;Up to nine extra dispatches.
EXTCUR equ 04E9H ;Cursor to markers 6-9
EXTCURL equ 0589H ;Set markers 6-9.
EXTCUR2 equ 053DH ;"Home" key dispatch.
COLDST equ 2D08H ;Cold start jump @ 100H

; Equates for dispatch addresses inside WS

CRU equ 643EH ;Cursor up.
CRD equ 6424H ;Cursor down.
CRF equ 63A0H ;Cursor right/forward.
CRB equ 6365H ;Cursor left/backwards.
CLL equ 63F1H ;Cursor to left side.
CRR equ 63D3H ;Cursor to right end of line.
CTT equ 6478H ;Cursor to top of screen (Home).
CBB equ 6483H ;Cursor to bottom of screen.
INLIN equ 6549H ;Insert line.
DELIN equ 0242H ;Delete line.
DERIT equ 67E4H ;Delete character at cursor.
TOGL equ 6543H ;Toggle insert mode.
RELMAR equ 021CH ;Margin release.
SETRUL equ 0236H ;Margin from file line.
CENTER equ 0234H ;Center text on line.
BFIL equ 6B18H ;Jump to beginning of file.
EFIL equ 6B1EH ;Jump to end of text.
UPRED equ 0204H ;Save and re-edit file.
PARAT equ 0248H ;Temporary indent (^OG).
VFIND equ 0212H ;Find prompt (^QF)

org EXTCUR
db ESC,01 ;Cursor to top of screen.
dw CTT
db ESC,02 ;Cursor to bottom of screen.
dw CBB
db ESC,03 ;Cursor to end of line
dw CRR
db ESC,04 ;Cursor to left of screen.
dw CLL

org EXTCURL
db ESC,0CH ;Insert line.
dw INLIN
db ESC,0DH ;Delete line.
dw DELIN
db ESC,0EH ;Delete character (^G)
dw DERIT
db ESC,00 ;Insert toggle.
dw TOGL

org EXTCUR2
db ESC,08 ;Overlay alternate delete (1F)
dw CTT

; The following patches correct or modify a number of areas
; to save the bother of using INSTALL.

org 190H ;Modify the Signon Message.
db 'Zenith Z-19 Terminal

org 2AAH ;MicroPro's initialization is wrong.

db 0FFH ;Patches USELST properly for Z19.
db 0,0,0 ;Reserved by WS.
db 1,1 ;Set timing delays to 1 ms.

org XTAB
db ESC,13H ;Margin release=f1.
dw RELMAR
db ESC,14H ;Mar from file line=f2.
dw SETRUL
db ESC,15H ;Center text=f3.
dw CENTER
db ESC,16H ;Find=f4 (^QF)
dw VFIND
db ESC,17H ;Indent=f5
dw PARAT
db ESC,10H ;Beginning of text=blue.
dw BFIL
db ESC,11H ;End of text=red.
dw EFIL
db ESC,12H ;Save & re-edit=white.
dw UPRED

org TRMUNI
db 08 ;Number of characters to send.

; Overlay any existing patches for closing session.

CURSOR 1,25 ;Get to 25th line
db ESC,'E' ;and erase it.
db ESC,'u' ;Normalize keypad.

org UNISUB
jmp MORPAT ;Set up jump for de-init.

org MORPAT
mvi c,09H ;Print string.
lxi d,CURSUP
call BDOS
ret

CURSUP:
CURSOR 1,24 ;Avoid clearing screen so
db esc,'yl'
db '$' ;end-session err msgs remain.

; The following code modifies WS's jump from 100H into
; its initialization routines. Control is given to
; the 25th line routine (below) and then the jump is
; restored. The routine branches there and WS
; initializes normally. The reason for this is that
; you would otherwise have to increase the size of WS.COM from
; 14K to about 30K, drastically increasing the load time
; to handle only 150 or so extra bytes.

; In this version, the screen intialization is buried in
; WS's communication area.

; After patching, "SAVE 63 WS.COM".

```


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CIRCLE 273 ON READER SERVICE CARD


```

org 100H          MEMORY
jmp              ;Function prints string.

org MEMORY
INITIALIZE:
mvi c,09H        ;Function prints string.
lxi d,MESSAGE
call BDOS

; Re-patch WS entry point.
lxi b,0003      ;Number of characters
lxi d,100H     ;destination
lxi h,TRUJMP   ;Overlay characters
ldir          ;You can't use an 8085.
jmp 100H       ;Cold start.

TRUJMP: db (jmp)
        dw COLDST ;WS cold start jump.
        ret      ;Back to WS.

MESSAGE:
db ESC,'x','l' ;Enable 25th line.
db ESC,'x','6' ;Shift the keypad.
CURSOR 1,25    ;Put the cursor at 1 25, col 1
REVID
db 'mar rel=f1'
REVOFF
SPACE
REVID
db 'mar/line=f2'
REVOFF
SPACE
REVID
db 'center=f3'
REVOFF
SPACE
REVID
db 'find=f4'
REVOFF
SPACE
REVID
db 'indent=f5'
REVOFF
SPACE
REVID
db 'begin=blue'
REVOFF
SPACE
REVID
db 'end=red'
REVOFF
SPACE
REVID
db 'save=white'
REVOFF
SPACE
;End of line 25 print.
db ESC,'H'     ;Home the cursor.
db '!',
end INITIALIZE
    
```

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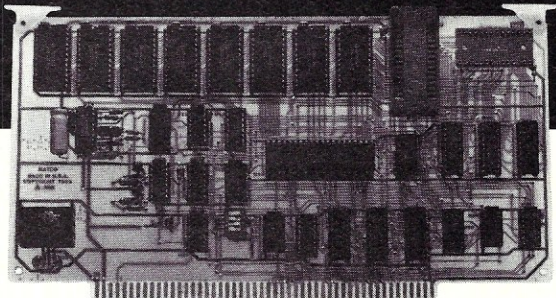
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CIRCLE 274 ON READER SERVICE CARD

W&A

Workman & Associates
112 Marion Avenue, Suite 3B
Pasadena CA 91106
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THE TRANSPORTER...Now your CP/M machines can have one-sided conversations! One copy of the Transporter (on the sending machine) will transfer any file from one computer to another. It requires matching ports (serial or some parallel) or modems. Detailed manual included. The Transporter is \$69.50.

"A Primer on Pascal for CP/M Systems"

Full of examples and suggestions to make learning Pascal easier. Contains both a disk and a detailed manual with a glossary and an error-correcting guide. Pascal Primer -- 5-1/4" \$89.50 -- 8" \$79.50

The Pascal Primer is for either Pascal/M or MT+. The programs are from Grogono's "Programming in Pascal" and Kernighan & Plauger's "Software Tools in Pascal", \$20.00 each (not included).

BDS's C COMPILER

Leor Zolman's BDS C Compiler -- generates compact 8080 code FAST! Comes with a 200-page manual and example programs. Other disks of useful C programs will be available soon. \$130.00 from W & A

Disk formats include: 8", Apple CP/M, NorthStar, Osborne, KayPro, Xerox, Monroe, and Otrona. All U.S. orders are postpaid. Catalog on request.

CIRCLE 278 ON READER SERVICE CARD

AT LAST!

A NEW BOOK DEALING WITH ASSEMBLY LANGUAGE FOR CP/M[®] SYSTEM USERS

CP/M is a registered trademark of Digital Research, Inc.

Introduction to CP/M Assembly Language is a step-by-step instruction manual on how to construct simple programs operating in CP/M that work!

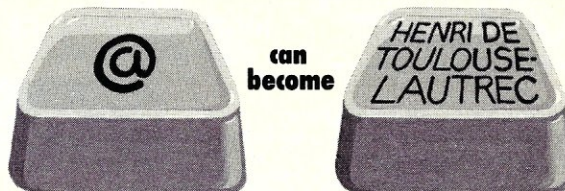
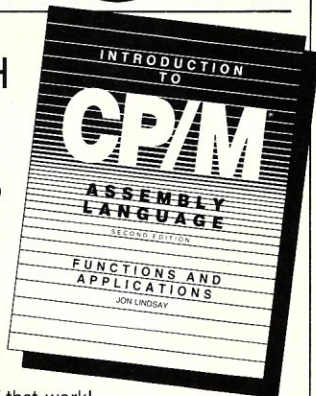
The full size (8 1/2 x 11) perfect-bound 180 pages present the reader with various ways of inputting and outputting data to a terminal, as well as sending data to a line printer. Since the I/O methods used are based on CP/M function constructions, the programs are meant to be interchangeable with "standard" CP/M systems. The reader can immediately "talk" with his computer in assembly language. **Only minimal prior exposure to assembly language is required.** Two useful programs are constructed to demonstrate CP/M techniques: **Single-drive copy program (sequential filing); Data base program (random access filing).** Also included is a simple game program demonstrating some basic game programming techniques and a short section on program troubleshooting.

TO ORDER SEND: \$15.95 PLUS \$1.25 FOR POSTAGE AND HANDLING (EUROPE—ADD \$7.00 FOR POSTAGE) (CALIFORNIA RES. ADD 6% SALES TAX) TO:

EXECUTIVE COMPUTER

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CIRCLE 92 ON READER SERVICE CARD



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SMARTKEY™ is a unique utility that can redefine any ASCII character or function key to become anything you want. For example, "#" becomes "pip b:=a:pas[v]". With a single stroke, a key can represent a chosen character or string at the system level or within a program. Instantly. Without rewiring or soldering.

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2130 S. Vermont Ave., Los Angeles, CA 90007/(213) 737-7252

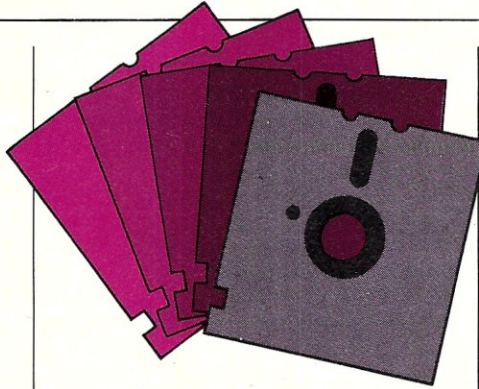
SMARTKEY™ is compatible with all standard versions of CP/M.™
Programs copyrighted by FBN Software.
WordStar™ is a registered trademark of MicroPro, Inc.
CP/M™ is a trademark of Digital Research.



CIRCLE 189 ON READER SERVICE CARD

Software Directory

Program name: GrafTalk 2.0
Hardware system: Z80 or 8080, with CP/M or MP/M
Language: Object code
Description: GrafTalk is a device-independent business graphics package that uses English-language commands. The version 2 release incorporates all the features of version 1 for producing bar, pie, line, and symbol plots. It also includes these new features: access to a menu mode at the user's choice, with either standard menus or customized menus created by the user; a built-in mini spreadsheet capability that allows viewing and manipulation of the data set; several new types of bar charts; increased flexibility in number and types of access lines; increased flexibility in data sets (including larger data sets, subsets, etc.); a built-in editor and a large range of graphics and text commands. GrafTalk ac-



cepts data as in an ordinary table of numbers and supports multiple plots on a single surface, user-adjustable names, labels and legends, and an on-line help facility.
When released: April 1983 (see p. 74 for a review of version 1).
Price: \$450; Version 1 upgrade, \$100.
Included with price: Disk containing software and drivers for many screens, printers, and plotters; manual (with full-color tutorial sections).

Where to purchase it:
Redding Group, Inc.
 609 Main St.
 Ridgefield, CT 06877
 CIRCLE #117 ON READER SERVICE CARD

Program name: MODEM 8-16
Hardware systems: CompuPro 8/16 and MP/M 8-16 V2F
Minimum memory size: 192K
Language: Object code
Description: Permits bidirectional file transfer and asynchronous communication via modem or RS-232 interface between any terminal and another mainframe, minicomputer, or CP/M and MP/M 8-16 based system. The system's other operations are not affected and the program can support as many as six modems simultaneously. Under MODEM 8-16, each terminal within a GCS multiuser system can operate either in "terminal" mode as a remote station of the external

MCP

**MAKES
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MCP 64KS (64K X 8) STATIC S-100 MEMORY

Sixty-four k bytes of low power high performance (2k x 8) 150ns static ram for systems requiring the ultimate in reliable performance. Extended address capability to one megabyte is provided. ASSEMBLED AND TESTED LIST \$390.00 **YOUR PRICE \$238.00**



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Operates at 2.4, or 6MHz. Includes two serial ports using 8251 usarts with selectable baud rates from 50 to 19.2k. Three programmable 8 bit parallel ports, 1k onboard static ram, and 2716 Eprom with monitor. Onboard ram and eprom can be disabled on system boot. ASSEMBLED AND TESTED LIST \$350.00 **YOUR PRICE \$200.00**



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Utilizes the WD1793 double density F/D controller chip and the WD1691 floppy support logic chip. The MCP/FDC offers superb performance and reliability due to enhanced data recovery and write precomp support. The MCP/FDC will support up to four 8" single or double sided Shugart, Qume, Siemens or compatible drives. CP/M 2.2 Bios supplied on standard density 8" diskette. CP/M86 and MS-DOS operating systems with MCP/FDC support available. CP/M 2.2 Bios with MCP/FDC and Miniscribe 5.25 winchester using Xcomp hard disk controller is also available. ASSEMBLED AND TESTED LIST \$288.00 **YOUR PRICE \$200.00**



CP/M 2.2 CONFIGURED FOR MCP S-100 BOARDS \$130.00

- COMPLETE MAINFRAMES SEVEN S-100 SLOTS CONFIGURED READY TO RUN.**
 Six MHz MCP/SCC-6 Z80B, with serial and parallel ports, MCP/FDC double density disk controller, MCP 64ks static memory and CP/M 2.2.
- WITH TWO 8" SSDD FLOPPYS \$2495.00
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 - WITH 8" DSDD FLOPPY & 5.25 WINCHESTER (15.7MB FORMATED) \$4795.00

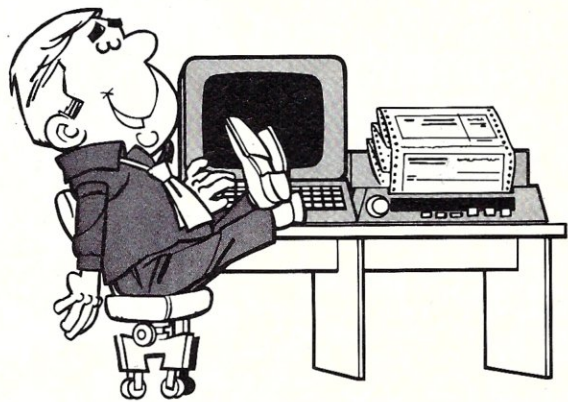
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 Print complete checks, pay bills, keep checking and payable accounts, get reports on income, expenses, profit, pay and tax records.

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CIRCLE 110 ON READER SERVICE CARD

BURN EPROMS USING CP/M*

EPROM PROGRAMMING SYSTEM RUNS UNDER CP/M

COMMAND SUMMARY

-PROGRAM EPROM(S) FROM DISK FILE -READ EPROM INTO RAM
 -PROGRAM EPROM FROM RAM -DISPLAY/MODIFY RAM
 -READ DISK FILE INTO RAM -VERIFY EPROM IS ERASED
 -COMPARE EPROM W/RAM -COPY EPROM

FEATURES

-STAND ALONE SINGLE BOARD (6X7.5) PROGRAMS 2708, 2756, 2716, 2732, 2732A AND 2764 EPROMS.
 -NO PERSONALITY MODULES OR DIP SWITCHES TO CHANGE - 100% ELECTRONIC SWITCHING OF EPROM TYPES.
 -INTERFACES THROUGH ONE 8 BIT INPUT PORT AND ONE 8 BIT OUTPUT PORT. 16 WIRES - NO SPECIAL HANDSHAKE LINES.
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Now you can afford to build a professional EPROM programmer.

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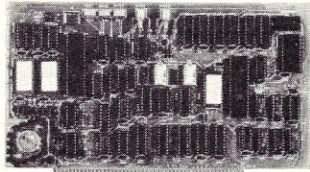
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SAL/80® and SAL/86™
 do for assembly language what RATFOR does for FORTRAN but emits **OPTIMALLY DENSE** code. SAL/8X includes console I/O primitives which trivialize the task of writing complex interactive user interfaces. Improves programmer productivity by a factor of two and program maintainability by an order of magnitude. Extensively documented, available for all CP/M compatible disk formats.

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80 CHARACTER VIDEO BOARD - S-100



- All This on ONE BOARD:
- Keyboard port with TYPE-AHEAD buffer
 - 8275 CRT controller with light pen port
 - Two 2716's - program & character rom's
 - Optional 2716 for CHARACTER GRAPHICS
 - All screen & keyboard ram
 - SIMULTANEOUS I/O or Memory mapped
 - Z-80 MPU - 2 or 4 Mhz system clock
 - Easy to adapt Software
 - Uses only EASY-TO-GET parts
 - Use in any S-100 system
 - 696 Bus Compliance: D8 M16 I8 T200
 - Build for less than \$200
 - iNow includes Crystal and Heat Sink, \$9.85 value.

Introducing The VDB-A
 Bare board with Documentation \$49.50
 + \$2.50 s&h (Ill.res. add 6% tax)
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CIRCLE 67 ON READER SERVICE CARD

Software Directory continued . . .

system, or in "command" mode, which allows each terminal to specify parameters under which information will be exchanged and understood by the external system.

Other features include the ability to store sequences of commands as a file, and simultaneous communications with the operating system while in use. The program's large command set also allows users to automate complex communica-

tions procedures as well as control and customize the entire telecommunications process.

When released: February 1983
Price: \$295

Included with price: Disk and manual

Where to purchase it:

Gifford Computer Systems
 1922 Republic Ave.
 San Leandro, CA 94577
 (415) 895-0798

CIRCLE #118 ON READER SERVICE CARD



ULTRA-RES GRAPHICS

IEEE-696 S-100 MONOCHROME \$495
 - 1 x 512 x 512 Pixel
 - Single board system

IEEE-696 S-100 MONOCHROME / COLOR \$995
 - 1 x 1024 x 1024 Pixel
 - Expandible to 8 x 1024 x 1024 Pixel

IEEE-696 S-100 EIGHT COLOR \$1250
 - 3 x 512 x 512 Pixel
 - 8 Color RGB
 - Two board system

MULTIBUS EIGHT COLOR \$2695
 - 3 x 1024 x 1024 Pixel
 - Eight color RGB
 - Single board system

IBM-PC MONOCHROME \$995
 - 1 x 1024 x 1024 Pixel
 - Expandible to 8 x 1024 x 1024

FEATURES

Software drivers, Hardware zoom, Programmable Display Resolution, Windowing, Multi-Controller Capability, NEC UPD7220 Graphic Controller

ULTRA-RES Trademark CSD Incorporated Starting Prices
MULTIBUS Trademark Intel Corporation

C.S.D. Incorporated

P.O. Box 253 Sudbury, Massachusetts 01776
 (617) 443-2750

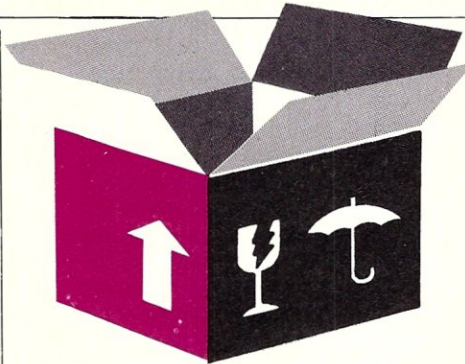
CIRCLE 204 ON READER SERVICE CARD

New Products

Dual CRT terminal

The IMS CRT stand-alone terminal has a separate microprocessor for each of its major functions: keyboard control and screen handling. It can be customized to emulate nearly any conventional CRT.

The IMS CRT has all the capability of a CRT but includes a general-purpose Z80 microcomputer complete with two high-speed RS-422 serial ports, one RS-232 printer port, 64K of RAM, and a battery-backed-up realtime calendar



clock.

In expanded mode the terminal becomes a node processor in a multiuser, multiprocessor network environment.

Price: basic CRT, \$1095; expanded CRT, \$1795.

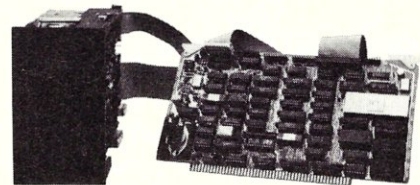
IMS International, 2800 Lockheed Way, Carson City, NV 89701; (702) 883-7611. **CIRCLE #119 ON READER SERVICE CARD**

5¼" hard disk S-100 subsystem

Advanced Digital Corp. has an-

nounced a 5¼" Winchester hard disk subsystem for S-100 microcomputers built around ADC's HDC-1001 hard disk controller board. It is available in 5, 10, 20, and 40MB configurations. The HDC-1001 is IEEE-696 compatible, features an on-board microprocessor, and has error-correction capabilities. Other ECC features include up to 9-bit single-burst correction; multiple-burst detection, programmable correction/detection span, process check/syndrome bits in serial fashion; and supports read/write, short/long features.

The Model HDC-1001 controller provides control for up to 4 drives and up to 8 R/W



FINALLY, a high performance semiconductor disk at an affordable price.

★ ★ ★ ★ ★ QUASI-DISK ★ ★ ★ ★ ★

FEATURES:

- FULLY S-100/696 COMPATIBLE.
- UNIQUE DESIGN GUARANTEES THAT THE BOARD WILL WORK IN STANDARD AND NON-STANDARD S-100 SYSTEMS OR YOUR MONEY BACK.
- 512K BYTES OF ONBOARD MEMORY (64K X 1 CHIPS), EXPANDABLE TO 2 MEGABYTES BY PLUGGING IN 256K RAMS. (64K AND 256K CHIPS MAY BE MIXED).
- ERROR DETECTION MAY BE ENABLED IF DESIRED.
- DMA COMPATIBLE WITH TRANSFER RATES UP TO 1 MEGABYTE/SECOND.
- BATTERY BACKUP LOGIC IS INCLUDED, WITH NO ADDITIONAL HARDWARE REQUIRED.
- ONBOARD ACTIVITY INDICATORS DISPLAY DRIVE ACTIVE AND OVERRUN ERROR STATUS.
- MULTILAYER BOARD IMPROVES PERFORMANCE BY REDUCING BOARD NOISE LEVELS, IMPORTANT IN DYNAMIC RAM PRODUCTS.
- PRICE INCLUDES INSTALLATION SOFTWARE ON 8" SINGLE-SIDED, SINGLE-DENSITY DISKETTE - SOURCE CODE IS ALSO PROVIDED.
- SEVERAL SAMPLE CP/M* BIOS ROUTINES ARE SUPPLIED TO SIMPLIFY INTEGRATION INTO ANY CP/M* BASED SYSTEM.
- THE QUASI-DISK IS COVERED BY A 1 YEAR LIMITED WARRANTY COVERING ALL PARTS AND LABOUR.

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QUASI-DISK IS A HIGH CAPACITY, I/O MAPPED RAM BOARD WHICH ACTS LIKE AN ADDITIONAL DISK DRIVE ON ANY S-100 SYSTEM. DISK ACCESS TIMES ARE SUBSTANTIALLY REDUCED DUE TO THE ELIMINATION OF ELECTROMECHANICAL DELAYS SUCH AS HEAD LOAD TIMES, DISK ROTATION TIMES, SETTling TIMES, ETC.

INSTALLATION IS AS SIMPLE AS EXECUTING A PROGRAM SUPPLIED WITH THE BOARD. SPEED IMPROVEMENTS RANGING FROM 2 TO 50 TIMES ARE NOT UNUSUAL AND DEPEND ON DISK UTILIZATION.

Introductory price: \$1499.00
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SOFTWARE**

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CP/M**

Explore the mazes of the CP/M operating system with this menu-driven 8-inch disk which allows you to (1) look into every hidden cranny of a CP/M disk; (2) change any ASCII or hex byte; (3) recover erased files; (4) create "autoload" disks; (5) find and lock out bad sectors; (6) reconstruct files from crashed disks. And more! \$39.95.

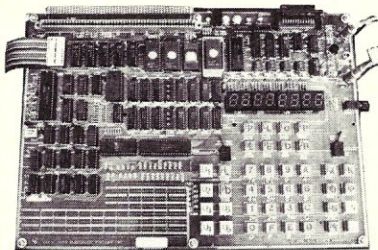
Hard-copy instructions included. For recommended parallel reading: CP/M PRIMER by Murtha and Waite, \$14.95. Send check for prompt shipment. Add \$2.25 per order for shipping. Return for refund if not satisfied. CP/M is a registered trademark of Digital Research, Inc. Requires two drives, 32K.

TELEPRINT, INC.

P.O. Box 10B, Sylvania, Ga 30467

CIRCLE 270 ON READER SERVICE CARD

**EPROM PROGRAMMER
EMULATOR AND Z80
COMPUTER ALL IN ONE
\$495 SYSTEM, \$299 KIT**



. 2758, 2716/2516 plus 2732/2532, 2764 /2564,
27126 Personality Modules and Emulator Adaptors.
. S-100 Memory Board Extension
(see BYTE 1983 Feb. issue p.491).
.. KIT does not include chassis nor power
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PLOTPAK can drive a screen and plotter simultaneously and includes your choice of the following drivers:

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PLOTPAK (.REL file) two drivers \$275

PLOTPAK (source code) two drivers \$365



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CIRCLE 187 ON READER SERVICE CARD

New Products continued . . .

heads. It has built-in data separation and features data rates of up to 5 MB/sec, 256-sector addressing range, CRC generation/verification on ID fields, unlimited sector interleave capability, automatic retries on all errors and automatic restore and re-seek on seek error.

The subsystem comes complete with controller board, connector cable, CP/M BIOS disk and several hard disk drives, depending on the capac-

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Price: 5 MB, \$1800; 20MB, \$2000.

Advanced Digital Corp.,
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512K RAM with parity	only \$879
256K RAM with dual RS232 & parallel I/O	only \$669
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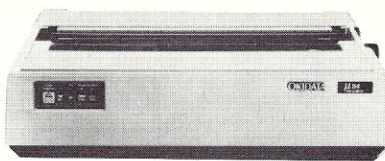
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CIRCLE 203 ON READER SERVICE CARD

New Products continued . . .

Upgraded Microline 84 printer

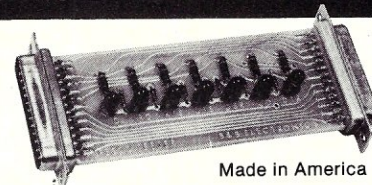
Upgrades and enhancements to the high-performance Microline 84 dot matrix printer are contained in the "Step 2" Microline 84. Along with correspondence-quality printing, the "Step 2" models feature full compatibility with WordStar, Visicalc, and other popular software packages, thus eliminating the need for modifications when using these types of



software in the correspondence mode.

Other improvements include a switch-selectable interface, select/deselect control, Spanish character set and forward feed superscript/subscript printing.

**Now... You Can Monitor
7 Most Important
RS-232 Interface Lines**



Made in America

RS-232-INTERFACE TESTER

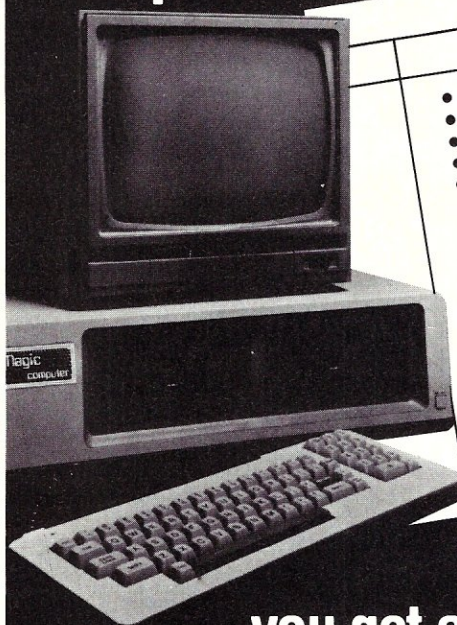
connects in series with any RS-232 interface. LED's clearly display status of 7 functions: transmit data, receive data, request to send, clear to send, data set ready, carrier detect, data terminal ready. Requires no power; may be left in permanently. Satisfaction guaranteed. **ORDER NOW!** Only \$39.95, plus \$1.75 for postage & handling. Illinois residents add 5% sales tax. We accept MC and Visa. Purchase Orders from rated Corps accepted. FREE, illustrated catalog of problem detecting equipment.

B&B electronics

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CIRCLE 149 ON READER SERVICE CARD

**Are you paying more
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you are for your
computer?**



OPTIONS
DESCRIPTION

- 64K Base System
- Additional Memory for Display
- Auxiliary Display Processor
- Display Adapter
- 12 Inch High Resolution Monitor
- 80 Character Display
- Upper/Lower Case
- Detachable Keyboard
- Numeric Pad with Function Keys
- Second Disk Drive
- Parallel Printer Port
- RS-232C Port
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CIRCLE 45 ON READER SERVICE CARD

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Timin FORTH RELEASE 3.1 \$99.95
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Timin FORTH Manual \$29.95
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Martian Technologies

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619-464-2924

CIRCLE 246 ON READER SERVICE CARD

**MAGNOLIA
MICROSYSTEMS**

**Makes the
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89/90
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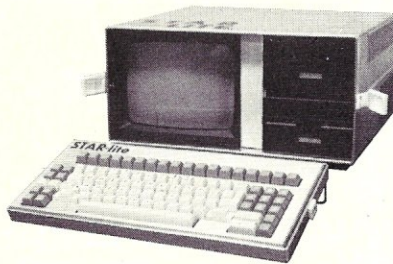
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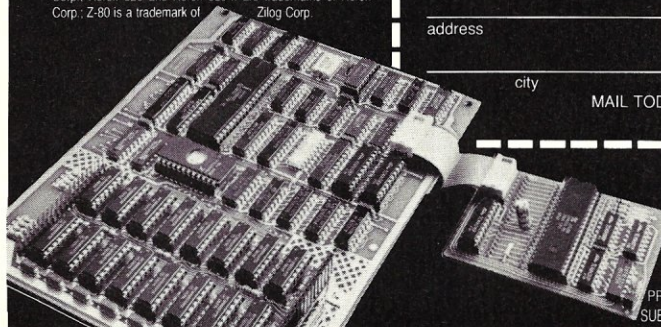
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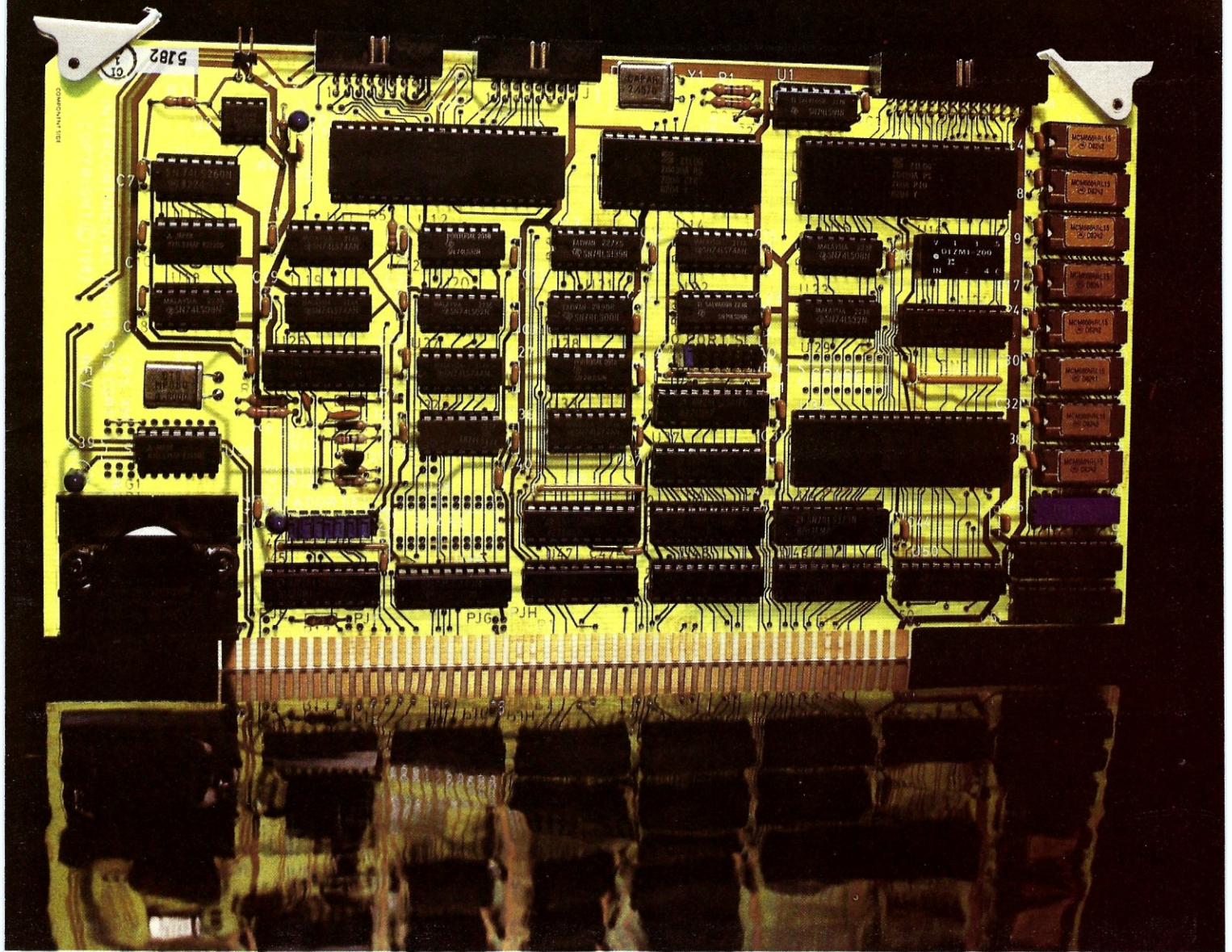
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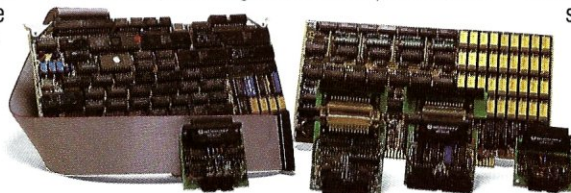
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Ron Hipschman (Curator)
and Rik Myslewski (Development),
the Exploratorium science museum.



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