the CP/M* and S-100 user's journal

$2.95 U.S.A.

MICROSYSTEMS™

JUL/AUG 1982 VOL. 3/NO. 4

SYSTEM DEVELOPMENT SOFTWARE

See Pages 22-41

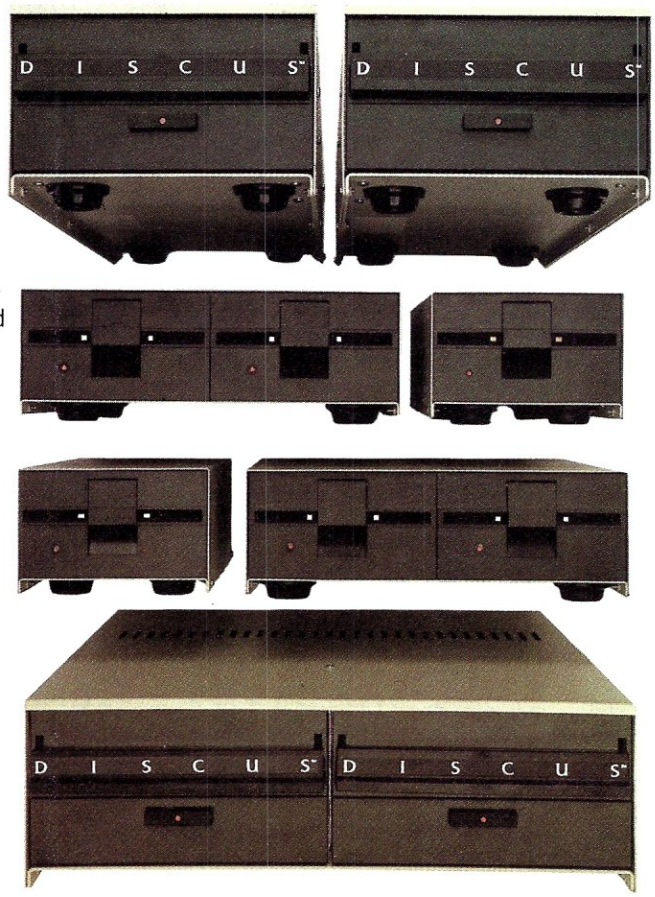
Also in this Issue

and more

Complete Table of Contents on Page 3

MORROW DESIGNS

Cost effective answers to floppy disk problems.



DMA answers. Standard, accumulator transfer floppy disk controllers can stall your microcomputer system's CPU for as long as 160 milliseconds. Just to access and transfer a sector of data to main memory. If CPU processing speed and system performance are critical, you need something better. That's where Morrow Designs' new intelligent Disk Jockey DMA™ controller comes in. This new breed of perpherial handles both 5¼" and 8" drives and can read almost any format in existence. Speed? Your CPU runs at full tilt while the DMA controller seeks and gathers a sector of data. How? Information transfers to and from main memory occur as "cycle steals" from the system bus. And the missing memory cycles are transparent to the CPU totalling only two milliseconds instead of the usual 80.

Build a buffer. Give the Disk Jockey DMA a little extra memory and your system's performance gets even better. The extra storage is used as a track buffer. So, whenever a sector on a new track is read, the track buffer is automatically filled with the other sectors on the track. The result? Additional data on the track is immediately available. Without the 80 millisecond rotational latency normally encountered. And similar efficiencies occur with disk writes. Sectors in the track buffer are conditionally written on the disk only if a new track is accessed. And only one revolution of the disk is required.

Now, prices:* All systems listed are supplied with a floppy disk drive, Disk Jockey Direct Memory Access Controller, CP/M** 2.2 operating system, power supply, fan, cables, cabinet and Microsoft 5.2 BASIC.

Even lower prices. Morrow Designs' floppy disk systems with Disk Jockey™ 2D controllers offer the same high quality at even lower prices. Now without memory mapping!

Fast answers. See Morrow Designs' family of cost effective floppy disk systems at your computer dealer. For a somewhat more leisurely answer, circle the reader service number below. For immediate answers, phone us at (415) 524-2101.

LOOK TO MORROW FOR ANSWERS.

5¼ Inch Systems (formatted data)	
400,000 Bytes (1) Dual Sided 48 TPI Drive	$ 995
800,000 Bytes (2) Dual Sided 48 TPI Drive	$1695
800,000 Bytes (1) Dual Sided 96 TPI Drive	$1495
1,600,000 Bytes (2) Dual Sided 96 TPI Drive	$2495

OEM pricing available

8 Inch Systems (formatted data)	
500,000 Bytes (1) Single Sided Drive	$1195
1,000,000 Bytes (2) Single Sided Drive	$1975
1,000,000 Bytes (1) Dual Sided Drive	$1495
2,200,000 Bytes (2) Dual Sided Drive	$2575

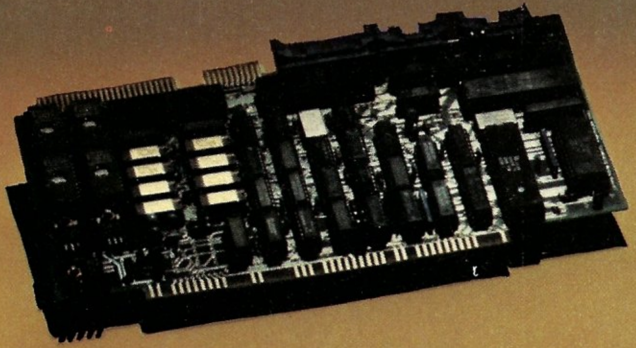
OEM pricing available

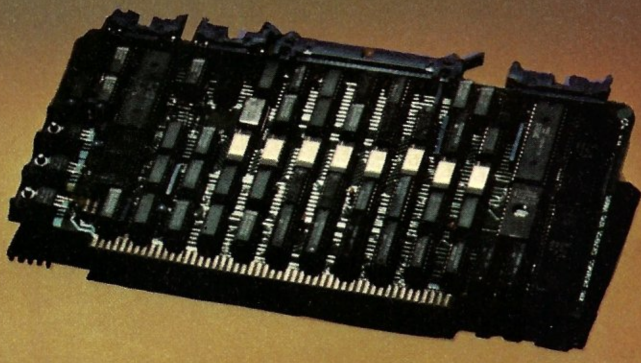
*Prices subject to change without notice.
Disk Jockey DMA and Disk Jockey 2D are trademarks of Morrow Designs
**CP/M is a trademark of Digital Research.

MORROW DESIGNS

5221 Central Avenue, Richmond, CA 94804
(415) 524-2101

CIRCLE 1 ON READER SERVICE CARD





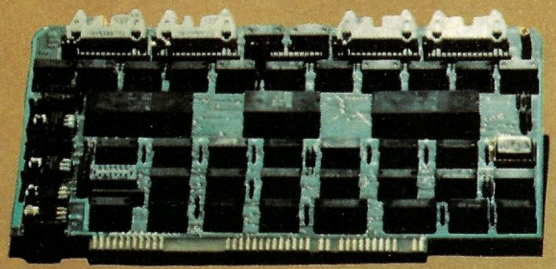
Performance . . .

SBC-100S SLAVE PROCESSOR

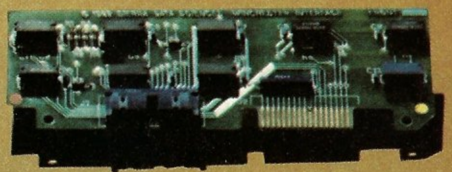
- Z80A CPU
- 64K Bank Switchable Memory
- 16K EPROM
- 2 RS-232 Chan. (up to 19.2K BAUD)
- 4 Parrallel Ports
- 4 Timers
- IEEE 696 Buss Interface
- Expansion Interface (X-Buss)
- On Board EPROM Burner (Opt.)
- **$795.00** Single Unit Quantity

SBC-100 MASTER PROCESSOR

- Z80A CPU
- 64K Bank Switchable Memory
- 4K EPROM
- NEC 765 FDC with PLL interfaces to all Shugart compatible Drives
- 2 RS-232 Chan. (up to 19.2K BAUD)
- 2 Parrallel Ports
- 4 Timers
- IEEE 696 Buss Interface
- **$895.00** Single Unit Quantity



SDS-ZSIO/4
ZSIO 4 Port RS-232
Serial Expansion Board
$295.00 Single Unit Quantity



SDS-HARD DISK INTERFACE
Micropolis 1220 Series
Interface Adapter
$150.00 Single Unit Quantity
(Includes Software Drivers, Cabling, and Mounting Hardware.)

Software Support . . .

*CPM 2.2 for Single User Systems
**TURBODOS Single User or Networking

*Registered Trade Mark of Digital Research Corporation.
**Registered Trade Mark of Software 2000.

. . . And Quality

- Boards Tested on "Bed of Nails"
- Support Logic meets MIL-STD-833 Specifications
- Gold Plated Connectors
- Full One Year Warranty

We have it ALL!

HARDWARE
SOFTWARE
SIERRA DATA SCIENCES
Fresno, California

Marketing Division
21162 Lorain Avenue
Fairview Park, Ohio 44126
(216)331-8500
TELEX 980131 WDMR

CIRCLE 2 ON READER SERVICE CARD

the CP/M* and S-100 user's journal

MICROSYSTEMS™

Volume 3/Number 4 July/August 1982

Staff

Editorial correspondence is welcomed and should be sent to: Sol Libes, c/o MICROSYSTEMS, Box 1192, Mountainside, NJ 07092. Phone: (201)522-9347.

For information on commercial advertising, write to: MICROSYSTEMS Advertising Dep't., One Park Avenue, New York, NY 10016, or call Jeff Weiner at (212)725-7957.

MICROSYSTEMS (ISSN #0199-7955) is published bi-monthly by Ahl Computing, Inc., a subsidiary of Ziff-Davis Publishing Company. David Ahl, President; Elizabeth B. Staples, Vice-President; Selwyn Taubman, Treasurer; Bertram A. Abrams, Secretary.

Second Class postage paid at New York, NY 10016 and at additional mailing offices. POSTMASTER: Send address changes to MICROSYSTEMS, PO Box 1987, Morristown, NJ 07960. Subscriptions are $24.97 for 12 issues. Canadian prices are $5.00 per year additional; other foreign $8.00 per year additional (U.S. currency only).

In This Issue

by Sol Libes

EDITOR'S PAGE

On May 17th, the Amateur Computer Group of New Jersey ran its seventh annual Trenton Computer Festival. Over 10,000 avid microcomputer users attended the event. One of the highlights of TCF-82 was a two-hour meeting of the CP/M-SIG/M user groups. Several hundred people attended this session. The featured speaker was Dr. Gary Kildall, President of Digital Research and creator of CP/M. Gary talked about DR's direction in operating systems and what DR is doing in the 8-and 16-bit areas. The following are the highlights of his talk.

Although CP/M is DR's best known product, DR has many other products including MP/M, CP/Net and Concurrent CP/M. CP/M, MP/M and CP/Net are available in both 8-bit (8080) and 16-bit versions (8086), while Concurrent CP/M is presently available only in 16-bit form. DR expects to release an 8-bit version later this year.

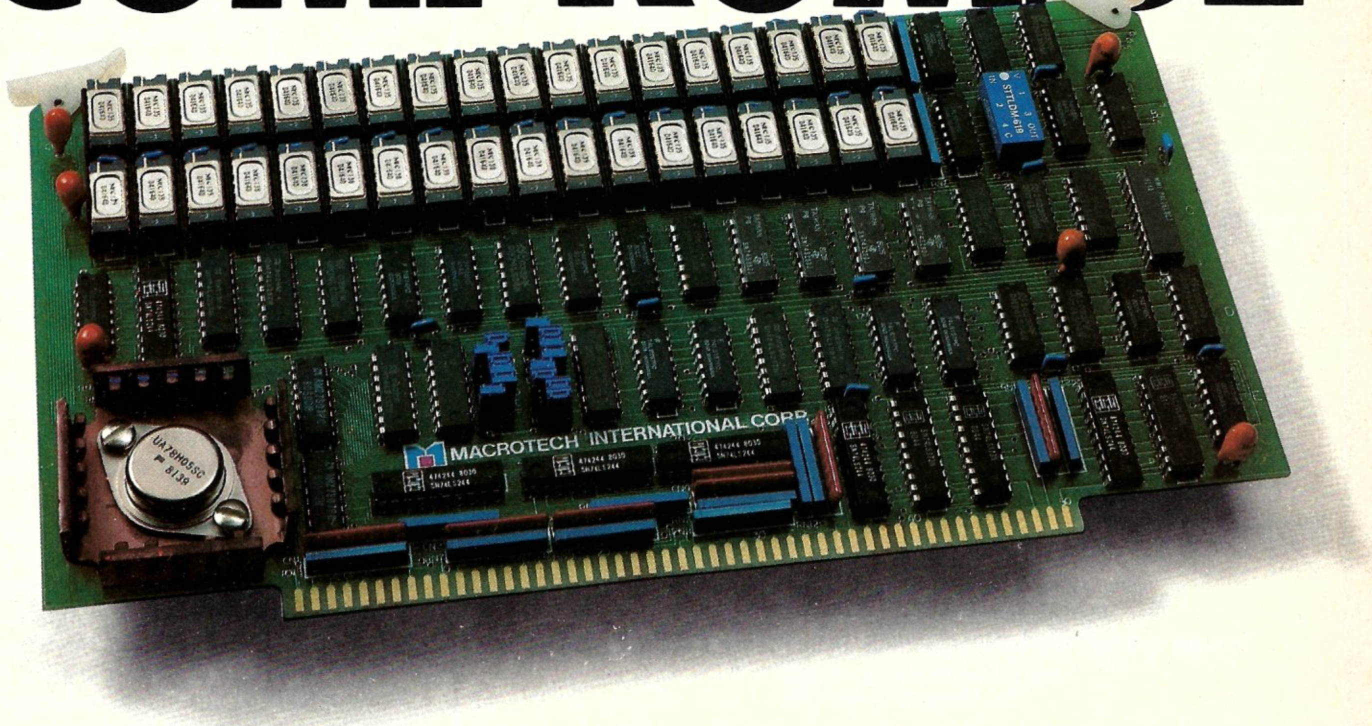
Operating systems in 8-bit environments face certain limitations; they are typically floppy disk based, have smaller and more restrictive instruction sets, and small memory space. However, these systems are low in cost and users have access to a very large, mature software base. The 8-bit operating systems are, of necessity, small in size, mostly single user, single stream, with no overlays and limited space for applications programs. Application space can be expanded via bank-switched memory. For example MP/M-II, in an 8-bit system creates a multi-user, multiprocessing enviroment consisting of 48K memory spaces for each user. Hence, memory space for application programs is still limited, causing many programs to just limp along.

16-bit systems offer much more memory space. The 8086 offers 1 Megabyte of memory, making possible lots of 64K segments which can be packed one on top of the other so that application program space is effectively unlimited. Even

The SIG/M group and Gary Kildall at the Trenton Computer Festival. From left to right: Henry Kee, Howard Fingerhut, Gary Kildall, Bill Chin, Bruce Ratoff and Sol Libes.

THE MULTI-USER FRIENDLY 256K MEMORY BOARD WITH

NO COMPROMISE



No Compromise in Performance
- ☐ Main-frame type memory mapping for optimal BANK SWITCHED applications or 24-BIT extended addressing
- ☐ Operates in *any* S-100 System IEEE/696† or non IEEE
- ☐ DMA operation fully supported†
- ☐ 8/16 data transfer protocol†
- ☐ Up to 6 MHZ with no wait states; Up to 10 MHZ with automatic wait state assertion
- ☐ Parity error detection†
- ☐ Double parity in 16-BIT operation

No Compromise in Features
- ☐ All memory/refresh cycle timing is generated ON BOARD providing easy CPU independent characterization
- ☐ Ideal for use with the new generation of operating systems: CP/M-80,™* CP/M-86,™* MP/M-11,™* MP/M-86,™* OASIS,™** UNIX™***

No Compromise in Quality
- ☐ Multilayer board and bus signal filtering for noise-free operation
- ☐ Thorough 100% final test and burn-in

No Compromise in Versatility
- ☐ Manual provides source listing and complete installation guide for MP/M-II™* BANK SWITCHED multi-user applications
- ☐ For the CP/M-2.2™* user: Manual includes implementations of 'Virtual Disk' for solid state disk/file applications

No Compromise in Customer Support
- ☐ Comprehensive technical manual
- ☐ User hot-line
- ☐ Full one year parts and labor warranty

†In accordance with IEEE-696 standard
Registered trademarks of: *Digital Research, **Phase I, and ***Bell Labs.

ORDER NOW

(213) 887-5737

If you wish, send a check or money order for $1,379 (in California add 6% sales tax where applicable).

Manual available at $25.00 each refundable with order.

MACROTECH International Corp.,
22133 Cohasset St., Canoga Park,
California 91303

MACROTECH International Corp.,
22133 Cohasset St., Canoga Park,
California 91303

CIRCLE 4 ON READER SERVICE CARD

Editor's Page, continued...

though the 8086 provides for segmentation, relocation and a number of added facilities, it still has a relatively simple instruction set. 16-bit systems generally also utilize hard disks. Although the software base is still very limited compared to the 8-bit software base, it is moving along very well.

The successful software in the 16-bit area will be the software that takes into account the increased functionality that is available. The operating system can be larger to accomodate the increased functionality. The smallest 16-bit system that anyone is really going to work with is 128K, so it is no longer necessary to limit the operating system to 4-6K. The enhancements to CP/M and MP/M in the 16-bit environment include things like background/foreground operation (concurrency) and multi-access file systems. Thus CP/M-86 is a "bridge" into the 16-bit world. It is exactly like CP/M-80 with memory-management for a larger memory space and features for handling multiple resident programs. The data structures and file systems are exactly the same, making conversion of applications programs very easy.

Furthermore, MP/M-86 has an option for an MP/Net interface and a real-time nucleus that supports concurrent operation. It is well suited to multi-processor applications such as robotics, as well as multi-user business systems. It has a new file system (BDOS 3) with password protection, time and date stamps and record and file lockout.

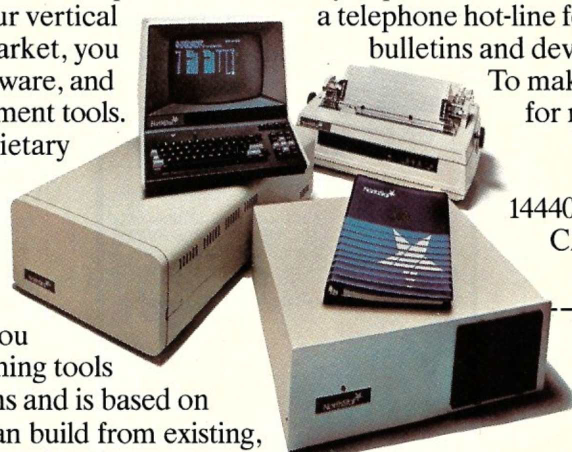
Concurrent operation allows a single user to use his system as if it were several systems on which the user runs different applications concurrently. This is done via "virtual consoles" to which the user can easily switch back and forth. For example, a programmer can edit and compile a program on one virtual console, switch to another console to debug the program and on another virtual console print the program. The user can then switch back to the debugger and editor to make a patch to the program. Everything is managed via a multi-access file system with file and record lockout to prevent files from being corrupted.

Multi-user concurrency is well suited to on-line multi-user business systems such as one using a common

Systems Houses can rely on NORTH STAR

We make your applications work like a dream.

Whatever you're dreaming up, we can help turn it into reality. To successfully bring your vertical market application system to market, you need cost effective, reliable hardware, and state-of-the-art software development tools. North Star offers our own proprietary development systems as well as CP/M.® Our new "Application Development System" (ADS) lets you create your own software packages for a wide variety of applications. ADS provides you with a powerful set of programming tools for creating business applications and is based on the popular language "C." You can build from existing, proven software (word processing, data base management and accounting) by integrating your software with our standard business applications.



Systems Houses receive our full support including extensive documentation, programming seminars led by experienced business application programmers, a telephone hot-line for your programmers, software bulletins and development hardware discounts.

To make your dreams come true, and for more information, please write North Star Computers, Inc., ATTN: OEM Sales Dept., 14440 Catalina Street, San Leandro, CA 94577. Phone (415) 357-8500. TWX/Telex (910) 366-7001.

For more information on North Star's Application Development System, clip this coupon.

MS 7 82

NAME ____________________

COMPANY ____________________

ADDRESS ____________________

CITY ____________ STATE ____________

ZIP ____________ PHONE ____________

FOLLOW THE STAR

NorthStar™

CIRCLE 6 ON READER SERVICE CARD

Editor's Page, continued...

customer base for sales, invoicing and shipping. The key to successful operation of such a system is also the multi-access file system. Unix does not have a multi-access file system. Rather, system users are expected to stay away from one another in the file system. MP/M-I did not have a multi-access file system, and this turned out to be a problem. It took DR about a year and a half to work out their multi-access file system.

The conventional method of having a multi-access file system is use the file or record lockout. However, this has the disadvantage that if a given console has locked the record and then that console user leaves or the console goes down for some reason the record is locked against entry from other users. The usual practice is for a time limit to be placed on the lockout (e.g., 10 minutes). However, DR chose to use the technique used by IBM. DR calls it "test and write record." When a console wishes to change a record it reads out the entire record, changes it and writes back the altered and original records to the system. The system then checks to see if the original record sent back is the same as the record currently in the data base. If it is, the record is updated. If it is not, it is assumed that the record has been changed in the meantime by some other terminal, and a notice is sent back that the file has been changed. The terminal now requests the altered record, makes its alterations and sends both records back again. Eventually the record will be updated properly. The record is locked between the time it reads the record and updates it. The feature must be coded into the application program. The application program can lockout a file, a record or a sequence of records and do a test-and-write record.

The 8-bit area is still a very active area for DR and they are working on new versions of the 8-bit software that will have many of the new features currently available for their 16-bit software. Versions of CBasic, Pascal /MT+ and CIS Cobol have already been released in 16-bit form. PL/I-86 is now in beta test and should be released in fall. They have also released XLT-86 which translates 8080 source programs into 8086 code with data analysis of the code to optimize it for the 16-bit environment.

DR is actively working on operating systems for the 68000. They are working on three levels of 68000 operating systems: CP/M and concurrent CP/M single user systems and an MP/M system with enhancements. They will have a totally new file system with a shell around it to make it look like either CP/M or MP/M or any system they wish. Like all other DR operating systems these will also have a user-configurable BIOS. CP/M-68K is currently running in house and should become available toward the later part of the summer.

Unfortunately, Gary felt that he could not talk about projects currently in R&D other than to say that they are being heavily influenced by the work that has been done with Smalltalk and the Xerox systems. He also said that DR is heavily involved with graphics. The emphasis is on user-friendly interfaces.

CP/M-3 is now in beta test. The BDOS (Version 4) file system will have the features introduced in MP/M-II (e.g., time and date stamps, etc.), with many speed enhancements and options for record caching. It will also have a greatly enhanced full screen editor.

In commenting on MS-DOS versus CP/M, Gary expressed the feeling that MS-DOS is "a CP/M clone" between CP/M V1.4 and V2. It is very similar to CP/M, but does not emulate it exactly. ■

Think Ahead!

Multi-user MP/M™ 8-16 can run proven 8 bit CP/M 2.2™ software and 16 bit CP/M 86™ software *at the same time.* Get it now, use it for years!

MP/M 8-16 gives you:

- **Effortless upgrading** from 8 to 16 bit software (e.g. CBASIC™ to CBASIC 86™) without leaving your data behind. Your 8 bit data and source files are ready right now to run in the 16 bit world!

- **Complete compatibility** with CP/M 2.2, CP/M 86, MP/M 2™, and MP/M 86™ software. Everyone else says pick only one; with **MP/M 8-16**, you get it all!

- **Large CP/M 2.2 program user area—61K!** This is 6K more user space than you get on a conventional single-user implementation of CP/M 2.2!

- **Upgradable hardware**—our boards are compatible with the IEEE 696 bus (and we've got 20 bus slots!). Our state-of-the-art systems can keep pace with the state-of-the-art, just add boards. Think ahead!

MP/M 8-16 is a proprietary implementation of Digital Research's MP/M 86 operating system, configured for CompuPro™ by G&G Engineering. **MP/M 8-16**'s 8 bit capability is not an emulation. **MP/M 8-16** uses CompuPro's 8085/8088 CPU board to run CP/M 2.2 compatible programs on a high speed 8085 CPU and CP/M 86 compatible programs on a high speed 8088.

All boards in our **MP/M 8-16** systems are CompuPro's Certified System Components, which includes a two year immediate replacement warranty.

MP/M 8-16 systems start at $8995, terminals not included.

G&G Engineering and CompuPro do it best!

G&G Engineering is an authorized CompuPro systems center. We offer completely integrated CompuPro based systems running CP/M, MP/M, and UNIX®.

G&G ENGINEERING

1922 Republic Avenue, San Leandro, CA 94577 (415) 895-0798

CIRCLE 9 ON READER SERVICE CARD

LETTERS TO THE EDITOR

Looking For SOL-20 PC Boards

Dear Editor:

First, I would like to congratulate you on the quality of *Microsystems*. It certainly fills a need for those of us who are convinced that S-100 and CP/M are the way to go. I particularly like your choice of articles. Let's hope that Ziff-Davis does not have the same effect on you that McGraw-Hill has had on *Byte*.

As a suggestion, I would like to see more articles on modifying the CP/M BIOS and adapting it to various special requirements. I also need more information on the mechanics of the various CP/M utilities such as the debugger.

Finally, I need help. In addition to an S-100 system, I have a SOL-20 which is currently moribund. The problem appears to be either a broken trace on the PC board or a bad socket. Shortly after Processor Technology's demise, ASAP Computer Products was offering SOL-20 PC Boards for $50. When I tried to order one they were sold out. Some of these boards may be still around and available. Any ideas, suggestions or help that your readers may care to offer will be gratefully accepted.

Peter T.E. Nevius
2419 Brookshire Dr.
Schenectady, NY 12309

A Timestamp For CP/M

Dear Editor:

There is a potential problem with the circuit presented in the article "A Timestrap for CP/M" in the Mar/Apr 1982 issue. The register that controls the HOLD, READ and WRITE lines is not cleared when the system is powered up. If any of these lines end up in the active state, the data in the clock chip (MSM5832) can be modified or destroyed. There is an easy fix for this problem. A 74LS273 can be substitued for the command register chip (74LS374). It is pin compatible and functionally equivalent with the exception of pin one. Pin one on the 74LS273 is a master reset that can be connected to the power on clear signal from the IEEE-696 bus (pin 99). This will guarantee that the command register does not compromise the accuracy of the clock chip during power up. The 74LS273 does not have the ability to tri-state its outputs, but this is not required in this instance.

John S. Robison
Horsham, PA

Dear Mr. Robison: You are correct that not clearing the command register at power up poses a potential *problem, although for data to be modified* both *the HOLD and WRITE lines would have to be high for at least 150 microseconds. In practice, this does not seem to happen. I checked the clock on 3 May, and it differed from the time signal by only 3 seconds. The previous check was performed on 1 March, when the difference was 2 seconds (not corrected). My system gets turned on and off almost daily—but perhaps my register chip is unusual in that its natural "bias" is to go to all-zeroes at power-up. Mr. Robison's fix would certainly guarantee accuracy regardless of individual chip characteristics.* —*Chris Terry*

Interface To CalComp Model 114 Disk Drive

Dear Editor:

I'm writing to ask your readers' help in finding an S-100 interface card to a CalComp model 114 disk drive. These drives (which originally cost about $20,000 each) are very rugged mechanically and the removeable disk packs can each store about 30 Mbytes. This drive, unfortunately, does not have an SMD interface.

I thought I had found an electronic development company on the West Coast to build the interface, but the press of the other business has shelved the project for two years with no completion date in sight. Hence, I'm again looking for a supplier.

There were thousands of these drives built and they are now being replaced by newer technology, so it seems there is a good market for an S-100 card. I have complete technical information (Manual and schematics) which I'll make available if needed.

Ron Tipton
P.O. Box 227
Greenwood, MO 64034

Use Your Computer to Build A Computer

Dear Editor:

In regards to the article in the Jan/Feb 82 issue "Use Your Computer to build a Computer": I sent a disk as was requested in the article. The reply was very prompt.

In addition to the SORT program they offered, they provided a nice letter on the same disk plus three other listings, two of which are the best CP/M software programs I have.

One of them is a program directory that provides the following:

1) Alphabetical listing of files
2) Total space on disk
3) Total space used on disk
4) Total space remaining on disk
5) Number of extents used and available

The second program is called FIX. It is really good. Two of the most useful features are:

1) Erased File Directory
2) Recover Erased Files

There are about 15 programs included in FIX. All that is necessary to use FIX is to type FIX, EFD and all of the erased files are listed.

Then to recover any of the erased files, type REF (FN.FT), and you are done.

William Harmon
Torrance, CA

ERRATA

Dear Editor:

This letter is promoted by your editorial comments in general, and those in the Volume 3, Number 1 issue in particular.

I have noted and accepted your enthusiasm for the S-100 hardware and CP/M based software. On frequent occasion, however, your enthusiasm has taken the place of plain, old-fashioned accuracy. When this condition concerns only statements identified as rumors, no harm is done. Unfortunately, you do err on simple factual matters also. And too frequently to inspire confidence, in my opinion.

A longstanding example, which you may say is mere semantics, while I say is a factual error, is your constant reference to the "S-100 bus standard." In fact, no such standard exists. What you have in mind is only a proposed standard. Until that proposal is formally adopted by the IEEE, it has no more standing than any other proposal.

Your more recent errors, one of which concerns me personally, are in the issue mentioned above. The SIG/M group has adopted a policy of supplying disks to groups rather than individuals. They have published this modus operandi infrequently in the ACGNJ newsletter. I have never seen anything that would lead me to believe that the CPMUG has done likewise. Certainly, nothing in *LIFELINES* has been said to that effect. I have as recently as six weeks ago received delivery of disks from them, as an individual.

Further, while I may be flattered to see my name in print under certain circumstances, it is totally inaccurate to say that I am a "SIG/M Software Distribution Group," as you did on page 12.

I only own five SIG/M disks, purchased through the mail long ago, for my private use, before their group sales policy took effect. I never did anything to suggest that I wanted to distribute disks, nor was I ever asked to do so. In short, the subject never came up in my private transactions. It would be very interesting to me to learn how you or anyone else in the ACGNJ arrived at the conclusion that I am a "distribution group." Also, how many other names are incorrectly on that list?

I have spent many an hour working for various volunteer groups and would be the first to defend those who feel their work is usually unappreciated. What must be remembered by even the volunteer worker is to always "check your facts." This episode has reinforced my belief that much material in your column cannot be relied on until substantiated elsewhere. I trust that you will accept these comments in the spirit in which they are given, and that your future printed efforts will display factual correctness.

S.F. Rinkunas
Whitehall, PA

Dear Mr. Rinkunas: I have always tried to be careful to point out that the IEEE696/-S100 Standard is still being worked on and, although very close to adoption, is still a "proposed" standard. The standard was voted on by the committee members and approved in June 1981. Three committee members assumed the responsibility for finalizing a few details, entering the proposed standard onto a word processor and submitting it to the IEEE Computer Standards committee. Regretfully, these individuals, all volunteers, have been very busy on other projects and have not yet completed this work. In the meantime, virtually every S-100 product manufacturer has declared his intention to bring new designs into conformance with the proposed standard.

Regarding the SIG/M software distribution list published in the Jan/Feb 1982 issue, note the following. This list was furnished to me by Bill Chin, the coordinator of SIG/M. You can be sure that I will get back to Bill and question him as to the validity of this list. —*Editor*

Intro To The C Programming Language

Dear Editor:

I enjoyed the article "An Introduction to the C Programming Language" in your November/December issue. However I noticed a few errors in your description of the C language.

The most significant difficulty is in your discussion of pointers. The statements

```
char fcb[12], *pfcb;
pfcb = fcb; /* (not &fcb)  */
```

will set pfcb to point to the first element of the array fcb (fcb[0]). The name of the array without a subscript is a constant, and cannot have its address taken. This construction is valid for all arrays.

Another point not clearly explained is pointer arithmetic. A pointer that has been set to point to an element in an array will point to the next element in the array if it is incremented, and the i'th cell after the pointer if "i" is added to it, even for arbitrarily complex arrays (including arrays of arrays or arrays of structures). The following statements

```
float fvar[10], *fptr, *fptrl;
fptr = &fvar[3];
fptr += 5;
fptrl = fptr++;
```

will set fptr to point to fvar[9] and fptr1 to fvar[8].

Also, if two pointers, p1 and p2, point to the same array, p1 - p2 will result in the number of elements between p1 and p2 (negative if p1 < p2).

A number of other minor errors cropped up:

```
x op= y (ie x += y)
```

is not equivalent to

```
x = x op y
```

In the first expression, x is only evaluated once, the second, twice. This feature is important when side effects occur, such as

```
x[++i] += y;
```

The bitwise inclusive or operator is | , exclusive or is ^ , ones complement is ~, and the logical or is || .

Types were not fully described: *unsigned* declares an unsigned integer. Also, *short* and *long* can prefix any basic type (a *long float* is the same as *double*), with *int* being the default (*short* alone = *short int*).

I was sorry not to see Aztec C mentioned. It is an almost totally complete subset of the language (more so than BDS C) and the designer plans floats and long ints in a future version of the compiler.

Larry Hamelin
Albany, CA

Author's response:

I agree with Mr. Hamelin's description of pointers, and would like to point out that the statements:

```
char fcb[12], *pfcb;
pfcb = &fcb;    /* erroneous */
```

should have been printed as:

```
pfcb = &fcb[0];
```

or

```
pfcb = fcb;
```

as Mr. Hamelin states. The variable fcb contains the address of the first element of the array.

Additionally, I felt that a very complex discussion of some of the more unclear features of pointer arithmetic was unnecessary in a first introduction to the language features.

In the same manner, the statement

```
x op= y
```

is similar to

```
x = x op y
```

in most cases. In the case of Mr. Hamelin's example:

```
x[++i] += y;
```

this is not so. That statement would be seen as:

```
x[i] = x[++i] + y;
 (1)      (2)
```

in the normal implementation of C. What happens is that expression 2 is evaluated prior to expression 1. The variable "i" is incremented and y is then added to the value of x[i] (after 'i' is incremented). That sum is then assigned x[i], also after 'i' has been incremented. If the expression was identical:

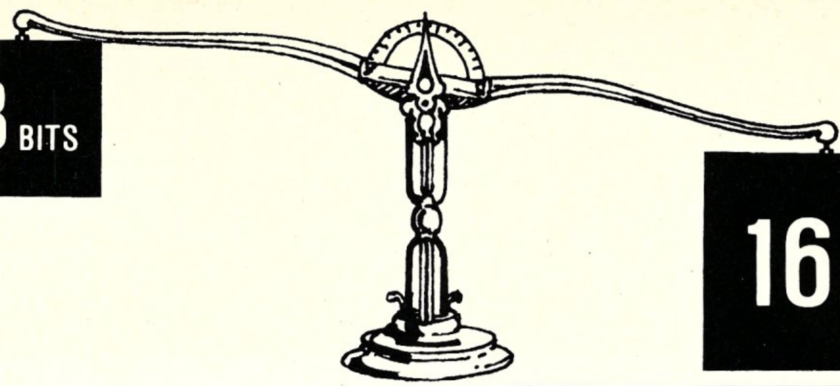
```
x[++i] = x[++i] + y
```

the sum would be placed in the element following.

Mr. Hamelin's observations of the missing bitwise operators is correct. They must have vanished at some time during the publication process.

As for the Aztec C Compiler, I received it after the article had been sent to press. I will be evaluating it in a future article. At this point, it would be unfair to say whether it is better or worse than any of the other implementations. —David A. Gewirtz.

8 BITS



16 BITS

MICROCOMPUTERS

THE CHOICE JUST GOT EASIER!

PRICE $4390 Gets you a Tec-86 Complete 16 Bit 8086 System, including 64K Bytes of Memory, Dual 8 Inch Double Density Floppy Disks, and more. . . (See complete Tec-86 specs below.)

PERFORMANCE Faster Processing, Increased Address Space, up to One Megabyte of available memory, and the Increased throughput of the the TEC-86 16 Bit System means that you can now do work on a microcomputer never before practical with the slower 8 Bit systems.

SOFTWARE CP/M-86™ Brings the World of CP/M software up to the 16 bit systems. BASIC-86™, MS-Fortran™, MS-PASCAL™ are just a few of the Languages currently available.

EXPANSION Memory Expansion up to ONE MEGABYTE. Disk Storage can be increased to over 30 Megabytes with our Winchester Disk Subsystem. Multi User Systems available soon!

QUALITY Full ONE YEAR WARRANTY is standard on TECMAR components. This Warranty is possible due to our High Engineering Standards, and Thorough Product Testing.

DELIVERY We have been delivering 16 Bit Boards and Systems for nearly two years. Most orders are shipped from stock or within 30 days.

S100 A/D $765
Analog to Digital Converter with Timer/Counter

12 Bit Accuracy, 16 Channels, 30 KHz Conversion, Five Programmable Timer/Counters for:
- Time of Day
- Triggering Conversions
- Counting Conversions
- Counting External Signals
- Interrupting the CPU

Options: Programmable Gain; 14, 16 Bit Accuracy; 40, 100, 125 KHz Conversion; Expansion to 256 Channels

$4390 TEC-86 $4390
16 BIT 8086 MICROCOMPUTER SYSTEM

FEATURES: 5 MHz 8086 CPU * 64K Bytes RAM * S100 IEEE-696 * Dual 8 Inch Double Density Floppy Disk Drives * Two RS 232 Serial Ports, 50 to 19200 Baud * Three Parallel Ports * ROM Boot for CP/M-86 * Heavy Duty Power Supply * Attractive Industrial Quality Desk Top Cabinet * Completely Assembled and Tested * **OPTIONS:** Up to One Megabyte of Memory, Double Sided Double Density Floppy Disks * Up to 31 Megabytes of Winchester Fixed Disk Storage. * CP/M-86 * BASIC-86 * MS-FORTRAN * MS-PASCAL * CBASIC/86™ * PASCAL/M86™

$10990 TEC-86W $10990

Same Great Features as our TEC-86 except that the TEC-86W has 256K of RAM, and our 31 Megabyte Winchester Disk Subsystem.

NEW — 64K/256K S100 MEMORY $595/$1695

8 and 16 Bit Transfer for 8 and 16 Bit Systems
MP/M and MP/M-86 Compatible, Up to 7 users on one 256K board.
Parity Detection with Interrupt and LED Indication
Hardware Write Protect
Full DMA Capability
24/20/16 bit Address Decoding
Enable/Disable 8K/32K Segments
Bank Select in 8K/32K Segments
Meets IEEE-696 Specifications

See our catalog for many other fine S-100 and Apple Boards including: — Analog to Digital Converters *(16-256 channels; 12, 14, or 16 bit accuracy; 30, 40, 100, or 125 KHz; programmable gain; timer/counters)* **— Digital to Analog Converters** *(12 bit accuracy, 3 microsecond conversion)* **— 8086 CPU Board — I/O Boards — 16K Static RAM — Real-time Video Digitizer and Display.**

TECMAR INC.

DEALER INQUIRIES INVITED

23600 Mercantile Rd. • Cleveland, OH 44122

TECMAR, INC.
(216) 464-7410

NEWS & VIEWS

by Sol Libes

Rumors

Digital Research and Microsoft are reportedly working on upgrades of their languages to utilize the 8087. Introductions are expected shortly. .....Godbout has also disclosed that they are working on CPU cards for the 68000 and National 16032. Introduction is expected in 1983. Godbout expects to furnish CP/M-68K with their 68000 CPU card ....Digital Research is also rumored readying a relocating macroassembler for CP/M-86. This may be released as early as this month.

Godbout News

Mark Garetz, newly appointed General Manager of CompuPro, a division of Godbout Electronics, announced that CompuPro will be changing their marketing approach from selling just boards to selling complete systems. Their first system will be the MP/M-8/16 containing dual 8085/8088 processors and running the G&G Engineering implementation of MP/M that allows up to eight users to run any combination of CP/M-80 and CP/M-86 software. Mark Garetz, incidentally, personally designed many of the system's components. Mark has also taken over as chairman of the IEEE S-100/696 Bus Standard Committee.

Digital Research News

Digital Research has announced two new products. Pascal/MT+86 and Concurrent CP/M-86. All applications programs written in Pascal/MT+ can be recompiled with Pascal/MT+86 and executed under CP/M-86 and MP/M-86. It is a complete implementation of the International Standards Organization (ISO) Pascal standard, and also supports the Intel 8087 coprocessor.

Concurrent CP/M-86 allows a single user to perform several jobs simultaneously, permitting the user to interact with the computer as if it were several computers in one. The first implementation is for the IBM Displaywriter, with versions for other systems to follow.

OASIS News

Phase One Systems Inc, supplier of the Oasis operating system has released a new applications software directory. It lists over 400 packages for the OASIS system. Free copies can be obtained from: Phase One Systems, 7700 Edgewater Drive, Suite 830, Oakland CA 94621-3051; (415)562-8085, TWX 910-366-7139.

Video Recorder Winchester Backup Introduced

Alpha Micro (17881 Sky Park North, Box 18347, Irvine, CA 92713) appears to be the first company to introduce an S-100 controller card which allows a video cassette recorder to be used to back up a Winchester drive. It allows a standard VHS or Beta recorder to be used. It provides file-oriented backup and a directory allowing selection and retrieval of random and sequential files. One tape can typically be used to backup 100MB of data, although this varies with length of tape, type of files and amount of recording redundancy desired.

Other CP/M-Oriented Magazines

Microsystems was the first magazine introduced to cover the CP/M area in depth. However, it is no longer the only one. There are now two others which also emphasize CP/M and are worth your attention.

Lifelines magazine is published by Lifeboat Associates (actually Lifelines Publishing Corp.) 1651 Third

POWER & RELIABILITY

Toughest Boards in Town... IEEE696/S-100. Systems too!

256 Kb Dynamic Memory

Available now from Dual Systems: DMEM/256 memory boards. Put the most density of memory ever available on your IEEE/S-100 bus. Get industrial-grade quality with this ruggedly built board: it's been burned-in for 168 hours.

- ☐ FULL 256 Kb on a single board.
- ☐ Two independently addressable 128 Kb blocks.
- ☐ Runs in 8 MHz system.
- ☐ Runs at 4 MHz bus speed (no wait states).
- ☐ Runs in 8 or 16-bit systems with 8 or 16-bit wide data paths.
- ☐ Extended 24-bit addressing.
- ☐ Parity error or detection-generates either interrupt or bus error signals on error.
- ☐ DMEM/256KP (Parity)... $1495

Static Non-Volatile Memory

The Dual Systems CMEM memory boards combine high speed CMOS memories with new 3–10 year lithium batteries to give you the non-volatility of an EPROM board while retaining the instant writability of a high-speed read/write RAM.

- ☐ Runs at 6 MHz (no wait states).
- ☐ 8 or 16-bit with 8 or 16-bit wide data paths.
- ☐ Extended 24-bit addressing and bank select.
- ☐ CMEM/32K $995
- ☐ CMEM/16K $795
- ☐ CMEM/8K $695

Non-Stop Clock

Keeps time with power off. Our industrial clock utilizes a new lithium battery for 3–8 years use. Easiest clock to program you'll ever see. Runs in all S-100 systems.

- ☐ Year, date, hrs., mins., and secs.
- ☐ Uses new LSI CMOS chip.

CMEM/32K

A/D Converter

IEEE696/S-100 AIM-12 industrial standard module designed for industrial analog-to-digital use.

- ☐ Runs in all S-100 systems.
- ☐ 32-channel, 16-differential.
- ☐ 12-bit resolution/accuracy.
- ☐ 25-microsecond conversions.
- ☐ Instrumentation amplifier.
- ☐ BASIC program provided.
- ☐ AIM-12 w/1-1000 gain transducer amplifier... $785.
- ☐ AIM-12B... $695.

D/A Converter

AOM-12 IEEE696/S-100 industrial level digital-to-analog (D/A) converter.

- 12-bit ± 1/2 L.S.B. accuracy over full 0–70°C temperature range.
- Outputs 0–10, ± 5, or ± 10 volts.
- Short circuit protection, all outputs.
- Switch-programmable for multiple boards.
- AOM-12: $675.

VIC 4-20

Standard output for industrial control 4-20 mA D/A converter. Used in conjunction with the D/A board.

- VIC4-20, $675.

DMA Serial I/O

The SIO-4/DMA is an intelligent, DMA, high performance S100 four port serial input/output board. It conforms to the IEEE-696 specification and is designed to work with older S100 machines. The board is intended to be used with asynchronous terminals or printers in a multi-user system.

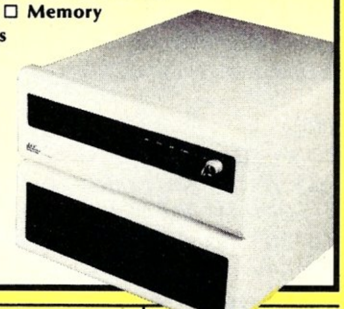
- ☐ Program selectable Baud rate.
- ☐ DMA transfers for output.
- ☐ 24-bits of address supported with no restrictions on boundaries.
- ☐ Can be connected to RS-232 terminals or modems.
- ☐ 256-bytes of FIFO buffer for input characters.
- ☐ RS-232 drivers and receivers conform fully to specification.
- ☐ Control-S/Control-Q protocol supported.
- ☐ Printers with 'Buffer full' signal lines supported.
- ☐ Limited synchronous mode capability.
- ☐ Occupies only 16 I/O addresses.

DUAL/68000

...Hard Power from the Soft Support of UNIX®

A new and powerful computer has been born... the System 83. The versatile UNIX* operating system pilots the System 83's raw power through a myriad of software such as "C", FORTRAN, PASCAL, BASIC, COBOL, and even Networking. Step into a bold new frontier with more power than you ever dreamed possible.

☐ UNIX V7 configured by UNISOFT ☐ Full IEEE 696/S-100 Compatability ☐ MC68000 8MHz Processor ☐ 32-Bit Data Operations with 32-Bit Internal Registers ☐ 16-Bit Data Transfer Operations ☐ Memory Management Allows Concurrent Use of Mapped and Non-mapped Address space ☐ 16 Mb of Main Memory Directly Addressable ☐ 7 Vectored Interrupt Levels ☐ 256 Kb of RAM with Parity Per Board Slot**



* UNIX is a trademark of Bell Laboratories and is supported on the DUAL System 83 by UNISOFT

**UNISOFT is a trademark of UNISOFT Corporation of Berkeley, CA.

OEM and Dealer pricing is available.

DUAL

Sales representatives in most metropolitan areas.

DUAL SYSTEMS CORPORATION

system reliability/system integrity

720 Channing Way • Berkeley • CA 94710 • (415) 549-3854/3890 • Telex: 172029 SPX

CIRCLE 13 ON READER SERVICE CARD

Ave, New York, NY 10028. Published monthly, it is nearly 60 pages in size and carries very little advertising. It covers the CP/M software area in depth. Each issue carries regular articles by Ward Christensen (author of some of the best utility software in the CPMUG library), Carl Warren, Kelley Smith and Mike Karas, and other CP/M authorities. The magazine is definitely aimed at the more sophisticated software user. Also *Lifelines* publicizes the releases of CPMUG (also an adjunct of Lifeboat) and bugs and release information on software carried by Lifeboat and others. The editorial content of the magazine has improved tremendously since Ed Currie took over as editor about a year ago. Subscriptions are $18/yr (US, Canada, Mexico) or $40 (elsewhere). Single copies are $2.50.

Datacast magazine is published by Wireless Digital Inc, 333 Swett Rd, Woodside, CA 94062. The magazine emphasizes "software and telecommunications for users." However, about 60% of the first three issues published emphasize CP/M topics. The articles are mostly of the tutorial (e.g., Wordstar, Mailmerge) or survey type (lists of CP/M suppliers) and hence the magazine appears intended for the beginning CP/M user. Each issue is typically 64 pages in size. Although not specified, a yearly subscription appears to include six issues. Cost is $18/yr domestic (no foreign rate is specified). This makes *Datacast* the most expensive of the microcomputer-oriented magazines.

Unix Where Art Thou?

Last fall I had promised that this issue of Microsystems would highlight Unix-like systems. It is obvious that it does not. What happened?

At that time I had made arrangements with five vendors who were advertising "Unix-type" systems to loan us multi-user systems for review. They promised that we would receive the systems in December, and I arranged with authors to review the systems for this issue. I regret to report that as of mid-May we had not received a single system and that the suppliers were promising delivery in June or July. Although some of these vendors have started shipping single-user systems, to date none are shipping multi-user systems. I have therefore rescheduled the "Unix" issue for January 1983, and am keeping my fingers crossed.

In speaking to these suppliers, the problem appears to be two-fold. First, the task of transporting Unix from its DEC PDP-11 environment to that of a 16-bit micro is a formidable task — much more difficult than they had first thought. Secondly, once they had their Unix-like operating systems running they were disappointed with the response times and therefore are investing a considerable amount of time in tuning the software. Furthermore, suppliers who have developed CP/M emulators which run as a task under their Unix-like systems have encountered problems of speed and applications programs whose authors have not adhered to CP/M's rules, causing unexpected results.

User Groups News

SIG/M: The SIG/M has announced five more volumes of public domain software, bringing their total up to 60 volumes. The contents of the new volumes are:

56 - Musicraft Software System
57 - Musicraft Selections
58 - Musicraft System Source
59 - PISTOL: Portably Implemented STack Oriented Language
60 - Miscellaneous CP/M Utilities

The SIG/M disks are available on 8" CP/M SD disks at $5/Vol. + $1/order (shipping/handling) domestic, and $6/Vol. + $3/order foreign (prepaid U.S. funds drawn on a U.S. bank). Their printed catalog is $1.50 for U.S. orders, and $2 for foreign. Order from: SIG/M, Box 97, Iselin, NJ 08830.

CPMUG: The CP/M User's Group has announced three new volumes of public domain software, bringing their total up to 80 volumes. The new volumes are:

78 - Miscellaneous CP/M Utilities
79 - Modem programs for PMMI and DC Hayes Smartmodem
80 - Cromemco Structured Basic Programs

The CPMUG disks are $8/disk-domestic and $12/disk-foreign. Their printed catalog is $6-domestic and $11-foreign. Order from: CPMUG, 1651 Third Ave., New York, NY 10028.

EXIDY SORCERER UG: I have received a copy of "Sorcerer's Apprentice," the newsletter published by the International Computer Users Group (for Exidy Sorcerer users), Box 33, Madison Heights, MI 48071. The 24-page newsletter was packed with very interesting articles for users of these systems. A sample copy is $3 North America, $4 elsewhere. Annual membership is $18 (USA 3rd class), $24 (USA, Canada, Mexico 1st class), others $32.

SD SYSTEMS Z-80 STARTER SYSTEM UG: This group publishes a monthly newsletter with a yearly membership cost of $10. Write to: ZSTART, 6000 Puffer Rd, Downers Grove, IL 60516.

OSBORNE UG's: Ozymandias II, an Osborne User Group based in Canada has moved. Contact them at: Box 65, Station G, Toronto, Ontario, M4M3E8.

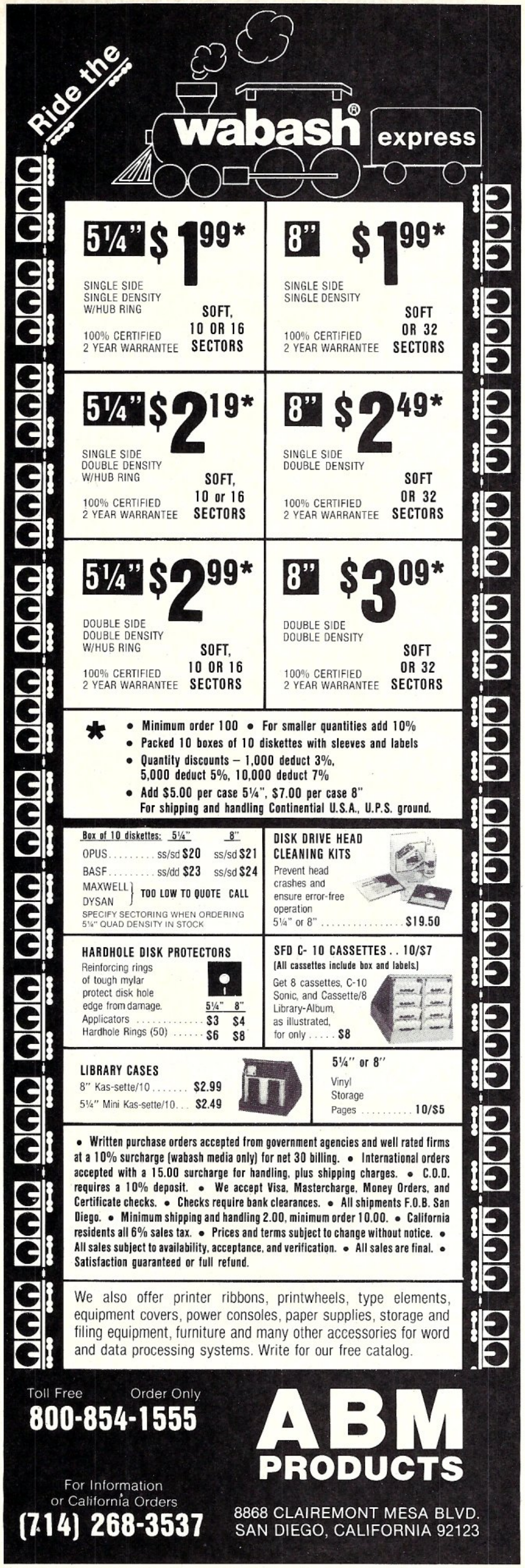
The Osborne National Users Group, Box 424, Northridge, CA 91328 is publishing a monthly newsletter. Membership is $10/yr although they are currently running a membership drive at $10/18 months.

NEVADA COBOL UG: A new group for supporting Nevada Cobol has been formed. For information contact: Bob Blum, Nevada Cobol UG, 5536 Colbert Trail, Norcross, GA 30092; (404)449-8948.

Upcoming Events

USENIX, /USR/GROUP & SOFTWARE TOOLS UG Conference: This Unix conference will be held July 6-9 in Boston, MA at the Copley Plaza and Sheraton Hotels. For more information contact: USENIX Association, Box 8, Rockefeller University, 1230 York Ave., New York, NY 10021; (212)570-8934.

FORTH Workshops: Inner Access Corporation will be running separate 5-day workshops in Forth Fundamentals ($395), applications ($495) and systems ($495) during July and August. For more information contact: Inner Access Corporation, Box 888, Belmont CA 94002; (415)591-8295.



CIRCLE 17 ON READER SERVICE CARD

The CP/M* Bus

by Anthony Skjellum

In the last installment of "The CP/M Bus," we discussed the CP/M SUBMIT facility. As promised, this installment will include a discussion of a public domain batch facility called SUPERSUB written by Ron Fowler of Westland, MI. This program is upward compatible with SUBMIT and offers some new and useful features.

Two minor topics will also be covered in this installment. The first is a discussion of modifications necessary to make DDT use restart (RST) vectors other than RST 7. The second is a short discussion about the Z800 as an alternative upgrade to the 8086/8 for 8080/Z80 users.

I will be happy to answer reader questions about CP/M. Send your questions to my attention, care of *Microsystems.*

SUPERSUB

To use SUBMIT, it is necessary to prepare a command file using an editor (e.g., ED, Wordstar, etc). SUPERSUB provides two optional modes which allow batch processes to be prepared without the use of a text editor. Also, nesting of batch processes is supported. These and other new features will be discussed in turn.

Summary Mode

Summary mode provides a way to enter a short batch job directly on the SUPERSUB command line. The mode is invoked by placing a "/" character as the first item on the command line. Batch process lines then appear following the division-sign and are delimited by semi-colons. A simple example is:

```
A>SUPERSUB  / STAT A:; STAT B:
```

Another use of summary mode is:

```
A>SUPERSUB / B:; ERA *.BAS; A:; PIP B:=A:*.BAS; STAT B:
```

As shown in the above examples, the summary mode makes entry of short batch jobs much less time consuming than with SUBMIT.

Interactive Mode

It is sometimes convenient to enter longer batch jobs in an interactive fashion. SUPERSUB supports such an interactive mode. It is invoked by the command sequence "SUPERSUB /". SUPERSUB then prompts the user with an asterisk and batch lines are entered. Entry is terminated by just typing a return at the beginning of a line. Here is an example:

```
A>SUPERSUB /
*B:
*ERA *.BAS
*A:
*PIP B:=A:*.BAS
*STAT B:
*
```

This sequence produces the same batch process as the second summary mode example. The choice between summary mode and interactive mode will depend on the size of the batch job, convenience in entry of the lines, and personal preference.

Help Function

SUPERSUB provides an interactive command summary, should this be needed. It is activated by executing SUPERSUB with no arguments.

Nesting

Under SUBMIT, batch lines do not normally themselves contain SUBMIT calls. Any existing batch file ($$$.SUB) is deleted when SUBMIT is invoked. Hence, undesirable results occur if the SUBMIT command is placed within a series of batch lines as illustrated here:

```
DIR
B:
: RUN.SUB is a special SUBMIT function
SUBMIT RUN
A:
DIR
: WE ARE DONE
```

All lines after the fourth would never get executed. SUPERSUB avoids this problem, and thus permits nesting of batch processes as illustrated above.

Nesting can be quite useful. For example, it permits a complicated batch process to be made up of several modular ones. In connection with SUPERSUB's summary and interactive modes, complicated command sequences can be requested with minimal typing. Some nesting examples follow.

Imagine that we wish to compile a set of C programs under the BDS C compiler. Each must be compiled and then linked. This could be done through a submit command called CCC.SUB:

```
: CCC.SUB --- compile and link BDS code
: $1 if file name (we add .C)
CC $1.C
CLINK $1 (any other standard type libraries)
```

To compile and link a set of C programs would then require an additional batch file to call CCC several times:

```
: COMPILE -- compile several C programs & link them
SUPERSUB CCC FILE1
SUPERSUB CCC FILE2
SUPERSUB CCC FILE3
...
SUPERSUB CCC FILEN
: done
```

If CCC were a more complicated operation, it might also include its own SUPERSUB calls.

We could also imagine using the CCC batch process as a shorthand during interactive or summary mode. An interactive mode session might take the following form:

```
A>SUPERSUB /
*SUPERSUB CCC ALPHA
*SUPERSUB CCC BETA
*
```

where ALPHA.C and BETA.C are C programs to be compiled.

In order to allow nesting, SUPERSUB appends to the current $$$.SUB and does not delete any current $$$.SUB file. SUPERSUB's documentation states that there is a limit of 128 nesting levels which is set by the CCP.

CP/M Bus, continued...

Where to obtain SUPERSUB

SUPERSUB is available through several of the CBBS systems nationwide at no cost. These systems have been discussed at length in Microsystems Vol.2/No.3. The program is supplied in source code (8080 assembly language) and hence may be modified and/or improved by end users.

RST Mods for DDT

Some 8080/Z80 computer systems preempt the RST 7 vector for a hardware interrupt of some kind. This makes DDT unusable since DDT needs a RST vector for its debugging modes. The choice of RST 7 is not special and it is quite straightforward to alter DDT to use another RST instruction/location (i.e., one of RST 1 to RST 6).

Some type of monitor program will be required for making these changes to DDT since it probably won't be functional if a given system needs the patches in the first place. Five locations need to be changed. To begin, enter the following command line at the CCP level:

```
A>DDT ^<char>
```

where ^ <char> is a control character such as control-A. This trick will cause the CCP to load DDT and then discover an error so DDT won't get executed. After the error message ("?") is displayed, exit CP/M and enter whatever monitor facility is available for modifying memory locations. Below we illustrate the changes and include addresses for DDT versions 1.4 and 2.2. Parenthetical values are included for the change to RST 5:

Address (1.4, 2.2)	Old Value	New Value
08E7H, 08E7H	38H	Byte address of RST vector (28H for RST 5)
08F0H, 08EDH	39H	RST Vector address+1 (29H for RST 5)
0AD5H, 0AD5H	0FFH	Val. of RST Instruction (0EFH for RST 5)
0FE4H, 0FEAH	0FFH	Val. of RST Instruction
10EEH, 10F4H	0FFH	Val. of RST Instruction

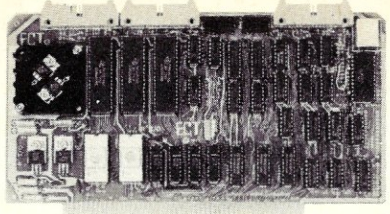
With these changes, DDT should work on any CP/M system with at least one free RST vector other than RST 0.

The Z800 and CP/M Systems

A new user community is growing around the 8086 family of microprocessors and the CP/M-86 operating system. Because of programs like Digital Research's XLT86 which translate 8080 assembler code into 8086 code, the transition from the 8-bit world may be less painful than one could otherwise imagine. However, it seems that users currently switching from the 8080 or Z80 to the 8086/8 could more easily switch to a better Z80 and hence retain most if not all of their software investments (including programs which don't come with source code). Zilog will eventually release the Z800 which will be a considerably improved Z80. Such a microprocessor would have a tremendous software base immediately available and could eventually replace 8080/Z80 processors on most S-100 systems. This means that CP/M-80 programs and software will be directly useful for many years to come (with enhanced performance). I think that 8080/Z80 users should look forward to seeing the release of the Z800 or a similar device. ■

CUSTOM PRODUCTS

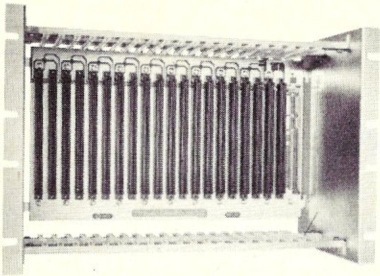
DESIGN • LAYOUT MANUFACTURING



R ²I/O

ROM/RAM & I/O

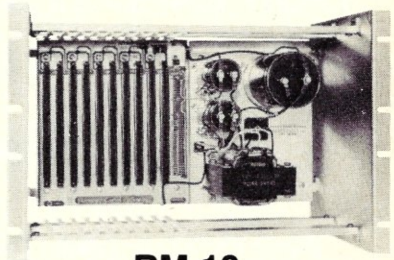
S-100 PRODUCTS



ECT-100-F

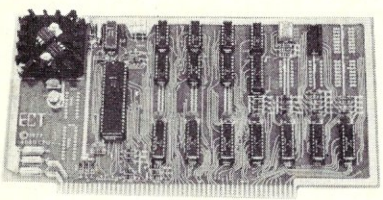
RACKMOUNT CARD CAGES

ECT™



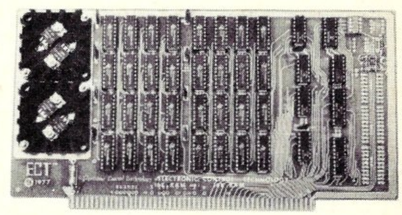
RM-10

CARD CAGE & POWER SUPPLY



8080 CPU

CENTRAL PROCESSING UNITS

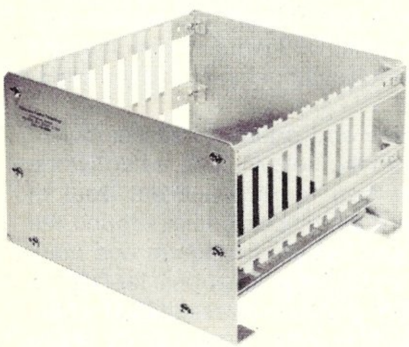


16K RAM

FULLY STATIC MEMORY

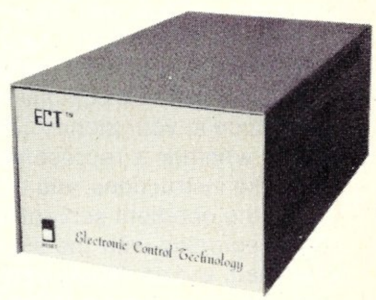
BUILDING BLOCKS FOR MICROCOMPUTER SYSTEMS, DEDICATED CONTROLLERS AND TEST EQUIPMENT

CARD CAGES, POWER SUPPLIES MAINFRAMES, CPU'S, MEMORY I/O, OEM VARIATIONS



CCMB-10-F MIN

6,10 OR 20 SLOT CARD CAGES



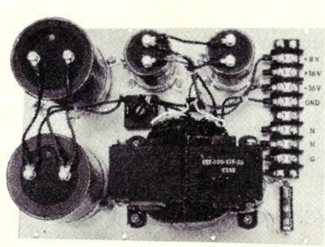
TT-10

TABLE TOP MAINFRAMES

ELECTRONIC CONTROL TECHNOLOGY, INC.

763 Ramsey Ave., Hillside, NJ 07205 (201) 686-8080

SPECIALIZING IN QUALITY MICRO COMPUTER HARDWARE



PS-30 A

POWER SUPPLIES

CIRCLE 20 ON READER SERVICE CARD

MULTIBUS® PRODUCTS

MULTIBUS IS A TRADEMARK OF INTEL CORP.

D80 by DG Software

by Fred L. Gohlke

An 8080/8085/Z80 machine code disassembler.

Disassemblers are tools. The size and shape tool you want depends on the job you want to do. Most CP/M users have used DDT for their small jobs, but DDT has its shortcomings.

DG Software has provided a new tool—D80—which has considerable power for large disassembly jobs. It is quick and, within limits, does an excellent job.

Probably the biggest problem in disassembling machine code is divining the logic of the programmer who wrote the original code. That's a task I dislike, even when I have the source code available, and is one I'll avoid like the plague except in a dire emergency.

Close behind deciphering the logic, in terms of big disassembly problems, is the difficulty of separating actual machine instructions from tables and storage areas. I know of no machine with the ability to handle either of these problems without human intervention.

The point of D80 is to make the solution of these problems as painless as possible (something like a dentist who says it won't hurt).

To use D80, give it the name of the .COM file you want to disassemble. On command, it dumps a small portion of the code to your monitor. By examining this code you decide whether it represents instructions or data. If it looks like instructions, you tell D80 to disassemble it.

Like the obedient servant it is, D80 disassembles the code beginning with the start of the segment you just examined, and continues until it reaches either an illegal instruction, an unconditional jump, an unconditional return, or a jump to the contents of the HL register pair. When it reaches one of these conditions, D80 stops, leaving the most recently disassembled statements on your monitor, and dumps the code which follows to your screen. You again decide whether or not the succeeding bytes are machine instructions and, if so, continue as above.

If the succeeding bytes don't look like instructions, you tell D80 whether you think they represent tables or storage, and continue. While this is going on, D80 is building a system map showing the beginning and ending addresses of each segment of machine code; of each table area; and of each storage area; and is building a symbol table containing all addresses referenced or jumped to by the disassembled machine code.

The system map and a list of all values which D80 hasn't been able to resolve is immediately available to the user, on command. By referring to this map frequently, it is possible to eliminate unresolved addresses within the program (but not external references, obviously). However, since addresses can be computed at run time and absolute values can be computed at assembly time and loaded into registers, the chances that the INITIAL disassembly of a complex program will re-assemble and run properly are slim.

The entire process just described takes place on the first pass through the code to be disassembled. The first pass is highly interactive. D80 displays the code, and the user interprets its meaning. Meanwhile D80 reads the .COM file, disassembles, builds the symbol table, and writes the source code file as appropriate.

The second pass is all D80. When the user has eliminated the unresolved entries in the symbol table to his own satisfaction, and tells D80 to start the second pass, *it does.* Quicker than a wink, D80 writes a disk file with the full system map, the full symbol table, and the disassembled source code.

But it isn't all peaches and cream. Disassembly of unknown code, even with the help of D80, is hard work. Fairly trivial programs can require a great deal of effort—complex ones are a formidable task. I found the best approach was to go through a program and mark only the obvious table and storage locations, let D80 do the second pass on this partially disassembled code, and then list the disassembly. After careful study of this partial disassembly, it's usually possible to get a general idea of what the code (at least part of it) is doing. Then by making notes on this preliminary listing, start D80 from scratch again and do a more thorough job.

The User's Manual

I find it difficult to rate the D80 User's Manual. The problem centers around who you are rating it for—the novice or the professional. For the novice, it is probably a complete disaster. But, on the other hand, disassembly of complex code hardly rates as a novice task. Personally, I'd suggest the novice stay with DDT.

For the professional, the manual is adequate. In all probability it was written by the author of D80, since it tends to present the features of D80 in a subjective manner. All of the features and commands are explained in detail, but usually by reference to other D80 features or commands. Thus, you must be familiar with the system

Fred Gohlke, 1000 Blair Rd., Carteret, NJ 07008.

to understand the manual, and you must understand the manual to become familiar with the system.

There are a couple of nit-picking errors in the manual which English language purists will find annoying. But then, it wasn't written for English language purists. This is a work document, produced by a worker, to work with. The first time through (the time you'd like to digest the whole system so you can get on with your work) you will find fault with the manual. Later on, though, when you become more familiar with the system, it's not really too bad.

While this type of manual is, as I said, adequate, it's a shame that many of the neat features of D80 are hidden from the user the first time through. I, for one, tend to read a user's manual once and thereafter refer to it only for an explanation of specific commands I'm using. With the D80 User's Manual, it pays to read it a number of times after you've started using the system, to get the full flavor of D80.

Some D80 Features

Speed: D80 is fast. After a little practice I was able to do an INITIAL disassembly of a 4K program which produced 1500+ lines of source code and a 22K source file in 35 minutes. That seems good, but it's not a fraction of the whole story, because when the INITIAL disassembly is finished the real work starts. (Just incidentally, INITIAL disassembly is my term, not D80's. What I'm trying to tell you is that you'll disassemble the same program a number of times before you get a complete disassembly.)

Analyzing and understanding those 1500 lines of code is no trivial matter. D80 has done its job quickly and well. Your job may be something else again.

The System: D80 is designed to run under CP/M or MP/M, but is not limited to those systems. The technical information for using D80 in a non-CP/M environment is included in the manual. It will run in systems as small as 24K (it overwrites the CCP in a 24K system).

D80 is a disk disassembler. It reads the .COM file from disk and writes the source code to disk as you go along. It maintains the symbol table and system map in memory. This means you can disassemble almost any size program as long as you have enough memory to handle the table and map.

You can save the system map to disk at any time, which means you can disassemble part of the code, save the map, stop, and pick up later where you left off.

D80 will disassemble code for the 8080, 8085, and the Z80 processors. Intel disassemblies are placed in .ASM files, and Zilog disassemblies are placed in .MAC files. The system comes up in the Z80 mode, and the other options are simply entered as commands if desired. The default mode can be easily changed if the user wants the system to come up on one of the other two modes, but it isn't worth the bother unless you have an unusually heavy workload.

The sytem contains readily accessible "HELP" commands which are always a nice feature.

Evaluation

In general, I have the impression that D80 is well written. I found no systemic errors. If one did have problems, though, it would take some time to correct them since the author (distributor?) doesn't provide a phone number. All requests for support must be submitted by mail. I have no idea whether such requests would be honored.

Within the constraints mentioned in the text of this report, I would rate D80:

Functionality	5
Ease of Use	4
Speed	5
Manual	3

(Scale 1 to 5 where 1 is poor and 5 is excellent)

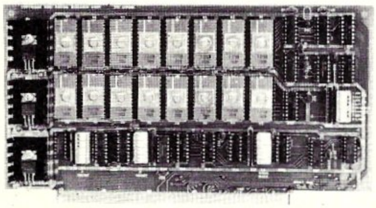
D80 costs $85.00 and may be ordered from DG Software, P. O. Box 1035, Iowa City, IA 52244. ■

D80 Help Commands

```
HLP 1
        FIRST PASS DISASSEMBLY COMMANDS:

   ADD SEGMENT TO MAP                DELETE
DISPLAY  NO DISPLAY  GLOBAL          SEGMENT TYPE
*******  **********  ******          ******* ****
DAS      DMC         GMC             XMC     CODE
TAB      DMT         GMT             XMT     TABLE
STG      DMS         GMS             XMS     STORAGE

        FINAL DISASSEMBLY COMMANDS:

        FAS -- DISPLAY
        FMD -- NO DISPLAY

HLP 2
MAP AND SYMBOL TABLE COMMANDS:
*****************************
NEW -- CLEAR ALL
MAP -- DISPLAY MAP LISTS
SYM -- DISPLAY ENTIRE SYMBOL TABLE
REF -- REFORM SYMBOL TABLE
SVM -- SAVE MAP ONTO DISK FILE
LDM -- LOAD MAP FROM DISK FILE

HLP 3
FILE DEFINITION COMMANDS:
*************************
DSK -- DEFINE DISK SOURCE FILE
OUT -- OUTPUT DRIVE SPECIFICATION
EXC -- FILE EXECUTION ADDRESS
LOC -- ACTUAL FILE LOCATION
ADR -- DISPLAY INPUT FILE ADDRESSES

HLP 4
FORMAT COMMANDS:
****************
D80 -- SELECT 8080 CODES
D85 -- SELECT 8085 CODES
Z80 -- SELECT Z80 CODES
LIN -- CONSOLE CHARACTERS PER LINE IN HEX
DEL -- CONSOLE INPUT DELETE CHARACTER IN HEX
ESC -- CONSOLE OUTPUT BACKSPACE CHARACTER IN HEX

HLP 5
SPECIAL FUNCTION COMMANDS:
**************************
HLP -- COMMAND SUMMARY
END -- RETURN TO CP/M
CONTROL-C -- RETURN TO CP/M
SAV -- SAVE ALL THAT FOLLOWS TO(CR)
CONTROL-R -- RESTORE "SAVED" LINE
CONTROL-S -- STOP LISTING, START WITH ANY KEY
CONTROL-X -- TERMINATE/CLEAR LINE
(ESCAPE) -- PERFORM "DAS" COMMAND
DUM -- DUMP FILE DATA
(CR) -- BUMP POINTER AND DO "DUM" COMMAND
CONTROL-P -- TOGGLE LIST DEVICE
```

DIGITAL RESEARCH COMPUTERS
(214) 271-3538

32K S-100 EPROM CARD
NEW!



$79.95
KIT

USES 2716's

Blank PC Board - $34

ASSEMBLED & TESTED
ADD $30

SPECIAL: 2716 EPROM's (450 NS) Are $9.95 Ea. With Above Kit.

KIT FEATURES:
1. Uses +5V only 2716 (2Kx8) EPROM's.
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible.
4. Addressable as two independent 16K blocks.
5. Cromemco extended or Northstar bank select.
6. On board wait state circuitry if needed.
7. Any or all EPROM locations can be disabled.
8. Double sided PC board, solder-masked, silk-screened.
9. Gold plated contact fingers.
10. Unselected EPROM's automatically powered down for low power.
11. Fully buffered and bypassed.
12. Easy and quick to assemble.

64K S100 STATIC RAM

$399.00 KIT

NEW!

LOW POWER!

RAM OR EPROM!

BLANK PC BOARD WITH DOCUMENTATION
$55

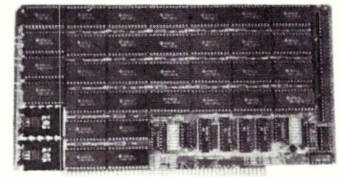
SUPPORT ICs + CAPS
$17.50

FULL SOCKET SET
$14.50

FULLY SUPPORTS THE NEW IEEE 696 S100 STANDARD (AS PROPOSED)

FOR 56K KIT $349

ASSEMBLED AND TESTED ADD $40



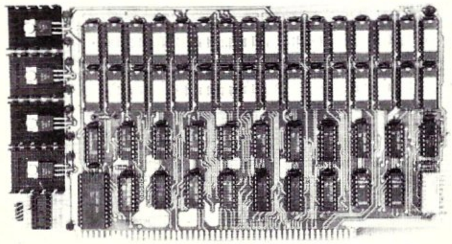
FEATURES:
* Uses new 2K x 8 (TMM 2016 or HM 6116) RAMs.
* Fully supports IEEE 696 24 BIT Extended Addressing.
* 64K draws only approximately 500 MA.
* 200 NS RAMs are standard. (TOSHIBA makes TMM 2016s as fast as 100 NS. FOR YOUR HIGH SPEED APPLICATIONS.)
* SUPPORTS PHANTOM (BOTH LOWER 32K AND ENTIRE BOARD).
* 2716 EPROMs may be installed in any of top 48K.
* Any of the top 8K (E000 H AND ABOVE) may be disabled to provide windows to eliminate any possible conflicts with your system monitor, disk controller, etc.
* Perfect for small systems since BOTH RAM and EPROM may co-exist on the same board.
* BOARD may be partially populated as 56K.

16K STATIC RAM KIT-S 100 BUSS

PRICE CUT!

$149.95 KIT

FOR 4MHZ ADD $10



KIT FEATURES:
1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA-**$33**

LOW PROFILE SOCKET SET-**$12**

SUPPORT IC'S & CAPS-**$19.95**

ASSEMBLED & TESTED-**ADD $35**

OUR #1 SELLING RAM BOARD!

64K SS-50 STATIC RAM

$299.00 (48K KIT)

NEW!

LOW POWER!

RAM OR EPROM!

BLANK PC BOARD WITH DOCUMENTATION
$52

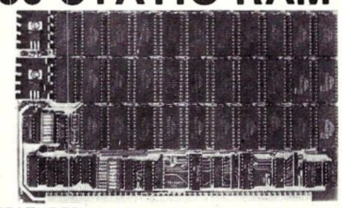
SUPPORT ICs + CAPS
$18.00

FULL SOCKET SET
$15.00

56K Kit $349

64K KIT $395

ASSEMBLED AND TESTED ADD $40



FEATURES:
* Uses new 2K x 8 (TMM 2016 or HM 6116) RAMs.
* Fully supports Extended Addressing.
* 64K draws only approximately 500 MA.
* 200 NS RAMs are standard. (TOSHIBA makes TMM 2016s as fast as 100 NS. FOR YOUR HIGH SPEED APPLICATIONS.)
* Board is configured as 3-16K blocks and 8-2K blocks (within any 64K block) for maximum flexibility.
* 2716 EPROMs may be installed anywhere on Board.
* Top 16K may be disabled in 2K blocks to avoid any I/O conflicts.
* One Board supports both RAM and EPROM.
* RAM supports 2MHZ operation at no extra charge!
* Board may be partially populated in 16K increments.

STEREO!
S-100 SOUND COMPUTER BOARD
NEW!

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY3-8910 NMOS computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE, etc.

KIT FEATURES:
* TWO GI SOUND COMPUTER IC'S.
* FOUR PARALLEL I/O PORTS ON BOARD.
* USES ON BOARD AUDIO AMPS OR YOUR STEREO.
* ON BOARD PROTO TYPING AREA.
* ALL SOCKETS, PARTS AND HARDWARE ARE INCLUDED.
* PC BOARD IS SOLDERMASKED, SILK SCREENED, WITH GOLD CONTACTS.
* EASY, QUICK, AND FUN TO BUILD. WITH FULL INSTRUCTIONS.
* USES PROGRAMMED I/O FOR MAXIMUM SYSTEM FLEXIBILITY.

Both Basic and Assembly Language Programming examples are included.

COMPLETE KIT!
$84.95
(WITH DATA MANUAL)

BLANK PC BOARD W/DATA
$31

SOFTWARE:

SCL™ is now available! Our Sound Command Language makes writing Sound Effects programs a SNAP! SCL™ also includes routines for Register-Examine-Modify, Memory-Examine-Modify, and Play-Memory. SCL™ is available on CP/M* compatible diskette or 2708 or 2716. Diskette - **$24.95** 2708 - **$19.95** 2716 - **$29.95.** Diskette includes the source. EPROM'S are ORG at E000H. **(Diskette is 8 Inch Soft Sectored)**

SPECIAL PURCHASE!

UART SALE!

TR1602B — SAME AS TMS6011, AY5-1013, ETC. 40 PIN DIP

TR1602B

$2.95 EACH **4 For $10.00**

CRT CONTROLLER CHIP

SMC #CRT 5037. PROGRAMMABLE FOR 80 x 24, ETC. VERY RARE SURPLUS FIND. WITH PIN OUT. $12.95 EACH.

4K STATIC RAM

National Semi. MM5257. Arranged 4K x 1. +5V, 18 PIN DIP. A Lower Power, Plug in Replacement for TMS 4044. 450 NS. Several Boards on the Market Will Accept These Rams. SUPER SURPLUS PURCHASE! **PRIME NEW UNITS!**

8 FOR $16   32 FOR $59.95

NEW! G.I. COMPUTER SOUND CHIP

AY3-8910. As featured in July, 1979 BYTE! A fantastically powerful Sound & Music Generator. Perfect for use with any 8 Bit Microprocessor. Contains: 3 Tone Channels, Noise Generator, 3 Channels of Amplitude Control, 16 bit Envelope Period Control, 2-8 Bit Parallel I/O, 3 D to A Converters, plus much more! All in one 40 Pin DIP. Super easy interface to the S-100 or other busses. **$11.95** **PRICE CUT!**
SPECIAL OFFER: ~~$14.95~~ each   Add $3 for 60 page Data Manual.

Digital Research Computers
(OF TEXAS)

P.O. BOX 401565 • GARLAND, TEXAS 75040 • (214) 271-3538

TERMS: Add $2.00 postage. We pay balance. Orders under $15 add 75¢ handling. No C.O.D. We accept Visa and MasterCharge. Tex. Res. add 5% Tax. Foreign orders (except Canada) add 20% P & H. Orders over $50, add 85¢ for insurance.

ALL SALES ARE MADE SUBJECT TO THE TERMS OF OUR 90 DAY LIMITED WARRANTY. A COPY OF THIS WARRANTY IS AVAILABLE FREE, ON REQUEST.

*TRADEMARK OF DIGITAL RESEARCH.   WE ARE NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE SUPPLIERS OF CPM SOFTWARE.

NEW PRICES EFFECTIVE ON THE 1ST DAY OF THE COVER MONTH OF THIS MAGAZINE

NEW LOWER PRICES

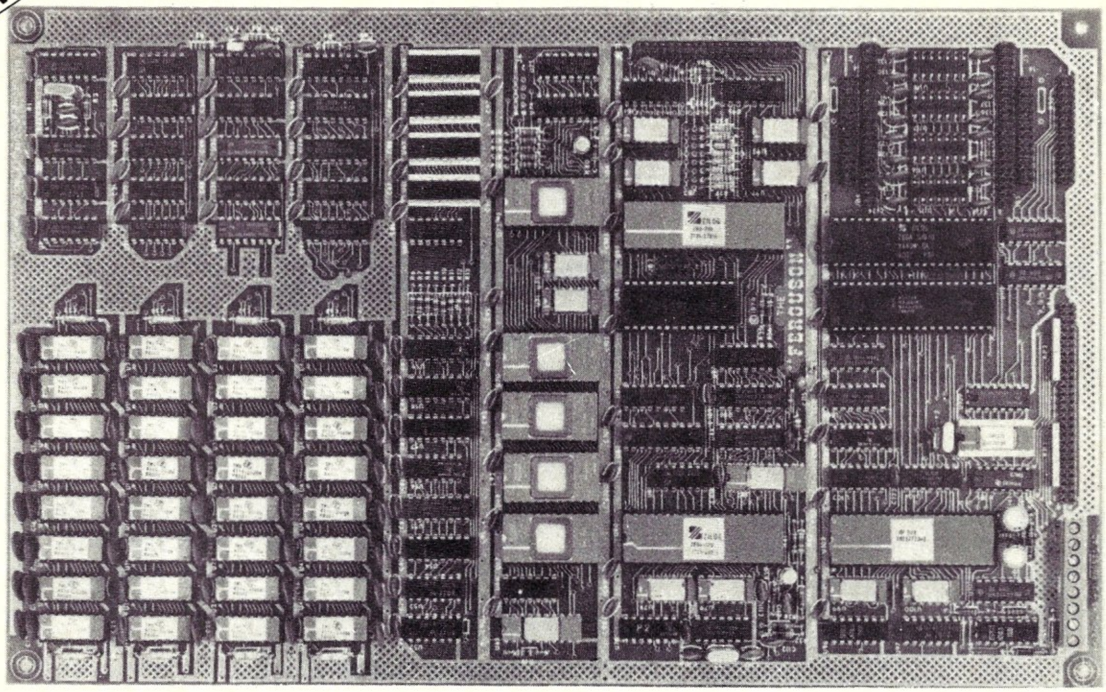
NEW!

"THE BIG BOARD"

OEM - INDUSTRIAL - BUSINESS - SCIENTIFIC

SINGLE BOARD COMPUTER KIT!

Z-80 CPU! 64K RAM!



PARTIALLY ASSEMBLED KITS
For All Sockets Installed
And Soldered Add $50.

WANT MORE INFO?
Full Documentation and
Schematics — $5.

U.K. AND EUROPE: CONTACT VINCELORD LTD. 47 GOLDHURST TERRACE LONDON NW6

THE BIG BOARD PROJECT: Three years in the works, and maybe too good to be true. A tribute to hard headed, no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M*. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, an enclosure, C.R.T., and you have a total Business System for about 1/3 the cost you might expect to pay.

$399.00** (64K KIT BASIC I/O)

SIZE: 8½ x 13¾ IN.
SAME AS AN 8 IN. DRIVE.
REQUIRES: +5V @ 3 AMPS
+ - 12V @ .5 AMPS.

FULLY SOCKETED!

FEATURES: (Remember, all this on one board!)

64K RAM

Uses industry standard 4116 RAM'S. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERUPTS. Fully buffered and runs 8080 software.

SERIAL I/O (OPTIONAL)

Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: $49

BASIC I/O

Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true. 5 x 7 Matrix - Upper & Lower Case

FLOPPY DISC CONTROLLER

Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M* 2.2.

TWO PORT PARALLEL I/O (OPTIONAL)

Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. User selectable hand shake polarity. Set of all parts and connectors for parallel I/O: $19.95

REAL TIME CLOCK (OPTIONAL)

Uses Z-80 CTC. Can be configured as a Counter on Real Time Clock. Set of all parts: $9.95

BLANK PC BOARD — $149

The blank Big Board PC Board comes complete with full documentation (including schematics), the character ROM, the PFM 3.3 MONITOR ROM, and a diskette with the source of our BIOS, BOOT, and PFM 3.3 MONITOR.

CP/M* 2.2 FOR BIG BOARD

The popular CP/M* D.O.S. to run on Big Board is available for $159.00.

PRICE CUT!

PFM 3.3 2K SYSTEM MONITOR

The real power of the Big Board lies in its PFM 3.3 on board monitor. PFM commands include: Dump Memory, Boot CP/M*, Copy, Examine, Fill Memory, Test Memory, Go To, Read and Write I/O Ports, Disc Read (Drive, Track, Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided.
Z-80 is a Trademark of Zilog.

Digital Research Computers
(OF TEXAS)
P.O. BOX 401565 • GARLAND, TEXAS 75040 • (214) 271-3538

TERMS: Shipments will be made approximately 3 to 6 weeks after we receive your order, VISA, MC, cash accepted. We will accept COD's (for the Big Board only) with a $75 deposit. Balance UPS COD. Add $4.00 shipping.
USA AND CANADA ONLY

*TRADEMARK OF DIGITAL RESEARCH. NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE ORIGINATORS OF CPM SOFTWARE
**1 TO 4 PIECE DOMESTIC USA PRICE.
CIRCLE 21 ON READER SERVICE CARD

RAID: An 8080 Interactive Emulator

by Andrew L. Bender

Debugging and program tracing facilities are perhaps the most difficult to evaluate objectively. First, a debugging program is invoked when there is an error or improper functioning of the program under test. This leads to a certain, usually negative, psychological condition when the debugger is invoked. Second, some of the most frustrating time in programming is spent in using debugging aids to find mistakes in programs and these aids are often inadequate in one or more ways, compounding the problem. Finally, once a particular debugger has been learned by the programmer, there is resistance to change — a sort of worn pair of shoes or familiar sweater effect. This resistance is greatly increased with time and becomes a function of how familiar you are with the commands and the effects of each command on the debugging process. Naturally, the more you use a debugging tool, like any tool, the less you think about it as a tool and the more you unconsciously incorporate it into your thought process.

I start the subject of this product review with this introduction because I feel that the review of an unfamiliar debugger is subject to a great degree of personal bias. I will try to keep my bias to a minimum to give as accurate and objective a review as possible.

RAID is a debugging aid which incorporates many desirable features. The acronym RAID stands for "Real-Time Assembler Interactive Debugger." It can emulate the 8080 by simulating the action, in software, of each 8080 instruction. It can selectively trace certain selected segments of the program under test, using a variety of conditions to discontinue the trace or to initiate other debugging actions. Most importantly, it can be used in a real-time environment to allow debugging of programs operating under time constraints or with interrupt hardware. The manual starts out with the sentence: "The many unique and sophisticated features embodied in RAID make it the most powerful assembly language debugging system ever devised for a micro-computer."This is immediately followed by the statement that RAID was designed to be easy to use and very forgiving to the inexperienced user. I do not always agree with this statement.

Andrew Bender, 641 Victoria Terrace, Paramus, NJ 07652.

Documentation

The manual is a printed, 45-page loose leaf book. It is poorly written — despite the admonition to the user "only with a fluent understanding of the characteristics and features of RAID can its full potential be utilized." The manual is organized by the type of command, with a description of each one. The descriptions seem quite terse although examples for each command are given. The commands are a confusing collection of single- and double-letter codes which, I agree, need to be fully mastered before you can use RAID in an intelligent fashion. Nonetheless, the notion of presenting a subset of all of the commands as a nucleus on which you can logically learn the other commands seems to have escaped the designer. This psychological impediment was the biggest problem I had with RAID. I just couldn't learn all of those jumbled letters in the order in which they were presented. After a few days I began to perceive the manual as a sort of alphabet soup which I was going to sit down to eat. As I blew on the hot soup the alphabet noodles swirled around in random fashion in an incomprehensive set of unpronounceables, a freshly opened box of anagrams. It was difficult to get going with the manual. I like to learn new things and know that it does require some effort, but the stiff, formal style of presentation made the material hard to learn.

After an introduction to RAID by means of the manual, I found that the program itself is supplied in different sizes. I have a 60K system, but the nearest size RAID on the disk was 56K. I wasted 4K. Installing RAID was simple — just copy it onto the disk where it resides like any other program. Wait, what was this... another program SMBMAK? What does that do? Well, it seems RAID is written for ISIS and uses the symbol table generated by the ISIS assemblers. Since you

and I are probably not using ISIS, we need SMBMAK to make an ISIS appearing symbol table from Digital Research's MAC or ASM assemblers. This is done by letting SMBMAK run through the print file of the MAC or ASM program. This creates problems if you used another assembler like MACRO-80 or CDL's MACRO2. SMBMAK might not like the file format of these assemblers. RAID will use the symbol table so that you can be at home with your debugging task. You can use the labels in RAID commands that you used in the assembly language program. You can use them the same way too! For example, if you equate NEXT to START+7 in your assembly language program then using NEXT as an address in a RAID command will be the same as using START+7. If you desire, RAID contains powerful features for defining and redefining symbols so that symbols can be defined during debugging as required and with the assembly language feature, actual assembly language code can be inserted into a program with RAID. It is then only necessary to enter these changes in your original assembly language program. This is a very useful feature which is well integrated into the structure of RAID.

RAID is an expensive but useful tool which finds its major application in the debugging of non-trivial assembly language 8080 programs. Its symbolic features are geared to an earlier generation of assemblers and its manual needs some serious, well thought-out psychological engineering.

Because RAID is designed to debug programs assembled with absolute assemblers (an absolute assembler is an assembler which generates non-relocatable instructions at fixed memory addresses), its use with modular relocatable programs with the assembly language/symbol table feature is questionable. First, there is no means for specifying relocation bases for symbol tables. Also, in a more complex situation where several relocatable programs are being tested there is no method for specifying which modules contain not only which addresses but the more difficult task of which duplicated symbols belong to which modules, and which of those modules the debugging patch is being assembled for. This deficiency makes these RAID features, which the RAID designers seem most proud of, almost unuseable in certain situations. While many programmers are still using absolute assemblers, the overwhelming number of serious assembly language programmers would not use such an assembler unless dictated by the situation. These situations are few — to wit, assembling CP/M's BOOT or CBIOS. Even the new MP/M uses a relocatable assembler.

I found the symbol table feature relatively worthless because of the use of relocatable assemblers in most of my work. However, there might be ways to update the feature to a useful adjunct. When debugging relocated programs one always has to add the relocation base of a module to the addresses in that module. The relocation base is the address in memory where that module is loaded. This problem is then compounded because programs can be assembled relative to more than one relocation base. As an example, a program can have its instructions located in a CSEG (control segment), its "local data" located in a DSEG (data segment) and its global data located in COMMON. There may be more than one common storage area so that certain coroutines share certain areas of memory. In these cases there is a different relocation base for each common area as well as for the DSEG and CSEG areas. Each of these area addresses needs to be added to the operand address or to the instruction address, resulting in the programmer doing a considerable amount of arithmetic in hex or octal. This was probably the force behind the introduction of the TI-59 Programmer calculator. I use mine quite heavily during debugging. RAID does not address itself to this problem.

The debugging commands in RAID are fairly standard. For example, the B command sets a breakpoint, while R removes a breakpoint. After this there are many variations possible. You can loop past a breakpoint address a specified number of times and then stop or you can set up a series of conditions which will interrupt execution and return control to you. If certain limits are exceeded or if an address limit is reached, you can obtain control. In this mode, RAID simulates the 8080 instructions at about 800 instructions per second. During this simulation, RAID is always monitoring the contents of the simulated registers, the instruction counter and the operand address register. Whenever almost any condition you can think of exists RAID can be made to stop simulation and return control to the console. It is this area of RAID which is so powerful yet so difficult to commit to memory. Because of its great flexibility, there are a confusing array of flags and indicators which must be manipulated to set up the set of conditions on which execution is to be interrupted.

For those situations in which timing is critical, the ability to execute a subroutine or group of subroutines in real time is present. This means that simulation is turned off and that the program executes the instructions in real time. The user is cautioned that these areas of the program must be thoroughly checked first. This is very useful in resolving areas in which a program has or seems to have timing problems. Certain programs seem to misbehave because of what is incorrectly diagnosed as a timing error. Investigation of these errors with RAID sometimes disclose that the error is elsewhere in the program and has nothing to do with timing. Because this type of error is expensive to trace, RAID can literally pay for itself with the diagnosis of a single timing bug.

There are other areas of less glamour where tracing down bugs is a simply boring, clerical task. One such error is in programs which have large numbers of stack operations. Any experienced programmer can tell you that sooner or later you will push too much or pop too much. RAID diagnoses this error and saves hours of looking at memory dumps of stack areas. If you have done this, you know what this means — shuffling the address bytes to get the location of which subroutines are stacked where, and where the registers are saved. RAID even tells you about these stack problems without being asked. Similarly, I am sure that at least once in your life you stored an item in an area you didn't want to store it in. RAID detects this if you set protect mode and reports back that you have jumped to a bad address or written to a protected zone of memory.

Now, these features are all nice features and without the symbol table/assembly mode features they are certainly worth having, but how big is RAID? It is really quite small. It only needs 13K, but remember what it does. It resides in upper memory, overlaying the CCP and the upper portion of the TPA. And, if all of the features which RAID seems to have are not quite enough, RAID allows you to define memory structures in the form of linked lists. This is explained rather poorly in the manual under the operations which deal with this feature. Since many programs which are non-trivial use linked storage lists, this is a very important feature. It should be explained more clearly in the manual.

Conclusion

In summary, RAID is an expensive but useful tool which finds its major application in the debugging of non-trivial assembly language 8080 programs. Its symbolic features are geared to an earlier generation of assemblers and its manual needs some serious, well thought-out psychological engineering. Despite these drawbacks, if you need such a program it's really a powerful addition to your library. You will need time to read the manual, to unlearn your present debugger and to wear-in the shoes and sweater of RAID. After a few weeks you will be quite adept at using it. I suggest that the RAID vendor, Southern Systems of Birmingham, make three minor changes. First, add Z-80 capabilities to RAID. Second, hire a psychological consulting firm which specializes in computer manual preparation to throughly rewrite the manual. Finally, add capabilities to directly read the symbol table of RMAC, MAC and MACRO 80 to allow for relocation of at least one symbol table. This will allow one program to be debugged in a complex without unduly increasing the size of the resident debugger. RAID is a technically well thought-out product but the lack of relocation abilities and Z-80 operations limit it.

RAID is available from: Southern Computer Systems, PO Box 3373A, Birmingham, AL 35255. The cost is $250. ■

CIRCLE 101 ON READER SERVICE CARD

Three Macro Assemblers Compared

by Andrew L. Bender

A comparison of CDL's Macro-2, Digital Research's MAC and Microsoft's Macro 80. All three are high-powered assemblers designed for serious program development.

Reviewing software is a far more tedious job than I had expected. I have tried to bring together the features of the software in a comparative manner, but readers should keep in mind that this isn't a tutorial on Assemblers and linking loaders.

The three Assemblers are: MACRO-2, written by Computer Design Labs (CDL); MACRO-80 (Version 3.31), written by Microsoft and MAC (Version 2.0), written by Digital Research. All of these Assemblers were tested by assembling real programs (programs written to do other tasks than testing Assemblers) from the CPMUG library and from my system. Test conditions were provided by an Ithaca Intersystems 2MHz Z-80 CPU, 60K of Memory (TDL Z-16), Micromation doubler/Megabox disk system and MITS 2SIO/2 serial I/O board. This hardware was contained in an IMSAI-8080 mainframe. All disk operations were in double density. Speed tests, without an accurate way of measuring time (a real-time clock on a computer system that locks out interrupts isn't accurate), are of little value. Later, I will show that "speed of assembly" is not what you are really interested in.

Prices ranged from $85 to $175. However, it should be noted that MACRO-80 includes a linking loader, library manager and cross reference symbol table generator. MACRO-2 did not include any other companion programs. MAC does not generate relocatable code so that no linking loader is necessary.

Documentation

The Microsoft MACRO-80 Assembler came with a poorly documented 30 page manual. In all fairness to Microsoft, they do make clear that the manual "...is designed to serve as a reference guide to the MACRO-80 package." They do not say it is a learning guide. However, later in the same paragraph they have the audacity to state that if you know Assembly language programming you will know enough to program using the manual, your ideas and MACRO-80. Despite the terse, specification style language there are annoying ambiguities in the manual. For example, there is confusion between the terms "label," "symbol" and "name." Looking at the general specification for a statement, one could code every EQU, SET and MACRO instruction incorrectly based on this ambiguity.

There are other annoying problems with the documentation. Items which should have been logically grouped together were scattered all over the manual. The quality of reproduction of the manual is poor; it appeared to have been produced by xerographic printing. The manual is often in disagreement with the program it documents—perhaps these are program bugs. Definitions made by the manual are not used later in defining how items are to be coded, and there are no coding examples. Since I have been using Assemblers for more than twenty years, I felt that with very little additional information, I should be able to write a MACRO-80 program. I was wrong. Perhaps I need more time and experience, or perhaps the manual needs more depth.

The CDL MACRO-2 manual, on the other hand, is somewhat better written. The manual is 74 pages long, and gives a good introduction to the Assembler facilities. However, it is not a tutorial and there are only a few examples given. Had the writers spent more time on the manual no one would be using any other Z-80 Assembler. Unfortunately, most of the features of this superb product are "sleepers"; they are undocumented or poorly documented in the manual and are

Andrew Bender, Neurological Services, Inc., 336 Center Ave., Westwood, NJ 07675.

waiting for the user to discover them either by accident or by experimentation. Also, there is no guidance on how to use these features to their best advantage. I experimented with this Assembler for some 17 days and was surprised what could be done with it. If you think that the tricks were not designed into the Assembler you are very wrong. It is obvious that the designers spent a great deal of time putting all of these extras in. Too bad they did not document them better.

Many of the concepts introduced in the CDL MACRO-2 manual could use an example to illustrate them. This is especially true of certain specialized operators which are not commonly used in today's assemblers. The shorthand style of the language adds to the confusion rather than aiding understanding. Some of the pseudo operations were well documented but the language tended to be somewhat terse and explanations were fuzzy in spots. The use of some pseudo-ops were unclear at best. The manual's reproduction was on a par with Microsoft's MACRO-80's, namely xerographic printing—ugh!

The Digital Research MAC worked perfectly. It is reliable, fast and a bargain if you only want a macro assembler for 8080 code.

The Digital Research MAC manual was by far the best. Each reading seemed to add more to my understanding of the facilities of the Assembler. There are multiple examples of the use of MAC facilities including several systems designs with MAC. If you decide on the Microsoft MACRO-80 Assembler, I strongly recommend you buy the Digital Research MAC manual. More about this later.

Using The Assemblers

Using the documentation to MACRO-80 as a guide, I tried to assemble a few old MITS DOS Assembler programs (a "non-macro" dialect of MACRO-80) and found that there were some problems with definitions. Aside from these trivial problems, the results were perfect. Later, I assembled programs which used the macro facility to some degree—and problems occurred. The mechanism for inserting prestored macro libraries did not work. The SET directive blew up and generated one byte of object code each time it was invoked. Finally an "X" error occurred in the listing, a great surprise because the error code was not documented anywhere in the manual. Hoping this was a problem with the source code and ever mindful of the fact that it can happen with a Macro Assembler, I checked the code by assembling it with another Intel compatible Macro Assembler (not reviewed here) and found that there were no problems. I know that many, if not all of these quirks have been fixed in later versions (Version 3.4) of Microsoft's MACRO-80.

The CDL MACRO-2 performed well, with no hitches in assembling any relocatable program. Because the manual was unclear, there were problems when I tried to make an Intel hex file suitable for loading with DDT or LOAD. Evidently, saying .PABS isn't enough. Although not explained in the manual you also need .PHEX and .XLINK pseudo ops to produce a hex file which contains no linkage information. (.PABS is a pseudo op which forces MACRO-2 to generate an absolute object code file.) I did not like the CDL mnemonics until I tried to make a Z-80 version of my CBIOS. Then I liked them because it was not necessary to change all my op codes to Zilog mnemonics.

The Digital Research MAC worked perfectly. It is reliable, fast and a bargain if you only want a macro assembler for 8080 code. There was not one feature which offered any unpleasant surprises. Because of the superb documentation which contains an excellent tutorial on Macro Assemblers, I got used to this Assembler and became very fond of the manual. Unlike the other manuals it is printed and bound. Pages do not stick together, and the printing is sharp. If MAC could produce relocatable code it would be up-to-date and very much a competitor for the other Assemblers. Digital Research has announced a relocatable assembler (RMAC) as part of their PL/I-80 package. I am certain that this will meet the high standards we have all come to expect from Digital Research.

CDL's LINKER, the linkage editor for MACRO-2, is by far the most flexible linkage editor I have come across.

Operating Speed

Since Assemblers, like editors and debuggers, are program development tools they become an extention of the programmer in the programming process and figure into the important EDIT->ASSEMBLE->DEBUG cycle. If the Assembler or any other item in the process is too slow, it causes mental fatigue and decreases the efficiency of the process. MAC, which does not generate relocatable code, and therefore has none of the overhead associated with this task, was faster than MACRO-80. MACRO-2 and MACRO-80 were quite different when it came to speed. The MACRO-2 Assembler was at least 30% faster than MACRO-80. MACRO-80 also always needs to use its linkage editor since it, unlike MACRO-2, cannot generate Intel Hex format absolute code directly as

Table 1. *Macro Assembler Comparative Features.*

Features	Digital Research MAC	CDL MACRO-2	Microsoft MACRO-80
Change Radix of evaluation	no	yes[3]	yes
Trace macro expansion	yes	yes[1]	yes
Label rules: Op code as a label	no	yes	yes
Terminating colon	no	yes	yes
Maximum label size	16 charac.	any length	any length
Significant characters	16	6	6
Direct renaming of pseudo-operations	no	yes	no
Define symbol value at assembly time	no	yes	no
Op code used as an operand	yes	yes	yes[2]
Inclusion of prestored code	yes	yes	yes
String length operator	no	yes	no
Local and global symbols (outside macro)	no	yes	no
Symbol type operator	no	no	yes
Temporary variables	no	yes	no
Host processor	8080/Z80	Z80	8080/Z80
Cross reference listing	no	no	yes[4]
Documentation	excellent	fair	poor
Output object file format	Intel hex	Intel hex or CDL relocatable	Microsoft relocatable
Initial mode of assembly[5]	8080—abs.	Z80-reloc.	8080-reloc.
Input file format	not special[6]	not special	not special[6]
Printed and/or saved symbol table	yes	yes	yes
List Price macro-assembler	$120	$99.95	$149
linking editor	not avail.	$79.95	included with assembler

Footnotes:

1. MACRO-2 can trace at different levels in a multi-level expansion with selectivity.
2. 8080 only.
3. Both a pseduo-op and operator exist for this purpose.
4. As a separate program. Refer to article.
5. Expected initial processor and format of object file.
6. MAC tolerates a line number, MACRO-80 needs special format line number, if present, generated by the EDIT-80 program.

an Assembler output in those cases where absolute programs are desired. MACRO-2 contains pseudo operations to allow this type of output format (see above).

Each time that you make a change in a program with MACRO-80 it is necessary to go through the linkage editing step to get an absolute module that you can test. Now, the EDIT->ASSEMBLE->DEBUG cycle becomes EDIT->ASSEMBLE->LINKEDIT->DEBUG. This really slows things down. There is one important consideration however, you can debug little functional subroutines more efficiently and quickly than a huge "blob" program so that you make fewer cycles through the development process. Small programs also assemble faster. Once little functional subroutines are developed, they can be easily put into a library so that when you need that function it is available to you without doing another assembly or, worse, recoding the program each time that function is needed.

Comparing Features

Some of the areas in which all three Assemblers are the same are the ability to trace MACRO expansions, the inclusion of prestored library code, generation of a symbol table display, and the ability to handle the input text of most editors.

Areas where the three Assemblers differ are many (see Table 1 for comparisons). The CDL MACRO-2 Assembler only runs on a Z-80 system, while the others run on both Z80 and 8080 systems.

LINK-80, the linkage editor for MACRO-80, is flexible and includes many features. There are a few things I would have liked to see, such as an ENTRY command allowing the programmer to define the starting address of the program at link edit time.

The commands for the Microsoft LINK-80 linkage editor were such that they could be placed in a "SUBMIT" file with only a parameter or two necessary in the call to SUBMIT to link a complex of programs which might, under ordinary circumstances, require typing in many names of files. Microsoft's LINK-80 ran very quickly and produced a storage map containing the actual, relocated memory addresses in a highly readable, useful form. I was impressed with the valuble information contained in this storage map.

CDL's LINKER, the linkage editor for MACRO-2 is, by far, the most flexible linkage editor I have come across. It includes many of the features of LINK-80, and much more. The first few pages of LINKER's manual contain an overview of link editor operations, a description of the terms used in the manual and a guide to the operation of LINKER. It is not only able to prepare HEX and COM FILES, but can also generate relocatable files in which certain of the symbol definitions are resolved and others are left unresolved. Hence you can not only generate libraries in a single relocatable file (you can also do this with Microsoft's LIB library manager) but can also, during testing and checkout, generate working modules linked up with their external suitably resolved references. Those programs which are still on the "test bench" can be rapidly linked because most of the symbol resolution is done previously with their support modules "prelinked." LINKER can also put the commands for link editing in a file and control the placement of programs.

I tested LINKER (Version 2.01) on a set of programs which were translated to CDL MACRO-2 format by a general purpose macro generator. There were no problems. Unlike the MACRO-2 manual, which I mentioned earlier, LINKER's manual is clear and well written. The input format of LINKER does not correspond to the relocatable format adopted by Microsoft and, more recently, Digital Research. This means that the relocatable elements producted by MACRO-80 and RMAC cannot be linked by LINKER, and those relocatable elements produced by MACRO-2 cannot be linked by LINK-80. It should be possible to write a program to convert the different relocatable formats.

LINKER reads the relocatable text of each module it is linking twice. This results in a slower linkage editing step for most very large programs, except in those cases where a large group of relocatable elements have been collected and prelinked. LINKER compares favorably with the UNIVAC 1100 Series "Collector" and the IBM 370 Linkage Editor in its scope and design.

A cross reference table was available only on the MACRO-80. It was very slow—but not as slow as a simjlar task program running under a Basic interpreter. MACRO-80 and MACRO-2 are fussy about finding a colon at the end of a label. MAC doesn't care. MAC won't let you use an op code as a label, but MACRO-80 and MACRO-2 both will.

There were some areas where the differences seemed to matter more. The fact that MACRO-80 could be used to assemble either Zilog Z-80 mnemonic code or 8080 Intel mnemonic code is important if your mainframe CPU card can be swapped to either a Z-80 or 8080 and you have both kinds of program around. MACRO-2 can also assemble both 8080 and Z-80 programs, but only when the Z-80 programs are in CDL's unique mnemonic dialect rather than the Zilog mnemonics. CDL (previously TDL—Technical Design Labs) uses Intel mnemonics for all instructions which are common to the 8080/8085 and Z-80. The extended Z-80 op code mnemonics are logical extensions of the Intel mnemonics. Hence, programs written using CDL mnemonics cannot be directly assembled with MACRO-80 or MAC and programs written with Zilog mnemonics cannot be assembled with MACRO-2 or MAC. The CDL op codes seem to make much more sense because the entire program doesn't look like a series of "LD" instructions. Intel uses store instructions when data is stored in memory, and move or load instructions when data is moved between registers or brought to or from memory. If you are brought up on the Zilog mnemonics they may make a lot of sense. However, when you are converting a program written for the 8080 to the Z-80, Zilog mnemonics are cumbersome. With CDL mnemonics, every line does not have to be rewritten. With Zilog mnemonics, almost every line must be recoded.

If you will not be preparing system programs or assembly coded production/application programs, then the ASM Assembler included with CP/M is excellent and will meet your needs without spending money for one of these high-powered assemblers.

The CDL mnemonics conform closely to the IEEE standard on microcomputer Assemblers. Rumor has it that the creators of MACRO-2 are developing an even more powerful assembler which allows the use of Zilog Z-80 op codes and even greater speed.

One really strong point for the CDL MACRO-2 Assembler is its ability to request assignment of variables at assembly time. This feature is very useful in preparing different versions of the same program without changing the parameters with a text editor. A prime example of this is changing "MSIZE" in your CBIOS without having to go back to your editor. Another advanced feature which helps in the support of good macro generation facilities is the string length operator which allows you to determine in a macro, or anywhere for that matter, how long a string argument is.

None of these assemblers will directly assemble the Intel 8085 RIM and SIM instructions. This is no real problem since a simple macro can handle this.

The macro facility in MAC and MACRO-80 are virtually identical. They work well but offer no special virtues. The MACRO-2 macro definition differs from the Intel definitions but is much more "powerful" in scope than the Intel macro language. This means, however, that the MACRO-2 Assembler could not use the Intel macro definitions. This is no problem unless your program happens to start with many pages of macro definitions which would require recoding.

Documentation being what it is, the assembler must produce its own documentation of the program being assembled. MACRO-80 can produce an octal or hex listing of the object code. Its pseudo-ops and listing formats are also nice and useful. Unfortunately, the page count is always incorrect and the title of the listing appears on the second page of the listing. The manual writer states that there are "subpage counts" as well as page counts. It seems to me that an assembly of a single program doesn't need two page ones. The instructions written by the programmer are standard Intel or Zilog mnemonics. In Z-80 mode even the pseudo operations can be Zilog pseudo-operation instructions. That is very desirable.

MACRO-2 produces a nice appearing hex listing which is subject to an extensive set of listing controls, with even the width and length of the page being adjustable—a nice feature for publication. For ease in coding, MACRO-2 seems to be more human oriented. One doesn't write :CM,"BDOS EQU 5". Rather, the programmer writes "BDOS == 5" which is easier to write and is more meaningful.

In Conclusion

Now you make your choice and pay your money. If you will not be preparing system programs or assembly coded production/application programs, then the ASM Assembler included with CP/M is excellent and will meet your needs without spending money for one of these high-powered assemblers. Your investment in one of these assemblers should be dictated by your needs and programming habits. If you write functional subroutines, dealing with relocatable programs and doing some hex arithmetic during debugging then I strongly recommend the purchase of MACRO-2 or MACRO-80 (also buy the MAC manual as a text on how to use all of the MACRO features which are available). If you have a Z-80 system, the MACRO-80 Assembler can be switched to handle Intel or Zilog op codes and pseudo operations which are different. If you don't mind the unconventional CDL mnemonics, the different (but more powerful) macro structure and being able to run only on a Z-80 machine, then MACRO-2 is what you would want to use. I'm not sure that I could recommend MAC at this point as a stand-alone development tool because it seems to be supplanted by the new Assembler which Digital Research is supplying with PL/I. MAC is still used by many people but its inability to generate relocatable code seriously hampers its utility in today's programming climate.

Keep in mind that many of the programs in the CP/M and SIG/M User Group Libraries have been assembled with MAC. For this reason alone, MAC may represent a wise investment. Add MAC's reasonable cost and great utility in handling the CP/M and SIG/M User Libraries you might be wise to invest in MAC. In addition, Digital Research's CP/M 2.x CBIOS is assembled best with MAC. ■

The PDS Assembly Language Development System

by Mark Zeiger

If you are looking for a full-featured 8080/Z-80 assembly language development system at a reasonable price, Allen Ashley's PDS is the thing for you. Versions are available for CP/M, North Star, or Micropolis disk operating systems. For $99 you get the following:

1. ASMB—An assembler/editor
2. MAKRO—A macro assembler
3. EDIT—A character oriented text editor
4. DEBUG— A debugger (also HEXBUG, LINKBUG, COMBUG for CP/M)
5. LINKED—A linker (North Star only)
6. KWIK—A relocating loader (North Star)

All of the above programs will run on an 8080 system, but both assemblers will handle Z-80 code, as well as the debuggers. This is the most comprehensive set of programs I have seen for the North Star system, and while you can buy a better editor that will run under CP/M and probably a more sophisticated macro assembler, you will wind up paying at least twice the money that you would pay for PDS.

When I first started writing this review, I was using a North Star system and was therefore able to examine both the North Star and CP/M versions of PDS that Mr. Ashley has written. Since I do not have access to Micropolis drives, I can not describe any differences that may exist between the Micropolis version and the other two. What follows is a description of the assemblers, debuggers, and editor as well as the linkage protocols needed for assembly of library files.

ASMB: The Interactive Assembler/Editor

An assembler/editor is a single package which allows a programmer to write a line-oriented assembly language program and then assemble it. This is similar to a Basic interpreter which allows instructions to be entered into memory and then executes those instructions. Thus it is not necessary to use a separate editor to create source code, then invoke an assembler to create a hex or rel file, and finally use a loader or linker to make an object or "com" file. Small to medium sized programs may be written quickly and assembled in a very short time. If syntax errors are discovered, re-editing and re-assembly will take a matter of seconds instead of minutes.

ASMB seems very convenient, and you might wonder why anybody would want to use the separate programs instead of this integrated system. There are some drawbacks. The first is that the entire source file must reside in memory before it can be assembled; therefore this system can not be used to create a large program, since a well-commented source file is usually six to ten times larger than the object file it produces. Also a system such as this usually requires that text be formatted in a specific manner and use labels of a specific length. I like to create my own formats to improve the structure and readability of source code. I also like long labels that are descriptive. But for small program development, the conveniences offered by a program such as ASMB outweigh its disadvantages.

ASMB is very convenient and versatile to use on all but the most complex of assemblies.

One of the first software packages written for the 8080 was Processor Tech's SP1, which later evolved into ALS-8. The program was modified by others to work on various disk systems, but it was essentially SP1 with a few extra I/O commands. PDS has all the features of those assemblers and many more. First, it will assemble Z-80 code using mnemonics which are similar to the widely used Intel mnemonics. There are even op codes for the recently discovered undocumented Z-80 instructions which allow you to treat the index registers as eight-bit registers.

ASMB has other advanced features that you would not expect to find in an editor/assembler. It has conditional assembly (using IF <exp> ... ENDIF), the SET operand (which allows the value of a label to be changed dynamically) and a DB expression which allows multibyte assignments (including ASCII strings). It also has a USE operand which will let a programmer

Mark Zeiger, 198-01 67th St., Flushing, NY 11365.

NEW! TPM* for TRS-80 Model II
NEW! System/6 Package
Computer Design Labs

Z80* Disk Software

We have acquired the rights to all TDL software (& hardware). TDL software has long had the reputation of being the best in the industry. Computer Design Labs will continue to maintain, evolve and add to this superior line of quality software.

— Carl Galletti and Roger Amidon, owners.

Software with Manual/Manual Alone

All of the software below is available on any of the following media for operation with a Z80 CPU using the CP/M* or similar type disk operating system (such as our own TPM*).

for TRS-80* CP/M (Model I or II)
for 8" CP/M (soft sectored single density)
for 5¼" CP/M (soft sectored single density)
for 5¼" North Star CP/M (single density)
for 5¼" North Star CP/M (double density)

BASIC I

A powerful and fast Z80 Basic interpreter with EDIT, RENUMBER, TRACE, PRINT USING, assembly language subroutine CALL, LOADGO for "chaining", COPY to move text, EXCHANGE, KILL, LINE INPUT, error intercept, sequential file handling in both ASCII and binary formats, and much, much more. It runs in a little over 12 K. An excellent choice for games since the precision was limited to 7 digits in order to make it one of the fastest around. $49.95/$15.

BASIC II

Basic I but with 12 digit precision to make its power available to the business world with only a slight sacrifice in speed. Still runs faster than most other Basics (even those with much less precision). $99.95/$15.

BUSINESS BASIC

The most powerful Basic for business applications. It adds to Basic II with random or sequential disk files in either fixed or variable record lengths, simultaneous access to multiple disk files, PRIVACY command to prohibit user access to source code, global editing, added math functions, and disk file maintenance capability without leaving Basic (list, rename, or delete). $179.95/$25.

ZEDIT

A character oriented text editor with 26 commands and "macro" capability for stringing multiple commands together. Included are a complete array of character move, add, delete, and display function. $49.95./$15.

ZTEL

Z80 Text Editing Language - Not just a text editor. Actually a language which allows you to edit text and also write, save, and recall programs which manipulate text. Commands include conditional branching, subroutine calls, iteration, block move, expression evaluation, and much more. Contains 36 value registers and 10 text registers. Be creative! Manipulate text with commands you write using Ztel. $79.95/$25.

TOP

A Z80 Text Output Processor which will do text formatting for manuals, documents, and other word processing jobs. Works with any text editor. Does justification, page numbering and headings, spacing, centering, and much more! $79.95/$25.

MACRO I

A macro assembler which will generate relocateable or absolute code for the 8080 or Z80 using standard Intel mnemonics plus TDL/Z80 extensions. Functions include 14 conditionals, 16 listing controls, 54 pseudo-ops, 11 arithmetic/logical operations, local and global symbols, chaining files, linking capability with optional linker, and recursive/reiterative macros. This assembler is so powerful you'll think it is doing all the work for you. It actually makes assembly language programming much less of an effort and more creative. $79.95/$20.

MACRO II

Expands upon Macro I's linking capability (which is useful but somewhat limited) thereby being able to take full advantage of the optional Linker. Also a time and date function has been added and the listing capability improved. $99.95/$25.

LINKER

How many times have you written the same subroutine in each new program? Top notch professional programmers compile a library of these subroutines and use a Linker to tie them together at assembly time. Development time is thus drastically reduced and becomes comparable to writing in a high level language but with all the speed of assembly language. So, get the new CDL Linker and start writing programs in a fraction of the time it took before. Linker is compatible with Macro I & II as well as TDL/Xitan assemblers version 2.0 or later. $79.95/$20.

DEBUG I

Many programmers give up on writing in assembly language even though they know their programs would be faster and more powerful. To them assembly language seems difficult to understand and follow, as well as being a nightmare to debug. Well, not with proper tools like Debug I. With Debug I you can easily follow the flow of any Z80 or 8080 program. Trace the program one step at a time or 10 steps or whatever you like. At each step you will be able to see the instruction executed and what it did. If desired, modifications can then be made before continuing. It's all under your control. You can even skip displaying a subroutine call and up to seven breakpoints can be set during execution. Use of Debug I can pay for itself many times over by saving you valuable debugging time. $79.95/$20.

DEBUG II

This is an expanded debugger which has all of the features of Debug I plus many more. You can "trap" (i.e. trace a program until a set of register, flag, and/or memory conditions occur). Also, instructions may be entered and executed immediately. This makes it easy to learn new instructions by examining registers/memory before and after. And a RADIX function allows changing between ASCII, binary, decimal, hex, octal, signed decimal, or split octal. All these features and more add up to give you a very powerful development tool. Both Debug I and II must run on a Z80 but will debug both Z80 and 8080 code. $99.95/$20.

ZAPPLE

A Z80 executive and debug monitor. Capable of search, ASCII put and display, read and write to I/O ports, hex math, breakpoint, execute, move, fill, display, read and write in Intel or binary format tape, and more! on disk $34.95/$15.

APPLE

8080 version of Zapple $34.95/$15.

NEW! TPM now available for TRS-80 Model II!

TPM*

A NEW Z80 disk operation system! This is not CP/M*. It's better! You can still run any program which runs with CP/M* but unlike CP/M* this operating system was written specifically for the Z80* and takes full advantage of its extra powerful instruction set. In other words its not warmed over 8080 code! Available for TRS-80* (Model I or II). Tarbell, Xitan DDDC, SD Sales "VERSA-FLOPPY", North Star (SD&DD), and Digital (Micro) Systems. $79.95/$25.

SYSTEM MONITOR BOARD (SMB II)

A complete I/0 board for S-100 systems. 2 serial ports, 2 parallel ports, 1200/2400 baud cassette tape interface, sockets for 2K of RAM, 3-2708/2716 EPROM's or ROM, jump on reset circuitry. Bare board $49.95/$20.

ROM FOR SMB II

2KX8 masked ROM of Zapple monitor. Includes source listing $34.95/$15.

PAYROLL (source code only)

The Osborne package. Requires C Basic 2.
5" disks $124.95 (manual not included)
8" disks $ 99.95 (manual not included)
Manual $20.00

ACCOUNTS PAYABLE/RECEIVABLE (source code only)

By Osborne, Requires C Basic 2
5" disks $124.95 (manual not included)
8" $99.95 (manual not included)
Manual $20.00

GENERAL LEDGER (source code only)

By Osborne. Requires C Basic 2
5" disks $99.95 (manual not included)
8" disks $99.95 (manual not included)
Manual $20.00

C BASIC 2

Required for Osborne software. $99.95/$20.

SYSTEM/6

TPM with utilities, Basic I interpreter, Basic E compiler, Macro I assembler, Debug I debugger, and ZEDIT text editor.
Above purchased separately costs $339.75
Special introductory offer: Only $179.75 with coupon!!

$160.

This Coupon Is Worth One Hundred And Sixty Dollars Toward The Full Price Of The SYSTEM/6 Package
System/6 with this coupon is only $179.95.
This is a limited time offer.

$160.00

ORDERING INFORMATION

Visa, Master Charge and C.O.D. O.K. To order call or write with the following information.

1. Name of Product (e.g. Macro I)
2. Media (e.g. 8" CP/M)
3. Price and method of payment (e.g. C.O.D.) include credit card info. if applicable.
4. Name, Address and Phone number.
5. For TPM orders only: Indicate if for TRS 80, Tarbell, Xitan DDDC, SD Sales (5¼" or 8"). ICOM (5¼" or 8"), North Star (single or double density) or Digital (Micro) Systems.
6. N.J. residents add 5% sales tax.

Manual cost applicable against price of subsequent software purchase in any item except for the Osborne software.

For information and tech queries call
609-599-2146

For phone orders ONLY call toll free
1-800-327-9191
Ext. 676
(Except Florida)

OEMS

Many CDL products are available for licensing to OEMs. Write to Carl Galletti with your requirements.

* Z80 is a trademark of Zilog
* TRS-80 is a trademark for Radio Shack
* TPM is a trademark of Computer Design Labs. It is not CP/M*
* CP/M is a trademark of Digital Research

Prices and specifications subject to change without notice.

DEALER INQUIRIES INVITED.

COMPUTER DESIGN LABS
342 Columbus Avenue
Trenton, N.J. 08629

CIRCLE 28 ON READER SERVICE CARD

PDS Review, continued...

use multiple location counters in a single program. All of these features are documented in the user manual.

The command set used by ASMB is similar to the command sets of the assemblers after which it is patterned. You may create an internal file space at any location in memory (which should be above 2500H to avoid overwriting the program). Source files may be read from or written to the disk and may be appended to source already existing in memory. The code may be assembled at any memory location or it may be assembled for one location while actually being stored at another. The source code may be listed either formatted with line numbers, or unformatted and the scrolling can be stopped by pressing the spacebar. Finally, there is a mini-editor that allows the user to correct errors in a line without retyping the entire line.

ASMB is very convenient and versatile to use on all but the most complex of assemblies. There are, however, a few annoying features. On the North Star package any reference to PSW (i.e., PUSH PSW) causes any error unless the PSW is first equated to 6. This error did not occur on the CP/M version. On both versions, combination of the USE and SET instructions generates an error even though the instructions perform exactly as the author specified they should, and do produce correct object code. When working under the North Star operating system you must first create a file on the disk before you start using ASMB. If you forget to do so, you will have to re-enter DOS, create the file, then go back to ASMB and save the file. You will have the same problem if you have enlarged the source of a file that has already been written and it becomes larger than the disk file. These problems do not exist on the CP/M version. And as stated before and seems to be a problem with most editor/assemblers, labels may have a maximum of five characters. In a long program you are really going to have to use you imagination to make up meaningful labels. Despite these few criticisms, ASMB is a fine program and by itself is almost worth $99... but wait—there's more to come!

EDIT: A Character-Oriented Text Editor

Edit is a character-oriented text editor similar to many other CP/M text editors. I like it better than CP/M's ED for two reasons. In CP/M's ED, if you accidentally press Control-C (which is easy to do since it is next to Control-Z) you will reboot the system and probably lose everything that was entered during the editing session. This will not happen with PDS Edit. The other nice feature of Edit is the ability to use an ASCII character to indicate the location of the "current activity pointer." This makes Edit much easier to use than other editors, since one of the biggest problems in using such an editor is to keep track of the pointer position. I found Edit easy to get used to because of the second feature, even though I had been using a screen editor up until this point.

If you are working under the North Star operating system, you don't really have a choice as to which editor you want to use. There just aren't that many available for the North Star environment; therefore Edit fills a big software gap and becomes a necessity.

The only difference between the CP/M and North Star versions is again in file creation. Using the North Star DOS, it is necessary to create the file in the operating system, then evoke Edit, type the file, and save it using Edit's "E" command. If you didn't guess right at the beginning and created a file that was too small, you will have to leave Edit, create a new file that is big enough, re-enter Edit and save the program. CP/M, with its dynamic file allocation, does not have that problem.

The Edit command set will allow you to create "macro" commands which can be repeated any number of times. It also has the capability of using multiple input files, thereby allowing you to read from many files and merge them.

Edit has all of the commands that are commonly found in character editors. The pointer may be moved forwards or backwards a given amount of characters or lines, and a given amount of characters or lines may be deleted from the buffer. It is possible to search for a string of characters and to substitute one string for another. One of the nice features of the search and substitute is the use of wildcards. The command SPGM@$$ will find the first occurrence of either PGMA, PBMB, PGMC, ... PGMZ, PGM1, PGM2, etc. since the character "@" means "match any character." There are other wildcards that have meanings other than "any character." Note that the "$" is the echo of the "escape" character (1BH) which is used as a command terminator as well as a string separator.

The Edit command set will allow you to create "macro" commands which can be repeated any number of times. One of the strong points of the macro feature is the ability to put a pause instruction in the command and allow the operator to decide on a course of action as the macro command is being performed. Edit also has the capability of using multiple input files, thereby allowing the user to read from many files and merge them. It has only one text buffer, which is a drawback, but you are able to define a block of text and then either move or delete the block. One last command that is unique to the PDS system is Edit's "N" command. This allows a file that is created by ASMB to be formatted into an ASCII file without line numbers. The file may then be assembled by Makro.

If you are using North Star DOS, then Edit is a necessity. With CP/M you might want to stay with the editor you are using, but if you don't like your current editor and do not feel like spending money for a screen editor, then give Edit a try. It's easy to use, small, fast, and comes with the package.

MAKRO: The PDS Macro Assembler

Remember that for your $99 you have already purchased an excellent Z-80 Editor/Assembler and a good text editor. For that same money you're going to get a relocating macro assembler. Macros are very useful in advanced program design because they can be used to make source code smaller and more readable. And if you are really good at it, you can use macros to do some very fancy assemblies.

A macro is a "template" of some code that you might wish to repeat a few times throughout the program in a slightly different manner (thus eliminating the use of a subroutine). To take what Mr. Ashley calls a trivial use of a macro (the only kind I really use), suppose you need a sequence of instructions that loads a register pair with an immediate value, adds the contents of that register pair to the HL registers, and stores the result in a memory location. The macro definition to generate such code would be:

```
RPADD:     MACRO      PAIR,VALUE,DEST
           LXI        PAIR,VALUE
           DAD        PAIR
           SHLD       DEST
           MACND
```

The first line of the macro definition names the macro (RPADD) and the parameters (PAIR, VALUE, and DEST). The next three lines are the instructions and the last line signifies the end of the macro definition. Somewhere in the program you might use the macro call "RPADD B,2571H,START+5". During the assembly the "B" will be substituted for "PAIR", "2571H" for "VALUE", and "START+5" for "DEST". The resulting code would be:

```
           LXI        B,2571H
           DAD        B
           SHLD       START+5
```

Notice that not only does one line of code (the macro call) generate many lines of code, but the same call can generate code that is slightly different (we could have used the DE or HL pairs). Macro processors have other features that give the programmer a great deal of power and flexibility in creating code. In his documentation, Mr. Ashley points out that an entire higher level language is implemented using macros. However I will not discuss other features of macro assemblers since I've been asked to write an article for a magazine, not a book.

To the best of my knowledge, Makro is the only assembler of its kind for the North Star operating system, but in CP/M it has competition. PDS Makro instructions differ somewhat in syntax from the other CP/M based macro assemblers (Digital Research MAC and RMAC, Microsoft M80, and CDL MACRO II). Which one you will prefer is of course a matter of opinion, but I found that Makro lacked some of the features that the others had to make complicated macro definitions easier to write. However, PDS Makro does have most of the important features such as conditional assemblies, macro flow control, macro nesting, and repetition control. Therefore you can do anything with Makro that can be done with the other CP/M assemblers.

Makro is not only a macro assembler; it is a linking macro assembler. Linkage and relocation are probably more useful features to most programmers than is macro capability. Relocating assemblers allow you to write your program in modules and then assemble them into one main program by using a linker (provided with the PDS package, naturally). Most programmers have many routines which they use over and over again. With a relocating assembler these routines only have to be written once and assembled into a library file. When writing the main program, you just have to inform the assembler that the routine you are calling is external to the program. After assembling the main program, you then must link it with the previously written subroutines. You may actually name the library file to be linked in the main program or you may use any symbolic name. If the linker can not find the library file on the disk, it will prompt you for the correct name at load time and you may enter it from the console.

The Macro package is a necessity if you're writing assembly language programs to be used by NorthStar system. However, if you normally use CP/M, then the relocating macro assemblers sold by Microsoft, CDL, or Digital Research are, in my opinion, more powerful.

As has been mentioned before, if you're working in North Star DOS, there is nothing that is comparable to the PDS macro assembler. I wish Mr. Ashley had written his assemblers so that they would create files instead of leaving it for the programmer to do in DOS, but the package is a necessity if you're writing assembly language programs to be used by North Star system. If you normally use CP/M, then the relocating macro assemblers sold by either Microsoft or Digital Research are, in my opinion, more powerful. You get those assemblers "free" if you buy any of the Microsoft compilers (Basic, Cobol, or Fortran) or PL/I from Digital Research, but those compilers will cost from three hundred to eight hundred dollars.

DEBUG: An 8080/Z-80 Debugger and Disassembler

That's right—there's more! Debug is a program similar to CP/M's DDT but with more features. In fact, the only feature of DDT that is missing from Debug is the "assemble" command. Using Debug, one may examine blocks of memory in either hex or ASCII, move bytes from one memory location to another, fill memory with a constant, examine and modify memory, and disassemble a program. Debug has two other features that are not in DDT. It is possible to compare two areas of storage and to search memory for a specific string of bytes.

The importance of any debugger lies in its ability to trace execution of a program. Debug has a single step feature, the ability to set breakpoints, and the ability to view all registers (including the Z-80 registers) in single step mode. There are a few commands that make it very easy to trace through loops and subroutines, and there is one invaluable command that

Debug has a single step feature, the ability to set breakpoints, and the ability to view all registers (including the Z-80 registers) in single step mode.

allows the program to execute normally until a register pair has reached a value specified by the operator. As Mr. Ashley states, the single step function of Debug will be the programmer's most valuable development tool.

Conclusions

If you are going to be doing any assembly language development for the North Star operating system, get the PDS package. It's a fantastic buy at $99 and there's really nothing comparable to it at any price. Remember that this package is also available to operate under the Micropolis system, and I think I have gone into enough detail so that those people with Micropolis drives can compare PDS to other packages on the market (if there are any).

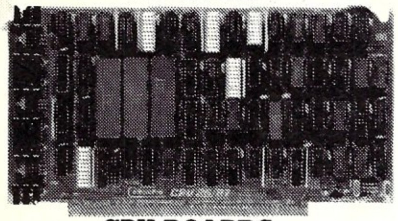
If you usually work with CP/M, then your decision is slightly more difficult. I feel that the Microsoft and Digital Research packages are slightly more sophisticated and easier to use, but I have been using them longer and am more familiar with them. They do cost more and do not come with an editor or debugger, but if you use CP/M, you already have those tools. The one thing you do not have is the interactive editor/assembler, and this alone is almost worth the entire price of the package.

The documentation for all the programs is very good and straightforward. Each program is described in its own section and all the commands are listed together for easy reference. The non-standard commands are explained in detail and examples are usually given (this is especially true in the section describing Makro). I encountered very few mistakes, and those that were present were corrected on a diskfile. Mr. Ashley also provides you with his phone number so that you may contact him if you are encountering problems with any of his programs.

The PDS Assembly Language Development System may be purchased from Allen Ashley, 395 Sierra Madre Villa, Pasadena, CA 91107; (213) 793-5748.

CIRCLE 103 ON READER SERVICE CARD

CompuPro™



NEW!

CPU BOARDS

CO-PROCESSOR 8086/8087 (816)

16 bit 8 or 10 MHz 8086 CPU with sockets for 8087 and 80130

Part No.	Description	List Price	Our Price
SHGBT186A	A&T 8MHz 8086 only	$695.00	$ 625.00
SHGBT186C	CSC 10MHz 8086 only	$850.00	$765.00
SHGBT186A87	A&T with 8087 option	$1295.00	$1225.00
SHGBT186C87	CSC with 8087 option*	$1550.00	$1456.00

*8087 requires slower clock speeds

DUAL PROCESSOR 8085-8088

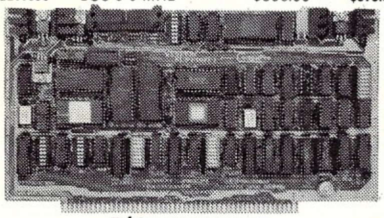
6 or 8 MHz Provides true 16 Bit Power with a standard 8 bit S-100 bus

SHGBT1612A	A&T 6Mhz	$425.00	$399.00
SHGBT1612C	CSC 6/8 MHz	$525.00	$498.00

CPU-Z Z80 CPU

2/4 MHz Z80 CPU 24 Bit Addressing

SHGBT160A	A&T	$295.00	$280.00
SHGBT160C	CSC 3-6 MHz	$395.00	$375.00



I/O BOARDS

SYSTEM SUPPORT 1 MULTIFUNCTION BOARD

Serial port (software prog. baud), 4K EPROM or RAM provision, 15 levels of interrupt, real time clock, optional math processor

Part No.	Description	List Price	Our Price
SHGBT162A	Assembled & Tested	$399.00	$360.00
SHGBT162C	CSC	$495.00	$460.00
SHGBT8231	Math Chip		$195.00
SHGBT8232	Math Chip		$195.00
SHGBT162AM1	A&T with 8231 Math Chip		$555.00
SHGBT162CM1	CSC w/8231 Math Chip		$655.00
SHGBT162AM2	A&T w/8232 Math Chip		$555.00
SHGBT162CM2	CSC w/8232 Math Chip		$655.00

MPX CHANNEL BOARD

I/O Multiplexer, using 8085A-2 CPU on board with 4K RAM

SHGBT166A4	Assembled & Tested	$495.00	$445.00
SHGBT166C4	CSC	$595.00	$535.00

With 16K RAM

SHGBT166A16	Assembled & Tested	$649.00	$585.00
SHGBT166C16	CSC	$749.00	$675.00

INTERFACER 1

Two Serial I/O

SHGBT133A	Assembled & Tested	$249.00	$219.00
SHGBT133C	CSC	$324.00	$298.00

INTERFACER 2

Three parallel, one serial I/O board

SHGBT150A	Assembled & Tested	$249.00	$219.00
SHGBT150C	CSC	$324.00	$289.00

INTERFACER 3

Eight channel multi-use serial I/O board

SHGBT1748A	Assembled & Tested	$699.00	$629.00
SHGBT1748C	CSC 200 hr. 8 Port	$849.00	$750.00
SHGBT1745A	Assembled & Tested	$599.00	$559.00
SHGBT1745C	CSC 200hr. 5 port	$699.00	$629.00

NEW!

INTERFACER 4

Three Serial, 1 Parallel, 1 Centronics Parallel

SHGBT187A	Assembled & Tested	$350.00	$315.00
SHGBT187C	CSC	$450.00	$415.00

SPECTRUM COLOR GRAPHICS

Color Graphics board with Parallel I/O

SHGBT144A	Assembled & Tested	$399.00	$349.00
SHGBT144C	CSC	$449.00	$339.00
SHGBT2D	Sublogic Universal Graphics Interpreter Software		$35.00

S-100 MOTHERBOARDS

Active termination, 6-12-20 Slot

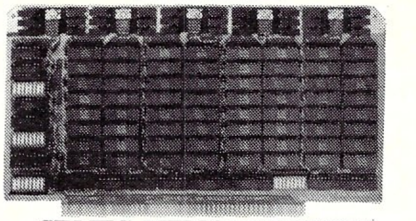
SHGBT153A	A&T 6 slot, 2 lbs.	$140.00	$126.00
SHGBT153C	CSC 6 slot, 2 lbs.	$190.00	$175.00
SHGBT154A	A&T 12 slot, 3 lbs.	$175.00	$155.00
SHGBT154C	CSC 12 slot, 3 lbs.	$240.00	$220.00
SHGBT155A	A&T 20 slot, 4 lbs.	$265.00	$235.00
SHGBT155C	CSC 20 slot, 4 lbs.	$340.00	$310.00

ACTIVE TERMINATOR

Allows older S-100 motherboards to run faster and quieter

SHGBT106A	Assembled & Tested		$59.50

CompuPro™



STATIC MEMORY BOARDS

RAM 20 - 32K STATIC RAM

RAM 20 10 MHz, 4K byte block disable, bank select or 24 bit addressing available 8, 16, 24 or 32K

Part No.	Description	List Price	Our Price
SHGBT164AA8	8K A&T	$210.00	$190.00
SHGBT164AC8	8K CSC	$280.00	$260.00
SHGBT164AA16	16K A&T	$285.00	$260.00
SHGBT164AC16	16K CSC	$355.00	$325.00
SHGBT164AA24	24K A&T	$355.00	$325.00
SHGBT164AC24	24K CSC	$425.00	$385.00
SHGBT164AA32	32K A&T	$425.00	$385.00
SHGBT164AC32	32K CSC	$495.00	$450.00

CMOS STATIC RAM

For a complete analysis of the advantages of CMOS memory, see the "Product Description" on page 416 of the January Issue of BYTE

RAM 17 - 64K CMOS STATIC RAM

RAM 17, 10 MHz, 2 Watt, DMA Compatible 24 Bit Addressing

SHGBT175A64	64K A&T	$599.00	$550.00
SHGBT175C64	64K CSC	$750.00	$699.00

RAM 16 - 32K x 16 BIT CMOS STATIC RAM

8 and/or 16 Bit

(816) RAM 16 10 MHz, 32K x 16 or 64K x 8 IEEE/696 16 Bit 2 Watt, 24 Bit Addressing

SHGBT180A	64K A&T	$650.00	$599.00
SHGBT180C	64K CSC	$750.00	$699.00

NEW! RAM 21 - 128K STATIC RAM

(816) RAM 21 12MHz, 128K x 8 or 64K x 16 IEEE/696 8 or 16 Bit 1.2 Amps, 24 Bit Addressing

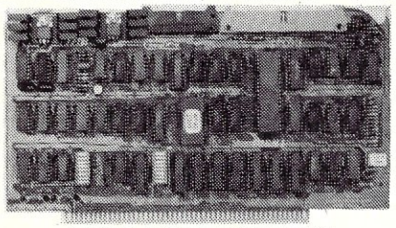
SHGBT190A	128K A&T	$1695.00	$1610.00
SHGBT190C	128K CSC	$1895.00	$1795.00

M-DRIVE SOLID STATE DISK DRIVE, (816) 3500% FASTER!

Not Really, But the Next Best Thing for CompuPro 8085/88 Users. Call for Detail on M-Drive.

M-Drive requires a 6MHz CPU 8085/88 dual processor, Disk 1 DMA disk controller and System Suport 1 Multifunction Board

SHGBTMD128K	128K of A&T memory & M-Drive Software		$1198.00
SHGBTMD128KC	128K of CSC memory & M-Drive Software		$1398.00
SHGBTMD256KA	256K of A&T memory & M-Drive Software		$2395.00
SHGBTMD256KC	256K of CSC memory & M-Drive Software		$2795.00



DISK CONTROLLERS

DISK 1 FLOPPY CONTROLLER

Fast DMA, Soft Sector, Controls 8" or 5¼" Single or Double Density. OUR BEST!

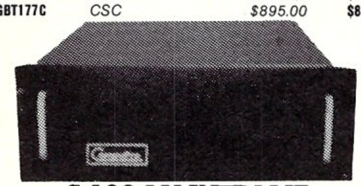
SHGBT171A	A&T	$495.00	$450.00
SHGBT171C	CSC	$595.00	$555.00
SHGBTCPM80*	CP/M 2.2 for Z80/8085 with manuals & BIOS 8" S/D disk		$175.00
SHGBTCPM86	CP/M for 8086 with manuals & BIOS 8" S/D disk		$300.00
SHGBTOAS8S	Oasis 8 bit single user 8" S/D disk		$500.00
SHGBTOAS8M	Oasis 8 bit multiuser, 8" S/D disk		$850.00

NEW!

DISK 2/SELECTOR CHANNEL HARD DISK CONTROLLER

Fast DMA 2 board set. Controls 4 Shugart 4000 series or Fujitsu 2300 type drives

SHGBT177A	Assembled & Tested	$795.00	$750.00
SHGBT177C	CSC	$895.00	$850.00

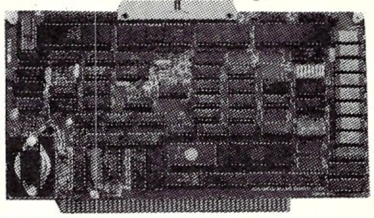


S-100 MAINFRAME

110V 60Hz CVT Mainframe uses famous 20 slot COMPUPRO Motherboard. 55 lbs.

SHGBTENC20RM	20 Slot Rack Mount	$895.00	$825.00
SHGBTENC20DK	20 Slot Desk Top	$825.00	$760.00

ADVANCED MICRO DIGITAL CORPORATION

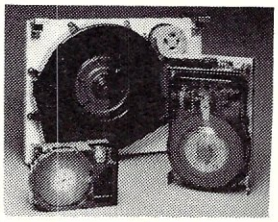


SUPERQUAD - ADVANCED MICRO DIGITAL AT LAST, A FULL S-100 SYSTEM ON A SINGLE BOARD!

● IEEE S-100 Bus Compatible ● Z80A CPU @ 4MHz ● Floppy Disk Controller, Single & Double Density (Supports up to 4 disk drives 5¼" or 8") ● 64Kb Memory, 16K Bank Selectable ● S-100 Extended Address A16-23 ● 2 Serial and 2 Parallel I/O Ports ● 2K or 4K of Shadow EPROM ● Real Time Interrupt Clock ● One Year Warranty ● Runs with CP/M, MP/M, CP/NET ● All of These Features on a Single Standard Size S-100 Board.

Part No.	Description	List Price	Our Price
SHMADSDC1	A&T w/Asych RS232 ports	$875.00	$795.00
SHMADPS1	1 Asych adapter board required for each serial port used		$ 30.00

MORROW DESIGNS



NEW!

S-100 5-26 MB HARD DISK SUBSYSTEMS

5 - 10 Mb DMA SUBSYSTEMS

Each subsystem includes DMA Hard Disk Controller, Seagate ST506 5 Mb or ST412 10 Mb 5¼" Hard Disk, Cabinet, power supply, CP/M™2.2 and Microsoft BASIC.

SHMDSDMAM*	Software supplied on 8" IBM 3740 disk with blank I/O and INSTALL program
SHMDSDMAM*2B	Software configured for Morrow DJ/2B controller and Mult I/O as console
SHMDSDMAM*DMA	Software configured for Morrow DJ/DMA controller and Mult I/O as console
SHMDSDMAM*NS	Software supplied on 5¼" 10 sector North Star disk with blank I/O and INSTALL Program

Replace * in above part numbers with **5** for 5Mb Subsystems or **10** for 10Mb Subsystems.

DISCUSM5	- 5Mb Subsystems	$2195.00	$1975.00
DISCUSM10	- 10Mb Subsystems	$3195.00	$2875.00

(order by part numbers listed above)

DISCUS HDC 20-26 Mb SUBSYSTEMS

Each subsystem includes HDCA3 I/O mapped controller, Shugart SA4008 14" 26Mb or Fujitsu 2308 8" 20Mb Hard Disk, cabinet, power supply, CP/M™2.2 & Microsoft BASIC.

SHMDSHDC20	Discus M20 A&T	$4795.00	$3995.00
SHMDSHDC26	Discus M26 A&T	$4495.00	$3895.00

SSM

VIDEO AND I/O

VB 3 - HIGH RESOLUTION VIDEO

80 x 25 or 50 character video display Memory Mapped, Parallel Keyboard port

SHSSMVB3A24	80 x 24 A&T	$499.00	$440.00
SHSSMVB3UP	80 x 50 Line Upgrade		$ 39.00

VB 2 - I/O MAPPED 64 x 16 DISPLAY

I/O Mapped Video Board, with Parallel Keyboard port 64 x 16

SHSSMVB24A	Assembled & Tested	$269.00	$229.00

VB1B MEMORY MAPPED 64 x 16 DISPLAY

Memory Mapped Video Board 64 x 16 character display or 64 x 16 graphics display

SHSSMVB1A	Assembled & Tested	$242.00	$220.00

I/O 4

Two serial I/O, two parallel I/O

SHSSMI04A	Assembled & Tested	$290.00	$260.00

I/O 5

2 Serial, 3 parallel Including 1 Centronics

SHSSMI051	Assembled & Tested	$329.00	$309.00

I/O 8

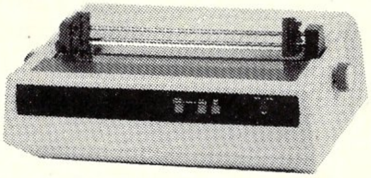
8 Port Serial I/O with Timer

SHSSMI08A	Assembled & Tested	$550.00	$495.00

PRIORITY ONE ELECTRONICS

FUJITSU & NEC

LETTER QUALITY PRINTERS FROM SELLUM



Interfaces: • RS232C and Current Loop • Centronics type parallel interface • IEEE/488 All are DIP switch selectable.
Personality Protocols: • NEC5510 • DIABLO 630 • QUME Sprint 9 • IBM Personal Computer • ATARI (Centronics 737).
Special Features: • Z80 CPU • 12K ROM • Standard 16K Buffer • Optional 48K Buffer • 50 - 19.2K baud • Micro-coded alarm differentiates error conditions with pulse combinations • Intelligent bi-directional printing with logic seeking • Complete word processing features • Self test • Auto reprint • Auto clear error • Proportional spacing • Supports Automatic justification • Complete Vector plotting routines • Sheet feeder mode allows easy interface to most mechanical sheet feeders • 6 month warrantee • Quiet - 60db • Front panel forms control • Universal power supply 115/220V 50/60 Hz.

80 CPS USING THE FUJITSU SP830

Part No.	Description	List Price	Our Price
SHSLMF86	*Intelligent Printer*	*$3495.00*	$2995.00
	OPTIONS		
SHSLMF86VFT	*Vertical forms tractor*		$200.00
SHSLMF8648K*	*48K RAM buffer*		$400.00

Call for pricing on sheet feed options

55 CPS USING THE NEC 7700

Part No.	Description	List Price	Our Price
SHSLMN77	*Intelligent Printer*	*$3295.00*	$2895.00
	OPTIONS		
SHSLMN77VFT	*Vertical Forms Tractor*		$ 230.00
SHSLMN77BDFT	*Bidirectional Forms Tractor*		$ 400.00
SHSLMN77CSF	*NEC Cut Sheet Feeder*		$1595.00
SHSLMN77CSF2	*Twin Cut Sheet Feeder*		$2150.00
SHSLMN7748K*	*48K RAM Buffer*		$ 400.00

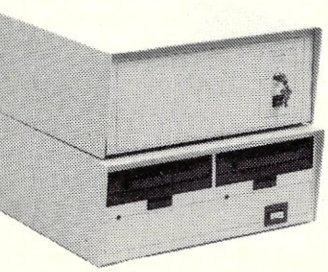
**Must be ordered with the printer*

INTERFACE CABLES

SHCPAM572	*Centronics IBM/NEC Cable*	$80.00
SHSCDB251	*RS232C Serial Cable*	$60.00

Call for other cables not listed

Para Dynamics



18 SLOT S-100 MAINFRAME

CVT Power Supply, forced air cooling; security lock 120 or 220V AC at 50 or 60Hz+8V@20A, ±16@3.5

SHPDN2018D	*Desk Top*	*$799.00*	$699.00
SHPDN2018R	*Rack Mount*	*$849.00*	$749.00

8 SLOT S-100 MAINFRAME WITH CUTOUTS FOR 2 5¼" DISK DRIVES

+5@5A, -5@500MA, +8@15A, +12@6A, +16@2, -16@2

SHPDN2508D	*Desk Top*	*$899.00*	$789.00
SHPDN2508R	*Rack Mount*	*$949.00*	$839.00

DISK DRIVE FACILITY

Accommodates two 8" floppy drives, of Shugart, Qume, or similar design and dimensions. 110 or 220V AC at 50 or 60Hz CVT power.

SHPDN2200D	*Desk Top*	*$659.00*	$579.00
SHPDN2200R	*Rack Mount*	*$679.00*	$595.00

PRONTO

Free standing cabinet. Will accept 2, 8" Floppy disks and 1, 8" Rigid disk. 18 slot card cage will accept the double height 10" x 10" S-100 cards (Alpha Micro and others) CVT Power Supply.

+24@7A, +16@2.2A, -16@3.5A, +8@20A, +5@5A

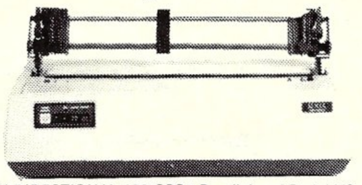
SHPDN2818	*PRONTO*	*$1295.00*	$1129.00

PRONTO COMPLETE WITH POWER SUPPLY POWER-UP SEQUENCER

SHPDN2818S	*with sequencer*	*$1395.00*	$1249.00

Shipped motor freight collect

OKIDATA



- *BI-DIRECTIONAL-120 CPS*
- *Parallel and Serial I/O*
- *9x9 Matrix (Alphanumeric)*
- *100 Thru 1200 Baud*
- *6x9 or 12 matrix for graphics*
- *Self Test*
- *5,8.3,10,16 Characters p/Inch*
- *Out of paper switch*
- *6 or 8 Lines per Inch*
- *Friction or Tractor Feed*
- *80 CPL@10 CPI for 82A*
- *3" to14" Top of form (Switch Selectable)*
- *132 CPL@10 CPI for 83A & 84*
- *10 Different Character Sets*

The above printers come complete with friction and tractor feed. Front panel selection of 10 different form lengths. Front or bottom paper loading for up to 4 part forms and tear bar. All three printers have a parallel interface as standard. The 82A and 83A also include a 1200 baud serial interface as standard.

Part No.	Description	List Price	SALE
SHOKIDAT82AT	80 column printer w/tractor (25 lbs.)		$539.00
SHOKBFRAPH82	High resolution graphics ROM 60x66		$ 75.00
SHOKIDAT83AT	132 column printer w/tractor (35 lbs.)		$750.00
SHOKIGRAPH83	High resolution graphics ROM 60x66		$ 75.00
SHOKISER2KBF	9600 Baud 2K serial buffer interface		$149.00
SHOKIDAT84AP	132 col. printer parallel interface with graphics (35 lbs.)		$ 1095.00
SHOKIDAT84AS	132 Col. printer 9600 baud serial 2K interface with graphics (35 lbs.)		$ 1250.00
SHMBSAPLINTWC*	Apple Parallel Interface w/cable (1 lb.)		$ 75.00

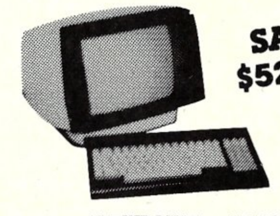
**Sold only with printers*

EPSON

SHEPNMX80	80 col./CPS tractor feed (17 lbs.)	$450.00
SHEPNMX80FT	with Tractor/Friction feed (20 lbs.)	$550.00
SHEPNMX100	132 col./80CPS (30 lbs.) Tractor/Friction Feed	$725.00
SHMBSAPLINTWC*	Apple parallel interface with cable	$ 75.00
SHMBSEI1*	Serial interface for EPSON Printers	$ 59.00

**Sold only with printers*

ADDS
Applied Digital Data Systems Inc.



SALE! $525.00

VIEWPOINT — ADDS

Detachable keyboard, RS232 interface and auxiliary port, 80 x 24 display, tiltable screen.

SHADDVWPR	*Sh. weight: 30 lbs.*	*$699.00*	$525.00

DISK CABINETS

V-100 - VISTA

• *Desk or rack mountable* • *Internal power and data cables* • *Drives pull out for easy service and maintenance*

SHVISV100	*Disk Drive Cabinet (43 lbs)*	*$495.00*	$449.00
SHVISV100	*With purchase of two 8" Disk Drives*		$399.00

SINGLE 8" - Q.T.

Single 8" cabinet with power supply

SHQTCDDC8	*(22 lbs.)*	*$249.00*	$225.00

DUAL 8" - Q.T.

Dual 8" cabinet with power supply

SHQTCDDC88	*(24 lbs.)*	*$395.00*	$349.00

5" CABINETS - VISTA

SHVIS9801	*Single 5" with P.S.*	$ 85.00
SHVIS9802	*Dual 5" with P.S.*	$110.00

SEND $1.00 TODAY FOR THE NEW, FULL COLOR SPRING 1982 ENGINEERING SELECTION GUIDE!

Tandon

Tandon TM-800 Thinline is exactly half the size of conventional 8" floppy disk drives.

1 ONE

Exactly one-half the height of any other model.
Proprietary, high-resolution, read-write heads patented by Tandon
D.C. only operation - no A.C. required
Industry standard interface.
Three millisecond track-to-track access time (9 lbs.)

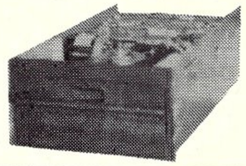
SHTNDTM8481	*Single Sided* **$425.00**	2 or more	$395.00
SHTNDTM8482	*Double Sided* **$575.00**	2 or more	$550.00
SHTNDTM8M	*Manual - not included with drive*		$ 10.00

TANDON 5¼" DRIVES

SHTNDTM1001	*Single Sided, 250KB (5 lbs.)*	$249.00* ea
	2 or More $220.00	
SHTNDTM1002	*Double Sided, 500KB*	$325.00 ea.
	2 or More $299.00	
SHTNDTM1003	*Single Sided, 500KB*	$325.00 ea.
	2 or More $299.00	
SHTNDTM1004	*Double Sided, 1000KB*	$449.00 ea.
	2 or More $420.00	
SHTNDTM5M	*manual, not included with drive*	$ 10.00

**As used in the IBM P.C.*

MITSUBISHI ELECTRIC



Better Than QUME! Better Than SHUGART!

8", Double-sided, double-density, interchangeable with QUME & Shugart

SHMITM289463	*Sh. Weight 16 lbs.*	$550.00
SHMITM289463M1	*Manual*	$ 10.00

2 or More $525.00 each

Shugart 801R

Single sided, double density - most popular 8" drive

SHSHU801R	*$425.00 ea. or 2 or more (16 lbs) for*	$395.00 ea.
SHSHUSA801RM	*Manual for 801R drives*	$ 10.00

INTERNATIONAL INSTRUMENTATION, INC.

UNIVERSAL DISK ENCLOSURES

• *Accepts any combination of 8" drives (QUME/Shugart 801R type or ½ size Tandon type)* • *Also accepts hard disks* • *Positive pressure* • *Optional Disk environment monitor shows supply voltage and internal cabinet temperature* • *Internal power and data cables provided.*

UNIVERSAL DRIVE CABINET complete with power supply, fan and filter, and all internal cables for attachment of two 8" floppy drives.

SHIIIUDE004	Dual Drive Cabinet (Sh. Wt. 40 lbs)	$495.00	$450.00
SHIIIUDE004EM	w/Environmental Monitor installed	$584.95	$535.00
SHIIIUDE004AUG	Dual Drive cabinet with Augmentation power supply module to increase 5V supply from 6 amps to 9 amps for use with two hard disks or 4 Tandon drives. Also includes Disk Environment Monitor (45 lbs.)	$733.00	$650.00
SHIIIUDERCK	19" Rack Mount kit UDE004		$ 89.95

THIN THREE DRIVE CABINET complete with power supply, and all internal cables for attachment of three thin 8" floppy drives (Tankdon type). One AC power connector is also provided for use with full size drive.

SHIIIUDETT	Three Drive Cabinet (Sh. Wt. 35 lbs)	$495.00	$450.00
SHIIIUDETTTEM	with Environmental Monitor installed	$584.95	$535.00

PRIORITY ONE ELECTRONICS ©

VISA master charge

9161-I DEERING AVE • CHATSWORTH, CA 91311 NEDA MEMBER MITA

ORDER TOLL FREE (800) 423-5922 - CA, AK, HI CALL (213) 709-5464

Terms. U.S. VISA, MC, BAC, Check, Money Order, U.S. Funds Only. CA residents add 6% Sales Tax. MINIMUM PREPAID ORDER $15.00. Include MINIMUM SHIPPING & HANDLING of $3.00 for the first 3 lbs., plus 25¢ for each additional pound. Orders over 50 lbs. sent freight collect. Just in case, please include your phone number. Prices subject to change without notice. We will do our best to maintain prices through August, 1982. Credit Card orders will be charged appropriate freight. If you haven't received your Spring '82 Engineering Selection Guide, send $1.00 for your copy today!. Sale prices are for prepaid orders only.

A Hardware Random Byte Generator

by John H. Gillespie

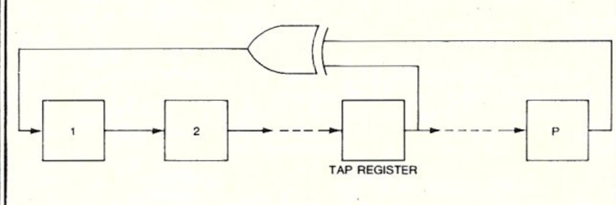
There are many occasions when large numbers of random numbers are required for simulations or Monte-Carlo procedures. In the population genetics simulations that I am involved with, it is not unusual to use tens of *billions* of random numbers in a single run. Such simulations require a fast and a "very random" random number generator. The pseudo-random number generators supplied with most languages often fail on both counts. The most spectacular recent failure is the random number generator supplied with the Microsoft Basic compiler. If you use this generator to produce two random integers between one and six, then the sum of these two integers will never equal seven (see *Lifelines* Vol. 1/No. 7). While good software random number generators of adequate speed can be written for large computers, on micros it is usually preferable to construct hardware generators when speed is critical. In this article, plans will be presented for a pseudo-random byte generator which latches a random byte onto the S-100 bus whenever an input instruction is executed for the appropriate port.

The random byte generator is based on the maximal-length feedback shift register (MLFSR) technique. The basic idea of a MLFSR is illustrated in Figure 1. If the number of registers is large and if the tap register is cleverly chosen, then this generator will produce a pseudo-random sequence of bits which passes most criteria of randomness. A good place to read the basic ideas about these generators and their construction using TTL circuitry is the *TTL Cookbook*.

John Gillespie, Dep't of Genetics, University of California, Davis, CA 95616.

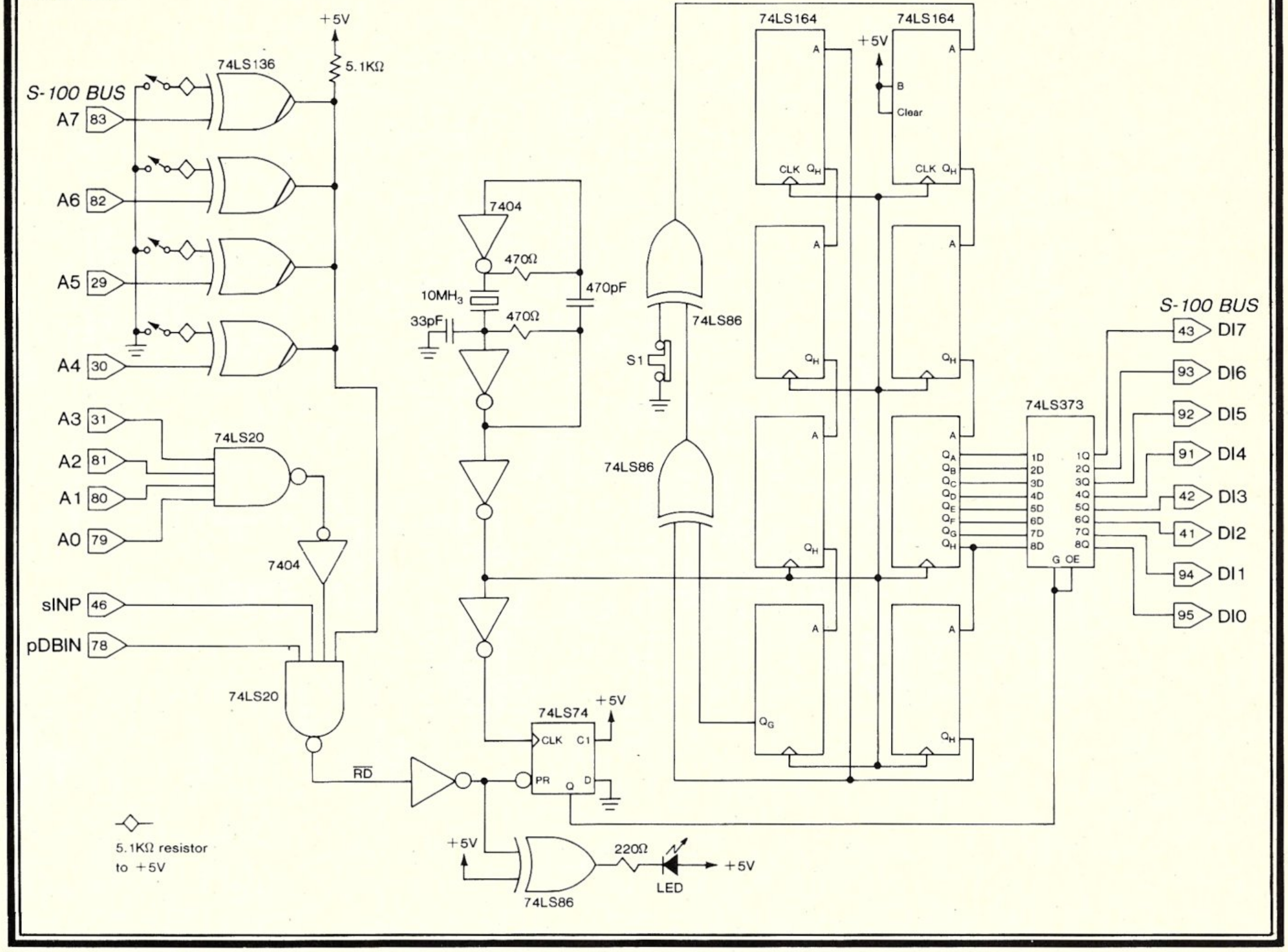
The mathematical properties of the sequence of bits generated by a MLFSR are well known. The books by Gill or Golomb give most of the details. For our purposes, the relevant fact is that the tap register may be chosen in such a way as to guarantee that the sequence of bits will be maximal length before the cycle repeats. There are usually quite a few different tap registers that will generate a maximal length sequence for a given total number of registers. Finding one such tap register can be hairy since it involves factoring polynomials over Galois Fields Modulo 2. Fortunately, there are extensive tables of tap registers which generate maximal length sequences. A particularly useful table is presented in the paper by Arvillias and Maritsas.

Figure 1.
A Maximum-Length Feedback Shift Register.



Given that the total number of registers, p, and the tap register have been settled on, the mathematical theory tells us that the length of the sequence will be 2^p-1 before it repeats. For example, the generator described in this article uses a 63 stage generator, so it will generate 2^{63}-1 or approximately 9×10^{18} bits before it

Figure 2. *A S-100 Random Byte Generator Using a MLFSR.*



repeats. The generator is clocked at 10 MHz so the sequence will run for about 30,000 years before repeating.

Implementing one of these generators on the S-100 bus is very simple. A wiring diagram for a 63-stage generator is given in Figure 2. The dip switch allows the generator to be addressed at any of 16 port addresses of the form XF hex, X=0,1,...,F. The momentary switch S1 is necessary if the generator should contain zeros in each stage on power-up, it will continue to generate only zeros. By momentarily closing S1 some high bits are introduced. Once the generator has at least one high bit it can never return to a state where each register contains a zero. The generator is clocked at 10 MHz, in part to assure that two successive calls will provide bytes from widely separated regions of the sequence. A second reason concerns the bus timing. Some circuitry must be provided to protect against latching onto the bus while the generator is in transition. This is accomplished by the D-flip flop. The latching occurs on the first trailing edge of the generator's clock after the $\overline{RD}$ signal goes low. Since the shift registers are clocked on the leading edge, the contents of the shift registers will always be stable when latched onto the bus. This circuit causes a delay of up to 100 nanoseconds from the time that $\overline{RD}$ goes low until the latching occurs. This delay causes no problems with 2-MHz 8080's or 8085's, or with 4-MHz Z-80's because of the wait status that is internally inserted in the Z-80 during input instructions. However, this interface definitely does not meet the IEEE timing standards. It will meet the standard on a 4 MHz bus if a 20-MHz crystal is substituted, giving a maximal delay of 50 nanoseconds. This equals the 25±0.01 tcy maximum allowed by the standard. Alternatively, a simple circuit to generate a wait state can be included.

The entire generator can be wire-wrapped on a small portion of a prototype board in a few hours. The basic design can be embellished by adding a 74LS374 Octal latch to latch the generated bytes onto an 8-LED display which can be attached to the board by a jumper and placed outside of the computer enclosure. This is useful for debugging to make sure that the generated bytes are the same as those being read by the computer.

Once constructed, the random byte generator should be thoroughly tested for randomness. There are two reasons for this. The first is simply to make sure that no errors were made in the wiring. The second is more complicated. It turns out that all of the mathematical demonstrations of the randomness properties of these

Figure 3.

```
/**********************************************************************
*                                                                     *
*                           rantest                                   *
*  A program to test the performance of the hardware random number    *
*  generator.                                                         *
*                                                                     *
**********************************************************************/

#include <std.h>

static double mean = 0.0;
static double variance = 0.0;
static unsigned int n = 0;
static unsigned char *base = NULL;

main()
{
        double bit_prob[8], runs_t[8], chisquared();
        int i;

        putlin("\n     Test of the hardware random number generator\n",52);
        putlin("\nHow many random bytes? ",24); putch(-1);
        n = getint(10);     /*  get decimal integer from stdin  */

        ranfill(base = alloc(n, NULL), n);
        bit_pattern(bit_prob);
        runs_test(runs_t);

        putfmt("\n          bit     prob[bit=1]     runs t\n");
        for (i = 0; i <= 7; i++)
                putfmt("%12i%14.4f%13.4f\n", i, bit_prob[i], runs_t[i]);
        putfmt("\nmean number of one bits per byte = %.4f,  variance = %.4f\n",
                mean, variance);
        putfmt("normalized chisquared = %.4f\n\n", chisquared());
}

bit_pattern(bit_prob)
double *bit_prob;
{
        unsigned char *p;
        unsigned int a[8], total, rbyte, i, j;
        unsigned long m = 0, v = 0;

        for (i = 0; i <= 7; i++)
                a[i] = 0;
        p = base;
        for (i = 1; i <= n; i++) {
                rbyte = *p++;
                total = 0;
                for (j = 0; j <= 7; j++)
                        if (rbyte & (1 << j)) {
                                        a[j]++;
                                        total++;
                        }
                m += total;
                v += total * total;
        }
        mean = ((double) m) / n;
        variance = ((double) v) / n - mean * mean;
        for (i = 0; i <= 7; i++)
                bit_prob[i] = ((double) a[i]) / n;
}

runs_test(runs_t)
double *runs_t;
{
        unsigned char *p;
        unsigned int last_r, i, j, runs[8], rbyte, mask;
        double dn, rmean, sigma, sqrt();

        for (i = 0; i <= 7; i++)
                runs[i] = 1;
        p = base;
        last_r = *p++;
        for (i = 2; i <= n; i++) {
                rbyte = *p++;
                mask = 1;
                for (j = 0; j <= 7; j++) {
                        if ((rbyte & mask) != (last_r & mask))
                                runs[j]++;
                        mask <<= 1;
                        }
                last_r = rbyte;
        }
        dn = (double) n;
        rmean = dn / 2.0 - 1.0;
        sigma = sqrt(dn * (dn - 2.0) / (4.0 * (dn - 1.0)));
        for (i = 0; i <= 7; i++)
                runs_t[i] = (runs[i] - rmean) / sigma;
}

double chisquared()
{
        unsigned char *p;
        unsigned int m[256], i;
        double expect, chisq = 0.0, temp, sqrt();

        for (i = 0; i <= 255; i++)
                m[i] = 0;
        p = base;
        for (i = 1; i <= n; i++)
                m[*p++]++;
        expect = n / 256.0;
        for (i = 0; i <= 255; i++) {
                temp = m[i] - expect;
                chisq += temp * temp / expect;
        }
        return((chisq - 255.0) / sqrt(510.0));
}

B>
;:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::;
;                                                                     ;
;                         ranfill                                     ;
;       ranfill(base, n)                                              ;
;       unsigned char *base;                                          ;
;       int n;                                                        ;
;       ranfill places n random bytes in memory beginning at base     ;
;                                                                     ;
;:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::;

.z80
public          ranfill
ext             c$ent,c$ret
rng             equ     0bfh            ;port address of random no. gen.

ranfill:
                call    c$ent           ;save c environment
                pop     hl              ;inc sp by 2
                pop     hl              ;"
                pop     hl              ;hl = base
                pop     bc              ;bc = n
loop:           in      a,(rng)         ;get random byte
                ld      (hl),a          ;stash it
                inc     hl              ;kick pointer
                dec     bc              ;decrement counter
                ld      a,b
                or      c               ;check counter
                jr      nz,loop         ;jump if counter > 0
                jp      c$ret           ;return to c
end

B>
```

Figure 4. *Typical outputs of rantest program.*

```
     Test of the hardware random number generator

How many random bytes? 30000

           bit      prob[bit=1]      runs t
            0         0.5039        -0.4272
            1         0.5014        -0.5427
            2         0.4971         0.3349
            3         0.4961         0.4619
            4         0.5029         0.1848
            5         0.5013        -0.3233
            6         0.4980        -1.7667
            7         0.4907        -0.3580

mean number of one bits per byte = 3.9914,
variance = 1.9858 normalized chisquared = -0.9890
          Test of the pli-80 function rand

How many random bytes? 30000

           bit      prob[bit=1]      runs t
            0         0.5000        54.1679
            1         0.4999         5.4387
            2         0.5000         2.6789
            3         0.4997        -1.3510
            4         0.4999         0.7275
            5         0.5003        -0.9700
            6         0.5005        -0.1270
            7         0.5010         0.1155

mean number of one bits per byte = 4.0011,
variance = 2.0022 normalized chisquared = -0.0942
```

generators are based on averages taken over the entire sequence. In general, one is only using a very small fraction of the total sequence so the available mathematics is not entirely relevant. This necessitates that the generator be thoroughly examined with a series of statistical tests. In Figure 3 I have included a C listing of a program which examines several properties of the generators. The program starts off by calling the assembly language subroutine *ranfill* which places n random bytes in memory beginning at base for later testing. It is best to generate the random bytes as quickly as possible, since if correlations are to appear they will most likely involve bytes relatively close together in the sequence. The bytes are then examined in sequence by three C functions:

Bit_pattern. This procedure calculates three quantities: 1) the fraction of one bits in each position in the generated bytes; 2) the mean number of one bits per byte; and 3) the variance in the number of one bits per byte. If everything is working we would expect about half of the bits to be ones and half to be zeros for each of the 8 bit positions among the n bytes. If this fraction lies outside of the range $0.5 \pm 1/4n$ then there is reason to suspect the generator. If the fraction exceeds 0.5 then a good place to look for problems is with the interface to the bus. If the timing isn't correct the result is usually to read FFhex, which causes the inflation in the fraction of one bits. The mean number of one bits per byte should be about 4.0, while the variance should be about 2.0. If there are correlations between neighboring bits within a byte, this should cause the variance to be other than 2.0.

Chisquared. This procedure tests to see if all 256 bytes are generated with equal frequency. If the normalized chisquared lies outside of the range $\pm$ 1.96 more often than 1 time in 20, something is amiss. In earlier versions I found this to be another good indicator of interface problems. The normalized chisquared is used because the degrees of freedom (255) are so large.

Runs_test. This test examines the number of runs of zeros and ones for each bit throughout the entire n bytes. This is a very good test for randomness between successive bytes. If the t-values lie outside of the range ± 1.96 more often than 1 time in 20, something is wrong. Details of this test may be found in an elementary statistics book.

Figure 4 gives a typical output from this program. As is evident, the generator checks out quite well.

If the *rantest* program is modified to examine the high order eight bits of the random number generator supplied with PL/I-80 the results are as in Figure 4. The runs test shows that the lowest two bits are not at all random in their behavior. This is a property of multiplicative generators that is of no concern for simple applications, but can obviously cause serious problems in more sophisticated programs, particularly those requiring truly random bytes and not uniform random variates. ■

References

Arvillias, A. C. and Maritsas, D. G. "Toggle-resistors generating in parallel k kth decimations of m-sequences $x^p + x^k + 1$ design tables," *IEEE Trans. Comp.*C-28(2), pp. 89-101. 1979.

Gill, A. *Linear Sequential Circuits.* New York: McGraw-Hill., 1966.

Golomb, S.W. *Shift Register Sequences.* San Francisco, CA: Holden-Day, Inc., 1967.

Lancaster, Don. *TTL Cookbook.* Indianapolis, IN: Howard W. Sams and Co., Inc., 1974.

Error Detection And Correction Codes

by Robert B. MacKinnon

A summary of the techniques used to detect transmission errors and the means of automatic correction.

Principles

Digital computers, especially those involved in data communications, are susceptible to extraneous noise sources that introduce transmission errors. Although the effects from noise sources can be minimized, they can't be totally eliminated; as a result, errors can creep in. However, through the use of error detection hardware and algorithms, it is possible for transient errors to be detected and corrected. For years, digital communications systems, unattended data gathering equipment and digital computers have used special codes to perform the correction process. These codes range from the simple parity checking process to complex polynomial codes such as the Bosi-Chaudhri code. No matter which system is chosen, all error correction codes must adhere to certain principles of redundancy and efficiency.

After detecting an error, the system has to do one of the following three operations:

1. Ignore it.
2. Flag the error and ask for retransmission of the information.
3. Correct the error upon detection without asking for retransmission.

Each level of detection involves increasing complexity of implementation and redundancy. *Redundant information* is extraneous data to the original meaning of the data. It is added to help reduce the chance of an undetected error occuring during the transmission of data. Redundant information is defined as:

R = 1 - ((no. of info. bits) / (total no. of bits))

For example, assume a simple parity check bit is added to an eight bit digital word. The redundancy resulting from adding this bit is:

1 - (8 / 9) = 0.111 or 11.1%

This means that 11.1 percent of that digital word is totally unnecessary to the original meaning of the data.

Robert B. MacKinnon, 5 Parkway 1709, Willowdale, Ontario, Canada M2J1L9.

We can see that as more bits are used as error checking bits, the digital word becomes longer and less efficient. *Efficiency* is the converse of redundancy and is defined as:

E = 1 - R

For the above example, the efficiency of the simple parity check is:

1 - 0.111 = 0.889 or 88.9%

Code Distance

When an error occurs in a digital transmission, the receiving station does one of three operations—(1) ignore the error, (2) ask for a retransmission or (3) correct the error. Each level of error detection implies an increase in redundancy.

The first level—to ignore the error—has a redundancy of zero and an efficiency of 100%. In some cases (ie. telegrams via TTY), the errors can be ignored and the human operator can interpolate between the errors. However, such a system would be totally unacceptable for digital transmission. For most simple digital transmission systems, the second level of error detection—asking for retransmission of the information—is used. The receiving station uses a simple M-out-of-N code, parity check or checksum to detect a single bit deviation and then asks for retransmission of the errored data block.

As the detection scheme becomes more complex, a measurement of the effectiveness of the code is required. The measurement is arbitrary and is called the *code distance* (ie. the minimum separation between code words). If the minimum distance between code words is one, the code cannot detect any errors. When the code distance is two, the scheme cannot correct any errors but can detect single bit errors. A code distance of three implies detection of double bit errors and correction of single bit errors. This distance is often referred to as the *hamming distance*.

TO ORDER CALL
(617) 641-1241

TECHNICAL SUPPORT
(617) 641-1235

SoftwareBanc

ONE FANEUIL HALL MARKETPLACE, BOSTON, MA 02109

OPEN A SoftwareBanc SAVINGS ACCOUNT TODAY*

WHEN IT COMES TO dBASE II WE WROTE THE BOOK

DEAR COMPUTER OWNER,

EVERYONE WANTS TO SELL YOU **dBASE II.** AT SOFTWAREBANC, WE HELP YOU USE IT. THAT IS WHY WE WROTE THE **dBASE II USER'S GUIDE,** AND TEACH **dBASE II** CLASSES AROUND THE COUNTRY.

WE DON'T USE HIGH PRESSURE SALESPEOPLE OR GIVE AWAY A FREE TOASTER WITH EVERY PURCHASE. WE SIMPLY STAND BEHIND OUR PRODUCTS AND OFFER THE HIGHEST LEVEL OF TECHNICAL SUPPORT POSSIBLE.

BEFORE YOU BUY **dBASE II** FROM ANYONE ELSE, TALK TO THEIR "TECHNICAL SUPPORT DEPARTMENT," THEN GIVE US A CALL.

SoftwareBanc
THE dBASE II SPECIALISTS

dBASE II	**$595**	60 DAY MONEY BACK GUARANTEE!
dUTIL	**$ 75**	UTILITIES FOR THE dBASE II PROGRAMMER
QUICKCODE	**$249**	CREATES COMPLETE PROGRAMS IN THE dBASE II LANGUAGE, YET IT REQUIRES NO PROGRAMMING KNOWLEDGE. ALSO ALLOWS dBASE II FILES TO BE USED WITH WORDSTAR AND MAILMERGE.
dBASE II USER'S GUIDE	**$ 29**	FREE WITH THE PURCHASE OF dBASE II.
dBASE II CLASSES		TAUGHT BY THE AUTHOR OF THE dBASE II USER'S GUIDE. REGISTER NOW FOR THE FOLLOWING CITIES:

CHICAGO	**JULY 31 - AUG. 1**
LOS ANGELES	**JULY 16 - 17**
SAN FRANCISCO	**JULY 10 - 11**

NOW SCHEDULING PRIVATE dBASE II CLASSES!

* **SoftwareBanc SAVINGS PLAN:** Every purchase increases the discount you receive on that purchase and future purchases.

DISCOUNT SCHEDULE

TOTAL PURCHASES	DISCOUNT RATE
UP TO $499	1%
$500 TO $999	2%
$1000 TO $1499	3%
$1500 TO $1999	4%
$2000 AND UP	5%

The more you buy, the more you save. Invest in the **SoftwareBanc** today!

Payment may be made by Mastercard, Visa check, money order, wire transfers. Mass residents please add 5% sales tax. Add $5.00 for shipping and handling. Overseas orders add additional $10.00. Prices subject to change without notice. All items subject to availability. ® — Mfgs. Trademark.

CIRCLE 36 ON READER SERVICE CARD

Figure 1 presents the first seven code distances. Each level increase involves a decrease in efficiency but an increase in reliability of the code. Usually the adoption of a particular error correction code involves trading off some reliability for ease of implementation or speed.

Figure 1. *Code Distances*

Distance	Detection		Correction
1	0		0
2	1		0
3	2	or	1
4	2	plus	1
5	2	plus	2
6	3	plus	2
7	3	plus	3

Fixed Weight Codes

The Fixed Weight or M-out-of-N code is an integral character representation code which detects single bit errors. Each character that the code will represent must contain 'M' number of ones out of a possible 'N' information bits. This code differs from most because there are no extraneous redundant bits; rather, the *content* of the information determines whether an error has occured. The possible number of character representations is severely limited by such an encoding scheme. The total number of legal combinations possible with this code is given by:

$$Q = N! / (M! (N - M) !)$$

For example, a 4-out-of-8 code provides:

$$Q = 8! / (4! (8 - 4) !) = 70 \text{ characters}$$

and the usable number of information bits is given by the equation

$$D = LOG \text{ (total no. of bits)}$$

which means, for the above example, the usable number of information bits contained in the code is:

$$D = LOG\ (70) = 6.13 \text{ bits}$$

$$R = 1 - (6.13 / 8) = 0.233 \text{ ot } 23.3\%$$

Another limitation of this code is its inability to resolve double-bit errors.

Parity

The most common form of error detection is the parity code. Parity can exist in two forms, even or odd. Even parity adds on a one bit to the digital word when the total number of ones in the word is even. It adds a zero bit if the number is odd. Conversly, odd parity adds a one bit when the total number of ones is odd. Parity is easy to generate and to detect and has a low redundancy. However, it is limited to detection of only single-bit errors (code distance is two). It can be shown that approximately 30% of the time, simple parity checking will fail to detect most errors that occur to an eight bit word when transmitted. Noise pulses usually last long enough to destroy the integrity of at least two of the bits. Other methods using polynomial checks have been devised to detect these double-bit errors.

Polynominal Codes

As mentioned above, codes containing simple parity checks permit the detection of errors but offer no means of correction. If sufficient redundancy is added to the original information in the correct patterns, codes can be constructed so the errors can be corrected at the receiving station, without the need to retransmit the block in error. Such forward acting codes are discussed below.

Matrix Sum

In the matrix sum correction code, each character of the set to be encoded is arbitrarily assigned a number. For instance, assume A=1, B=2, C=3, and so on for the entire alphabet. Next, the letters are grouped in threes, the numbers assigned and arranged in rows to form a square matrix. The sums of all the rows and columns are taken and the total of the row and column sums taken (Figure 2).

The sums are converted back to corresponding characters and transmitted serially as below:

A B C D E F G H I L O R F O X S

Figure 2. *Matrix Sum Encoding*

1	2	3	6		A	B	C	F
4	5	6	15		D	E	F	O
7	8	9	24		G	H	I	X
12	15	18	45		L	O	R	S

If any letter or letters were to be garbled when transmitted, the decoding process is a simple substitution process for the received character information; add vertically and horizontally to see where the error occurred and subtract vertically to determine the correct character. This system has been used by the U.S. Navy when transmitting RTTY messages. It is apparent that the system of encoding and decoding is tedious—but particularly suited to computer applications with one way transmissions since the code does not utilize any form of feedback. The 3 x 3 matrix will correct 90% of all single-bit errors and a 9 x 9 matrix will correct 99.9% of all errors with only a 23.4% overhead in message length. The redundency of this method is 0.19 or nineteen percent.

Hamming Code

The most popular EDC code in use in digital computers today is the Hamming Code. This system introduces a code distance of 3: sufficient enough to correct single-bit errors and detect double-bit errors. This is done by associating even parity check bits with unique combinations of information bits. Each check bit is responsible for checking the parity of its particular combination of information bits; for example, in the case of an eight bit word (as tabulated in figure 3) C1 checks I3, I5, I7, I9 and I11; C2 checks parity for I3, I6, I7, I10 and I11; C4 checks I5, I6, I7 and I12; and C8 checks I9, I10, I11 and I12. By gating the check bits into appropriate holding registers, the receiving device can determine the validity of the received character, determine the position of the bit in error, correct it (by reversing it), remove the parity bits and deliver the corrected words. The Hamming Code determines the position of the bit in error by first detecting an even parity error, then using the C1, C2, C4 and C8 output as a binary value pointing to the position of the bit in error.

Figure 3. *Hamming Chart and Resulting Boolean Equations*

Check Bit Register Output				Error
C8	C4	C2	C1	Bits
0	0	0	0	NONE
0	0	0	1	C1
0	0	1	0	C2
0	0	1	1	I3
0	1	0	0	C4
0	1	0	1	I5
0	1	1	0	I6
0	1	1	1	I7
1	0	0	0	C8
1	0	0	1	I9
1	0	1	0	I10
1	0	1	1	I11
1	1	0	0	I12
1	1	0	1	-
1	1	1	0	-
1	1	1	1	-

Note: The subscripts for the Error Bits above indicate the absolute bit positions (i.e. the indices of the bits being checked). The 'I' prefix indicates the actual data bits and the 'C' prefix indicates the check bits. As the example shows the machine requires twelve bits to check a single byte of data.

Boolean Equations for the Hamming Check Bits

C1 = (C1 + I3 + I7 + I9 + I11)
C2 = (C2 + I3 + I6 + I7 + I10 + I11)
C4 = (C4 + I5 + I6 + I7 + I12)
C8 = (C8 + I9 + I10 + I11 + I12)

For a single byte word, four Hamming bits are required, increasing the redundancy of the code to 0.667. This inefficiency is offset by the forward acting characteristic inhrent in the code. That is, the correction occurs at the receiving station and retransmission of the data is eliminated. ■

GETFILE— A Useful CP/M Utility Program

by Thomas W. Cage

Load and execute a file anywhere in memory.

The CP/M operating system has many advantages, however, one of its disadvantages is the inability to load files into memory at locations other than the beginning of the TPA. The program GETFILE.COM will allow the user to load a file into memory at any location above 00FFH and then provide the option of executing an address chosen by the user.

Example:

A GETFILE FILENAME.EXT 5000
Enter Execution Address in HEX: 5000

A non HEX number, CR, or a number less than 0100H will return to the CP/M system. Loading a dummy file of 0 length will allow you to not alter memory and directly jump to a chosen address.

Example:

A GETFILE DUMMY.DMB 0100
Enter Execution Address in HEX:XXYY

A valid address must follow the dummy file name but the execution address can be any valid four digit hex number.

When the GETFILE program is loaded into the TPA, it reads address 0005H to obtain the DOS entry point. It then subtracts the difference for the beginning of the CCP minus 0100H, stores this in the DE register and relocates itself to the calculated address. ■

Thomas W. Cage, P. O. Box 806, Roswell, GA 30075.

```
                ;       'GETFILE', A CP/M Utility
                ;        Reads an Input File and stores it at address 0XXYYH
                ;
                ;        THOMAS W CAGE
                ;        December 10, 1980 --- Public Domain
                ;
                ;
0100            ORG     100H
0005 =          BDOS    EQU     05H     ;DOS Entry Point
0080 =          BUFF    EQU     80H     ;Input Disk Buffer Address
0001 =          CONS    EQU     01H     ;Read Console
0000 =          CPM     EQU     00H     ;Restart CP/M System
001A =          EOM     EQU     1AH     ;End of Message Flag
005C =          FCB     EQU     5CH     ;File Control Block Address
006D =          HBYTE   EQU     6DH     ;High Byte of Storage Address in FCB
000F =          IBP     EQU     0FH     ;Input Buffer Address
006F =          LBYTE   EQU     6FH     ;Low Byte of Storage Address in FCB
00C0 =          LENGTH  EQU     0C0H    ;Length of Relocatable part of GETFILE
0B28 =          MSGM    EQU     0B28H   ;Modify Exit in MSG subroutine
0A06 =          OFFSET  EQU     0A06H   ;BDOS-Start of CCP-256 (for CP/M 2.011)
000F =          OPENF   EQU     0FH     ;File Open
0014 =          READF   EQU     14H     ;Read Function
0200 =          TPA     EQU     200H    ;Address of Relocatable part of GETFILE
0002 =          TYPEF   EQU     02H     ;Type Function
                ;
                ;
0100 2A6D00     INITI:  LHLD    HBYTE   ;Load Storage Address in ASCII
0103 010000             LXI     B,0     ;Convert ASCII Address to HEX
0106 7D                 MOV     A,L     ;High Nibble
0107 CD3E01             CALL    HEX
010A 7C                 MOV     A,H     ;Low Nibble
010B CD3E01             CALL    HEX
010E 2A6F00             LHLD    LBYTE
0111 7D                 MOV     A,L     ;High Nibble
0112 CD3E01             CALL    HEX
0115 7C                 MOV     A,H     ;Low Nibble
0116 CD3E01             CALL    HEX
0119 DD7C00             MOV     A,HX    ;Move High Byte to ACC
011C B7                 ORA     A       ;Test for Storage Address less than 0100H
011D 2839               JRZ     ERROR
011F 21280B             LXI     H,MSGM  ;Modify MSG Exit
0122 224402             SHLD    MSG+6
0125 2A0600             LHLD    BDOS+1  ;Load BDOS Address
0128 11060A             LXI     D,OFFSET
012B ED52               SBC     HL,DE   ;Subtract OFFSET from BDOS Address
012D E5                 PUSH    H       ;Save Calculated GETFILE Address
012E 7C                 MOV     A,H
012F 324002             STA     MSG+2   ;Modify Relocatable High Address Byte
0132 110002             LXI     D,TPA
0135 EB                 XCHG            ;Address Pointers
0136 06C0               MVI     B,LENGTH
0138 EDA0       MOVE:   LDI             ;Memory to Memory Transfer
013A 10FC               DJNZ    MOVE
013C E1                 POP     H
013D E9                 PCHL
                ;
013E D630       HEX:    SUI     48      ;Convert ASCII to HEX
0140 FE0A               CPI     10
```

```
0142 3802                JRC     HEX1     ;Test for ACC < 10
0144 D607                SUI     7
0146 FE10       HEX1:    CPI     16       ;Test for Valid Entry
0148 300C                JRNC    ERROR    ;Test for ACC > 15
014A 5F                  MOV     E,A
014B DD29DD29            ADD IX,IX! ADD IX,IX    ;Left Shift Address Data
014F DD29DD29            ADD IX,IX! ADD IX,IX
0153 DD09                ADD     IX,BC
0155 C9                  RET
                ;
0156 215F01     ERROR:   LXI     H,MSG1   ;Error Message
0159 CD4102              CALL    MSG+3
015C C30000              JMP     CPM
                ;
015F 0D0A496E76MSG1:     DB      13,10,'Invalid Entry ...',7,13,10,10,26
                ;
0200                     ORG     200H
0200 115C00     GFILE:   LXI     D,FCB    ;Open the File for Input
0203 0E0F                MVI     C,OPENF
0205 CD0500              CALL    BDOS
0208 AF                  XRA     A
0209 327C00              STA     FCBCR
020C 3E80                MVI     A,128
020E 320F00              STA     IBP      ;Set Buffer Pointer to 128
0211 21FFFF              LXI     H,OFFFFH;Set to -1 to start
0214 3A0F00     GBYTE:   LDA     IBP      ;Get Next Byte
0217 FE80                CPI     128
0219 200E                JRNZ    SBYTE
021B D9                  EXX              ;Read Disk File Record
021C 115C00              LXI     D,FCB
021F 0E14                MVI     C,READF
0221 CD0500              CALL    BDOS
0224 D9                  EXX
0225 B7                  ORA     A        ;Check for Errors
0226 2016                JRNZ    MSG
0228 AF                  XRA     A
0229 5F         SBYTE:   MOV     E,A      ;Read the Byte at BUFF + ACC
022A 1600                MVI     D,0
022C 3C                  INR     A        ;Pointer is Incremented
022D 320F00              STA     IBP      ;Save the Current File Address
0230 E5                  PUSH    H
0231 218000              LXI     H,BUFF
0234 19                  DAD     D
0235 7E                  MOV     A,M      ;Byte is in the Accumulator
0236 E1                  POP     H        ;Restore File Address and Increment
0237 DD7700              MOV     IX,0,A   ;Store Data at Address 0XXYYH
023A DD23                INX     IX       ;Increment Address Pointer
023C 18D6                JR      GBYTE
                ;
023E 217C02     MSG:     LXI     H,MSG2   ;GMSG, High Byte is Modified
0241 7E                  MOV     A,M      ;Print Message
0242 FE1A                CPI     EOM
0244 C800                RZ!     NOP      ;(JRZ KEYBD) Modified for Relocation
0246 D9                  EXX              ;Save Registers
0247 5F                  MOV     E,A
0248 0E02                MVI     C,TYPEF
024A CD0500              CALL    BDOS
024D D9                  EXX              ;Restore Registers
024E 23                  INX     H
024F 18F0                JR      MSG
                ;
0251 210000     KEYBD:   LXI     H,0      ;Input 4 digit HEX number from Terminal
0254 110000              LXI     D,0
0257 0604                MVI     B,4      ;Digit Counter
0259 D9         KEY1:    EXX
025A 0E01                MVI     C,CONS
025C CD0500              CALL    BDOS
025F D9                  EXX
0260 D630                SUI     48       ;Convert ASCII to HEX
0262 FE0A                CPI     10
0264 3802                JRC     KEY2     ;Test for ACC < 10
0266 D607                SUI     7
0268 FE10       KEY2:    CPI     16       ;Test for Valid Entry
026A D20000              JNC     CPM      ;Test for ACC > 15
026D 5F                  MOV     E,A
026E 29292929            DAD H! DAD H! DAD H! DAD H;Left Shift Keyboard Data
0272 19                  DAD     D
0273 10E4                DJNZ    KEY1     ;Decrement Digit Counter
0275 E5                  PUSH    H
0276 7C                  MOV     A,H
0277 B7                  ORA     A        ;Test for Address less than 0100H
0278 CA0000              JZ      CPM      ;Return to CP/M System
027B E9                  PCHL
                ;
027C 0D0A0A456EMSG2:     DB      13,10,10,'Enter Execution Address in HEX: ',26
                ;
                ;
                ;        File Control Block Definitions
005C =          FCBDN    EQU     FCB+0    ;Disk Name
005D =          FCBFN    EQU     FCB+1    ;File Name
0065 =          FCBFT    EQU     FCB+9    ;Disk File Type (3 characters)
0068 =          FCBRL    EQU     FCB+12   ;File's Currnet Reel Number
006B =          FCBRC    EQU     FCB+15   ;File's Record Count (0 to 128)
007C =          FCBCR    EQU     FCB+32   ;Current (next) Record Number (0 to 127)
007D =          FCBLN    EQU     FCB+33   ;FCB Length
                ;
02A0                     END

A>
```

UNIPROM: State-Of-The-Art EPROM Programming

by Steve Leibson

A short tutorial on EPROM's and a review of the Cer-Tek S-100 UNIPROM board.

EPROM's are useful; erasable, programmable read-only memories (EPROM's) can be used to store programs and data for uses ranging from simple peripheral drivers to entire languages. I use an EPROM in my North Star Horizon to store the routines which transform my memory-mapped video S-100 board into a Soroc IQ-120 terminal emulator. My big problem in using EPROM's has been programming them. This article tells you how I solved that problem.

Introduction to EPROM's

The EPROM and the microprocessor were both born in the early 1970's. As early semiconductor devices, neither had much capability. The 4004 and 8008 were primitive processors and the 1702 EPROM could only store 256 bytes.

Improved processing technology has brought us a rapid evolution in EPROM capacity. The 2708 quadrupled storage to 1024 bytes. The introduction of the 2508 and 2758 five-volt only EPROM's acknowledged that microprocessor systems were headed toward single, five-volt power supplies. Currently, there is a wide range of capacities available from 1024 bytes in the 2508 and 2758 parts to 8192 bytes in the 2764. The 2528 promises to double this limit again to 16384 bytes of storage.

Manufacturers of EPROM's, in their race to supply us with greater capacities, have also given us a few problems to deal with. Newer EPROM technologies sometimes require different programming techniques. Sometimes, two manufacturers producing the next bigger part will select incompatible pinouts. These problems can make it very difficult to select an EPROM programmer that can program a wide range of devices.

Steve Leibson, 4040 Greenbriar Rd., Boulder, CO 80303.

EPROM Programmers

An EPROM can be thought of as a vast array of field-effect transistors (FET's). Normally, the FET is off, current does not flow between the source and drain. If a charge is placed on the gate of the FET however, it will turn on and allow current to flow.

In EPROM FET's, there is a "floating gate" which is isolated from the rest of the FET by an insulating material. A high gate-to-source voltage will drive electrons through the insulator and deposit them in the floating gate. When the voltage is removed, the electrons no longer have the energy to cross the insulating barrier and the FET is permanently on.

The high voltage is the programming voltage. Each type of EPROM has precise requirements for how much voltage is to be applied and for how long. Not enough voltage or too little time and the FET will not be programmed. Too much voltage or time may result in a damaged part.

EPROM's may also be erased, that is what the "E" stands for. Until recently, the only way to erase an EPROM was with ultraviolet light. This required that EPROM's be packaged with quartz windows to allcw light to strike the chip. The ultraviolet light energizes the electrons trapped in the floating gate and allows them to cross the insulating barrier. This drains the gate of electrons and turns the FET off.

Newer parts, electrically erasable programmable read-only memories (EEPROM's) can be erased with a

LOOK NO FURTHER.................................. WE'VE GOT YOUR PRICE!

ALTOS COMPUTERS	RETAIL	PREPAY
5000-15 Single User (64K, 2-1MB 5" disks)	$2995	$2399
5000-5D Single User (64K, 1MB+5MB 5" disk)	$5995	$4799
8600-10 8-User (512K, .5MB + 10MB disks)	$10500	$8399

AVL 'EAGLE' SERIES DESKTOP COMPUTERS		
Eagle II Desktop System (64K, dual 400K disk)		$2995
Eagle III Desktop System (64K, dual 800K disk)		$3995
Eagle IV Desktop System (64K, 800K+7 .5MB disk)		$5995
for 'Acctg. Plus' & 'Spellbinder' W/P ADD		$1000

BASIS COMPUTERS	RETAIL	PREPAY
BASIS 102 (64K, Z80/6502 **APPLE COMPATIBLE)**	$1995	$1699
CP/M, monitors & various disk drives also available		

COLUMBIA DATA PRODUCTS COMPUTERS	RETAIL	PREPAY
NEW! Multi Personal Computer (128K, 2-400K disks, 8-slots) (IBM PC LOOK-ALIKE - far greater value!)	$2995	$2499
1503-2 System (128K, dual 800K disks)	$2845	$2229
1802-1 System (128K, dual 1MB 8" disks)	$4495	$3499
CONCEPT 1000 - *MultiBus* - up to 16 users		CALL!

CORVUS DESKTOP COMPUTERS		
32-bit Mainframe power in a desktop system		
NEW! 'Concept' (256K, 68000, 120X56 CRT) from		$4995
Disk subsystems (6, 11 & 20MB) from		$2695

DIGITAL EQUIPMENT CORP. (DEC)	RETAIL	PREPAY
Destined to become legends in their own time		
'Rainbow 100' Z80/8088 w/CP/M-80/86, 132X24 CRT		$2795
Professional 300 series (F11 CPU) from	$3995	CALL!

DYNABYTE S100 COMPUTERS	RETAIL	PREPAY
NEW! Series 6600 & 6900 'TriBus' Computers (Z80/8088) (S100, MultiBus & proprietary)		CALL!

MORROW 'DECISION' S100 COMPUTERS	RETAIL	PREPAY
'Desktop' model (65K, 2-400K 5" disks)	$4195	$3495
'Rackmount' model (65K, 2-500K 8" disks)	$4375	$3695
Discus M5 (5MB rigid disk subsystem)	$2195	$1995
Discus M10 (10MB 8" rigid disk subsystem)	$3195	$2695
Discus M20 (20MB 8" rigid disk subsystem)	$4795	$3995
A822S Dual Slimline 8" floppy pkg. (2MB)	$1995	$1695

N.E.C. DESKTOP COMPUTERS	RETAIL	PREPAY
Hold on to your hats . . . the 'Advanced Personal Computer' has arrived! **Desktop computing will never be the same!**		
NEW! 'APC' 128K, 8086, 1MB 8" disk GREEN	$3295	$2795
NEW! 'APC' 128K, 8086, 2MB 8" disks COLOR	$4995	$4195
Options: 128K RAM **$600** 8087 **$200** 2S+2P I/O	**$250**	
PC8001 Pers. Computer or PC8031 Dual Disk	$995	$700
PC8012 I/O & RAM Expansion Unit	$649	$500
SPECIAL 64K System, I/O, Dual Disk, 80X24 CRT		$2099

NON-LINEAR SYSTEMS PORTABLE COMPUTERS

KAYCOMP II a better value than either **Osborne or Otrona!** Includes: *9" 80X24 CRT*, two *180K* disks, 64K, Z80, CP/M, 'Select' W/P, SuperSpell, MicroPlan, MBASIC, etc. **$1795**
NLS Battery Pack/Charger Option $350

SANYO DESKTOP COMPUTERS	RETAIL	PREPAY
MBC-1000 'Creative Computer' 66K, Z80, 300K disk		$1795
BDF-160 Single 300K Add-on Drive Pkg.	$995	$895
BDF-360 Dual 300K Add-on Drive Pkg.	$1595	$1339
BDF-860 Dual 1MB 8" Add-on Drive Pkg.	$2995	$2695
MBC-2000 64K Desktop System (2-300K disk)	$3495	$2995
MBC-3000 64K Desktop System (2-1MB disk)	$6495	$5495

SYSTEMS GROUP S100 COMPUTERS	RETAIL	PREPAY
System 2814 (64K RAM, 2MB Disk)	$5890	$4599
System 2824 Two User (128K RAM, 2MB Disk)	$6980	$5449
System 2819 (64K RAM, 11MB Disk)	$8905	$6949

TELEVIDEO COMPUTER SYSTEMS	RETAIL	PREPAY
TS-800 64K Satellite Wrkstn. for TS-806	$1795	$1399
TS-802 Desktop System (64K, 2-800K disks)	$3495	$2699
TS-802H Similar with 7.5MB Rigid Disk	$6995	$5299
TS-806 Computer (64K, 800K + 7.5MB disk)	$7195	$5499
'TeleSolutions' (WordStar & CalcStar)	$495	$400
NEW! 16-bit systems - available soon! CALL & RESERVE NOW!		

VECTOR GRAPHIC S100 SYSTEMS

Vector offers ON-SITE service & the most powerful W/P & spreadsheet software available on CP/M systems.
TOP RATED in user surveys for over three years!
For a limited period, we are passing FACTORY INCENTIVES straight thru to the customer, including: Memorite III, ExecuPlan, AccuChart & DataManager software (worth $1435).

	REGULAR	W/REBATE
System 2600 (64K, 2-600K disks, Z80B)	$4495	$3895
System 2800 - dual 1MB 8" drives	IN STOCK!	CALL!
System 3005 (64K, 600K + 5MB disks, Z80B)	$6495	$5895

ALL MODELS AVAILABLE AT SIMILAR SAVINGS!
If you can find a better value than Vector - BUY IT!

XEROX DESKTOP COMPUTER SYSTEMS	RETAIL	PREPAY
'SAM' 820-1 (64K, dual 92K drives)	$2995	$2395
'SAM' 820-2 (64K, dual 8" 256K drives)	$3795	$2995
'SAM' 820-4 (64K, dual 8" 1MB drives)		CALL!
Add **$169** for CP/M		

VIDEO DISPLAY TERMINALS	RETAIL	PREPAY
ADDS 'Viewpoint' series from	$695	$589
ADDS 'Viewpoint 90' emulating terminal	$1295	$1099
AMPEX Dialog-80 **CLOSEOUT SPECIAL**	$1195	$699
DEC VT-101	$1650	$1099
DEC VT-131	$2450	$1669
LSI ADM-22	$695	CALL!
PIICEON 2010 (80 X 66 Lines)	$3595	$2999
SCION MicroAngelo Color & B/W Terminals from		$2249
TeleVideo 910	$699	$589
TeleVideo 925C	$995	$799
TeleVideo 950C	$1195	$949
NEW! TeleVideo 970		CALL!
NEW! TeleVideo 'Intelligent I' (w/64K RAM)	$1695	$1399
Wyse WY-100 -or- Altos 'SmartTerm'	$995	$899
Wyse WY-200 (132X25)		$1199
Zenith Z19 CRT Terminal (VT52 compatible)	$895	$799

MATRIX PRINTERS	RETAIL	PREPAY
NEW! Anadex DP9501A Printer (200 cps)	$1725	$1399
NEW! Anadex DP9620A (300/150 cps) DP/WP Printer		$1599
DEC Letterprinter 100 (30/80/240 cps) DP/WP Prtr.		CALL!
Florida Data OSP120 (600/150 cps) Printer	$3900	$3399
Flor. Data OSP130 (600/150/100 cps) Printer	$4200	$3699
IDS 'Prism' 4-color printer (150/200 cps)	$1995	$1699
Tally MT100 series (40/160 cps) from	$830	CALL!
Tally MT1800 series (50/200 cps) Printers	$1995	$1639
Okidata 82A (120 cps - RS232 & Cent.)	$649	$499
Okidata 83A (120 cps - wide carrage)	$995	$799
Okidata 84 (200 cps - Dot Plot Graphics)	$1495	$1199

LETTER QUALITY PRINTERS	RETAIL	PREPAY
Diablo 620 Printer (25 cps)	$2000	$1699
Diablo 630 Printer (40 cps)	$2900	$2099
Diablo 630 KSR Terminal (40 cps)	$3325	$2749
NEC 3510 (RS232) or 3530 (Cent.) Printer	$2295	$1899
NEC 7700 Printer (O.E.M. parallel)	$2995	$2399
NEC 7710 (RS232) or 7730 (Cent.) Printer	$3095	$2499
NEC 7720 KSR Terminal (55 cps)	$3610	$2899
Qume Sprint 9/35 (35 cps) Printer	$2160	$1899
Qume Sprint 9/45 (45 cps) Ltd. Panel	$2495	$2099
Qume Sprint 9/45 (45 cps) Full Front Panel	$2660	$2249
TEC (C. Itoh) F10 Printer (40 cps)	$1995	$1499
Single Bin Sheet Feeder Mechanism	$1550	$1100
Dual Bin Sheet Feeder Mechanism	$2300	$1600
Envelope Feeder Mechanism	$1495	$1100
(Please specify NEC, Qume, Diablo or TEC model)		
CLOSEOUT - Qume Sprint 3 & 5 'SpeedFeed'	$1295	$599

SOFTWARE 'BEST-SELLER' LIST	RETAIL	PREPAY
Ashton-Tate 'dBASE II' Relational DBMS	$700	$530
'dBase II' for 8088/8086		CALL!
Aspen 'ProofReader & Grammatik'	$279	$229
BPI Acctg., Job Cost or Inventory Modules	$395	$319
CIS COBOL Compiler	$850	$750
Digital Research PL/I-80	$500	$425
Digital Research 'Pascal MT+'	$475	$425
DMA 'THE FORMULA' Applications Generator	$595	$500
Ecosoft 'MicroStat' Statistics Library	$295	$269
Fox & Geller 'Quickscreen' Screen Bldr.	$149	$135
InterSystems 'PASCAL-ZB' Z80 PASCAL	$395	$350
Lexisoft 'Spellbinder' Word Processing	$495	$300
MarketFax Sales & Marketing Tools	$500	$425
mDBS III with DRS, QRS & RTL Utilities		$3000
MicroPro WordStar w/ MailMerge & *Tutorial*	$665	$429
MicroPro 'DataStar' File Manager	$350	$235
Microsoft BASIC-80 Compiler	$395	$325
Microsoft FORTRAN-80 Compiler	$500	$400
Microsoft COBOL-80 Compiler	$750	$600
NECHE 'Select' or NECIS 'Benchmark' W/P	$495	$400
NECHE 'Report Manager' Electronic Wksht.	$200	$169
NWA 'Statpak' Statistics Library	$495	$400
NPI Law Office Mgr. w/ G/L & Docket Control		$4000
Oasis 'The Word Plus' Speller (50K words)	$150	$109
Open Systems Acctg. & Inv. (per module)	$995	$795
Palantir Word Processing Package	$425	$350
Peachtree 'PeachPak 4' (GL, AR, AP, PR, INV)	$2475	$2000
'Reformatter' CP/M to IBM -or- DEC formats		$200
'Select' w/'SuperCalc' W/P Package	$595	$400
Sorcim 'SuperCalc' Electronic Worksheet	$295	$219
Sorcim 'Pascal/M' for 8086 and 8088	$495	$400
Sorcim 'TRANS-86' Translator for 8086	$125	$109
Sorcim 'ACT-86/88' (8086/8088 X-assembler)	$175	$139
Star Systems Acctg. (GL, AR, OE, AP, PO, PR)	$1600	$1100
Star Systems Property Management	$950	$799
Systems Plus 'Acctg. Plus' (8 modules)	$4760	$3500
Systems Plus (Any One Module)	$595	$469
Target PlannerCalc gridsheet		$50
TLB Solomon I Acctg. System (MDBS based)	$2595	$2200
TLB Solomon Series II Job Cost Acctg.	$3495	$3000
Vector 'VPS' Series (MEM3, EPL2, etc.)	$1585	$1250
Vector 'CONECT' Communications Software		$150
Vector CP/M 2.5 128K Upgrade (w/64K RAM card)		$895

(much more available - please call)

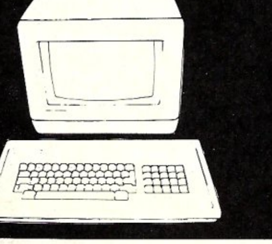
S100 & MultiBus Circuit Cards - 10% to 20% off

IMB offers the **FINEST SELECTION** and **BEST VALUES** in computers, peripherals and software, for the discriminating buyer. Our affiliate, Budget InfoSystems, is an 'Authorized Distributor' for many product lines and offers 'Full Service' for each - **COMPLETE WARRANTY PROTECTION IS ALWAYS ASSURED!**

IMB specializes in service to **FOREIGN, PROFESSIONAL, MILITARY, GOVERNMENTAL, INSTITUTIONAL, and O.E.M.** markets! Call for details regarding quantity discounts and low cost leasing plans.

IMB values all of its customers, but we must encourage the untutored novice to purchase from a local *'Authorized Dealer'*, to preserve product integrity. Feel free to contact our office if no local dealer is available. We must insist that 'Turn-key Systems' be purchased through our 'Full Service' associate, **Budget InfoSystems**, to assure proper customer support.

TERMS; PREPAYMENT **CONTACT;** Scott Secor, Gen'l. Mgr.
F.O.B.: MPLS MN **DELIVERY:** Stock to 4 wks. A.R.O.



International Microcomputer Brokers
607 NE Highway Ten—Jefferson Center
(across from NorthTown Mall)
Blaine, MN 55434
(612) 780-5361 -or- 786-5545
Hours: Daily 10AM to 6PM CST

CIRCLE 39 ON READER SERVICE CARD

voltage. Most EEPROM's are not pin-compatible with the older EPROM's and require different programming signals. Newer EEPROM's, to be available from Hitachi (48016) and General Instruments (5716) in the second half of 1982 are pin- and programming-compatible with the 2716.

EPROM programmers must be able to supply the precise voltages and timings required by the EPROM's they program. Since different types of EPROM's require different programming techniques, the greater the number of types of EPROM's a programmer can program, the more complex the programmer's background must be.

Industrial programmers such as those available from Pro-Log and Data I/O can program a vast array of EPROM's and PROM's. They are based on microprocessors which are programmed with the various EPROM programming requirements. They also cost several thousand dollars.

Our microcomputers are a good basis for programming EPROM's. They can be programmed for the precise timing required by several different parts. All that is needed is the proper connections to the EPROM and the necessary programming voltages.

Several S-100 boards are available which allow a system to program EPROM's. Most can only program one or two types of EPROM. I felt that I needed more flexibility than that because of the consulting work that I do. One EPROM type cannot cover all applications.

The Cer-Tek UNIPROM

The UNIPROM, a new board from Cer-Tek (6020 Doniphan Drive, El Paso, TX 79932) can program a wide range of devices. With software available from Cer-Tek, the UNIPROM can program the following devices:

2704, 2708, 2508, 2758, 2516, 2716, 2532, 2732, 8755, 2564

This list represents a range of EPROM capacity from 512 bytes to 8192 bytes. The 8755 is a combination ROM and I/O chip made by Intel.

The reason that the UNIPROM has this flexibility is that most of the programming characteristics are determined in software. Ten switches on the UNIPROM board route board signals to a 24-pin zero-insertion-force (ZIF) programming socket. These switches allow the UNIPROM to accomodate the different EPROM pinouts. The on-board ZIF socket can accomodate all the EPROM's listed above *except* the three-supply TMS2716, the Intel 2732, and the 2564. These three devices will be supported by a programming console which attaches to the UNIPROM with a cable. You may also wire cable adapters for these devices. The UNIPROM manuals show you how.

The TMS2716 requires three power supplies, unlike the Intel 2716, so Cer-Tek chose to support the more popular single-supply part on the board. The Intel 2732 has a different pin-out than the TI 2532. Cer-Tek decided that they could only support one pin-out with the on-board ZIF socket and chose the TMS2532 as the more popular device. The 2564 is supplied in a 28-pin package and simply won't fit into the on-board programming socket. These devices *are* supported in the disk-based software.

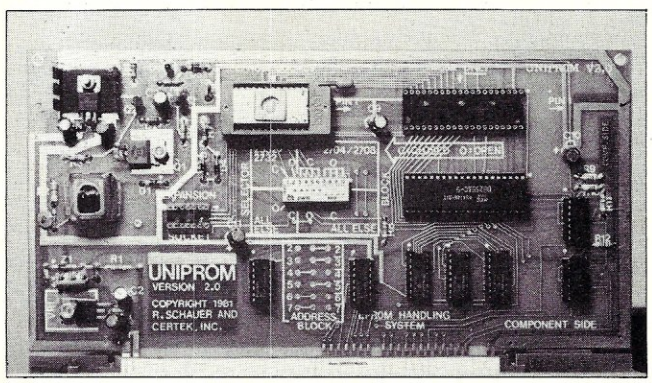
All of the signals routed to the EPROM are controlled through an 8255A Programmable Peripheral Interface (PPI). This chip has three eight-bit parallel ports which are used to drive the address and data pins of the EPROM. One bit of one of the PPI ports is used to turn the programming voltage on and off. A second bit is used to drive the Chip Select. Eight bits drive the data lines. This leaves 14 bits for address bits accomodating EPROM sizes up to 16K.

One key feature of the UNIPROM is that it is I/O mapped instead of memory mapped. The UNIPROM takes up only four I/O addresses. It is preset at the factory to reside at locations D0 through D3 (hex) but can be relocated by cutting some traces and soldering jumpers.

This board can be left in the system since it isn't likely to conflict with other boards. Many S-100 EPROM programmers place the EPROM to be programmed in the memory space of the computer, meaning that 16K of memory space are lost to the programmer. Usually, you cannot afford to leave a board like that in your system—but the UNIPROM does not have this problem.

Besides the PPI and the circuits needed to interface it to the S-100 bus, there is a DC-DC converter on the UNIPROM board which generates the 24.5 volt programming voltage from 12 volts. That is all there is to the UNIPROM. The board is an elegant, simple approach to EPROM programming.

Cer-Tek charges $199 for the assembled and tested UNIPROM board with manual. An EPROM Programming System manual explains the theory behind the UNIPROM, how to use it and includes schematics and explanations of how the hardware works.



The UNIPROM EPROM programming board for S-100 machines. In the center is the dip switch for setting the EPROM type. At the top are the 24-pin ZIF socket for the EPROM's and a 40-pin socket for 8755 EPROM and I/O combination chips.

UNIPROM Software

Also included in this manual is a source listing for the software required to control the UNIPROM. This software may be purchased for $55 on a 2716 EPROM. The software is written to load and execute from location 100 (hex), the start of the CP/M transient program area (TPA). You can also purchase software reassembled to run at other locations on EPROM for $80.

The EPROM-based software will run on 8080, 8085 and Z80 processors and can be installed in your computer two ways. If you have a socket in your system that can accomodate a 2716 (the five-volt kind), you may plug the EPROM in and use a monitor program such as CP/M's DDT to move the code from wherever the EPROM is located to location 100 whenever you need it. This method has the disadvantage of using up 2048 bytes of your computer's address space.

Cer-Tek has a nice solution to this waste of address space. You can load the UNIPROM software through the UNIPROM board using a short routine you key in. The routine will read the EPROM placed in the programming socket and load the code starting at the proper location.

I did not purchase the EPROM version of the UNIPROM software because a disk version of the software is available which has more capability for less money. This software is written for the CDOS and CP/M operating systems and costs $38. Included is a manual with a source listing. There is also a source file on the disk, intended to be assembled by the SD Systems Z80 assembler.

The disk software is available on 8" single-sided, single-density CP/M or CDOS disks, 5.25" CDOS disks and 5.25" North Star single-sided, single-density CP/M disks. The disk version of the UNIPROM software will run on 8080, 8085 and Z80 processors. I bought the North Star version which ran immediately. All of the EPROM's mentioned above are supported by the disk-based version of the software. The EPROM-based software does not support programming of 2564's and three-supply Texas Instruments 27616's.

UNIPROM software commands include:

B - Burn EPROM from memory image
D - Display memory
F - File name specifier for disk I/O
L - Load a disk file into memory
M - Move a block of memory
P - Program (change) RAM memory
R - Read an EPROM from UNIPROM to memory
S - Save memory to a disk file
T - Change EPROM type
V - Verify (compare) two blocks of memory

All commands are available in the disk version, as is a command menu which is obtained by typing a question mark. The EPROM version does not have the disk commands F, L or S since it is designed to be independent of a disk operating system. These commands can be replaced with others available from the disk operating software of your system. If you have a tape-based system, your tape commands will do nicely.

Other Accessories

Unfortunately, the programmer and the software don't quite prepare you to program EPROM's. There are two other accessories I feel you will need to take full advantage of the UNIPROM. The programming socket is a bit hard to get at when the board is in the system. I bought a Mullen S-100 board extender to cure this.

If you don't buy an extender, you may have to plug the EPROM into the UNIPROM before installing the board in your computer. Since you should always install the board when the power is off, you will be turning the computer on with the EPROM in place. That is a bad idea. Cer-Tek says that the programming voltage may come on at power-up. This could damage the EPROM depending on the state of the other signals to the EPROM. It could also program a location in the EPROM with bad data.

Another way to solve this problem is to build an extension cable that extends the programming socket. This way, you can put the UNIPROM in the computer, route the cable through a convenient opening in the back, and replace the computer's cover. This is also what the programming consoles from Cer-Tek will do for you, when they are available.

The Programmer Giveth/The Eraser Taketh Away

Unless you are very rich and don't mind throwing out EPROM's after one programming cycle, you will eventually need to erase some of the EPROM's that you program. One way to do this is to leave the EPROM's in the sun for a week or two. Intel says this will erase them. A faster method is to purchase an EPROM eraser. The least expensive eraser I could find was the U/V-1 which is made by LS Engineering (Canoga Park, CA). It is sold by Jade Computer Products (4901 W. Rosecrans, Hawthorne, CA, 90250) for $39.95. Jade's part number is XME-3200.

The U/V-1 came with no instructions, and it took me a half hour to figure out how to turn it on. I kept pushing the switch and nothing would happen. After a few minutes with an ohm meter and an old article on building EPROM erasers, I finally figured it out. To save you some time, I'll tell you how to start it up. A push button on the side of the U/V-1 is both an on/off switch and a starter. To turn the lamp on, push and hold the switch in until you can see a glow. Then release the switch and the light will stay on. It's always the simple things that get you!

Using the UNIPROM

After all this, we are finally ready to program some EPROM's. The first order of business is to set those ten switches on the board. Cer-Tek's manuals are good, but they are rather vague about setting the switches. The switches are grouped into two sets, one with two switches and the other with eight. The smaller set differentiates between 2532/2732's and all other EPROM's. The larger set differentiates between 2704/2708's and all other EPROM's.

The problem was that several switches are marked "O" and the others are marked "C". The markings were not explained in the manual. Some simple-minded observation of the circuit board showed a large marking stating that "O" stands for "open" and "C" is for "closed." (I told you it's the simple things that get you.) I feel Cer-Tek needs to improve this part of the manual. If the switches are set incorrectly, the EPROM may be damaged.

After setting the switches, plug the board into your extender and turn the computer on. Bring up the software and you are ready for a "burn." Before you install the EPROM for programming however; *make sure the "VPP ON!" LED is off!* If the LED is on, the programming voltage is switched on and inserting the EPROM into the live socket may damage it. The LED should be off when the programming software is initialized. If it is on, something is wrong with the software. Check that the board is located at the address the software believes it to be.

Cer-Tek's UNIPROM came out of the box, plugged into my system and worked the first time. The software is very easy to use and seems bug-free. If you are considering an EPROM programmer, the UNIPROM deserves serious consideration.

My First Burn

I tested the UNIPROM with 2758 and 2716 EPROM's. Those are the devices I use most of the time. After setting the switches on the UNIPROM, I booted the software, told the program that my system ran at 4 MHz, and that I would be programming 2758's. I placed the 2758 in the ZIF socket and requested a burn using the information at F000 (hex). That is where the terminal emulation software resides in my system.

In a little over 52 seconds, the EPROM had been checked for complete erasure, programmed and verified. The theoretical minimum programming time for a 2758 is 51.2 seconds. One interesting side note about the UNIPROM is that it sings while it is programming. Varying loads on the 25-volt switching supply during programming cause the step-up transformer to "chirp."

Next I tried a 2716. This merely required that I use the T(ype) command to specify the part. Again, I used the software at F000 (hex) for the source. The EPROM was checked, programmed and verified in a little less than 103 seconds. The theoretical minimum time required to program a 2716 is 102.4 seconds.

Finally, I found an old 2708 in my parts box that I had received as part of the IEEE MicroMouse contest. Since the UNIPROM can also program 2708's, I decided to try programming this part. After resetting the board switches for the 2708 and setting the EPROM type with the "T" command, I started the burn.

The first thing I noticed was the sound coming from the board was different. While 2716's and 2758's require 50 millisecond programming pulses, the

2708 requires pulses between 100 microseconds and 1 millisecond. A program pulse has to be applied to each location until 100 milliseconds worth of pulses have been applied to each location. The shorter pulses are barely audible. The theoretical minimum programming time for a 2708 is 102.4 seconds.

After 201 seconds, the terminal beeped and "verify error" was displayed. "Oh no," I thought, "problems." After reading the UNIPROM documentation carefully, one of three explanations was possible. One, the board might not be able to program 2708's. This wasn't likely. Two, the EPROM might have only been partially erased and "phantom" bits might have appeared during the programming. Three, the EPROM might not be any good. How much trust can you put in a part that you got for free in a mouse contest?

I temporarily ignored the first possibility and tried to verify the second by erasing the EPROM for an hour. Then I carefully placed an opaque label over the erase window on the EPROM. The UNIPROM manual states that stray light on the EPROM during programming might cause a faulty burn. Another programming attempt reproduced the first results and "verify error" sadly stared back at me from the screen.

"Time for possibility number three," I decided. Checking with the local electronics shops, I found another 2708, purchased it and fired up the UNIPROM once again. After a very long 201 seconds, "completed" was displayed. A perfect burn!

Further Software Explorations

Experimenting further with the disk-based software was very enlightening. The software is really a very good monitor for loading, patching and saving binary files. All commands are self-prompting. This differs from CP/M's DDT which requires you to remember command syntax. The only thing that takes some memory with the UNIPROM software is that spaces are used for delimiters instead of carriage returns.

One thing I did not like about the software is that the common "control P" function in many CP/M utilities is missing. This command turns on the printer port so that anything displayed on the console is also copied to the printer. I think this would be a useful feature to use in conjunction with the D(ump) command.

Another small problem with the software is error checking. When given an illegal response to the question of system clock speed, the program accepts the bogus input and merrily continues. Also, when illegal characters are typed during input, they cause the command to be immediately aborted before you can backspace and fix your mistake.

Conclusions

I am quite impressed with Cer-Tek's UNIPROM. It came out of the box, plugged into my system and worked the first time. The software is very easy to use and seems to be bug-free. The people at Cer-Tek have been most responsive to me and I feel they have a real committment to supporting this product. If you are considering an EPROM programmer, the UNIPROM deserves serious consideration. ■

CIRCLE 105 ON READER SERVICE CARD

CP/M V2.2 Patches

by Technical Support Group
Digital Research

MOVCPM.COM

Error Description(Patch 01, 3/31/81)

The following modification affects only CP/M systems that use the optional blocking and deblocking algorithms listed in Appendix G of the CP/M Alteration Guide. When updating a file under systems using the algorithms with no data added to the file, the last block of updated records is not written to that file. Contact Digital Research or your CP/M distributor if you are not certain that this patch applies to your system.

Patch Procedure:

Make sure that you have a back-up copy of MOVCPM. COM before using DDT to make the following changes. Use the Assemble command (A) and the Set command (S). After making the changes, return to the console command processor using the GO command and save the modified memory image on disk. Be sure to update the memory image on tracks 0 and 1 by executing the new MOVCPM program as described in the CP/M Alteration Guide and by integrating your customized I/O system.

```
A>ddt movcpm.com
  DDT VERS 2.0
  NEXT PC
  2700 0100
-alcd2
lCD2 nop                 (Instructions were
lCD3 nop                    DCR C
lCD4 lxi h,0                DCR C
lCD7                        JNZ 12DF)

-G0
                         (Number of pages to save
                          is determined from value
                          displayed under next.)
A > save 38 movcpm.com
```

Remember to install this patch to all CP/M systems that use the blocking/deblocking algorithms listed in Appendix G of the CP/M Alteration Guide.

Error Description(Patch 01-DD, 3/31/81):

The following modification affects only CP/M systems that use the cptional blocking and deblocking algorithms listed in Appendix G of the CP/M Alteration Guide. When updating a file under systems using the algorithms with no data added to the file, the last block of updated records is not written to that file. Contact Digital Research or your CP/M distributor if you are not certain that this patch applies to your system.

Patch Procedure:

Make sure you have a back-up copy of MOVCPM.COM before using DDT to make the following changes. Use the Assemble command (A) and the Set command (S). After making the changes, return to the console command processor using the GO command and save the modified memory image on disk. Be sure to update the memory image on tracks 0 and 1 by executing the new MOVCPM program as described in the CP/M Alteration Guide and by integrating your customized I/O system.

```
A>ddt movcpm.com
  DDT VERS 2.0
  NEXT PC
  2800 0100
-alcd2
lCD2 nop                 (Instructions were
lCD3 nop                    DCR C
lCD4 lxi h,0                DCR C
lCD7                        JNZ 12DF)

-G0
                         (Number of pages to save
                          is determined from value
                          displayed under next.)
save 39 movcpm.com
```

Remember to install this patch to all CP/M systems that use the blocking/deblocking algorithms listed in Appendix G of the CP/M Alteration Guide.

Error Description(Patch 01-4200H, 3/31/81)

The following modification affects only CP/M systems that use the optional blocking and deblocking algorithms listed in Appendix G of the CP/M Alteration Guide. When updating a file under systems using the algorithms with no data added to the file, the last block of updated records is not written to that file. Contact Digital Research or your CP/M distributor if you are not certain that this patch applies to your system.

Patch Procedure:

Make sure you have a back-up copy of MOVCPM.COM before using DDT to make the following changes. Use the Assemble command (A) and the Set command (S). After making the changes, return to the console command processor using the "G" command and save the modified memory image on disk. Be sure to update the memory image on tracks 0 and 1 by executing the new MOVCPM program as described in the CP/M Alteration Guide and by integrating your customized I/O system.

```
A>ddt movcpm.com
  DDT VERS 2.0
  NEXT PC
  6900 4300
-a5ED2
5ED2 nop                        (Instructions were
5ED3 nop                           DCR C
5ED4 lxi h,0                       DCR C
5ED7                               JNZ 12DF)


-G4200
                                (Number of pages to save
                                 is determined from value
                                 displayed under next.)
A > save 38 movcpm.com
```

Remember to install this patch to all CP/M systems that use the blocking/deblocking algorithms listed in Appendix G of the CP/M Alteration Guide

ASM.COM

Error Description (Patch 02, 3/16/81):

ASM occasionally generates an erroneous phase error when the identifier in a SET statement appears within an expression from another statement.

For example:

```
X     SET     1
Y     EQU     X
      END
```

This patch also applies to CP/M V1.4

Patch Procedure:

Make sure you have a back-up copy of ASM.COM before using DDT to make the following changes.

```
A>ddt asm.com
DDT VERS 2.2
NEXT  PC
2100 0100
-lldad
  lDAD  CALL 1352
  lDB0  CPI  05
  lDB2  CNZ  20DD
-aldad
lDAD  call lb8d
lDB0  .
-llb8d
  lB8D  NOP
  lB8E  NOP
  lB8F  NOP
-alb8d
lB8D  call 1352
lB90  ora a
lB91  jz ldb5
lB94  ret
lB95  .
-^C
A>save 32 asm.com
```

SUBMIT.COM

Error Description: (Patch 03, 6/27/80)

SUBMIT does not accept control characters in .SUB files. SUBMIT recognizes certain control characters when preceded by an up arrow. SUBMIT should interpret the two characters ^z as "control Z."

Patch Procedure:

Make sure you have a back-up copy of SUBMIT.COM before using DDT to make the following changes.

```
A>ddt submit.com
DDT V2.2
NEXT PC
0600 0100
-10441
  0441  SUI   61
  0443  STA   0E7D
  0446  MOV   C,A
  0447  MVI   A,19
  0449  CMP   C
  044A  JNC   0456
  044D  LXI   B,019D
  0450  CALL  02A7
  0453  JMP   045E
  0456  LDA   0E7D
  0459  INR   A
-s442
0442 61 41
0443 32 .
-g0

A>save 5 submit.com
```

Error Description (Patch 04, 6/27/81)

If drive A is not the default drive when running the SUBMIT program, the $$$.sub file is created on the currently logged in disk. Therefore, you can not run a SUBMIT job from any drive other than A. After making the following changes, the system will always create the $$$ .sub file on drive A.

Patch Procedure:

Make sure you have a back-up copy of SUBMIT.COM before using DDT to make the following changes.

```
A>ddt submit.com
DDT V2.2
NEXT PC
0600 0100
-d5bb
05BB 00 24 24 24 20 .$$$
05C0 20 20 20 20 53 55 42 00 00 00 1A 1A 1A 1A 1A 1A   SUB...
05D0 1A 1A 1A 1A 1A 1A 1A 1A 1A 1A 1A 1A 1A 1A 1A 1A ........

-
-s5bb
05BB 00 1
05BC 24 .
-g0
A>save 5 submit.com
```

PIP.COM

Error Description (Patch 05, 8/28/81):

A problem occurs with the PIP Start and Quit options when the Start and Quit strings are the same length.

7 Good reasons why you should subscribe to *Creative Computing.*

It's the Number One magazine of computer applications and software!

There's one place you can always be sure of learning more about microcomputer software and applications: *Creative Computing.*

Every month *Creative Computing* provides you with a continuing education on everything related to microcomputers and computer equipment. Useful articles, "how to" tutorials, exciting new applications, games and "no holds barred" reviews of the latest software and equipment make up a major part of *Creative Computing*'s editorial content.

We give you probing features on programming breakthroughs and important news. Plus in-depth articles on elementary, intermediate and advanced software and applications topics—to help you develop your knowledge and skills, save hundreds (perhaps thousands) of dollars in unneeded software, discover uses for your personal computer that you might never have considered. Articles that increase your overall "computer consciousness." Here's how:

1 *Creative Computing* gives you things to actually do with a computer.

Just owning a computer isn't enough. You've got to know what to do with it. That's why applications are our primary focus. Text editing, animation, graphics, business simulations, data base and file systems, music synthesis, control of household devices, communications, games—some of the applications and software you'll learn about in *Creative Computing.*

2 *Creative Computing* discusses business applications in simple, nontechnical language.

If you're a business person who needs to know about the latest developments in word processing and office applications, turn to *Creative Computing.* We clarify such business applications as investment analysis, futures evaluations, data base management, mailing list programs, text editing, word processing and simulations. And all the software available for business people.

3 *Creative Computing* helps you decide which computer equipment is best for you.

Our tough, no-nonsense equipment profiles arm you with the facts before you walk into a computer store. You'll know the right questions to ask and how to cut through the jargon and sales hype. We give you authoritative guidance in deciding what you need, what you don't need—and what's right for you and your pocketbook.

4 *Creative Computing* covers computer education in depth.

We started out as a computer education publication, and we're still committed to the educational community. We regularly carry articles on designing educational software, evaluating educational software, teaching concepts and terminology in computer education, text editing applications for literature and computer simulations in the classroom—plus a great deal more.

5 *Creative Computing* brings you hours of mind-expanding game entertainment.

We've got a soft spot for the computer game addict—and computer game software. We know you want to understand more about the new computer games flooding the market: which ones are easiest to learn? Require the most skill? Offer the most surprises? Give you the best graphics? Provide the most challenge? Contain a new twist? *Creative Computing* brings you the answers.

6 *Creative Computing* features the state of the art.

Columns on the most popular personal computers, a "software legal forum," letters to the editor. Reviews of books, games, organizations, dealers and events. Fascinating interviews with leading innovators, equipment designers, program developers and game inventors—men and women who'll give you a real glimpse of the future!

7 Our price is right.

By subscribing to *Creative Computing* now, you can save as much as 33% off the full subscription price. To learn elsewhere what you'll learn from *Creative Computing*, you might spend hundreds of dollars in course fees and books. Then you'd have to winnow out what you could use from all that you'd learned. But *Creative Computing* does that for you, so you'll have time to enjoy your own computing interests. And that saving of time makes this offer very inexpensive indeed.

Join over 150,000 *Creative Computing* readers by subscribing today! Just use the coupon at right.

SAVE UP TO 33%!

Creative Computing · P.O. Box 5214 · Boulder, Colorado 80322

YES! Send me *Creative Computing* for:

☐ One year (12 issues) for $19.97—I save 20%!
☐ Two years (24 issues) for $36.97—I save 26%!
☐ Three years (36 issues) for $49.97—I save 33%!

Savings based on full one-year subscription price of $24.97.

Check one: ☐ Payment enclosed. ☐ Bill me later.

Mr. / Mrs. / Ms.____________________
(please print full name) 8H096

Address____________________ Apt._____

City____________________

State______________ Zip______________

Offer valid in U.S. and possessions only. Please allow 30 to 60 days for delivery of first issue.

CP/M Patches, continued...

Patch Procedure:

Make sure you have a back-up copy of PIP.COM before using DDT to make the following changes.

```
A>ddt pip.com
DDT V2.2
NEXT PC
1E00 0100
-l1168
  1168  LDA   1F62
  116B  STA   1DF7
  116E  LXI   H,1F62
  1171  MVI   M,00
  1173  LDA   1DF9
  1176  INR   A
  1177  STA   1DF8
-a1168
1168  lxi h,1f62
116B  mov a,m
116C  sta 1df7
116F  mvi m,0
1171  lxi h,1df9
1174  mov a,m
1175  mvi m,0
1177  inr a
1178  dcx h
1179  mov m,a
117A  .
-g0
A>save 29 pip.com
```

Error Description (Patch 06, 11/10/81):

A problem occurs with the PIP object file transfer options when copying file to file.

Patch Procedure:

Make sure you have a back-up copy of PIP.COM before using DDT to make the following changes.

```
A>ddt pip.com
DDT V2.2
NEXT PC
1E00 0100
-l0713
  0713  LDA   1F5E
  0716  LXI   H,1E04
  0719  ORA   M
-a0713
0713  lda 1e04
0716  lxi h,1f5e
0719  .
-l1099
  1099  LDA   1E04
  109C  RAR
  109D  JNC   10B2
-a1099
1099  lda 1f5e
109C  .
-l1640
  1640  LDA   1E04
  1643  RAR
  1644  JNC   1652
-a1640
1640  lda  1f5e
1643  .
-g0
A>save 29 pip.com
```

Error Description (Patch 07, 1/21/82):

When using the SUBMIT and XSUB utilities to execute multiple PIP commands from a submit file, it is not possible to exit from PIP automatically. This is because the SUBMIT utility does not accept lines with only a carriage return.

This patch modifies PIP so that a period can be used to exit from PIP instead of a carriage return. In the submit file, place a single period (".") on a line by itself after the last PIP command to be executed.

Patch Procedure:

Make a back-up copy of PIP.COM before making any changes. The program DDT is required to make the changes. The changes are made by the following sequence of commands.

```
0A>DDT PIP.COM
DDT VERS 2.2
NEXT  PC
1E00 0100
-L54F
  054F  CPI 00
  0551  JNZ 055E
  0554  LHLD 1DFC
   . . .
-A54F
  054F  CPI 2
  0551  JNC 55E
  0554  .
-G0

A>SAVE 29 PIP.COM
```

Error Description (Patch 08, 1/21/82)

When using PIP to copy to the PRN logical device, the LPT physical device is automatically selected. This patch disables the selection of the LPT device and allows the PRN logical device to be used without affecting the current IOBYTE setting.

Patch Procedure:

Make a back-up copy of PIP.COM before making any changes. The program DDT is required to make the changes. The changes are made by the following sequence of commands.

```
0A>DDT PIP.COM
DDT VERS 2.2
NEXT  PC
1E00 0100
-LC66
  0C66  LXI H,0003
  0C69  MVI M,80
  0C6B  JMP 0C71
   . . .
-AC69
  0C69  NOP
  0C6A  NOP
  0C6B  .
-G0

A>SAVE 29 PIP.COM
```

DEBLOCK.ASM

Error Description (Patch 09, 2/11/82)

The following modification affects only CP/M systems that use the optional blocking and deblocking algorithms listed in Appendix G of the CP/M Alteration Guide. The sector blocking and deblocking algorithms provided in the guide work improperly in certain circumstances.

Patch Procedure:

Use the CP/M text editor to insert the following changes:

Following the comment on line 111 of Appendix G:

```
"read the selected CP/M sector"
```

Insert the following two lines:

```
xra     a           ;accum = 0
sta     unacnt      ;unacnt = 0
```

The next source lines remain as shown:

```
mvi     a,1
sta     readop          ;read operation
```

Insert the following code in your BIOS Home routine:

```
home:
     lda     hstwrt        ;check for pending write
     ora     a
     jnz     homed
     sta     hstact        ;clear host active flag
homed:
```

Continue with the rest of the home routine. ■

CP/M V2.2 Application Notes

by Technical Support Group
Digital Research

The CCP Auto-Load Feature
(AN-1, 6/25/81)

Applicable products and version numbers: CP/M V1.4, V2.0, and V2.2
Program: CCP (Console Command Processor)

Normally, you interact with the CP/M CCP following the sign-on prompt. Utilizing the CCP Auto Load feature however, CP/M will execute an intitial program immediately after loading the operating system.

Under normal operation, the CCP receives control from the BIOS upon a warm or cold boot. The beginning of the CCP module contains a two element jump vector and a command line that takes the following form.

```
CCP:    JMP    CCPSTART          ;START THE CONSOLE PROCESSOR
        JMP    CCPCLEAR          ;CLEAR THE INITIAL COMMAND
        DB     127               ;MAXIMUM COMMAND LENGTH
CL:     DB     0                 ;COMMAND LENGTH
        DB     '        '        ;8 BLANK CHARACTERS
        DB     '        '        ;       "
        DB     'COPYRIGHT...'    ;COPYRIGHT NOTICE
```

If control is transferred to location CCP (address 3400H in a 20K CP/M), the console processor examines the command length at location CL (3407H in a 20K CP/M). If the command length byte is zero, then you receive the sign-on prompt and the CCP waits for console input. If the command length byte is not zero, the CCP assumes an initial command has already been entered. The CCP will execute the command on each cold or warm boot if control is transferred to location CCP. However, if control is transferred to location CCP+3 (JMP CCPCLEAR), the initial command is cleared and the program enters the CCP at the command line level displaying the default drive prompt.

Specify the length of the initial command using a non-zero CL byte. The command must be followed by a terminating zero. CP/M will execute the command following that CL byte. Although only 16 blank spaces are provided, you can move the Digital Research copyright notice for more spaces.

You can initialize the command line of the CCP on the operating system tracks or in the relocatable image within the MOVCPM data area. The initial command will execute in distributed or reconfigured CP/M systems.

In MOVCPM.COM or following SYSGEN and SAVE commands, the CP/M memory image is saved above the cold boot loader code starting at location (980H). If the system boot routines require more than 80H bytes, the CCP code may begin at location 0A00H.

Modifying MOVCPM.COM is similar to modifying the the CCP. The difference is that the CCP starts at location 0980HH or 0A00H for systems requiring more than 80H bytes after DDT reads the CCP into memory.

The following procedure uses DDT to modify the CCP, allowing execution of the initial command "DIR" after each warm or cold boot.

```
A>movcpm *.*

CONSTRUCTING 64K CP/M Vers. 2.2
READY FOR "SYSGEN" OR
"SAVE 35 CPM64.COM

A>ddt cpm64.com
DDT VERS 2.2
NEXT PC
```

```
2400 0100
-d980
0980 C3 5C E7 C3 58 E7 7F 00 20 20 20 20 20 20 20 20 ...X...
0990 20 20 20 20 20 20 20 20 43 4F 50 59 52 49 47 48         COPYRIGH
09A0 54 20 28 43 29 20 31 39 37 39 2C 20 44 49 47 49 T (C) 1979, DIGI
09B0 54 41 4C 20 52 45 53 45 41 52 43 48 20 20 00 00 TAL RESEARCH  ..
09C0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ................
-s987
0987 00 3
0988 20 44
0989 20 49
098A 20 52
098B 20 0
098C 20 .
-d980
0980 C3 5C E7 C3 58 E7 7F 03 44 49 52 00 20 20 20 20 ...X...DIR.
0990 20 20 20 20 20 20 20 20 43 4F 50 59 52 49 47 48         COPYRIGH
09A0 54 20 28 43 29 20 31 39 37 39 2C 20 44 49 47 49 T (C) 1979, DIGI
09B0 54 41 4C 20 52 45 53 45 41 52 43 48 20 20 00 00 TAL RESEARCH  ..
09C0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ................
-g0
A>sysgen
SYSGEN VER 2.0
SOURCE DRIVE NAME (OR RETURN TO SKIP)
DESTINATION DRIVE NAME (OR RETURN TO REBOOT)b
DESTINATION ON B, THEN TYPE RETURN
FUNCTION COMPLETE
DESTINATION DRIVE NAME (OR RETURN TO REBOOT)
```

Reversing The Backspace And Rubout Key Functions And Making Rubout Identical To Backspace (AN-2, 6/25/81)

Applicable products and version numbers: CP/M V2.1 and V2.2
Program: BDOS

In the following code segment procedures, addresses given are hexadecimal offsets from the base of the CP/M system. The CCP is normally located at 980H but may be located at A00H if a two sector boot is used.

You can assemble the patch for your size memory system. The cpmbase will equal the BDOS entry point address at locations 6 and 7 in the base page of memory minus 806H. Be careful because this entry point address is changed when DDT or SID is loaded. Under DDT or SID you must follow the jump at location 5 until an address is found with a significant digit of at least 6. In the following example, the cpmbase would be E506H-806H or DD00H.

```
0005 JMP CD00
CD00 JMP D3A4
D3A4 XTHL
D3A5 SHLD E452
D3A8 XTHL
D3A9 JMP E506
```

Procedure to reverse the backspace and rubout key functions

Patch into the SYSGEN or MOVCPM image exactly as you would patch-in a new version of your BIOS using the DDT "i" command followed by the DDT "r" command. Use the same offset as your custom BIOS and install the following code.

```
cpmbase equ ?   ;subtrack 806h from address at location 6

        org  cpmbase + 0A02h

        cpi  7fh ;was cpi 08h

        org  cpmbase + 0A16h

        cpi  08h ;was cpi 7fh
```

Alternatively, you can install the above procedure directly into MOVCPM if you have MOVCPM.COM on your system disk. The patch will be applied automatically to any size system that you build using MOVCPM. Make sure you have a back-up copy of MOVCPM.COM before using DDT to make the following changes.

```
A>ddt movcpm.com
DDT VERS 2.2
NEXT  PC
2700 0100
-l1402
  1402  CPI   08
  1404  JNZ   0A16
  1407  MOV   A,B
  1408  ORA   A
  1409  JZ    09EF
  140C  DCR   B
  140D  LDA   0B0C
  1410  STA   0B0A
  1413  JMP   0A70
  1416  CPI   7F
  1418  JNZ   0A26
-s1403
1403 08 7f
1404 C2 .
-s1417
1417 7f 8
1418 C2 .
-g0

A>save 38 movcpm1.com
```

The new program MOVCPMI.COM is used in place of MOVCPM.COM. The backspace and rubout key functions will be reversed for any CP/M system generated with MOVCPMI.COM.

Procedure to make RUBOUT identical to BACKSPACE

Before installing this patch, the code at cpmbase + 0AIBh should read:

```
mov      a,b
ora      a
jz       cpmbase + 09EFh
mov      a,m
dcr      b
dcx      h
jmp      cpmbase + 0AA9h
```

Patch into the SYSGEN or MOVCPM image exactly as you would patch-in a new version of your BIOS using the DDT "i" command followed by the DDT "r" command. Use the same offset as your custom BIOS and install the following code.

```
cpmbase equ       ?
;
;
          org     cpmbase + 0A1Bh
;
          mvi     a,8h
          jmp     cpmbase + 0A07h
          end
```

Alternatively, the above procedure can be installed directly into MOVCPM if you have MOVCPM.COM on your systems disk. The patch will be installed automatically in any size system that you build using MOVCPM. Make sure you have a back-up copy of MOVCPM.COM before using DDT to make the following changes.

```
A>ddt movcpm.com
DDT VERS 2.2
NEXT  PC
2700 0100
-l141b
  141B  MOV  A,B
  141C  ORA  A
  141D  JZ   09EF
  1420  MOV  A,M
  1421  DCR  B
  . . .

-a141b
141B mvi a,8
141D jmp a07
1420
-g0

A>save 38 movcpm1.com
```

The new program MOVCPM1.COM is used in place of MOVCPM.COM. The rubout and backspace key functions will be identical in any CP/M system generated with MOVCPM1.COM.

Sample BIOS For A Serial Printer Device (AN-3, 6/25/81)

Applicable products and version numbers: *CP[M V1.4, V2.0, V2.1 and V2.2*
Program: BIOS

The following code fragment will drive Diablo serial interface printers or other serial devices that use the X-ON/X-OFF protocol for synchronization. A device that uses this protocol receives data faster that it can print. The device transmits a control-S character when its buffer becomes full and a control-Q to receive more data after the buffer is emptied.

```
LIST$STAT EQU 00H
LIST$DATA EQU 01H
IN$MASK   EQU 02H
OUT$MASK  EQU 01H

LIST:
          CALL LISTST ! JZ LIST
          MOV A,C ! OUT LIST$DATA
          RET
LISTST
          ;return list status (0 if not ready, FF if ready)
          LXI H,LST$FLAG
          IN LIST$STAT ! ANI INS$MASK ! JZ NO$INPUT
          IN LIST$DATA ! ANI 7FH ! CPI 'Q'-'@' ! JNZ S?
          MVI M 0FFH
S?:       CPI 'S'-'@' ! JNZ NO$INPUT
          MVI M,0
NO$INPUT:
          IN LIST$STAT ! ANI OUT$MASK ! ANA M ! RZ
          ORI 255
          RET
LST$FLAG:
          DB      255      ;must be 255 initially.
```

BIOS Error Return Code Options (AN-4, 6/25/81)

Applicable products and version numbers: CP/M V2.2
Program: BIOS

Normally, CP/M responds only to a zero or non-zero value as the return code from the BIOS READ and WRITE entry points. If the value in register A is zero, CP/M assumes that the disk operation was completed successfully. If a non-zero value is in register A, the BDOS returns the message "BDOS ERR ON x: BAD SECTOR." You then have the option of typing <cr> to ignore the error or ctrl-C to abort.

This modification interjects three additional return codes for the BIOS READ and WRITE routines in register A as shown below.

0 - The disk read or write operation was successful
1 - Bad Sector-indicates permanent disk error
2 - Select Error - indicates the drive is not ready
3 - R/O - the disk is Read Only (used by WRITE)
4 - File R/O - (not normally used)

In the following code segment, addresses given are hexadecimal offsets from the base of the CP/M system. The CCP is normally located at 980H but may be located at A00H if a two sector boot is used.

You can assemble the patch for your size memory system. The cpmbase will equal the BDOS entry point address at locations 6 and 7 in the base page of memory minus 806H. Be careful because this entry point address is changed when DDT or SID is loaded. Under DDT or SID you must follow the jump at location 5 until an address is found with a least significant digit of 6. In the following example, the cpmbase would be E506H-806H or DD00H.

```
0005  JMP  CD00
CD00  JMP  D3A4
D3A4  XTHL
D3A5  SHLD E452
D3A8  XTHL
D3A9  JMP  E506
```

Patch into the SYSGEN or MOVCPM image exactly as you would patch-in a new version of your BIOS using the DDT "i" command followed by the DDT "r" command. Use the same offset as your custom BIOS.

Before installing this patch the code at the cpmbase + BBDH should read:

```
lxi     h,cpmbase +809H
jmp     cpmbase + B4AH
```

The above code is replaced by the following code.

```
cpmbase equu     ?
;
;
        org     cpmbase + BBDH
;
        lxi     h,cpmbase + 807H
        jmp     cpmbase + 83AH
        end
```

Alternatively, you can install the above procedure directly into MOVCPM if you have MOVCPM.COM on your system disk. The patch will be installed in any size system that you build using MOVCPM. Make sure you have a back-up copy of MOVCPM.COM before using DDT to install the following procedure.

```
A>ddt movcpm.com
DDT VERS 2.2
NEXT  PC
2700 0100
-115bd
  15BD  LXI   H,0809
  15C0  JMP   0B4A
  15C3  LHLD  15EA
  . . .

-a15bd
15BD lxi h,807
15C0 jmp 83a
15C3
-g0

A>save 38 movcpm1.com
```

The new program MOVCPM1.COM is used in place of MOVCPM.COM. Additional error return codes for the BIOS READ and WRITE routines are supported in any CP/M system generated with MOVCPM1.COM.

Improving The ^S Function (AN-5, 6/25/81)

Applicable products and version numbers: CP/M V2.2
Program: BDOS

The ^S function controls screen scrolling during CRT output. However, the system does not recognize ^S if another character is typed before it.

In the following code segment procedures, addresses given are hexadecimal offsets from the base of the CP/M system. The CCP is normally located at 980H but may be located at A00H if a two sector boot is used.

You can assemble the patch for your size memory system. The cpmbase will equal the BDOS entry point address at locations 6 and 7 in the base page of memory minus 806H. Be careful because this entry point address is changed when DDT or SID is loaded. Under DDT or SID you must follow the jump at location 5 until an address is found with a least significant digit of 6. In the following example, the cpmbase would be E506H-806H or DD00H.

```
0005  JMP   CD00
CD00  JMP   D3A4
D3A4  XTHL
D3A5  SHLD  E452
D3A8  XTHL
D3A9  JMP   E506
```

Patch into the SYSGEN or MOVCPM image exactly as you would patch-in a new version of your BIOS using the DDT "i" command followed by the DDT "r" command. Use the same offset as your custom BIOS. The call at cpmbase + 950H should be cpmbase + 923H before installing the following code.

```
cpmbase equ      ?
;
;
        org      cpmbase + 950h
;
        call     cpmbase + 92Ah
        end
```

Alternatively, you can install the above procedure directly into MOVCPM if you have MOVCPM.COM on your system disk. The patch will be applied automatically to any size system that you build using MOVCPM. Make sure you have a back-up copy of MOVCPM.COM before using DDT to make the following changes.

```
A>ddt movcpm.com
DDT VERS 2.2
NEXT  PC
2700 0100
-11350
  1350  CALL 0923
  1353  POP  B
  1354  PUSH B
  . . .

-a1350
1350 call 92a
1353 .
-g0

A>save 38 movcpm1.com
```

The new program MOVCPM1.COM is used in place of MOVCPM.COM. Any CP/M system generated with MOVCPM1.COM will have the improved ^S function.

Changing The Lines Per Page (AN-6, 6/25/81)

Applicable products and version numbers: CP/M V2.2
Program: ED.COM

This modification changes the number of lines scrolled by the "P" command in ED.COM from 23 to 14. Add 4200H to each address shown below for 4200H based systems. Make sure you have a back-up copy of ED.COM before using DDT to make the following changes.

```
A>ddt ed.com
DDT VERS 2.2
NEXT  PC
1B00 0100
-117da
  17DA  LXI  H,0017
  17DD  SHLD 1D1C
  17E0  RET
   .
   .
   .
-s17db
17DB 17 e
17DC 00 .
-^C
A>save 26 ed.com
```

Changing The Restart Number In DDT (AN-7, 6/25/81)

Applicable products and version numbers: CP/M V1.4, V2.0, V2.1, and V2.2
Program: DDT.COM

DDT uses RST 7 (machine instruction 0FFH) to set break points. To change the restart number, modify the three bytes indicated by "??" in the following procedure for a new restart instruction and location. The restart instruction uses the bit pattern 11XXX111 where XXX is the restart number you will use. (AFH is RST 1, B7H is RST 2, BFH is RST 3, etc.) The restart location is usually the restart number times 8. Do not use RST 0 because it is reserved for CP/M.

The following procedure applies to DDT supplied with CP/M V2.1 and V2.2 For V1.4 and V2.0 change the instructions at 19B and 19E to:

```
019B  sta  fe4
019E  sta  10ee
```

Make sure you have a back-up copy of DDT.COM before using DDT to make the following changes.

```
A>ddt ddt.com
DDT VERS 2.2
NEXT  PC
1400 0100
-1103
  103  JMP  013D
    .
    .
    .
-a103
0103  jmp  18b
-a18b
018B  lhld lec
018E  shld 8e7
0191  inx  h
0192  shld 8ed
0195  lda  leb
0198  sta  ad5
019B  sta  fea
019E  sta  10f4
01A1  jmp  13d
- slec
01EB ?? f7
01EC ?? 30
01ED ?? 00
01EE ?? .
-g0
A>save 19 ddt6.com
```

To change the restart number for DDT in the future, you have to modify only the three bytes 1EBH, 1ECH and 1EDH.

Nested Submit Files (AN-8, 6/25/81)

Applicable products and version numbers: CP/M V2.1 and V2.2
Program: SUBMIT.COM

The CP/M submit program allows another submit command to be embedded within a submit file. However, control does not return to the original submit file after executing the nested submit command. Use any standard editor to type the following procedure into a file named SUBPATCH.ASM.

```
;
;
subfcb: equ      5bbh
bdos:   equ      5
open:   equ      211h
;
        org      22dh          ;submit erase subroutine
```

Application Notes, continued...

```
;
opsl:   lda     subfcb+15       ;file open ok if ext not full
        ral
        rnc
        lxi     h,subfcb+12     ;try next extent
        inr     m
ops:    lxi     d,subfcb        ;open extent
        jmp     create
;
        org     25dh            ;submit create subroutine
create: call    open
        inr     a
        jnz     opsl            ;loop if open ok
        lxi     d,subfcb
        mvi     c,22
        call    bdos
        adi     1
        ret
;
;       the folloing code calls the above routines
;
        org     4feh
;
        call    ops             ;open the $$$.sub file
        jc      517h            ;jump if not opened ok
        lda     subfcb+15       ;set current record to end
        sta     subfcb+32
        jmp     51dh            ;jump if open ok
;
        org     subfcb
        db      1               ;force $$$.sub file to A:
;
        end
```

Assemble SUBPATCH.ASM to create the file SUB-PATCH.HEX. Then, use DDT to insert SUBPATCH.HEX into the SUBMIT.COM program as shown below.

```
A>ddt submit.com
DDT VERS 2.2
NEXT  PC
0600 0100
-isubpatch.hex
-r
-g0
A>save 5 submit.com
```

Configuring CP/M For Page Boundaries (AN-9, 9/29/81)

Applicable products and version numbers: CP/M V2.2
Program: MOVCPM.COM

Patch MOVCPM.COM to configure CP/M V2.2 for page boundaries (256 bytes) instead of kilobyte boundaries.

Make sure you have a back-up copy of MOVCPM.COM before using DDT to make the following changes. Changes are saved in a new file named PGMOV.COM. The first argument designates the size of the system in pages that PGMOV is to construct. The first argument is optional but must range between 64 and 255 (decimal) if used.

```
A>ddt movcpm.com
DDT VERS 2.2
NEXT  PC
2700 0100
-l165
  0165  CPI  10
  0167  JC   0172
  016A  MVI  L,00
  016C  MOV  H,A
  016D  DAD  H
-s166
0166 10 40
0167 DA .
-a16d
016D nop
016E nop
016F .
-l1a2
  01A2  ANI  FC
  01A4  MOV  H,A
  01A5  PUSH H
  01A6  LHLD 0006
-a1a2
01A2 ani fe
01A4 .
-g0
A>save 38 pgmov.com
```

NorthStar™ Topics

Running Old NorthStar Programs With The New DOS

by D.J. Anderson

Recently, NorthStar released a new version of their DOS, Release 5.2, which fixes several bugs with Basic. This is the first standard release that uses the lower part of the computer's memory: the DOS now starts at 0100H instead of 2000H.

This means that most users who have RAM from 0000 up will gain an extra 8K of usable memory (previously the DOS ignored this area). However, it will cause a problem if you have software that was purchased for a previous release.

If you have the source for purchased software, you can recompile it for the new location—user programs now start at 0E00H, instead of 2A00H or 2D00H. But what can you do if all you have is the object code? No one wants to go to the trouble of disassembling large programs, and simple relocating utilities that have appeared occasionally in various magazines require you to distinguish between data areas and instructions—nearly an impossible task, in many cases.

The answer is to write an interface program that will sit at 2000H, where the DOS used to be, and transfer calls to the new DOS at 0100H. In this way, the old program need not be modified at all.

The short program shown at right does just that. It contains all the information an application program expects to find in the DOS, and passes calls to the old DOS routines to the equivalent routine in the new DOS. With the exception of the directory lookup (DLOOK) routine, these are all just simple jumps. The DLOOK routine, however, sets the density flag (in double density systems), and so this must be done in the interface program as well.

To use this interface program, compile it and place it on disk with a go address of 2000H. Then, when you want to execute a program compiled for the old DOS, first execute the interface program:

```
+GO DOS2000

+GO program
```

D. J. Anderson, 755 Southmore Drive West, Ottawa, Ontario, Canada K1V 6Z9

```
2000          0002 *
2000          0003 * THIS MODULE ALLOWS PROGRAMS COMPILED FOR NORTHSTAR
2000          0004 * DOS AT 2000H TO WORK SUCCESSFULLY WITH THE DOS AT
2000          0005 * 0100H. IT MUST BE EXECUTED PRIOR TO EXECUTING THE
2000          0006 * USER PROGRAM.
2000          0007 *
2000          0008 DOS2000  START
0100          0009 DOSBASE  EQU    0100H
2000   319C20 0010          LXI    SP,STACK
2003   C33520 0011          JMP    SETUP        SETUP THIS INTERFACE
2006   00     0012          DB     0            FILLER
2007   C9     0013 OFTEN    RET
2008   0000   0014          DW     0
200A   C30000 0015 START    JMP    0
200D   C30D01 0016 COUT     JMP    DOSBASE+0DH
2010   C31001 0017 CIN      JMP    DOSBASE+10H
2013   C31301 0018 TINIT    JMP    DOSBASE+13H
2016   C31601 0019 CONTC    JMP    DOSBASE+16H
2019   C31901 0020 HDERR    JMP    DOSBASE+19H
201C   C35020 0021 DLOOK    JMP    FAKELOOK
201F   C31F01 0022 DWRIT    JMP    DOSBASE+1FH
2022   C32201 0023 DCOM     JMP    DOSBASE+22H
2025   C32501 0024 DLIST    JMP    DOSBASE+25H
2029   C32801 0025 DOS      JMP    DOSBASE+28H
202B   01     0026 RWCHK    DB     1            WANT READ AFTER WRITE
202C   C32C01 0027 DOSERR   JMP    DOSBASE+2CH
202F          0028 DEN      DS     1            DENSITY
2030   01     0029 AUTOS    DB     1            NO AUTOSTART
2031   0000   0030 INPBUFF  DW     0            ADDR OF DOS INPUT BUFFER
2033   00     0031 PAGES    DB     0            PAGE SIZE
2034   00     0032 CONFG    DB     0            CONFIG BYTE
2035          0033 *
2035   2A3101 0034 SETUP    LHLD   DOSBASE+31H GET ADDR OF INP BUFFER
2038   223120 0035          SHLD   INPBUFF      SET ADDR
203B   3A3401 0036          LDA    DOSBASE+34H GET CONFIG BYTE
203E   323420 0037          STA    CONFG        SET CONFIG BYTE
2041   2A0B01 0038          LHLD   DOSBASE+0BH
2044   220B20 0039          SHLD   START+1      SET DOS START ADDR
2047   3A3301 0040          LDA    DOSBASE+33H
204A   323320 0041          STA    PAGES        SET PAGE SIZE
204D   C32801 0042          JMP    DOSBASE+28H RETURN TO DOS
2050          0043 *
2050   CD1C01 0044 FAKELOOK CALL   DOSBASE+1CH DO DLOOK
2053   F5     0045          PUSH   PSW
2054   3A2F01 0046          LDA    DOSBASE+2FH GET DENSITY
2057   322F20 0047          STA    DEN          SET DENSITY
205A   F1     0048          POP    PSW
205B   C9     0049          RET
205C          0050 *
205C          0051          DS     64
209C          0052 STACK    EQU    $
209C          0053          END
NAME     VALU TY  LEN REFERENCES

AUTOS    2030  S 0001  29
BC       0000  C 0000
CIN      2010  I 0003  17
CONFG    2034  S 0001  32   37
CONTC    2016  I 0003  19
COUT     200D  I 0003  16
DCOM     2022  I 0003  23
DE       0002  C 0000
DEN      202F  S 0001  28   47
DLIST    2025  I 0003  24
DLOOK    201C  I 0003  21
DOS      2028  I 0003  25
DOS2000  2000 EA 0000   8
DOSBASE  0100  C 0000   9   16   17   18   19   20   22   23   24   25   27
                       34   36   38   40   42   44   46
DOSERR   202C  I 0003  27
DWRIT    201F  I 0003  22
FAKELOOK 2050  I 0003  44   21
HDERR    2019  I 0003  20
HL       0004  C 0000
INPBUFF  2031  W 0002  30   35
OFTEN    2007  I 0001  13
PAGES    2033  S 0001  31   41
PSW      0006  C 0000  45   48
RWCHK    202B  S 0001  26
SETUP    2035  I 0003  34   11
SP       0006  C 0000  10
STACK    209C  A 0000  52   10
START    200A  I 0003  15   39
TINIT    2013  I 0003  18

NO ERRORS;  29 LABELS;  FREE MEMORY=20634
OBJECT PROGRAM IS 009C HEX (156 DEC) BYTES LONG
102 SYMBOL TABLE ACCESSES
```

Cloning CP/M Disk Drives

by Andrew Klossner

To the basement hacker scrimping for additions for a microcomputer, just buying one floppy disk drive can devastate a hardware budget. However, there are quite a few functions which are difficult or impossible to perform on a single-disk system. The orientation of CP/M is toward a plurality of on-line disks, and many of the commonly available programs are useless without at least two drives.

The utilities supplied with CP/M illustrate this point. While PIP can be used to copy a file between disks when there are multiple drives, the procedure to copy files with a single drive is to invoke DDT to load a file, switch disks, then use the SAVE command to write it out. This requires both disks to be bootable, and can result in a new file longer than the original, since SAVE only understands half of the possible file lengths. In order to copy several files between disks, as when backing up a disk, it is necessary to repeat this procedure once for each file. Interrogating or changing the attributes of a data file requires that the STAT program reside on the data disk.

One way around this problem is to modify each CP/M program so that it can optionally pause and allow the operator to swap disks before it attempts to access a file on a new volume. For example, a modified PIP program, when presented with the command "B:DATA =A:DATA", would read file A:DATA into memory, then print the message "MOUNT DISK B" and wait for the operator to strike a key. This done, PIP would assume that the second disk had been mounted on the drive, and could proceed to write the file B:DATA. Before exiting, PIP would ask the operator to "MOUNT DISK A" so as to restore the originally booted disk.

The obvious problems with this solution are that modifying every application program involves quite a bit of work, and many programs are not available in source code and so cannot be tampered with. Fortunately, the effect of modifying every application program can be achieved by changing the code within CP/M itself.

This article presents two methods of modifying a custom BIOS to provide several "virtual" disk drives on a system with only one real drive. The first is easy to understand and implement; it will work in many but not all cases. The second is more difficult to implement, but will work in all cases and provides more efficient operation than the first. The reader is assumed to be a proficient 8080 assembly language programmer, fluent in CP/M commands and system calls, and familiar with the manual, CP/M 2.0 Alteration Guide.

Andrew Klossner, P.O. Box 283, Wilsonville, OR 97070.

The First Method of Modification

The first method involves redefining the semantics of the operation "select disk." In a vanilla BIOS, the SELDSK entry point is used to specify the disk drive to be used in the next I/O operation. On a one-drive system, only drive 0 will ever be active, so this entry point can be used to specify the actual disk volume for the next operation.

The following code fragment replaces the SELDSK code in the MDS BIOS, presented on page 45 of the Alteration Guide:

```
seldsk: ; select disk given by register c
        lxi     h,0000h ;return 0000 if error
        mov     a,c
        cpi     ndisks  ;too large?
        rnc             ;leave hl = 0000
        lda     curdsk  ;get current disk number
        cmp     c       ;is this the same disk as last time?
        jz      setdrive;if so, don't ask operator to swap
        mov     a,c     ;set CURDSK to new drive number
        sta     curdsk
        adi     'A'     ;prepare message to read:
        sta     msg2    ;  MOUNT DISK x,
        lxi     h,msg1  ;  HIT CARRIAGE RETURN
        call    prmsg
sel1:   call    conin   ;read a keyboard character
        cpi     0Dh     ;ignore all but carriage return
        jnz     sel1
        lxi     h,msg3  ;print carriage return, line feed
        call    prmsg
setdrive:
        lhld    curdsk
        mvi     h,0     ;hl=disk number
        dad     h       ;*2
        dad     h       ;*4
        dad     h       ;*8
        dad     h       ;*16
        lxi     d,dpbase
        dad     d       ;hl=disk header table address
        ret
msg1:   db      'MOUNT DISK '
msg2:   db      'x, HIT CARRIAGE RETURN: ',0
msg3:   db      cr,lf,0
curdsk: db      0       ;current disk: 0 is disk A
```

In addition, the following lines must be inserted after the label "wboot:" and before the first instruction of that routine:

```
mvi     c,0     ;warm boot, select disk A
call    seldsk
```

With a BIOS incorporating this change, the command "STAT B:" might result in the following interaction:

```
MOUNT DISK B, HIT CARRIAGE RETURN:

Bytes remaining on B: 166k

MOUNT DISK A, HIT CARRIAGE RETURN:
A>
```

Here, the operator was asked to insert a second disk; after this was done, STAT reported the free space on the disk, then returned to CP/M.

Now PIP can be used to back up a disk, with the command "PIPB:=A:*.*". A series of "MOUNT DISK" messages will result, requiring a sequence of fast shuffles by the operator. Because of the algorithms within PIP, each file copy requires four mounts, since the procedure is to: 1) Find the next file on disk A, 2) Create the file on disk B, 3) Read in the file from disk A, and 4) Write out and close the file to disk B. Files larger than available memory require additional mounts.

Any CP/M program that uses multiple disk drives can now be run, provided that the operator is willing to spend the necessary time swapping volumes. The number of "virtual" disk drives is the same as the number of Disk Parameter Blocks (DPB's) in the BIOS. There are four in the MDS BIOS, and so disks A, B, C, and D can be accessed.

When running a multiple-volume program, it can be disastrous to mount a disk other than the one called for. A good practice is to temporarily label the disks with their letter codes.

Deficiencies of the first method. This simple modification will work fine when dealing only with single-density floppy disks. However, when double-density disks are to be handled, complications creep into the picture. When the physical sector size is greater than 128, CP/M buffers several 128-byte records, writing them to disk only when a full physical sector has been filled. For example, if the physical disk sector size is 512, then four calls to the "write sector" entry point may result in just one disk operation.

Now consider this scenario: A program writes three logical records to a file on disk A, then "selects" disk B, causing the operator to remove disk A and mount disk B. The three records may have been stored in an internal buffer, waiting for the fourth record to be added before a 512-byte sector write is initiated. Next, the program writes a record to a file on disk B. CP/M notes that the fourth record for the disk A file is not forthcoming, and so proceeds to "flush" or write out the internal buffer in order to finish writing the first three records. However, since disk B is mounted instead of disk A, the new sector lands in a random and probably disastrous position on disk B, wiping out whatever data was in its place.

Even when dealing only with 128-byte physical sectors, the first method suffers because many programs issue "selects" without following up with disk I/O. For example, the keyboard command "B:STAT", used to run the program from the file "B:STAT.COM", causes the following sequence of calls to the BIOS:

```
Select disk B
Select track
Select sector
Select address
Read a sector
Select disk A
Select disk B
Select track
Select sector
Select address
Read a sector
Select disk A
Select disk B
...
```

The problem is that, after each record of "B:STAT.COM" is read, disk A is selected, then disk B is selected. The net result is that the operator has to swap disks dozens of times to execute a single program.

The Second Method of Modification

The second method circumvents both these problems. It is implemented as follows:

- Leave the "select disk" code as it was originally; that is, don't apply the modification of the first method.

- Reserve a byte of data, initially zero, labeled "CURDSK". This byte contains the number of the disk which is actually mounted on the drive, where number 0 is disk A, number 1 is disk B, etc.

Cloning Drives, continued...

- Add a subroutine (call it "DSKMNT") to the BIOS. This routine will check to see whether the currently mounted disk is the one upon which the next operation is to occur. It is called with the new disk number in register A. If the contents of A and CURDSK are the same, it quietly returns; otherwise it stores the new disk number into CURDSK and asks the operator to mount the new disk, in a manner similar to the first method.

- Isolate every segment of code in the BIOS which performs actual disk I/O. In a well designed BIOS, there will be one or two subroutines which are given total responsibility for disk operations. Modify each such segment to call the DSKMNT subroutine with the number of the disk in register C. In addition, change the I/O code so that actual disk I/O is always directed to drive 0, instead of going to any of several drives.

- Be sure to check the "warm boot" routine for disk I/O code. In at least one popular customized BIOS, the warm boot code includes a well designed but tricky sequence that re-reads the CCP and BDOS with a single, non-obvious OUT instruction. Before issuing this instruction, it should call DSKMNT to re-mount disk A.

Advantages/disadvantage of the second method. Using the second method of modification does have its drawbacks, the greatest being that it requires a large effort to seek out and modify every disk I/O operation in the BIOS. The advantages are that it will not clash with the buffering scheme, and useless "select disk" operations won't both the operator because the mount request is not issued until an actual disk read or write is scheduled.

Existing "Virtual Drive" Software

Several hardware vendors and software houses offer customized CP/M systems whose BIOS supports virtual disk drives using one of these techniques. A particularly good implementation, for the TRS-80 model II, is available from a company with the unlikely name of Pickles & Trout, in Goleta, CA. Their manual contains an excellent discussion of the consequences involved in using virtual drives.

Utility software packages are beginning to appear which run particularly well on virtual drive systems. For example, the Unica, a set of software tools from Knowlogy in Wilsonville, OR, includes a program which copies selected sets of files from one disk to another, using the minimum possible number of disk swaps. It does this by reading as many records as possible, from as many files as possible, into main memory before switching disks and writing them out. This software incorporates special code to eliminate extraneous disk selects when run under a BIOS using the first virtual disk method. ■

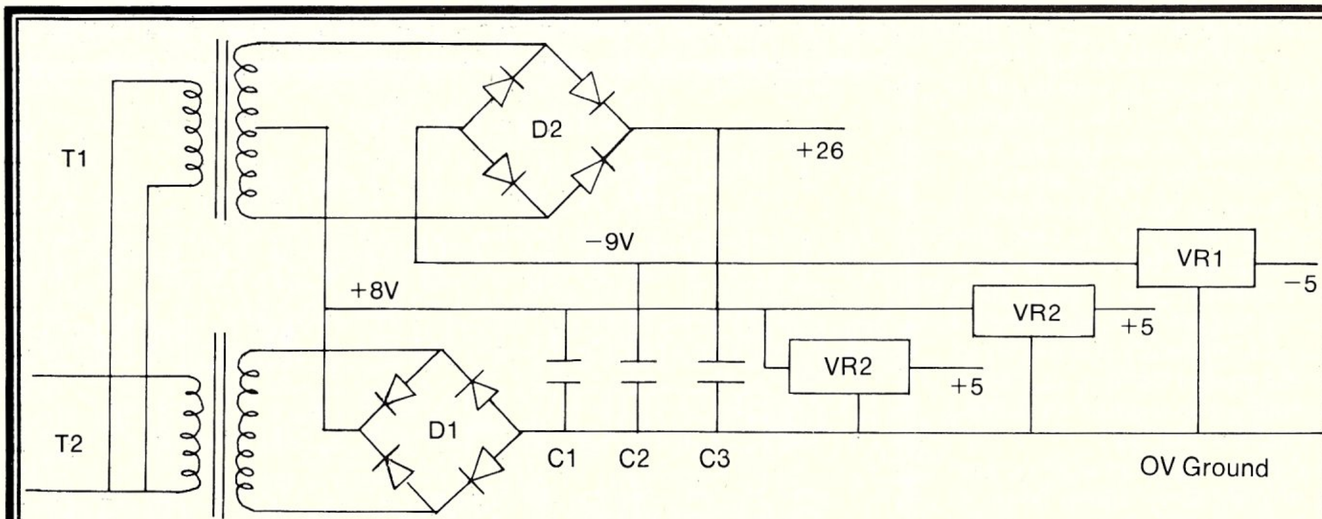
Low Cost Floppy Disk Power Supply

by Bob Zimmerer

Are you planning to buy a floppy disk? I bought one last summer and saved a little money by using this simple power supply. The two transformers are readily available, and by using them in the unconventional interconnection shown, provide the required and -5 volt regulated supply and the 26 volt unregulated supply for the stepper motor. My REMEX RFD 1000 requires about 1.5 amps at +5 volts, 1.2 amps at 26 volts when stepping, and a few milliamps at -5 volts. The voltages shown are measured while the disk is running. There is no need for regulating the 26 volts for the stepper motor.

The parts listed are the components I used. The exact value of the three filter capacitors is not critical; almost any large capacitors will do. The two bridge rectifiers are also not critical. Just be sure that they are at least 50V and can handle the current you need. The two +5V regulators are for the two disks I will eventually have. The single -5V regulator and 26 volt supply will handle two disk drives. With a little shopping around, you should be able to buy these parts for about $25.

Bob Zimmerer, 131 Second St., Port Angeles, WA 98362.



T1 Radio Shack 273-1512
25.2 V @ 2 Amps

C1, 8000 MF 15 V
C2, C3, 2900 MF 40 V

VR1, type 7905, −5 volt regulator .5 Amp
VR2, type 7805 +5 volt regulator 1.5 Amps

T2 STANCOR 5015
7.5 V @ 4 Amps

D1, VARO VH 148
D2, VARO VS-148

Introduction to Computer Graphics

by Lawrence E. Hughes

A brief survey of graphics displays, plotters and software.

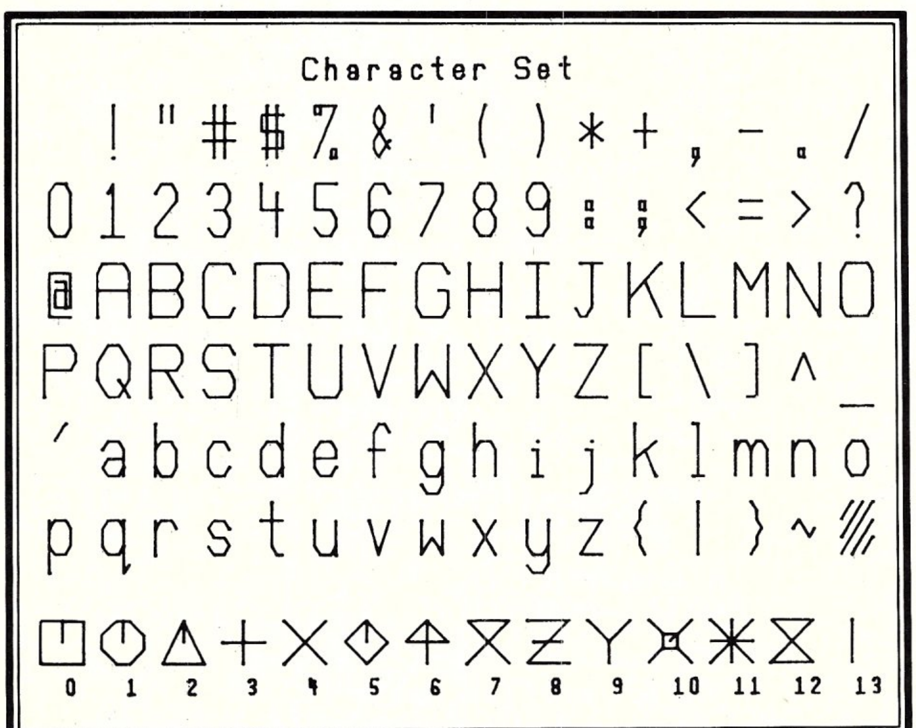
Since a number of peripherals suitable for general purpose, high resolution graphics have appeared on the market, I felt that it was time for an article describing some of the details involved in using them, from a software viewpoint. Let me begin by describing two important hardware characteristics necessary for supporting "general purpose" graphics.

First, there must be an absolute minimum of 300 x 200 addressable points, preferably 600 x 400 or more. Second, the peripheral must have the ability to draw a straight line (or contiguous series of dots, etc.) from any addressable point to any other addressable point, without affecting the rest of the display.

Capabilities such as erasing part or all of previously drawn lines, or reading the display memory can be useful, but are not essential. Capabilities such as character generation and curve or circle drawing generally are not worth the extra cost, as they can be done in software easily, inexpensively, and in more general ways.

Lawrence E. Hughes, Mycroft Labs, Inc., Box 6045, Tallahassee, FL 32301.

Systems that have a few (e.g., 64) special graphics characters (either fixed or programmable) are not particularly suitable for general purpose graphics, although a few things, such as data-entry forms, simple bar charts, etc. can be done with them. Any video-based raster scan system that is suitable for general purpose graphics will have at least one bit (or



more for color or multiple gray levels) per "pixel." This tends to require a large amount of memory (e.g., 32K for 512 x 512), but with the increasing density and decreasing cost of RAM chips, this is becoming less of a problem.

VIDEO GRAPHICS DISPLAYS

Several high resolution video displays are currently available for the S-100 bus, in the $1000 to $1500 range (including monitor). Three of these are: the SCION Microangelo, the CDL Dynamic Blackboard and the CAT 100. All three have at least one resolution setting in the 600 x 400 range. There are a few displays in the 300 x 200 range that are reasonably suitable, especially for preview applications, such as the Retrographics board for the Lear Siegler ADM-3A.

SCION's Microangelo

The SCION Microangelo MA512 (monochrome version) is a single S-100 board with an onboard Z80 and 32K of memory, in addition to the video generation circuitry. Firmware

Computer Graphics, continued...

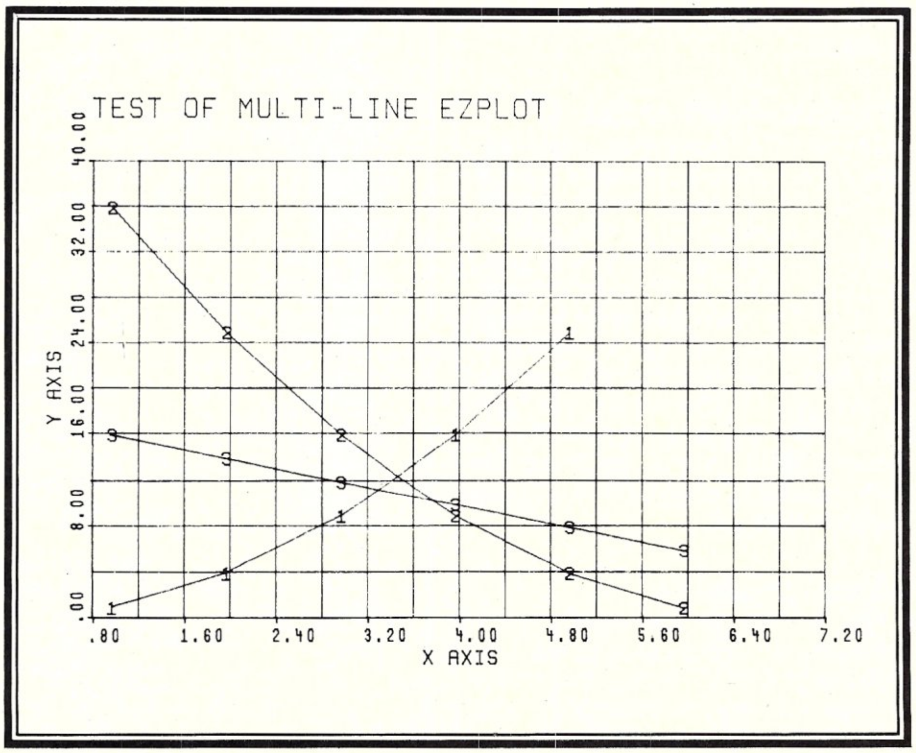
is included to support vector and character generation. There are 512 x 480 pixels, with a roughly 5:4 aspect ratio (i.e., squares that are "n" pixels on a side appear as rectangles), but this is typically accounted for in software. The board appears to the primary microprocessor as a data port with handshaking on a separate status port, much like a serial I/O port would appear. Unlike the CDL, full character generation and dumb terminal emulation is supported, which makes this board suitable as a primary console display. The list price is $1095 (for the board itself, with the basic firmware). A reasonable monitor can be had for $150 to $300, with a slow (P31) phosphor highly recommended. Color versions are a great deal more expensive. A high-quality monitor and keyboard are also available from SCION, as well as a light-pen.

CDL's Dynamic Blackboard

The Cambridge Development Labs (CDL) Dynamic Blackboard (monochrome version) is a three board set (S-100) with direct hardware access to the display memory, via several I/O ports. No firmware is included, but a number of support routines are supplied on disk. There are 640 x 512 addressable pixels, but only 480 horizontal lines are visible at any given time. One unusual feature of the CDL board is hardware scrolling. The aspect ratio is exactly 1:1. The access speed is very high, with rates of up to 500,000 pixels per second claimed. No general purpose high level software could begin to keep up with this, hence the display would not be a bottleneck for some time to come. Cost for the basic board set is $1200, with a monitor once again running about $150 to $300. Color versions are available at much higher prices.

Digital Graphics Systems' CAT-100

The CAT-100 is a slightly different animal than the previous two boards. It has a mechanism for capturing images from an analog TV signal, complete with 16 gray levels. It can, however, be configured for 512 x 480 monochrome display. It is a two board set (S-100 again), and the 32K of onboard memory can be accessed via a 2K window in the main processor's address space. The standard version is $1525, but a complete kit is available for $875. Once again, a $150 to $300 monitor is required. Color versions are somewhat more expensive.



GRAPHICS PLOTTERS

Several pen plotters currently available in the $500 to $1000 range are quite suitable for general purpose graphics. The Houston Instruments HIPLOT DMP-2, the Mauro PROAC, and the STROBE are three of these.

Houston Instruments HIPLOT Plotter

The Houston Instruments HIPLOT (DMP-2) is a "flatbed" plotter, where the pen can move in both X and Y directions over a fixed (10" x 7") area. Plotting speed is about 3" per second, and resolution is 200 points per inch (hence the addressable space is 2000 x 1400). Both serial and parallel interfaces are included in the standard unit. The list price is $1085. Larger and/or more intelligent versions are available at somewhat higher prices. This is an exceedingly well designed and well built unit.

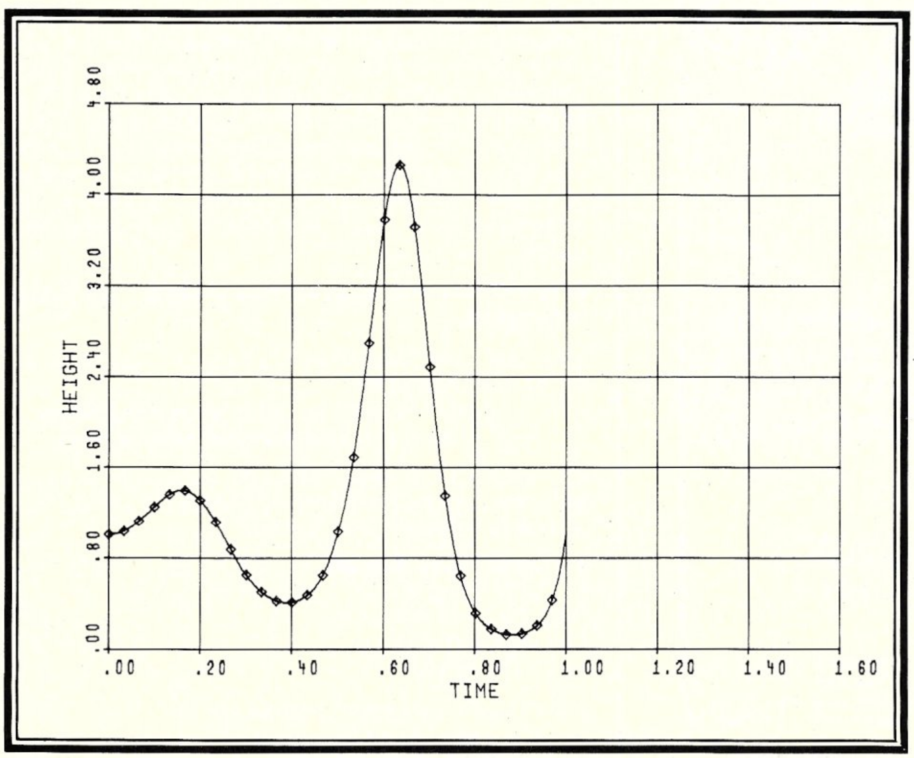
Mauro PROAC Plotter

The Mauro MP-250B PROAC plotter allows the pen to move back and forth in one direction, while the paper (11" wide) is moved back and forth through a channel under the pen axis (by wheels with shallow teeth) for the other direction. Resolution is 200 points per inch, for a total addressable space of 2000 x 1400 on a 10" by 7" page. The list price of the PROAC is $775, with a serial interface (strongly recommended) for an additional $195.

STROBE 100 Plotter

The STROBE model 100 is a "drum" plotter, where the pen is moved back and forth in one direction, while the 8.5" x 11" page (mounted on a cylindrical drum) is rotated underneath that axis for the other direction. Resolution is 500 points per inch on the newer units, older ones have 250 points per inch, with a total addressable space of 5000 x 3500 on a 10" x 7" page. The cost of the basic unit is $785, with a parallel interface. STROBE markets interfaces for a variety of machines, including an S-100 board for $145. A semi-intelligent serial interface will be available soon for about $300.00.

On any of the above plotters, through various combinations of small steps (increments) in one or both axes, lines of any length can be drawn in any direction (within the constraints of page size). From a software viewpoint, there are no major advantages to any of these designs, and they may be considered to be functionally identical.



Computer Graphics, continued...

DOT MATRIX PRINTERS

Dot matrix printers that offer access to each individual dot, such as the DataSouth DS180, offer yet another possible output device. Typically, with devices like this, a bit map of the final plot will be produced on a random access disk file, then pulled off sequentially, one line of dots at a time, and written to the dot addressable printer. This approach is necessary for two reasons: 1) once a line has been printed, it is not possible to back the paper up to add more dots (hence all dots for a given line must be plotted at once), and 2) the number of dots on a typical page exceeds central memory size (using one bit per dot), hence disk files must be used.

GRAPHICS SOFTWARE

Some plotters (e.g., any Tektronix compatible device, or the PROAC with its serial interface) understand how to draw, or move without drawing, from the current position to any new position in the addressable range. These are called "vector" devices. Other plotters only support access to raster scan pixels or very short vectors (e.g., .005 inches) in eight directions (incremental). The very lowest level of support software is only required for the latter variety, to make them simulate the vector type devices. The algorithms involved are relatively simple, and can be done with all integer arithmetic, with a minimum of multiplications and/or divisions. This is important because of speed considerations.

This level is often done in assembly language. Typical routines at this level allow drawing—or moving—from current position to any new position (expressed in integer raster point coordinates). In the case of a vector plotter such as the Tektronix, this might be as simple as encoding two 10-bit coordinates into a maximum of 4 ASCII characters, and sending them to the plotter. Such routines are called "hardware drivers." This level of software hides most of the differences in hardware characteristics.

The next level of software hides differences in coordinate systems, by translating coordinates from inches (relative to the lower left hand corner, or some user defined origin), into whatever absolute raster point coordinate system that the actual hardware uses. Such things as "windowing" and simple transformations in the plane are also implemented at this level. Windowing, or "clipping," is a technique that allows the user to specify a particular region (usually rectangular) on the plotting page, such that only those line segments, or portions thereof, that fall inside the window are actually drawn. Typical transformations implemented at this level might include magnification (in either or both axes), translation (ditto) and/or rotation about a given point. This is typically the lowest level accessible to the end user. An example would be the PLOT subroutine from the standard CALCOMP package.

If a set of higher level routines that draw characters, axes, grids, etc., are implemented in terms of such a routine, it is relatively easy to transport such a package to a new device by simply re-writing that one routine and any lower level drivers used by it. One major advantage of doing this is the ability to preview several plots, or versions of a single plot, on a video device such as the CDL board, and then actually draw selected ones on a pen plotter such as a HIPLOT, using essentially the same user code (just substituting drivers).

There are several standard, high level packages currently in widespread use on mainframes and minicomputers, such as the CALCOMP basic package (from California Computer Products, Inc., originally designed for their very expensive, large pen plotters). Tektronix also has a basic package called PLOT-10, which was originally developed for their 40xx series terminals. These packages typically include routines that can draw line segments, alphanumeric characters, linear and/or log axes, linear, semi-log and/or log grids, etc. Routines to map user's coordinate systems into inches are also included, as may be routines for curve fitting, smoothing, etc.

Such routines are typically designed in quite generalized manners, such that they can perform their function in a wide variety of ways (e.g., draw any character string, anywhere on the page, any size, and at any angle), by passing parameters. Languages such as Fortran and PL/I are particularly well suited to modular, parameterized routines. Pascal is not sufficiently modular, and is too strongly typed, while Basic is not at all modular, has no parameters on its subroutines, and is usally about 10 to 100 times slower than a good compiled language (which can be a serious problem with graphics). Note that the standard CALCOMP package, the PLOT-10 package, and the Mycroft Labs package are all available only for Fortran, although we will be releasing a version of our package for PL/I later. We have no plans at all for supporting Basic, Pascal or Cobol directly.

This kind of package is typically available to the user in the form of a pre-compiled "object library" of subroutines (callable from Fortran) that can be searched by a linkage editor for just those routines which a particular user's program has called (along with lower level routines called by those routines, etc).

As an example of this kind of subroutine, the SYMBOL routine from the CALCOMP basic package allows the drawing of one or more alphanumeric (or special) characters. The calling sequence is:

```
CALL SYMBOL(XO,YO,H,STRING,ANGLE,NCHAR)
```

where the parameters have the following meaning:

X0,Y0—x,y coordinates, in inches, relative to the current origin, of the lower left corner of the first character position (before rotation). The special value 999.0 can be used for either or both parameters to pick up (in that axis) where the last call to SYMBOL left off.

H—the height, in inches, of the characters, which also determines the width of each character, hence the length of the total string.

STRING—character string to be drawn, either in an array or a literal (e.g., "Hello").

ANGLE—angle of rotation, in degrees counterclockwise from 3 o'clock, about the point X0,Y0, of the baseline of the character string.

NCHAR—the number of characters to draw.

Note that there are certain other cases than the ones described, for drawing special symbols.

It is usually quite simple for a Fortran programmer to produce cartesian graphs of data, using a package such as this. Often, other routines that support log, semi-log and/or polar graphs will be included. Yet other routines may be present to support the drawing of bar charts (histograms), pie charts, etc.

The highest level of support typically provided by a complete graphics package would include one or more generalized interactive programs that would allow the user to enter data (or read it from disk files), enter titles, axis labels, and so on, then produce complete, annotated graphs on one or more actual plotters. Even non-programmers can readily learn to use such utility programs, although they give up much of the flexibility available to a programmer using the package directly from Fortran Programmers that prefer working in other languages can also make use of such utilities by writing data files to disk, which can then be read by the interactive utility.

Mycroft Labs offers a graphics package, called GRAFPAK, which is based on the standard CALCOMP basic routines. The package includes virtually all of the capabilities described in this article, and supports the following devices: Tektronix 40xx series terminals (or equivalent), Tektronix 4662 pen plotter, Houston Instruments HIPLOT DMP-2 pen plotter, CDL high resolution video board, and the SCION Microangelo high resolution video board. The following devices will be supported in the very near future: Mauro PROAC pen plotter, STROBE pen plotter, and DataSouth DS-180 dot addressable matrix printer. The price is $200.

For further information on the companies mentioned in this article, refer to the following list.

Mycroft Labs
P.O. Box 6045
Tallahassee, FL 32301
(904) 385-2708

SCION Corporation
12310 Pinecrest Road
Reston, VA 22091
(703) 476-6100

Cambridge Development Labs
36 Pleasant St.
Watertown, MA 02172
(617) 926-0869

Digital Graphics Systems
441 California Ave.
Palo Alto, CA 94306
(415) 494-6088

Houston Instrument, Inc.
One Houston Square
Austin, Texas, 78753
(512) 837-2820

Strobe, Inc.
897-5A Independence Ave.
Mountain View, CA 94043
(415) 969-5130

Mauro Engineering
2220 Pack Trail
Mount Shasta, CA 96067
(916) 926-4406

Orange County • Sunnyvale
San Diego • Los Angeles
San Fernando Valley • Dallas

Dot Matrix Printers

NEW EPSONS with GRAFTRAX-plus

Epson has improved and upgraded their best selling line of printers to include their new GRAFTRAX-plus graphics package. Features now include; 9 x 9 matrix, bi-directional/logic seeking, line spacing to n/216, programmable forms length and horizontal tabs, skip over perf, italics fonts, international symbols, superscript/subscript, normal, emphasized, double-strike, and double-emphasized print, underlining, line drawing graphics, 60/120 DPI bit image, software reset, adjustable right margin, and true back space.

MX-80 with GRAFTRAX-plus *80 column, 80 CPS, adjustable pin feed.*

PRM-28080 *MX-80 w/GRAFTRAX-plus* **$479.95**

MX-80FT with GRAFTRAX-plus *same as MX-80 with friction feed added.*

PRM-28082 *MX-80FT w/GRAFTRAX-plus* **$559.95**

MX-100 with GRAFTRAX-plus *132 column, correspondence quality, up to 15" paper, friction feed & adjustable pin feed, 9 x 9 dot matrix, 80 CPS.*

PRM-28100 *MX-100 w/GRAFTRAX-plus* **$754.95**

PRA-27084	*Serial interface*	**$54.95**
PRA-27088	*Serial intf & 2K buffer*	**$144.95**
PRA-27081	*Apple card*	**$39.95**
PRA-27082	*Apple cable*	**$19.95**
PRA-27086	*IEEE 488 card*	**$52.95**
PRA-27087	*TRS-80 cable*	**$24.95**
PRA-27085	*GRAFTRAX II*	**$59.95**
PRA-28085	*GRAFTRAX-plus*	**$79.95**
PRA-27090	*Extra print head*	**$44.95**
PRA-27083	*MX-80 ribbon cart.*	**$13.95**
PRA-27101	*MX-100 ribbon only*	**$9.95**

BETTER THAN EPSON ! - Okidata

Microline 82A *80/132 column, **120 CPS**, 9 x 9 dot matrix, friction feed, pin feed, adjustable tractor feed (optional), handles 4 part forms up to 9.5" wide, rear & bottom feed, paper tear bar, 100% duty cycle/200,000,000 character print head, bi-directional/logic seeking, **both serial & parallel interfaces included**, front panel switch & program control of 10 different form lengths, uses inexpensive spool type ribbons, double width & condensed characters, true lower case descenders & graphics*

PRM-43082 *Friction & pin feed* **$499.95**

Microline 83A *132/232 column, 120 CPS, handles forms up to 15" wide, removable tractor, plus all the features of the 82A.*

PRM-43083 *with FREE tractor* **$744.95**

Microline 84 *132/232 column, 200 CPS, full dot graphics built in, handles forms up to 15" wide, plus all the features of the 83A.*

PRM-43084	*Centronics parallel*	**$1149.95**
PRM-43085	*Serial with 2K buffer*	**$1249.95**

PRA-27081	*Apple card*	**$39.95**
PRA-27082	*Apple cable*	**$19.95**
PRA-27087	*TRS-80 cable*	**$24.95**
PRA-43081	*2K hi speed serial card*	**$169.95**
PRA-43082	*Hi-res graphics ROMs 82A*	**$79.95**
PRA-43083	*Hi-graphics ROMs 83A*	**$79.95**
PRA-43088	*Tractor option for 82A*	**$39.95**
PRA-43080	*Extra ribbons pkg. of 2*	**$9.95**

PRINTER PAL - F.M.J. Inc.

Desk top printer stand an paper holder

PRA-99080	*for MX-80, FT, Oki 82A, NEC*	**$24.95**
PRA-99100	*for MX-100, Oki 83A & 84*	**$29.95**

Terminals

VIDEO TERMINALS - Televideo

Inexpensive full-featured video terminals

VDT-901210	*Televideo 910*	**$685.00**
VDT-901213	*Televideo 912*	**$775.00**
VDT-901221	*Televideo 920*	**$845.00**
VDT-901225	*Televideo 925*	**$865.00**
VDT-991250	*Televideo 950*	**$1095.00**

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*	**$59.95**
END-000421	*Cabinet kit*	**$225.00**
END-000431	*A & T*	**$359.95**

8" Sub-Systems - Single Sided, Double Density

END-000423	*Kit w/2 FD100-8Ds*	**$975.00**
END-000424	*A & T w/2 FD100-8Ds*	**$1175.00**
END-000433	*Kit w/2 SA-801Rs*	**$999.95**
END-000434	*A & T w/2 SA-801Rs*	**$1195.00**

8" Sub-Systems - Double Sided, Double Density

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

Letter Quality Printers

LETTER QUALITY PRINTER - Jade

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*	**$959.95**
PRD-11002	*RS-232C serial model*	**$999.95**

STARWRITER F-10 - C. Itoh

New 40 CPS daisy wheel printer with full 15" carriage, uses standard Diablo print wheels and ribbons, both parallel and serial interfaces included.

PRD-22010 *Starwriter F-10* **$1595.95**

80 CPS LETTER QUALITY - Fujitsu

High speed daisy wheel printer with both RS-232C serial & Centronics parallel interfaces, emulates NEC 5510, Diablo 630, Qume, and will interface to the IBM Personal Computer, features include Z-80 CPU, 16K buffer (48K optional), bi-directional printing, & baud rates up to 19.2K

PRD-86100	*Fujitsu with 16K*	**$2895.00**
PRD-86200	*Fujitsu with 48K*	**$3195.00**
PRA-86000	*Adjustable tractor*	**$190.00**

Jade Bus Probe

THE BUS PROBE - Jade

Inexpensive S-100 Diagnostic Analyzer

So your computer is down. And you don't have an oscilloscope. And you don't have a front panel... You're not alone - most computers have their occasional bad days. But without diagnostic equipment such as an oscilloscope (expensive!) or a front panel (expensive!), it can be very difficult to pinpoint the problem. Even if you have an extender board with a superfast logic probe, you can't see more than one signal at a time. You're stuck, right?

Not anymore; Jade is proud to offer our cost-effective solution to the problems mentioned above: ***THE BUS PROBE.***

Whether you're a hobbyist with a cantankerous kluge or a field technician with an anxious computer owner breathing down your neck, you'll find THE BUS PROBE speeds your repair time remarkably. Just plug in THE BUS PROBE and you'll be able to see *all* the IEEE S-100 signals in action. THE BUS PROBE allows you to see inputs, outputs, memory reads and writes, instruction fetches, DMA channels, vectored interrupts, 8 or 16 bit wide data transfers, plus the three bus supply voltages.

An on-board pulse generator can provide repetitive resets, interrupts, or wait states, for trouble shooting.

TSX-200B	*Bare board*	**$59.95**
TSX-200K	*Kit*	**$119.95**
TSX-200A	*A&T*	**$149.95**

Prices may be slightly higher at our retail locations. Please contact the store in your area for exact pricing.

5¼" Disk Drives

Tandon TM100-1 *single-sided double-density 48 TPI*
MSM-551001 .... $248.95 ea 2 for **$219.95 ea**

Shugart SA400L *single-sided double-density 40 track*
MSM-104000 .... $234.95 ea 2 for **$224.95 ea**

Tandon TM100-2 *double-sided double-density 48 TPI*
MSM-551002 .... $324.95 ea 2 for **$298.95 ea**

Shugart SA450 *double-sided double-density 35 track*
MSM-104500 .... $349.95 ea 2 for **$329.95 ea**

Tandon TM100-3 *single-sided double-density 96 TPI*
MSM-551003 .... $324.95 ea 2 for **$298.95 ea**

Tandon TM100-4 *double-sided double-density 96 TPI*
MSM-551004 .... $448.95 ea 2 for **$419.95 ea**

MPI B-51 *single-sided double-density 40 track*
MSM-155100 .... $234.95 ea 2 for **$224.95 ea**

MPI B-52 *double-sided double-density 40 track*
MSM-155200 .... $344.95 ea 2 for **$334.95 ea**

MPI B-91 *single-sided double-density 77 track*
MSM-155300 .... $369.95 ea 2 for **$359.95 ea**

MPI B-92 *double-sided double-density 77 track*
MSM-155400 .... $469.95 ea 2 for **$459.95 ea**

5¼" Cabinets with Power Supply

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

8" Disk Drives

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**

Tandon TM848-1 *single-sided double-den thin-line*
MSF-558481 .... $424.95 ea 2 for **$394.95 ea**

Tandon TM848-2 *double-sided double-den thin-line*
MSF-558482 .... $574.95 ea 2 for **$549.95 ea**

Qume DT-8 *double-sided double-density*
MSF-750080 .... $524.95 ea 2 for **$498.95 ea**

Siemens FDD 100-8 *single-sided double-density*
MSF-201120 .... $384.95 ea 2 for **$349.95 ea**

Software

PLANNER CALC - Target Software

Spread sheet (what if ?) program designed for with the user in mind, user oriented (simple english) commands allow you to quickly master this powerful software, supplied on 8" disk for use with CP/M based systems.

SFC-12251050F	*8" CP/M version*	**$49.95**
SFC-12251053F	*8" Xerox*	**$49.95**
SFC-12251053M	*5¼" Xerox*	**$49.95**

Place Orders Toll Free

Continental U.S.	*Inside California*
800-421-5500	**800-262-1710**

For Technical Inquires or Customer Service call:

213-973-7707

JADE
Computer Products

4901 W. Rosecrans, Hawthorne, Ca 90250

TERMS of SALE: Cash, checks, credit cards, or Purchase Orders from qualified firms and institutions. **Minimum Order $15.00.** California residents add 6% tax. Minimum shipping & handling charge $3.00. **Pricing & availibility subject to change**

CIRCLE 18 ON READER SERVICE CARD

JADE Computer Products
13440 South Hawthorne Blvd.
Hawthorne 213-973-7330

JADE Computer Products
21800 Ventura Blvd
Woodland Hills 213-716-6120

JADE Computer Products
4950 Beltline Road
Dallas 214-458-2782

PLACE ORDERS TOLL FREE.

Continental U.S. - 800-421-5500
Inside California - 800-262-1710
Los Angeles Area - 213-973-7707

S-100 CPU Boards

8085/8086 - 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

8086/8087 - CompuPro
16 bit, 8 or 10 MHz 8086 CPU with provisions for 8087 & 80130.

CPU-70520A	8 MHz 8086 A & T	$624.95
CPU-70520C	8 MHz 8086 CSC	$764.95
CPU-70530A	with 8087 A & T	$1224.95
CPU-70530C	with 8087 CSC	$1455.95

CPU-Z - CompuPro
2/4 MHz Z80A CPU, 24 bit addressing.

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

SBC-200 - SD Systems
4 MHz Z-80A CPU with serial & parallel I/O, 1K RAM, 8K ROM space, monitor PROM included.

CPC-30200A	A & T	$399.95

THE BIG Z - Jade
2 or 4 MHz switchable Z-80 CPU board with serial I/O, accomodates 2708, 2716, or 2732 EPROM, baud rates from 75 to 9600.

CPU-30201B	Bare board w/manual	$35.00
CPU-30201K	Kit with manual	$139.95
CPU-30210A	A & T with manual	$199.95

CB-2 - SSM Microcomputer
2 or 4 MHz Z-80 CPU board with provision for up to 8K of ROM or 4K of RAM on board, extended addressing, IEEE S-100, front panel compatible.

CPU-30300K	Kit with manual	$229.95
CPU-30300A	A & T with manual	$274.95

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

2820 Z-80 DMA CPU - C.C.S.
4 MHz Z-80 CPU board with 2 serial I/O ports & Centronics parallel I/O port, separate data & status ports, DMA daisy chain compatible.

CPU-30420A	A & T with manual	$569.95

S-100 Disk Controllers

DISK 1 - CompuPro
8" or 5¼" DMA disk controller, single or double density, single or double sided, 10 MHz.

IOD-1810A	A & T	$449.95
IOD-1810C	CSC	$554.95
SFC-52506580F	8" CP/M 2.2 for Z-80	$174.95
SFC-52506586F	8" CP/M 2.2 for 8086	$299.95
SFO-54158000F	Oasis single user	$499.95
SFO-54158002F	Oasis multi-user	$849.95

DOUBLE D - Jade
High reliablity 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	$359.95
SFC-59002001F	CP/M 2.2 with Double D	$99.95

VERSAFLOPPY II - SD Systems
Double density disk controller for any combination of 5¼" and 8" single or double sided, analog phase-locked loop data separator, vectored interrupts, CP/M 2.2 & Oasis compatible, control/diagnostic software PROM included.

IOD-1160A	A & T with PROM	$359.95
SFC-55009047F	CP/M 2.2 with VF II	$99.95

2242 DISK CONTROLLER - C.C.S.
5¼" or 8" double density disk controller with on-board boot loader ROM, free CP/M 2.2 & manual set.

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

S-100 Memory Boards

256K RAMDISK - SD Systems
ExpandoRAM III expandable from 64K to 256K using 64K x 1 RAM chips, functions as ultra-high speed disk drive when used with optional RAMDISK software, compatible with CP/M, MP/M, Oasis, Cromemco, & most other Z-80 based systems.

MEM-65064A	64K A & T	$474.95
MEM-65128A	128K A & T	$574.95
MEM-65192A	192K A & T	$674.95
MEM-65256A	256K A & T	$774.95
SFC-55009000F	RAMDISK sftwr CP/M 2.2	$24.95

128K RAM 21 - CompuPro
128K x 8 bit or 64K x 16 bit static RAM board, 12 MHz, 24 bit addressing.

MEM-12810A	A & T	$1609.95
MEM-12810C	CSC	$1794.95

64K EXPANDORAM II - SD Systems
Expandable RAM board from 16K to 64K using 4116 RAM chips.

MEM-16630A	16K A & T	$344.95
MEM-32631A	32K A & T	$364.95
MEM-48632A	48K A & T	$384.95
MEM-64633A	64K A & T	$399.95

64K RAM 17 - CompuPro
64K CMOS static RAM board, 10 MHz, low power less than 4 watts, DMA compatible, 24 bit addressing.

MEM-64180A	64K A & T	$549.95
MEM-64180C	64K CSC	$698.95

64K RAM 16 - CompuPro
32K x 16 bit or 64K x 8 bit low power static RAM board, 10 MHz, 24 bit addressing.

MEM-32180A	RAM 16 A & T	$598.95
MEM-32180C	RAM 16 CSC	$698.95

64K STATIC RAM - SSM
IEEE 696/S-100 standard, up to 6MHz/8 Bit, 12MHz/16 Bit, 24 Bit extended addressing, disable-able in 2K increments

MEM-64300A	A & T	$749.95

64K STATIC RAM - Mem Merchant
64K static S-100 RAM card, 4 to 16K banks up to 8 MHz.

MEM-64400A	64K A & T	$594.95

2065 64K RAM - C.C.S.
4 MHz bank port/bank byte selectable, extended addressing, 16K bank selectable, front panel compatible.

MEM-64565A	64K A & T	$349.95

2066 64K RAM - C.C.S.
64K RAM board with bank and block select switching functions for Cromemeco Cromix & Alpha Micro.

MEM-64566A	64K A & T	$424.95

MEMORY BANK - Jade
4 MHz S-100 bank selectable expandable to 64K.

MEM-99730B	Bare board w/manual	$49.95
MEM-99730K	Kit with no RAM	$179.95
MEM-32731K	32K kit	$199.95
MEM-64733K	64K kit	$249.95
Assembled & Tested		add $50.00

32K RAM 20 - CompuPro
32K static RAM, up to 10 MHz, disable-able in 4K banks, bank select or 24 bit addressing.

MEM-16180A	16K A & T	$259.95
MEM-16180C	16K CSC	$324.95
MEM-24180A	24K A & T	$324.95
MEM-24180C	24K CSC	$384.95
MEM-32185A	32K A & T	$384.95
MEM-32185C	32K CSC	$449.95

16K STATIC RAM - Mem Merchant
4MHz lo-power static RAM board, IEEE S-100, bank selectable, addressable in 4K blocks, disable-able in 1K segments extended addressing.

MEM-16171A	16K A & T	$154.95

S-100 I/O Boards

SYSTEM SUPPORT 1 - CompuPro
Real time clock, three 16 bit interval timers, dual interrupt controllers(15 levels), up to 4K EPROM/RAM, RS-232C serial channel, provision for 9511A/9512 math chip.

IOX-1850A	SS1 A & T	$359.95
IOX-1850C	SS1 CSC	$459.95
IOX-1855A	with 9511 A & T	$554.95
IOX-1855C	with 9511 CSC	$654.95
IOX-1860A	with 9512 A & T	$554.95
IOX-1860C	with 9512 CSC	$654.95

INTERFACER 1 - CompuPro
2 serial I/O ports 50-19.2K baud.

IOI-1810A	A & T	$218.95
IOI-1810C	CSC	$288.95

INTERFACER 2 - CompuPro
3 parallel, 1 serial, & interrupt timer.

IOI-1820A	A & T	$218.95
IOI-1820C	CSC	$288.95

INTERFACER 3 - CompuPro
5 or 8 channel serial I/O board for interrupt driven multi-user systems up to 250K baud.

IOI-1835A	5 port A & T	$558.95
IOI-1835C	5 port CSC	$628.95
IOI-1838A	8 port A & T	$628.95
IOI-1838C	8 port CSC	$749.95

INTERFACER 4 - CompuPro
3 serial, 1 parallel, 1 Centronics parallel.

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

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

IOI-1875A	4K MPX A & T	$444.95
IOI-1875C	4K MPX CSC	$534.95
IOI-1880A	16K MPX A & T	$584.95
IOI-1880C	16K MPX CSC	$674.95

I/O-4 - SSM Microcomputer
2 serial I/O ports plus 2 parallel I/O ports.

IOI-1010B	Bare board w/manual	$35.00
IOI-1010K	Kit with manual	$179.95
IOI-1010A	A & T with manual	$249.95

I/O-5 - SSM Microcomputer
Two serial & 3 parallel I/O ports, 110-19.2K Baud

IOI-1015A	A & T	$289.95

I/O-8 - SSM Microcomputer
Eight software programmable serial I/O ports, 110 -19.2K Baud, ideal for multi-user systems

IOI-1018A	A & T	$469.95

MPC-4 - SD Systems
Intelligent 4-port serial I/O card, on-board Z-80A, 2K RAM, 4K PROM area, on-board firmware, fully buffered, vectored interrupts, four CTC channels, add to SD Board set for powerful multi-user system

IOI-1504A	A & T w/software	$495.00

2719 2 SER & 2 PAR - C.C.S.
Two RS-232C serial I/O ports plus two 8 bit parallel I/O ports.

IOI-1080A	A & T with manual	$349.95

2710 4 PORT SERIAL - C.C.S.
Four RS-232C serial I/O ports with full handshaking.

IOI-1060A	A & T with manual	$319.95

2830 6 PORT SERIAL - C.C.S.
Six asynchronous RS-232C serial I/O ports with programmable baud rates.

IOI-1040A	A & T with manual	$529.95

Prices may be slightly higher at our retail locations. Please call the store nearest you for local price and availability.

CIRCLE 18 ON READER SERVICE CARD

GRAFPAK From Mycroft Labs

by J. W. Long & J. Simon

We have assembled a package of plotter software (PLOTS) which is proving to be very useful for our scientific and engineering plotting applications. The package is menu-driven and allows generation of linear, semi-log and log-log plots with straight line curve fitting, on the basis of data points entered by the operator, or from data stored in an existing data file. The heart of the package is Mycroft Lab's "Grafpak" plotting package, which will be discussed in considerable detail later on. This software represents a beautiful example of Microsystem's software bus concept, in that we have simply taken commercially available software, added a few extras and have come up with a very powerful, easy-to-use, easily modified plotting package. PLOTS should be usable on any system running CP/M that has the necessary hardware and software (see Figure 1). PLOTS consists of two programs, a data editor and a plotter executive. The basic operation of PLOTS is very simple—the editor program prompts the operator for data points, axis labels, titles, etc. Upon completion of editing, this information is stored in a disk data file. The plotting executive is then automatically loaded, which accesses the data file and does the plotting, mostly by subroutine calls to Grafpak. Basic was used for the editor because program development is so easy in Basic, because the speed penalty for using it is of no consequence for data entry and, finally, because the string handling capabilities of Basic make it much easier to write the code for entry of string data (titles, axis labels, etc.). On the other hand, the fact that the plotting executive is all in Fortran results in very fast plotting and makes for compact plotting code, since it largely consists of subroutine calls to Grafpak.

The editor program has features one would expect: data points may be entered, deleted, changed, or reviewed, or data may be loaded from another disk file, then edited. Since the editor is written in Basic, changes of any desired sort are very easy to make. Our primary application for the package involves plotting of laboratory data. The example plots were produced by taking data directly from a student's laboratory notebook, using the editor. A very useful feature of the package is that the same data may be quickly plotted on any or all of the

The Grafpak package is a very powerful set of plotting subroutines which allows one to plot linear, semi-log and log-log plots, with labeled axes and files. Automatic scaling of data is provided, as well as scaling of the overall size of the plots.

three axis types: linear, semi-log or log-log. This is often done in scientific or engineering plotting where one is looking for a straight line relationship in the data. If any semblance of a straight line can be found, the editor includes a routine which will calculate and plot a least squares fit for the points.

Although we have not done it, it would be very simple to write a program to allow any algebraic function to be plotted. All that would be required is a program to calculate a set of x, y values over the range of interest, then store the values in a data file. PLOTS could then be used to load and plot the points.

J. Long & J. Simon, Broome Community College, Dep't of Chemistry, Binghamton, NY 13902.

Othello & Gomoku

C.D.E. offers new computerized versions of these two ancient games of tactical skill. **GOMOKU** is played on a 15 by 15 board, and the first player to get five in a row wins. Patterns of play are endless. Complete I/O features include game display, take back, autoplay, referee, set-up and problem modes. **OTHELLO** is played on an 8 by 8 board. Play proceeds by bracketing and "flipping" your opponent's men, and the player with the most squares at the end of the game is the winner. Both games have nine levels of play and are available for virtually any Z-80 based computer, in most CP/M formats or North Star DOS. Also available for TRS-80 Model 1 (running TRS DOS) and Model 2 (running CP/M). Games are available individually at $24.95 each, or $39.95 for both.

Adventure

The classic computer game

California Digital Engineering offers the fastest running version of this classic game available for a microcomputer. It returns instant response to hundreds of commands. This is the complete game, exactly as Crowther and Woods intended it, implemented by Chuck Crayne. Explore the colossal caves—over a hundred rooms! Steal treasures! Cast magic! Kill dwarves! Run from dragons! Get lost in the maze of twisty little passages! The Rubik's Cube of computer games. You won't be heard from for months! Only $35.00 in CP/M.

MAGIC TYPEWRITER™ is C.D.E.'s unique, all-purpose word processing and database management tool. It eliminates the need for separate programs for separate tasks. It offers not only a sophisticated text formatter, but a fast-sort, a mailing list program, and other special purpose features. You may examine any file on the disk without disturbing the file on the screen. Available in CP/M and North Star DOS at a cost of only $175.00.

C.D.E. HAS DISKS

Our disks are certified for two years, and include hard holes. Sold only in boxes of ten.

5¼″ double density (Specify soft, 10 or 16 sectors)	
Single sided	$25.95
Double sided	30.95
8″ single density	28.95
8″ double density	33.95

Sturdy, interlocking DISK BANK cases for safe storage or transporting of disks stack vertically or horizontally to build a useful system to your specifications. DISK BANK holding ten 5¼″ disks is $5.95, and for ten 8″ disks, $6.95.

Bowling Secretary

A unique program to keep complete league results, compute handicaps, and keep other statistics in order. Only $55 in North Star Basic.

All disks are in the CP/M format except where North Star DOS is indicated. Please let us know whether you require 5¼″ or 8″ disk, single or double density, single or double sided, soft, 10 or 16 sectors. North Star users indicate CP/M or DOS format. Please include $2 postage and handling with each order. For our complete brochure, write or call (213) 661-2031.

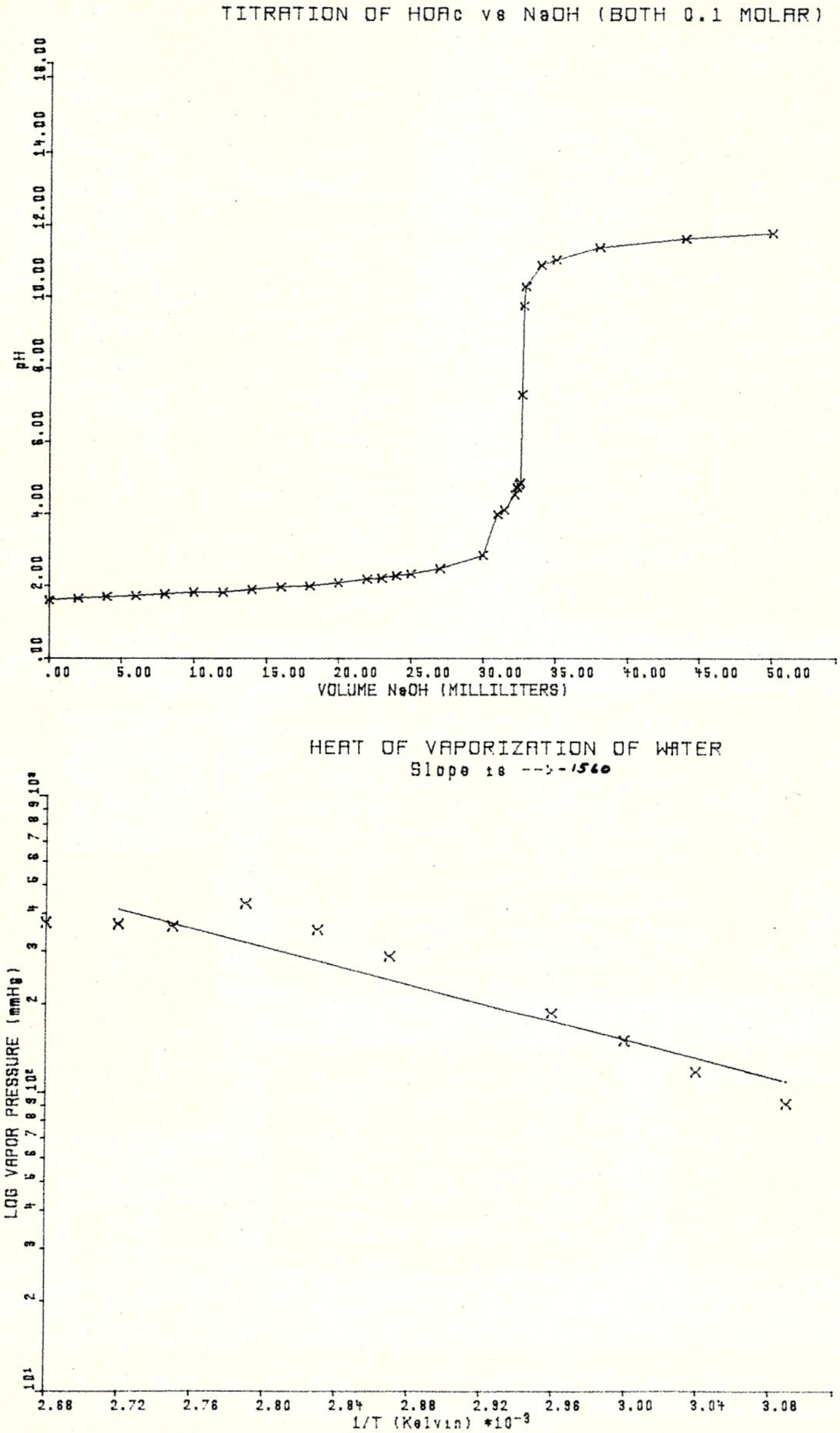
VISA® MasterCard

CDE CALIFORNIA DIGITAL ENGINEERING T.M.

P.O. BOX 526 ★ HOLLYWOOD, CA 90028

CIRCLE 66 ON READER SERVICE CARD

Figure 1. *Sample outputs from PLOTS programs.*



Some comments on Grafpak are in order here, inasmuch as it is the whole basis of PLOTS. The Grafpak package is a very powerful set of Fortran plotting subroutines which allows one to plot linear, semi-log and log-log plots, with labeled axes and files. Automatic scaling of data is provided, as well as scaling of the overall size of the plots. A single Fortran statement will enlarge or reduce the overall size of a plot. The pen location is monitored, so it is impossible to drive the pen on the HI plot against the stops, a very desirable feature! Grafpak has other features too numerous to mention here.

The documentation in Grafpak is for the most part excellent, as are the example plotting programs. Careful study will allow you to use all of the features of the package. The only area where the documentation is sketchy (and perhaps rightly so) is on getting the output of the package directed to the plotter. As supplied by Mycroft Labs, Grafpak sends all plotting information to the CP/M PUN: device. Initially, we were able to redirect the PUN: output to our second serial port by using DDT to modify the CP/M device driver dispatch table. We simply changed the jump table in the CP/M BIOS user area to cause PUN: to jump to the second serial port routine. Later, we added a new serial port, and then simply overwrote the PUN: code with a serial output routine for the new port. Again, the convenience of the software bus concept shows—very little patching is required to interface Grafpak to CP/M systems. The other ambiguity of the documentation was the absence of an example taking you through a sample session of preparing, compiling, and linking a plotting program. The listing in Figure 2 is an example of the steps, using a sample Fortran program (LOG.FOR) which comes with Grafpak. This probably should have been obvious to us, but it was not, so it took a good bit of guessing to get it right.

Grafpak has another feature which makes it an attractive piece of software. The software is modular enough that drivers may be written for it to use other plotting devices. Grafpak comes with drivers for both the HI-plot plotter, and the Tektronix 4010 family of graphics terminals. We have retrographics-equipped ADM 3 terminals which are equivalent to the TEK 4010, which makes it possible to direct plots to the video display. It is also possible to write drivers for other hardware. Mycroft Labs could provide assistance here, as they have written drivers for other plotters and would probably help with problems programmers might have in writing their own. Larry Hughes of Mycroft Labs proved very helpful in a number of telephone conversations when we were having trouble getting the TEK 4010 software working.

We will supply source listing for PLOTS, for three dollars, to cover handling and postage. (Make check payable to Joseph W. Long.) We can also supply the source on your disk (NorthStar 5" double density only) for no charge; please include an SASE for the return of your disk.

Grafpak is available from Mycroft Labs, P.O. Box 6045, Tallahassee, FL 32301; phone: (904)385-2708. The price of the package is $200.00, or $1,000.00 with all source code included. It is available on 8" single density soft-sectored format only. ■

CIRCLE 106 ON READER SERVICE CARD

Figure 2.

COMPILE LOG FOR
AND MAKE .PRN AND .REL FILES

```
A>F80 LOG,LOG=LOG
LOG
```

LOAD AND LINK LOG.REL

```
A>L80 LOG/N
```

SEARCH FOR UNDEFINED GLOBALS
SAVE LOG.COM

```
*LOG,PLOTLIB,FORLIB/S/G
```

LINK THESE. ORDER IS IMPORTANT. CALLS MAY BE MADE ONLY LEFT TO RIGHT

```
[0AD3    548E    84]
[Begin execution]
```

Figure 3. *System Requirements.*

56K CP/M
Microsoft Fortran 80
Microsoft Basic Compiler
(The compiler is required. The interpreted version of a program can not be linked with Fortran or Grafpak.)
Mycroft Labs Grafpak
Hi Plot Plotter or Tektronix
4010 Compatible Plotter

SOFTWARE DIRECTORY

Program Name: Spellbinder
Hardware System: CP/M + OASIS
Minimum Memory Size: 28K + Op System
Language: Assembly
Description: A full feature word processor with Office Management capabilities, integrated editing and printing sections. Special features include on-screen indents for outline creation, horizontal scrolling, user definable one-stroke function keys, and extremely flexible print formatting. Integrated print formatter includes bidirectional printing, true proportional spacing, print to and from screen, two column print, etc. The office management capabilities include both standard office procedures (forms handling, mail merge, cuesorting, alphanumeric selection and sorting, boiler plating, columnar manipulations such as removal, insertion, addition etc.) and a powerful macro capability which allows features to be added for the unique requirements of each user.
Release: June 1978
Price: $495
Included with price: Program, tutorial, reference and technical manual.
Where to purchase it:
Lexisoft
P.O. Box 267
Davis, CA 95616
(916)758-3630
CIRCLE 107 ON READER SERVICE CARD

Program Name: C/80 C-Compiler Version 2.0
Hardware System: 8" CP/M, 5" Osborne 1 or Heath/Zenith (CP/M or HDOS)
Language: 8080 object code
Description: C Compiler supporting full C data structures, pointers and multidimensional arrays. Supports major C language features with the exception of floats, longs and argument to macros. Includes data initialization and all C storage classes, and compiles all C arithmetic and logical operators and control statements, generating 8080 assembly language code for Macro-80, or for the included absolute assembler. A useful software development aid is the runtime profile facility, which can print execution time and frequency for each subroutine.
Release: March 1982
Price: $49.95 + $3 shipping ($2 for 5" disks); $10 for owners of previous version.
Included with price: Disk and manual.
Where to purchase it:
The Software Toolworks
14478 Glorietta Drive
Sherman Oaks, CA 91423
(213)986-4885
CIRCLE 108 ON READER SERVICE CARD

Program Name: INTROL-C for 6809
Hardware System: CP/M
Minimum Memory Size: 56K
Language: 8080 machine code
Description: A set of software development tools that allow C programs for 6809-based microprocessor systems to be created on 8080/Z80 development systems. Includes C compiler, 6809 assembler, object code linker, complete standard runtime library (with source code, in C) and library manager. Compiler supports all standard C except long, floating, and enumeration data types, initializers, bitfields, and structures as function parameters. All preprocessor directives are supported except #line and #if (#ifdef and #ifndef are supported, however). Compiled code is efficient, position independent, re-entrant, and ROMable. Price includes unlimited rights to distribute object code produced by compiler.
Release: February 1982
Price: $350.00
Included with price: 8" CP/M disk with object code, users manual.
Where to purchase it:
Introl Corp.
647 W. Virginia St.
Milwaukee, WI 53204
(414)276-2937
CIRCLE 109 ON READER SERVICE CARD

Program Name: Crosstalk Version 2.0
Hardware System: All CP/M systems
Minimum Memory Size: 32K
Language: 8080 Assembly language
Description: Allows microcomputer system to access almost any ASCII dial-up computer system, capture and store received data, send pre-edited files to a remote computer system, and exchange virtually any type and size of file with another Crosstalk system, regardless of disk format incompatibilities. Crosstalk can automatically dial up a system, establish access through passwords, and loan in data at full modem speed for off-line editing later.
Release: January 1982
Price: $150.00
Included with price: Diskette and 60 page manual.
Where to purchase it: Available at computer stores, Dealer + end user information is available from:
Microstuf, Inc.
1900 Leland Dr., Suite 12
Marietta, GA 30067
(404)952-0267
CIRCLE 111 ON READER SERVICE CARD

Program Name: Plink(TM), RCPMLINK-(TM)
Hardware System: Osborne 01
Minimum Memory Size: 64K
Description: Allows communications via modem. User friendly PLINK asks for Drive A or B, then file name, to quickly save file to disk. To send a file, a simple control T + PLINK asks for Drive A or B + file name. RCPMLINK is a multi-function communications program. Its primary function is the transfer of files between remote CP/M systems or other Osborne 01 computers. The transfer is accomplished via a block mode, with headers and checksums (or optionally CRC checking) to ensure data validity. Automatic retry (up to ten times) is attempted for every sector of data transmitted or received when parity, framing, or overrun errors are encountered on a data "byte," or on blocks of data that have checksum or CRC (cyclic redundancy check) errors. The user is given an option to quit, or retry after ten consecutive errors occur.
Release: March 1982
Included with price: 5-1/4" disk and manual.
Where to purchase it:
Wizard of OsZ
P.O. Box 964
Chatsworth, CA 91311
(213)341-9399

CIRCLE 112 ON READER SERVICE CARD

Program Name: SYSTEM-70
Hardware System: CP/M 8" SD, 5-1/4" North Star & Micropolis Mod II
Minimum Memory Size: 16K
Language: Assembler
Description: Development system software for National Semiconductor 70-Series microprocessors. With minor exceptions, assemblers feature instruction mnemonics and syntax as defined by the processor manufacturer. The macro-assembler includes full macro and conditional assembly features as well as the ability to chain a series of source files together during a single assembly. Programs developed under this system must be off-loaded to target processor for test. Facilities are provided to implement off-loading mechanism as a direct transfer from memory, via a byte stream over a CPU port, or via .COM or .HEX disk files.
Release: March 1982
Price: $150.00
Included with price: Disk documentation and user support.
Where to purchase it:
Allen Ashley
395 Sierra Madre Villa
Pasadena, CA 91107
(213)793-5748

CIRCLE 113 ON READER SERVICE CARD

Program Name: EPSET(tm)
Hardware System: 8" CP/M system or 5-1/4" NorthStar
Minimum Memory Size: 32K
Language: Object code
Description: "EPSET" contains nine files, eight of which are for testing EPSON-MX80's accuracy in printing its entire set of ASCII characters. The eighth file provides a menu for instantaneous selection and configuration of the EPSON-MX80 for combinations of characters per inch, single-, double-, and emphasized-strike, and line-spacing. The program is written in PL/I-80 for speed and precision.
Release: March 1982
Price: $39.95
Included with price: 8" disk or NorthStar 5-1/4" disk and manual.
Where to purchase it:
Success Analysis Corporation
743 Holly Oak Drive
Palo Alto, CA 94303
(415)494-2613

CIRCLE 114 ON READER SERVICE CARD

Program Name: SYSTEM-TMS7
Hardware System: CP/M 8" SD, 5-1/4" NorthStar, 5-1/4" Micropolis Mod II
Minimum Memory Size: 16K
Language: Assembler
Description: Development software that enables any CP/M system to serve as a development station for Texas Instruments TMS7000 series microprocessors. With minor exceptions, assemblers feature instruction mnemonics and syntax as defined by processor manufacturer. Macro assembler includes full macro and conditional assembly features as well as ability to chain a series of source files together during a single assembly. Programs developed under this system must be off-loaded to the target processor for test. Facilities are provided to implement off-loading mechanism as a direct transfer from memory, via a byte stream over a CPU port, or via .COM or .HEX disk files.
Release: 1982
Price: $150.00
Included with price: Macro assembler, interactive editor/assembler, text editor. Complete documentation is included and full user support is provided.
Where to purchase it:
Allen Ashley
395 Sierra Madre Villa
Pasadena, CA 91107
(213)793-5748

CIRCLE 115 ON READER SERVICE CARD

Program Name: SYSTEM-51
Hardware System: CP/M 8" SD 5-1/4" NorthStar & Micropolis Mod II.
Minimum Memory Size: 16K
Language: Assembler
Description: Development system software that enables a CP/M system to serve as a development station for Intel 8051/8751 single-chip processor. With minor exceptions, the assemblers feature instruction mnemonics and syntax as defined by Intel. The macro-assembler includes full macro and conditional assembly features as well as ability to chain a series of source files together during a single assembly. Programs developed under this system must be off-loaded to target processor for test. Facilities are provided to implement off-loading mechanism as a direct transfer from memory, via a byte stream over a CPU port, or via .COM or .HEX disk files.
Release: October 1981
Price: $150.00
Included with price: Disk, documentation, and user support.
Where to purchase it:
Allen Ashley
395 Sierra Madre Villa
Pasadena, CA 91107
(213)793-5748

CIRCLE 116 ON READER SERVICE CARD

Program Name: JRT Pascal version 2
Hardware System: CP/M compatible systems.
Minimum Memory Size: 52K
Language: Assembly Language
Description: Full Pascal compiler and run-time system. Supports double precision (14-digit) floating point arithmetic, 64K strings, virtual storage for external procedures, separate compilation. True dynamic storage with automatic compression totally eliminates storage waste due to fragmentation. Procedures are not limited in size, recursion, nesting. I/O system supports binary and ASCII files, random disk files by record number or by relative byte address for variable length records. JRT Pascal optimizes programmer time with one-step compile—no assembly or link needed—verbal error messages, dynamic trace control. Advanced assembly language interface. The activity analyzer monitors programs and prints a histogram of execution frequency by line number. A utility is included to convert Microsoft format REL files to JRT format.
Release: January 1982
Price: $295 (manual only $30)
Included with price: Disk (available in most formats), user's guide, 3-ring binder, user manual & report.
Where to purchase it:
JRT Systems
P.O.Box 22365
San Francisco, CA 94122
(415)566-4240

CIRCLE 117 ON READER SERVICE CARD

Program Name: MultI/OS (multi-user operating system)
Hardware System: Z80/8080/8085 incl. Altos, Superbrain, TRS-80 MOD II
Minimum Memory Size: 64K memory board each user, 8K shared partition.
Language: Assembler "C"
Description: Allows simultaneous use by up to 16 users of one microcomputer. Configuration library contains over 70 devices and 20 disk drivers. Features are: mixing 5" and 8" floppy disks and hard disks; multiple printers with automatic spooling; 56K bytes per user; full range of languages available; CP/M, CDOS, SDOS compatible; turnkey system features; interactive dialogue; record/lock using FMM; full single-user compatibility; "file mapped" messages for inter-user communications using high level languages; 15 disk units of 65 megabytes each; up to 975 megabytes on-line; user assignable subdirectories allow 63,504 files per unit; and many more.
Release: January 1981
Price:$900.00 end user. Call for OEM and dealer pricing.
Included with price: User manual and three month subscriber service for updates.
Where to purchase it:
InfoSoft Systems Inc.
25 Sylvan Road South
Westport, CT 06880
(203)226-8937

CIRCLE 118 ON READER SERVICE CARD

Program Name: SELECTOR V
Hardware System: Any CP/M, MP/M & any compatible system
Minimum Memory Size: 48K memory Partition
Language: Machine Language
Description: Processes multiple files and their relationships to each other to accomplish a wide variety of applications: accounting, inventory, label production, report or forms production, or anything requiring the maintenance of one or more lists. It is unique in its ability to produce sophisticated output without having to write programs. Menu-driven; requires a 24 by 80 cursor addressable terminal.
Release: November 1981
Price: $495.00
Included with price: Manual & program disk.
Where to purchase it:
Micro-Ap, Inc.
7033 Village Parkway/Suite 206
Dublin, CA 94566
(415)829-6697

CIRCLE 119 ON READER SERVICE CARD

Program Name: DDUP
Hardware System: Any system running CP/M 2.x
Minimum Memory Size: 32K
Language: 8080 machine code
Description: DDUP (Disk Duplication) provides a convenient way to duplicate a diskette and/or to verify that two diskettes are identical. DDUP is made to be independent of disk controller, type of drive, disk size and format. Automatically adapts to actual number of tracks and sectors per track for the disks used. Requires that source and destination disk be of same format and density. It will replace bad

sectors on source disk with blank sectors on destination disk thus enabling automatic recovery (what can be recovered from) of damaged files and "crashed" disks. During disk duplication and/or verification, all disk errors are listed on printer and/or console, with corresponding track, sector and allocation block (or 'group') numbers.
Release: March 1982
Price: $29.95 + $8 shipping/handling.
Included with price: Disk and 13 page user's guide.
Where to purchase it:
Elektrokonsult Inc.
Konnerudgt. 3
N-3000 Drammen
Norway
CIRCLE 120 ON READER SERVICE CARD

Program Name: MR EDit
Hardware System: CP/M or MP/M with st'd CRT
Minimum Memory Size: 24K Transient program space
Language: Assembler
Description: Full screen-oriented text editor. Commands given by text or command key. User defines own command keys. Supports primary + secondary input and output files. Command keys "live" and text in view at all times, even in command mode. Supports inset + over write, word wrap and paragraph alignment. Cursor movement by character line, paragraph, screen; left, right, up, or down. Deletion by character, word paragraph, screen, buffer. Supports top of file, end of file cursor positioning. Has paste/cut buffer, with loading by line, paragraph, or user-defined area, can print selected areas on line printer. Supports horizontal scrolling, command file handling + iteration macros, indent levels for structured programming.
Price: $19.95 (TN residents add 6.75% sales tax)
Included with price: Manual + distribution diskette.
Where to purchase it:
Micro Resources Corporation
6922 Harding Road
Nashville, TN 37221
(615)352-4605
CIRCLE 121 ON READER SERVICE CARD

Program Name: MultI/NET (networking faculty)
Hardware System: Z80/8080/8085 incl. Altos, Superbrain, TRS-80 Mod II
Minimum Memory Size: 16K-user node, 48K served node
Language: Assembler, "C"
Description: MultI/NET adds network capabilities to MultI/OS, I/OS and UNI/OS operating systems. The basic structure of MultI/NET follows the ISO open system interconnect structure, with the inter-unit message structure allowing flexible protocols. Some features of the system architecture are: network nodes can be either single user with disk, single user without disk, or multi-user with disk; shared resources, such as disks and printers, operate as server for the network nodes; multiple servers and users can be set up at the same location using MultI/OS. Standard facilities include: directory, sub-directory, remote task, password protection, interunit file transfer, file sharing, record/file lock, remote disk, directory assigning, remote spooler control, multiple printers both local and remote. Planned facilities include: gateways both SNA and X.25, bridges and electronic mail.
Release: New, call for details.
Price: $200.00/CPU. Call for OEM and dealer pricing.
Included with price: User manual and 3 month subscriber update service.
Where to purchase it:
InfoSoft Systems Inc.
25 Sylvan Road South
Westport, CT 06880
(203)226-8937
CIRCLE 122 ON READER SERVICE CARD

Program Name: Reliability Prediction
Hardware System: CP/M 2.2, DD 8" disk drives and 132 col. printer.
Minimum Memory Size: 64K
Language: C Basic-2
Description: A systematic procedure for determining the reliability on an electronic system based on Military Handbook 217, the standard used by the military for reliability analysis. Reliability prediction can be updated rapidly, especially important during the development of new equipment, but it can also be of significant benefit in improving the reliability of existing designs. Analyzing early design concepts can show potential problem areas and how the overall system reliability may be improved. Menu driven program does all actual failure rate calculations and computes total system failure rate and Mean-Time-Between-Failure. The calculations results may then be printed, showing reliability prediction by assembly and subassembly. Reports also show the application data for each system element and a summary of system structure. The 200 page instruction manual includes instructions for using the system with working examples and sample reports.
Release: May 1982
Price: $950
Included with price: Two 8" SD disks and 200 page manual.
Where to purchase it:
Elliam Associates
24000 Bessemer St.
Woodland Hills, CA 91367
(213)348-4278
CIRCLE 123 ON READER SERVICE CARD

NEW PRODUCTS

Low Cost/High Speed S-100 Data Encryption/Decryption Board & Software

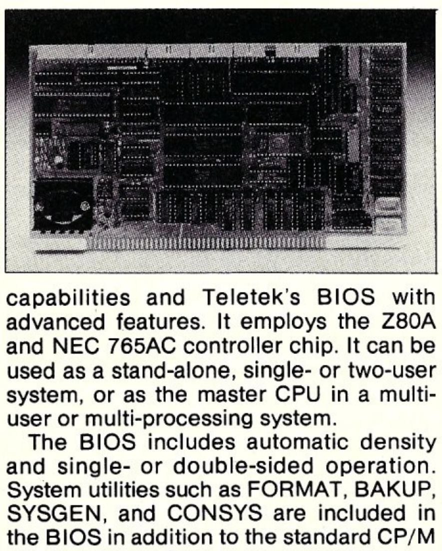
Data Star has introduced ENCRYPTOR, an efficient and economical encryption/decryption unit employing an S-100 compatible board. ENCRYPTOR features programmed input/output for key, data, commands and states; software for CP/M, MP/M and OASIS systems and takes only 25 microseconds to encrypt or decrypt 8 bytes. It allows for the security of microcomputer data, protecting the confidentiality of sensitive files, whether stored or in transmission. Data may be secured on any system equipped with the ENCRYPTOR (and supporting software) and may be sent to any compatible system. The encryption key is simply given to the desired recipient of the secured data (independent of said data) who, in turn, uses it in the DES function to decrypt the information. (NOTE: The key stored on the chip is not externally accessible.)

Each ENCRYPTOR is individually tested against NBS methods. The system interface features two program I/O ports (one for data, one for status), jumper-selectable port addresses and interrupt mode. It complies with IEEE 696.1/D2 and supports IEEE-696 use of VI* lines. It has a data transfer rate of 1.3 megabits per second. Price is $395; order from Data Star, 9700 Fair Oaks Blvd., Suite G, Fair Oaks, CA 95628; (916)966-6838.

CIRCLE 124 ON READER SERVICE CARD

SYSTEMASTER From Teletek

Teletek's SYSTEMASTER board combines all of the functions of a CPU board: memory board, floppy disk controller board, and an I/O board along with DMA



capabilities and Teletek's BIOS with advanced features. It employs the Z80A and NEC 765AC controller chip. It can be used as a stand-alone, single- or two-user system, or as the master CPU in a multi-user or multi-processing system.

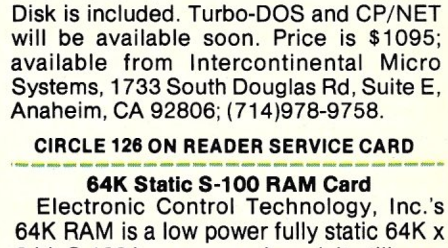
The BIOS includes automatic density and single- or double-sided operation. System utilities such as FORMAT, BAKUP, SYSGEN, and CONSYS are included in the BIOS in addition to the standard CP/M utilities. The BIOS will support 5-1/4" and 8" drives simultaneously. Single-user, multi-user, and multi-processing software is available through Teletek from Digital Research, Turbodos, and Infosoft.

Price: $895; available from Teletek, 9767F Business Park Drive, Sacramento, CA 95827; (916)361-1777.

CIRCLE 125 ON READER SERVICE CARD

Complete S-100 Computer

Intercontinental Micro Systems announces a complete system on an S-100/IEEE-696 board. The Z80A based model CPZ-48000 features 64K dynamic RAM, two synchronous or asynchronous I/O channels, two parallel I/O channels, memory management of 16 Mb of system memory, a floppy disk controller for single/double density-one/two sided-5/8" disk drives, eight vectored priority interrupts with Z80 mode 2 interrupts chained in, and capacity for either 2K or 4K onboard EPROM. A line of "personality" boards combine to make the CPZ-48000 compatible with 5-1/4" floppy disks, 8" floppy disks, full modems, Seagate, Priam, NEC, Diablo, Qume, Archive and RS422 speed serial interfaces. The CPZ-48000 can be used as a stand alone computer, network master, multiuser host and multiprocessor host.



MP/M and CP/M are available and Turbo-Disk is included. Turbo-DOS and CP/NET will be available soon. Price is $1095; available from Intercontinental Micro Systems, 1733 South Douglas Rd, Suite E, Anaheim, CA 92806; (714)978-9758.

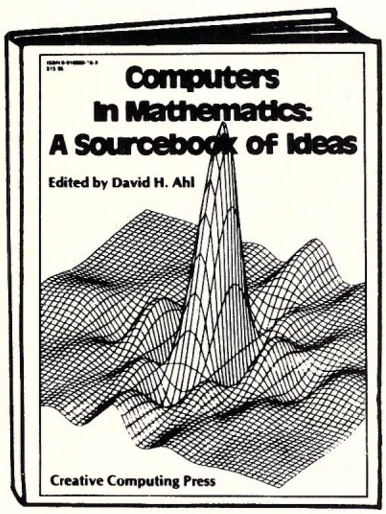
CIRCLE 126 ON READER SERVICE CARD

64K Static S-100 RAM Card

Electronic Control Technology, Inc.'s 64K RAM is a low power fully static 64K x 8-bit S-100 bus memory board. It utilizes a single supply 2K x 8-bit fully static memory IC with the same pinout as the 2716 EPROM, therefore ROM can be intermixed with the RAM. A DIP switch provides 24-bit extended addressing selection of the board on 64K boundaries; or the board can be used on just 16-bit address. For

Sourcebook of Ideas

Many mathematics ideas can be better illustrated with a computer than with a text book.



Consider Baseball cards. If there are 50 cards in a set, how many packs of bubble gum must be purchased to obtain a complete set of players? Many students will guess over 1 million packs yet on average it's only 329.

The formula to solve this problem is not easy. The computer simulation is. Yet you as a teacher probably don't have time to devise programs to illustrate concepts like this.

Between grades 1 and 12 there are 142 mathematical concepts in which the computer can play an important role. Things like arithmetic practice, X-Y coordinates, proving geometic theorems, probability, compounding and computation of pi by inscribed polygons.

Endorsed by NCTM

The National Council of Teachers of Mathematics has strongly endorsed the use of computers in the classroom. Unfortunately most textbooks have not yet responded to this endorsement and do not include programs or computer teaching techniques. You probably don't have the time to develop all these ideas either. What to do?

For the past six years, *Creative Computing* magazine has been running two or three articles per issue written by math teachers. These are classroom proven, tested ideas complete with flowcharts, programs and sample runs.

Teachers have been ordering back issues with those applications for years. However, many of these issues are now sold out or in very short supply.

So we took the most popular 134 articles and applications and reprinted them in a giant 224-page book called *Computers in Mathematics: A Sourcebook of Ideas.*

Ready-to-use-material

This book contains pragmatic, ready to use, classroom tested ideas on everything from simply binary counting to advanced techniques like multiple regression analysis and differential equations.

The book includes many activities that don't require a computer. And if you're considering expanding your computer facilities, you'll find a section on how to select a computer complete with an invaluable microcomputer comparison chart.

Another section presents over 250 problems, puzzles, and programming ideas, more than are found in most "problem collection" books.

Computers in Mathematics: A Sourcebook of Ideas is edited by David Ahl, one of the pioneers in computer education and the founder of *Creative Computing.*

The book is not cheap. It costs $15.95. However if you were to order just half of the back issues from which articles were drawn, they would cost you over $30.

Satisfaction Guaranteed

If you are teaching mathematics in any grade between 1 and 12, we're convinced you'll find this book of tremendous value. If, after receiving it and using it for 30 days you do not agree, you may return it for a full refund plus your return postage.

To order send payment* plus $1.00 postage and handling to Creative Computing, Dept. M720, 39 E. Hanover Avenue, Morris Plains, N.J. 07950. Orders may also be charged to your Visa, Mastercard or American Express account — by mail include credit card name, number and expiration date, or if you prefer, use our 24-hour toll-free number, 800-631-8112. In N.J. only 201-540-0445.

*N.J. Residents add 5% tax.

creative computing

Prob-lem

The world is full of intriguing problems that never got into a textbook.

Problems for Computer Solution

by Steve Rogowski

Ninety intriguing and fascinating prob lems, each thoroughly discussed and re erenced, make an excellent source c exercises in research and preliminar investigation. Eleven types of problem are provided in the following areas: arit metic, algebra, geometry, trigonometr number theory, probability, statistics, ca culus and science. Author Stephe Rogowski of SUNY-Albany has include several problems which have never bee solved. He feels that some research an an attempt to solve these will sharpe students' insight and awareness.

Some of the problems are not new lik the one asking how much the $24 th Indians were paid for Manhattan would b worth today had it been deposited in bank. However, this problem was revise to have a variable interest rate so it woul be a challenge to program. Of cours many of the problems are new and hav never been in print before.

The student edition has 106 pages an includes all 90 problems (with variations 7 appendices and a complete biblio raphy. Cost is $4.95.

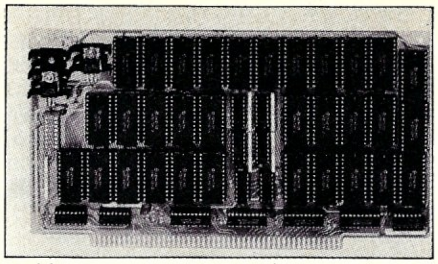
The 182-page teacher edition contain solutions to the problems, each with complete listing in Basic, sample runs, an in-depth analyses explaining th algorithms and theory involved. Cost i $9.95.

To order send payment* plus $2.00 postag and handling to Creative Computing, Dep M721, 39 E. Hanover Avenue, Morris Plain NJ 07950. Orders may also be charged t your Visa, Mastercard or American Expres account—by mail include credit card nam number and expiration date, or if you prefe use our 24-hour toll-free number, 800-631 8112. In N.J. only 201-540-0445.

*N.J. Residents add 5% tax.

creative computing

New Products, continued...



multi-user systems, 16K can remain global while 48K responds to extended addressing Portions of the board can be disabled (for memory-mapped disk controllers or ROM) in 2K blocks above E000, in 16K blocks, in any 2K block with jumper wires, or in any block or single address by phantom. CPU's can operate at 2 MHz or 4 MHz (DC to 10 MHz under certain conditions). Low profile IC sockets are provided for all IC's. Electronic Control Technology, Inc., 763 Ramsey Ave., Hillside, N.J. 07205; (201)686-8080.

CIRCLE 127 ON READER SERVICE CARD

S-100 Bubble Memory Card

Teleram Communications Corp. has introduced the S100B Bubble Memory System. The S100B MBMS is a self-contained magnetic bubble memory system using the Intel 7110 1-megabit bubble device. Each board has a capacity of 128K to 256K of non-volatile storage and takes up one S-100 slot. Up to four boards can be daisy-chained to provide 1 megabyte of storage. Driver software is included to interface the bubble system into any 8080/Z80 CP/M system (version 2.0). With its low power consumption, high reliability and compactness, bubble memory is suited for portable process control and point of sale applications to name a few.

It has an average access time of 40 msec, a data rate of 100K bits/sec (for a one bubble system) to 800K bits/sec eight bubble system). A 14-bit fire code is appended to each 256 bits of data for correction of up to 5-bit burst errors. It is CP/M compatible, can use polling, interrupt (two separate interrupt lines) or DMA. It fully conforms to the proposed IEEE/S-100 standard. Power fail detect insures that data will not be lost during unexpected power outages.

Prices are $2295 for 128K, $3495 for 256K and $1670 and $2620 each for 100 lots. Teleram Communications Corp., 2 Corporate Park Dr., White Plains, NY 10604, (914)694-9270.

CIRCLE 128 ON READER SERVICE CARD

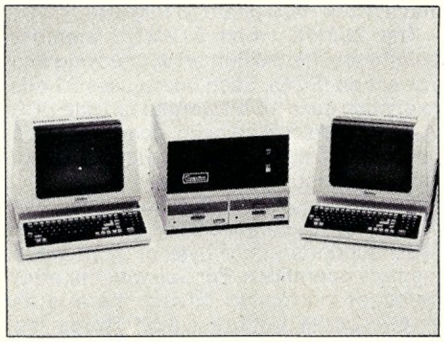
Multi-User System Runs 8/16-Bit Programs Simultaneously

A high speed multi-user system allowing simultaneous running of both 8- and 16-bit applications programs while providing 30% more available program area is now available from CompuPro.

A proprietary implementation of Digital Research's MP/M-86, MP/M 8-16 utilizes CompuPro's 8085/8088 CPU card and features 62K of user program space for 8-bit CP/M 2.2 compatible software. This compares to the standard 48K allowed under MP/M 2.

The new system performs both single-user and multi-user functions while running any combination of CP/M 2.2 or CP/M-86 software for as many as eight users.

System throughput is increased by the use of CompuPro's interrupt-driven DMA floppy disk and hard disk controllers, and by an optional M-DRIVE memory disk. The WARP DRIVE disk allows main system random access memory to emulate a disk drive, thus increasing throughput by as much as a factor of 30. A further enhancement to throughput is provided by CompuPro's MPX-1, a DMA channel controller board. Featuring an 8085 CPU and 16K of local memory, the MPX-1 directly accesses all I/O devices and relieves the system's 8085 and 8088 of most of the I/O tasks required.



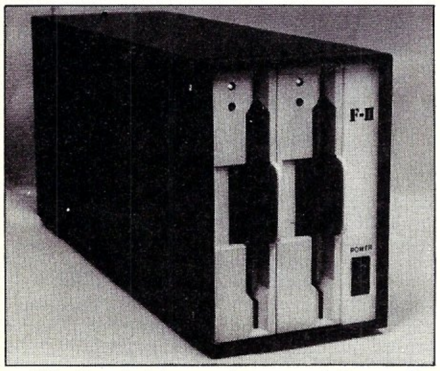
Both processors run at 6 MHz, providing a 300 percent improvement in throughput over 2 MHz systems, and can accept clock speeds up to 8 MHz for future requirements. Upon receipt of a single input instruction, the on-board hardware switches between processors, thus offering real-time multi-user capability. The board accesses 16 megabytes of memory and fully conforms to all IEEE-696/S-100 bus specifications.

ComprPro's MP/M 8-16 operating system is priced at $995.00. Contact CompuPro, Oakland Airport, CA 94614; (415)562-0638.

CIRCLE 129 ON READER SERVICE CARD

Slim DS/DD Disk System

The ISA's F2P and F2 are floppy disk subsystems using two 8" ultra-slim, double-sided, dual-density floppy disk drives. The F2P drives are fully signal-compatible with the Persci 299B drive so that they can be configured into any Cromemco system. The F2 is intended for use in general system configurations and has an interface which is fully compatible with the Shugart SA801R and SA850R drives. Their major features are the following:

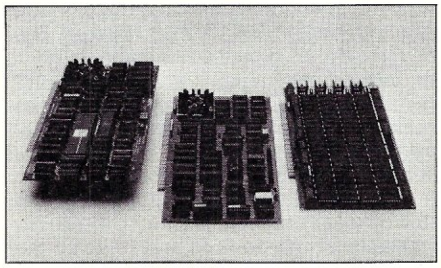


DC direct-drive motor, special cam for high reliability, 3 msec seek time, free space inside the cabinet for an interface board (F2), and power supply unit. Noise filter and blower are also provided. For more information, contact International Systems & Automation, Heian Bldg., 2-6-16 Okubo, Shinjuku-ku, Tokyo 160, Japan.

CIRCLE 130 ON READER SERVICE CARD

Cromemco 68000 Board Family With Error Correcting Memory

Cromemco has announced a new Dual Processor Unit (DPU) which incorporates both 68000 and Z-80A processors on a single S-100 board.



Also offered are a Memory Controller Unit (MCU), a 256K RAM bord (256MSU), and a 512K RAM board (512MSU).

The 256MSU and 512MSU memory boards provide built-in error checking and correction (ECC). Each board uses 22 bits to encode each 16-bit word to provide ECC via a modified Hamming code, allowing transparent detection and correction of single and double bit errors.

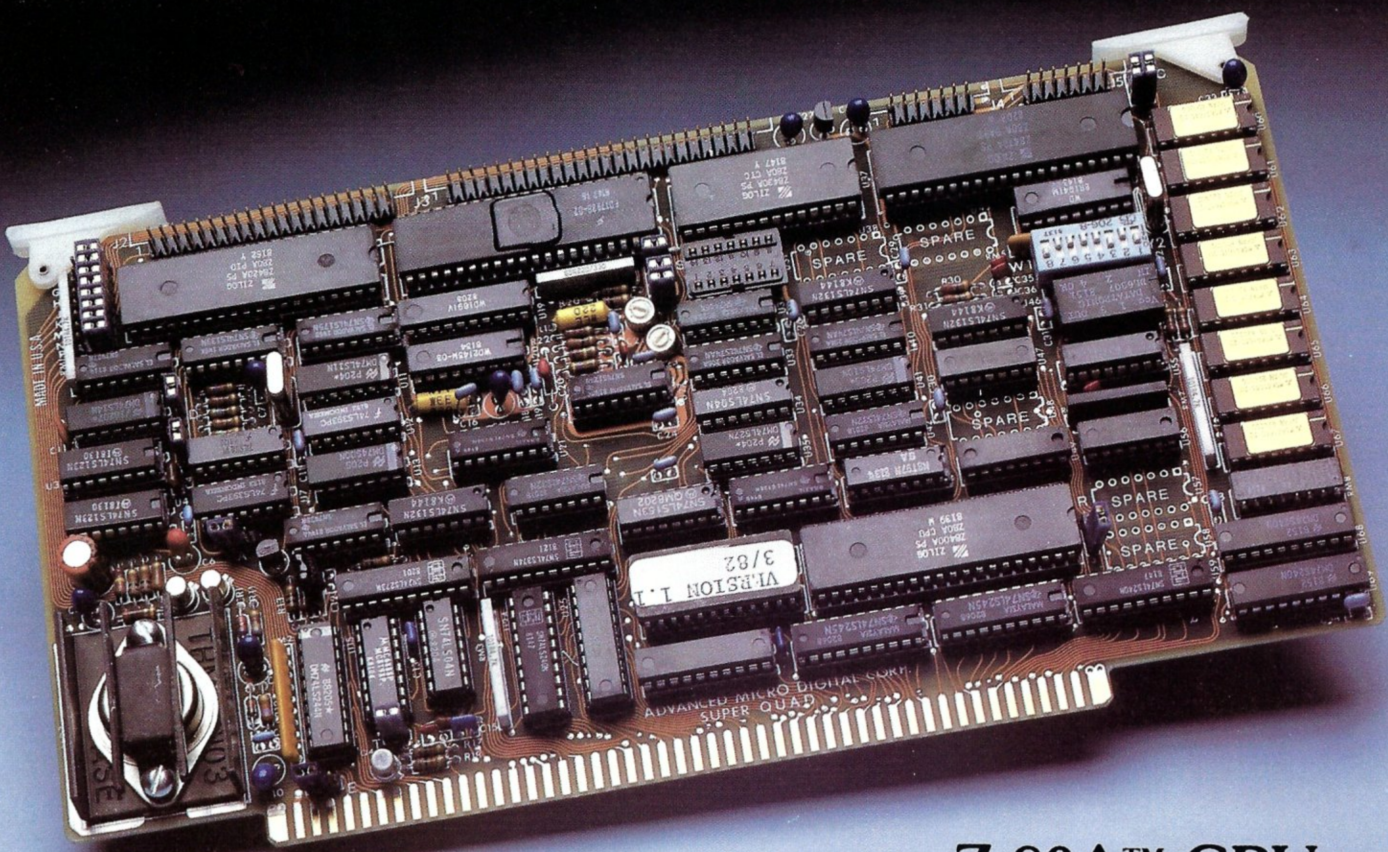
The Memory Controller Unit (MCU) can control up to eight memory boards. Each MSU supports either byte or word width memory operations. For use with the error detection/correction MCU's, there is an error-logging feature which stores the location of errors encountered, identifying which MSU and particular RAM chip on the MSU had the error.

The Dual Processor Unit (Model DPU) is $995. The Memory Controller Unit (Model MSU) is $495. The 256K and 512K Memory Storage Units (Model 256MSU and Model 512MSU) are $1995 and $2995 respectively. Available from Cromemco, Inc., 280 Bernardo Avenue, Mountain View, CA 94043; (415)964-7400.

CIRCLE 131 ON READER SERVICE CARD

Advertiser Index

The World's First



Z-80A™ CPU, Floppy Disk Controller, 64K of Memory, Serial & Parallel I/O Ports . . . all on a SINGLE S-100 BOARD!

Don't Buy Another One of Those 3 Board Sets Till You See What One Can Do!

Advanced Micro Digital has been producing the SUPER QUAD for some time now and it's truly one of a kind. Just plug this board into any S-100 mother board and hook-up your disk drives to it. It flies. Runs with CP/M, MP/M, and turbo-DOS. You can also plug in additional boards, I/O, hard disk controllers, etc. SUPER QUAD is a BUS master. The cost of this board is one third to one half of what you have been paying for the three board set. Just take a look at these features:

- IEEE S-100 Standard
- Z-80A CPU
- 64K of Bank Select Memory as well as extended addressing
- Double density floppy disk controller. Both 8 or 5¼" Disk Drives
- 2 serial & 2 parallel I/O ports (RS-232 and intelligent hard disk interface).
- 2K or 4K of monitor EPROM
- Runs with CP/M®, MP/M® and turbo-DOS™
- One year warranty.
- Free copy of bios disk.

Also introducing SUPER/SLAVE to run multi-processing operating systems such as turbo-DOS™. With 128/64K of memory, serial & parallel I/O, you can plug multiple of the slaves with the master and each user will have its own CPU and memory local.

ADVANCED MICRO DIGITAL CORPORATION

Now it's time to replace or throw away the old S-100 boards and plug the SUPER QUAD in. Save space, money and power.

Retail price is $875.

For more information write or call: Sales Dept.

CIRCLE 64 ON READER SERVICE CARD

7201 Garden Grove Blvd. • Suite E • Garden Grove CA 92641 • (714) 891-4004 TELEX: 678401 tab irin

MULTIPLE CHOICE FOR MULTIPLE USERS.

CompuPro, the company which pioneered active termination, dual processing for microcomputers, M-Drive (the first "solid-state" disk), and DMA soft/hard disk controllers, has now created the 8/16 bit multi-user operating system for the 80s.

MP/M 8-6 lists for $1000. System requirements include **CompuPro** dual processor (CPU 8085/88) based system with appropriate interfacing, memory, and disk capabilities, as well as the System Support 1 and MPX 1 boards. **MP/M 8-16** is used under license from Digital Research.

MP/M® 8-16, CompuPro's proprietary edition of Digital Research's MP/M 86 V2.X, unleashes the power of dual processing for unprecedented multi-user performance. Run the extensive library of 8 bit CP/M 2.2 software, ***and*** the latest 16 bit CP/M-86 software, ***simultaneously***—even run different software packages at different stations. There's also over 60K of temporary program area for each station; and, since both 8 and 16 bit software run under a true 16 bit operating system, speed and performance increases for ***any*** software run under **MP/M 8-16**.

To experience the state of the art in multi-user business, industrial, and scientific microcomputing, visit your authorized **CompuPro Systems Center**.

CompuPro
SYSTEMS

CompuPro division, Godbout Electronics, Oakland Airport, CA 94614-0355

CIRCLE 85 ON READER SERVICE CARD