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

$2.50 U.S.A.

MICROSYSTEMS™

MAR/APR 1982

VOL. 3/NO. 2

MULTI-USER OPERATING SYSTEMS

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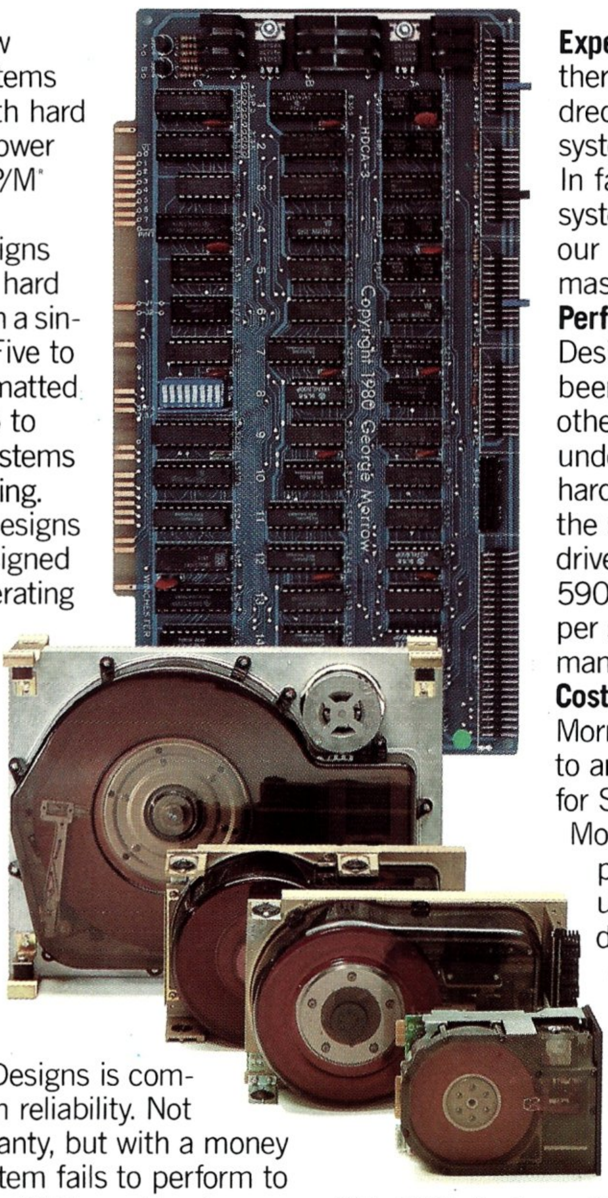

Complete systems. Morrow Designs hard disk subsystems are delivered complete with hard disk, controller, cabinet, power supply, fan, cables and CP/M* 2.2 operating system.

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S-100 and more. Morrow Designs hard disk systems are designed for use with the CP/M operating system. Available software packages allow our systems to run on any IEEE696/S-100 Standard system with no hardware modification. Plus, Cromemco,*** North Star,** Vector Graphics, Godbout, Dynabyte, Exidy,**** IMSAI, Micromation, Processor Technology and California Computer Systems.

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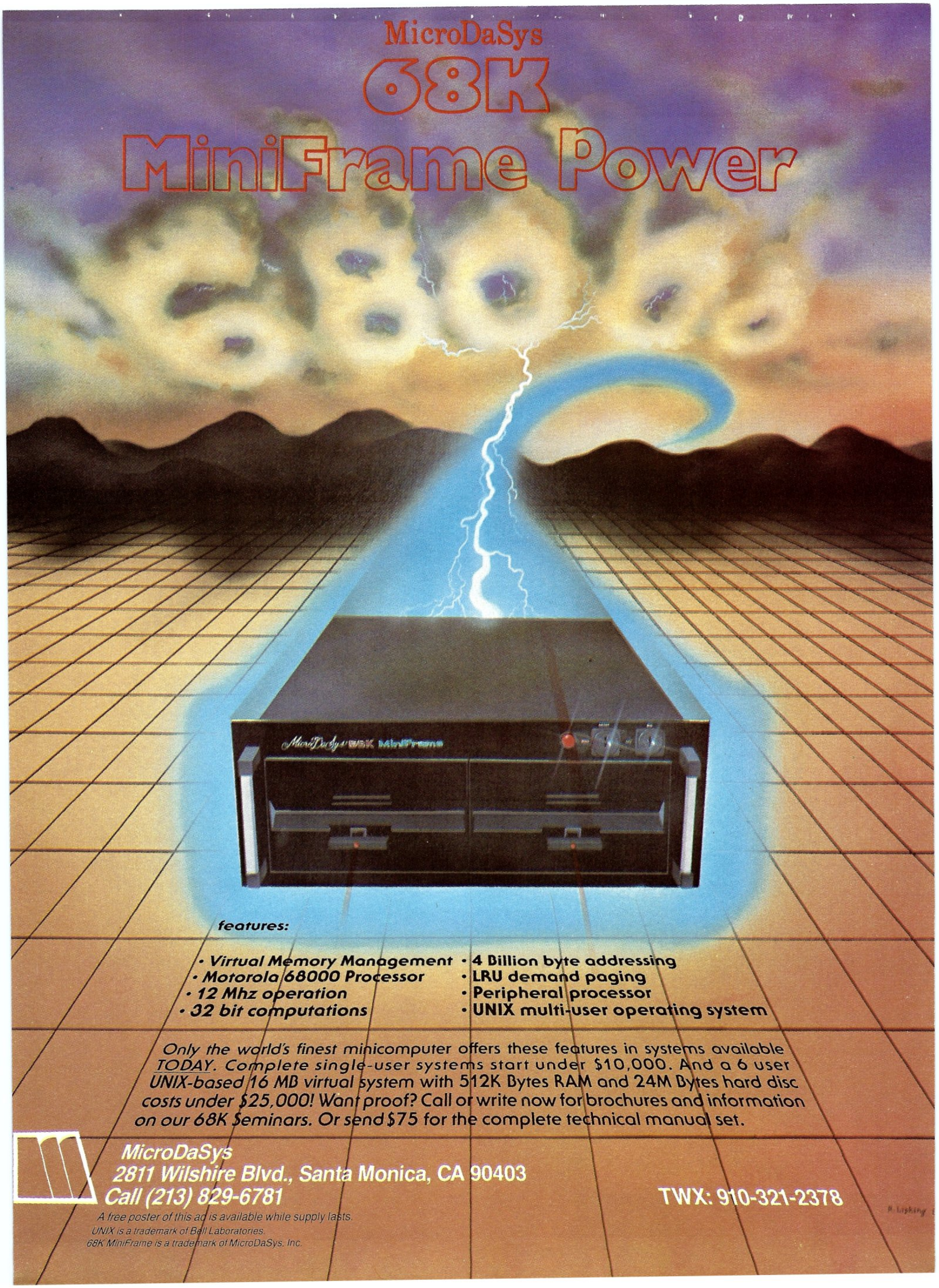
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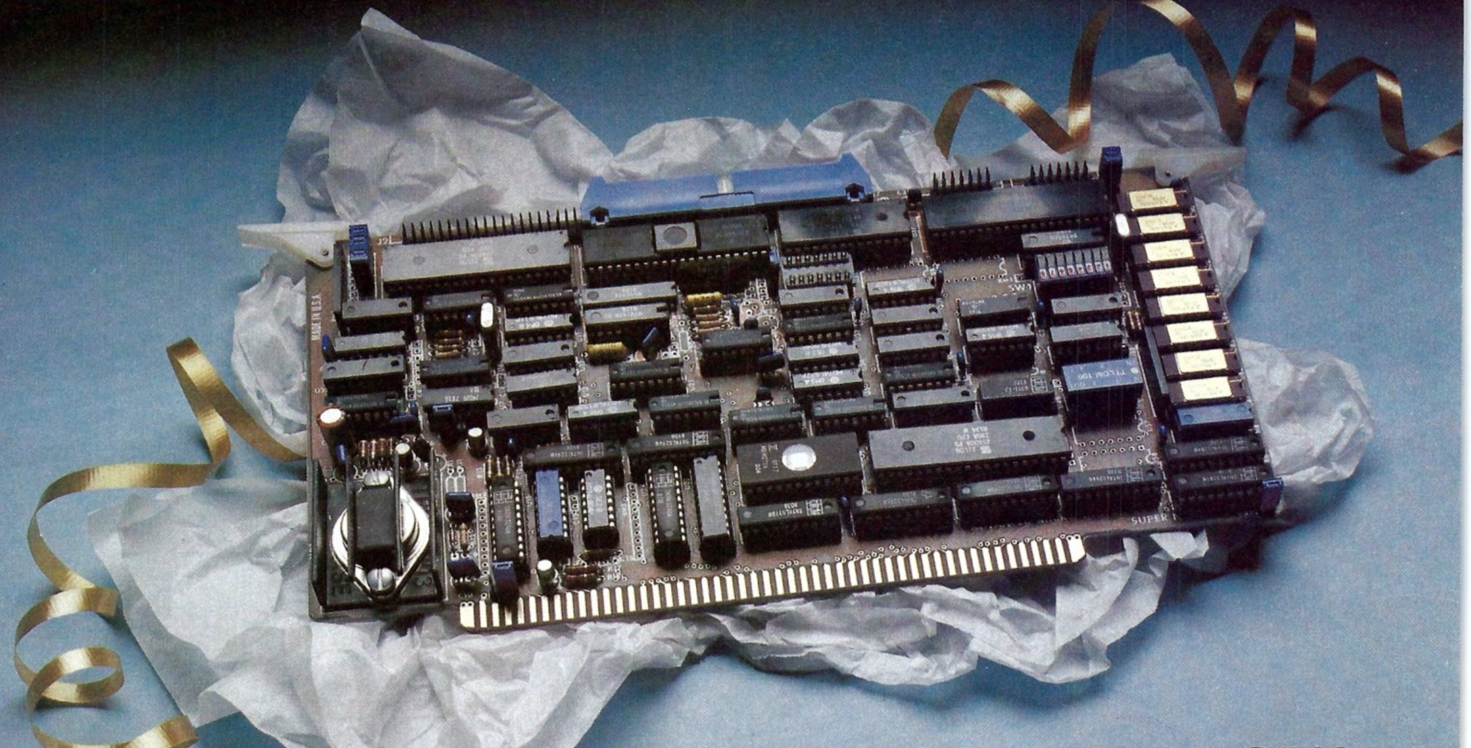

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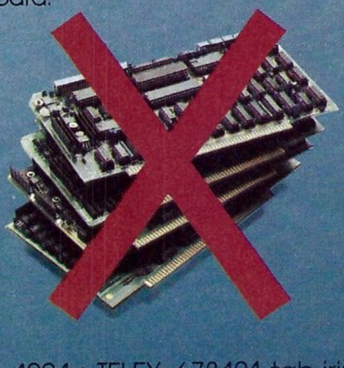

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the CP/M* and S-100 user's journal

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MEMBER MITA

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In This Issue

Multi-User Systems

Departments

Called "MP/M II™"

MP/M II, the multiuser extension of our CP/M operating system, answers the lucrative business community demand for small scale distributed processing. Smart OEM's, language companies and application programmers are enthusiastically extending their offerings to satisfy this "new" market.

MP/M II Features

Record locking and file locking ensure data base validity when multiple users access the same data.

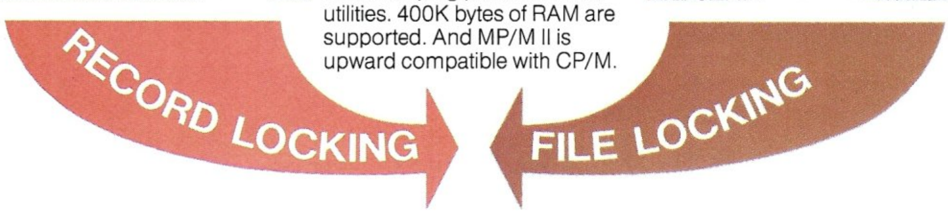
With 32 megabyte file capacity, you can daisy-chain 16 state-of-the-art disk drives, at 512 megabytes each. This gives you on-line storage of 8 gigabytes!

Fast performance is a certainty. Dispatch time between users requires as little as 600 microseconds.

Encrypted passwords provide security for user files and directories.

Time and date stamps indicate your last update of an application file and either last access or file creation.

Additional features provide increased performance with exceptionally low system overhead through streamlined housekeeping plus 30 refined utilities. 400K bytes of RAM are supported. And MP/M II is upward compatible with CP/M.



Substantial Capabilities Included

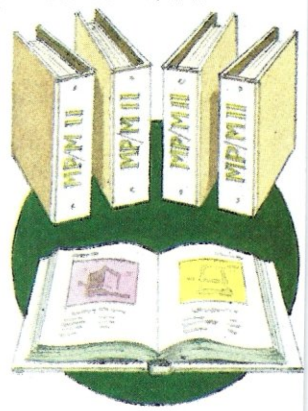
Major utilities in the MP/M II package include our RMAC™ assembler, LINK-80,™ LIB-80™ run time library manager, and RDT™ debugger.

Network capability: Your product's growth to CP/NET™ is provided in MP/M II.

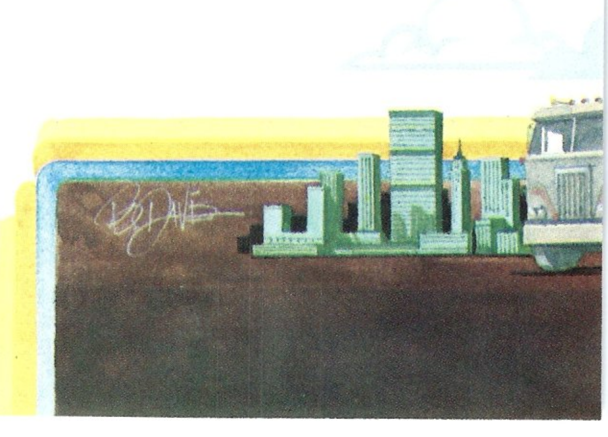
To Language & Application Companies:

You're seizing the time-perishable market advantages of MP/M II. Its five manuals help extend your products to multiuser status, with accuracy and speed. LINK-80's overlay facilities help produce a higher quality. LINK-80, RMAC and RDT are powerful development aids—which don't cost you a thing.

Compatible software accelerates your entry into the multiuser market. Most programs running under CP/M will run under MP/M II with little or no modification. Couple that with a built-in growth path, and you're protecting the future of your business with MP/M II.



Extend CP/M® to Multiuser Systems: Extend Your Profits



To Hardware OEM's:

The profitable impact of multiuser configurations is profound. Compare your sum-of-the-boxes pricing: Multiuser vs. single user. No question about it. Your next move will be to re-forecast sales quotas and profit margins. MP/M II is the key. With the market demand you read about, the act of extending your systems to MP/M II will bear handsome rewards. Your next step is equally clear. Have our marketing group expedite the MP/M II data sheet, OEM price list and contract. Here's an even more positive approach. Why not call our marketing group as your first priority?

These 14 companies are extending 24 languages to run under MP/M II:

Compiler Systems, Inc.
Control-C Software, Inc.
Digital Research
Ellis Computing
Laboratory Microsystems
Micro-Ap
Micro Focus, Inc.
Microsoft
MT Microsystems, Inc.
Ryan-McFarland Corp.
Sorcim Corporation
SuperSoft Associates
Tarbell Electronics
Timin Engineering Co.

To Dealers, Distributors, System Houses:

It takes less effort to make more money by selling multiuser systems. Selling an upgrade path is easier than moving dead end, dedicated systems. MP/M II means hard disks, multiple printers and terminals— add-ons right through full networking environments. One sale can truly generate cash for an extended period. So call your OEM for delivery of MP/M II based systems.

Every new market has its share of easy sales. For a while, somebody will take those orders hand over fist. Your share of that business will probably depend on a single factor: Your ability to get product *first.*

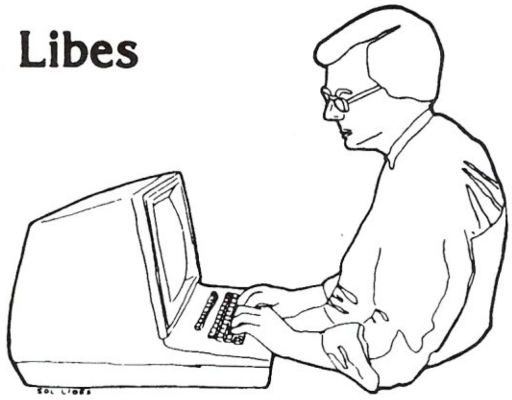
Digital Research

Over 250,000 microcomputers use our operating systems. Over 300 OEM's and 400 independent software vendors (ISV's) use our products as the basis of thousands of applications. These are listed in our CP/M Compatible Catalog. Over 25,000 copies, per edition, generate ISV's sales. FORUM, published quarterly, and ISV seminars provide technical and business advantages.

Multiuser Demand

Multiuser demand is more than a trend. The MP/M II market is a fact of business life. It elevates the microcomputer with larger scale capabilities, and a larger dollar/sale market base. You only get one chance to make a good first (market) impression. Now is the time. We're here to help. **Call (408) 649-3896,** or write: Digital Research, P.O. Box 579, Pacific Grove, CA 93950. Europe: Vector, Intl., Leuven, Belgium, 32(16)202496 Far East: Microsoftware Assoc., Tokyo, Japan, 03-403-2120

by Sol Libes



EDITOR'S PAGE

In my column in the November/December 1981 issue of *Microsystems*, the following appeared:

> As editor of *Microsystems*, I have on a few occasions rejected an article that I really would have liked to publish. The problem was that the article included source code that would have taken up an entire issue, and sometimes more than an entire issue. It was with deep regret that I rejected these articles.
>
> Although the magazine has nearly doubled in size from the first issue published less than two years ago, editorial space in the magazine is still at a premium. We have only a certain number of pages allocated in each issue for articles.
>
> Therefore, I am seriously considering omitting source code listings from the magazine when such listings are more than two or three pages long. Instead we would refer the reader to the author to obtain the source code on disk. After all, who really wants to key in a lot of code with its attendant entry problems? Personally, I certainly would be willing to pay a reasonable sum to save the time and entry problems. Also it would free up editorial space in the magazine so that we could include more articles.
>
> Before making such a radical change, I would like to hear from *Microsystems* readers and authors. Are you in favor, or opposed to the change? What do you feel is a reasonable charge for the source code? Please let me hear from you.

I received almost fifty responses from readers. It is indeed gratifying to see that so many people feel strongly enough about it to sit down and write to me. I wish to thank them all. I regret that we do not have the space to print the letters in the magazine. All were most complimentary about the magazine, and about 70% of the writers indicated that they were in favor of dropping lengthy source listings from the magazine. Of the 30% who were not in favor, most seemed to be either foreign subscribers or subscribers with non-standard disk systems.

Several subscribers suggested making the programs available on the CompuServe MicroNET, via the database of the CP/M Special Interest Group (CPMIG). I must confess that although I have been aware of this service for some time, I have never tried it. With all the free RIBBS and ARPANET facilities available to me, I trust that *Microsystems'* readers will excuse the oversight. I do intend to investigate the CompuServe CPMIG at the earliest opportunity.

Hence, we will continue to publish shorter listings as well as listings we judge to have broad interest. All authors of software, both published and not, will be encouraged to place their software into the SIG/M public domain software library. I have selected SIG/M because I feel that it has the widest distribution; its volumes are being distributed by over a hundred clubs, CPMUG and about a dozen RIBBS systems. I am also sure that someone will copy the SIG/M volumes to CompuServe, if this is not already being done. Furthermore, SIG/M does make their software available, on special order, for such non-standard disk formats as: TRS-80 I-III, Micropolis 5-1/4", NorthStar and Apple II. I will also ask each author to make source code printouts and disk copies available at a nominal charge.

I feel that this decision will work to the advantage of all our readers.

Articles Wanted

We are seeking articles on the following topics for inclusion in *Microsystems* during the second half of this year. If you would like to discuss such an article with me, feel free to call me any evening or weekend at (201)522-9347, or send the article to me at: Box 1192, Mountainside, NJ 07092. We have a free author's guide available.

- Reviews of Unix-like micro operating system packages for CP/M systems.
- Reviews of CP/M system development languages for micros (e.g., Ada, C, Pascal, etc.).
- Local network implementations on MP/M and S-100 systems.
- Interfacing CP/M and S-100 systems to the IEEE-488 bus, LSI-11 bus, etc.
- S-100 construction articles (e.g., 16-bit CPU, etc.).

Microsystems Show Schedule

Microsystems is represented at most major consumer and trade shows. We saw many of you at the Consumer Electronics Show in Las Vegas and the Which Computer Show in Birmingham, England earlier this year. Coming up, we'll be at the West Coast Computer Faire, San Francisco, March 19-21; Trenton Computer Festival, April 17, 18; National Computer Conference, June 7-10, Houston and the Consumer Electronics Show, June 6-9, Chicago. See you there!

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JANUS is supplied on IBM formatted, single density 8″ floppy disks. Other formats are available.

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NEWS & VIEWS

by Sol Libes

Trenton Computer Festival Here Again

On Saturday and Sunday, April 17 and 18th, several thousand computer hobbyists will gather at Trenton State College, Trenton, New Jersey for the 7th annual Trenton Computer Festival (TCF). TCF has the largest personal computer flea market in the country. Last year it covered an outdoor area of about seven acres, and over 6,000 hobbyists flocked from all across the United States to the event. Sellers lined up for the choice spots in the wee hours of the morning, long before the gates opened. The outdoor flea market featured everything from complete computer systems to tiny electronic parts... from used TRS-80, S-100 and Apple computers to disk drives and hard-to-find parts.

TCF also features an indoor commercial exhibitor area with ninety booths, and speaker and user group sessions.

TCF is operated by the Amateur Computer Group of New Jersey, the Philadelphia Area Computer Society and the Trenton State Computer Society. The funds raised help support these nonprofit organizations and their activities. For information call (609)771-2487, or write TCF-82, Trenton State College, Trenton, NJ 08625.

How Many S-100 Systems Are There?

The January 1982 issue of *Interface Age* contained an interesting article on business systems. Of special interest was a list of 116 business-oriented microcomputers. Forty of the systems use the S-100 bus, six use multibus, 56 use proprietary buses, three use the SS-50 bus, eleven use no system bus and one uses the DEC Q-bus.

Another notable feature of the article was a listing of systems shipped. The article listed the following S-100 manufacturers and units shipped:

Archives Inc.	1,500
California Computer Systems	500
Compal	700+
Dynabyte	4,500+
Exidy Systems Inc.	15,000
Findex	900
IMS International	5,000
Ithaca InterSystems	2,000
Micromation Inc.	1,000
North Star Computers Inc.	28,000
Polymorphic Systems	8,000
TEI Inc.	2,500+

The total is 69,000 systems. This list does not include several of the largest manufacturers of S-100 systems (e.g., Cromemco, Vector Graphic, Systems Group, Godbout Electronics, Morrow Designs, MicroDaSys, AlphaMicro, Lomas Data Products, Seattle Computer, Tarbell Electronics, Tecmar, Dual Systems, Quasar Data Products, etc.).

Further, when one adds to the list the S-100 systems in operation one must include MITS, Imsai, TDL, Processor Technology and the many other smaller S-100 manufacturers who are no longer with us. It therefore seems reasonable to estimate that there are now well over 300,000 S-100 systems in operation and that 40-50,000 S-100 systems are being sold annually.

CP/M-86 Goes Into Silicon

Intel has announced that it will soon provide a silicon version of the CP/M-86 operating system. The IC will operate with both the 8086 and 8088, and allow diskless operation, making it ideal for remote computers interconnected in a local distributed network sharing a large-capacity disk drive. The device is a 16K ROM plus timers and other logic, and will bear the part number 8086-E3. It should be available by mid-year.

In another development, Intel announced that it has signed OEM distribution agreements with Digital Research to provide custom versions of CP/M and MP/M for Intel's boards and systems.

SIG/M & CPMUG News

The SIG/M group has announced the release of twelve more volumes of public domain CP/M software bringing the total number of volumes up to 55. SIG/M has also released a printed 12-page catalog listing all of the software in their library and a listing of the SIG/M distribution points. The Catalog is $1.50 (U.S. first class) or $2.00 (foreign air mail; checks must be made in U.S. funds drawn on U.S. bank). Write: SIG/M, Box 97, Iselin, NJ 08830.

The CPMUG group has announced the release of ten more volumes of software, bringing their total up to 75 volumes. However, it should be noted

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Or a remarkable breakthrough called Split Screen Editing™ that lets you divide the screen into two parts, each showing a different document, and transfer sections of text between the two!

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News & Views, continued...

that their volumes 55 through 75 are reissues of the old SIG/M volumes 1 through 20. Hence, it you already have the SIG/M disks then you also have the CPMUG volumes 55-75. CPMUG is distributing the SIG/M disks in order to give them wider distribution. Unfortunately, CPMUG has put their own volume numbers on the disks, and has not clearly identified that they are the same as the original SIG/M disks.

Cromemco Releases 68000 Products

Cromemco Inc., of Mountain View CA, will soon start shipping its 68000 products which I first announced in the Sep/Oct 1981 issue of *Microsystems* There are three S-100 boards: The DPU dual processor board containing both 68000 and Z80 microprocessors ($995), the MCU memory controller board ($495) and the 256MSU 256K RAM board ($1995). A 512K RAM card is in the works.

The DPU can execute Z80 and 68000 instructions interchangeably, so that until a meaningful supply of 68000 software is available you can run Z80 software. Each CMU can serve as a memory manager for up to eight RAM cards. The 256MSU uses dynamic RAM chips and includes error detection, correction and logging capability that is transparent to the user. The user can consult a file to determine which RAM chips might be a little "soft" and need replacement.

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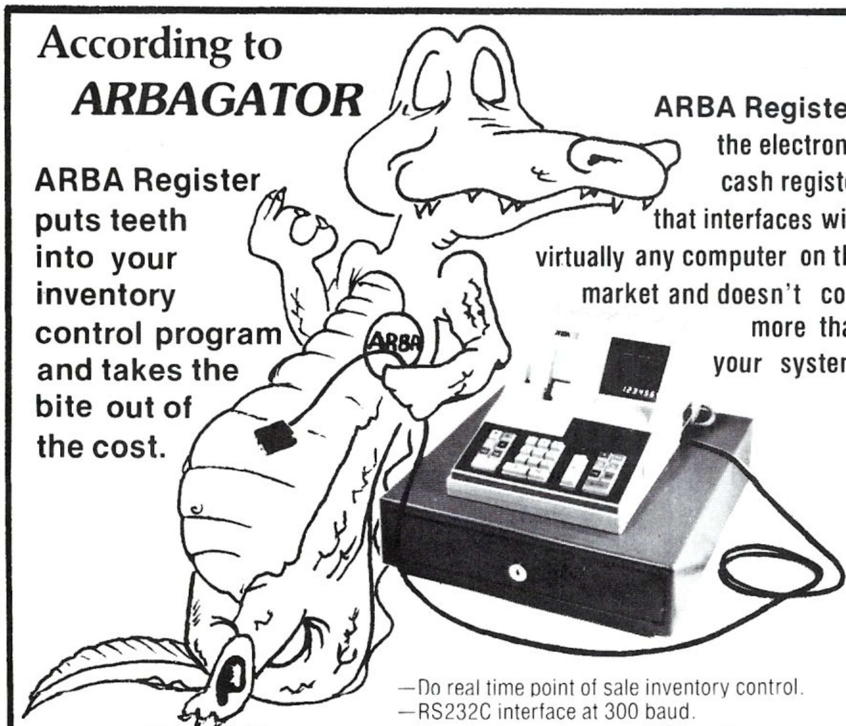

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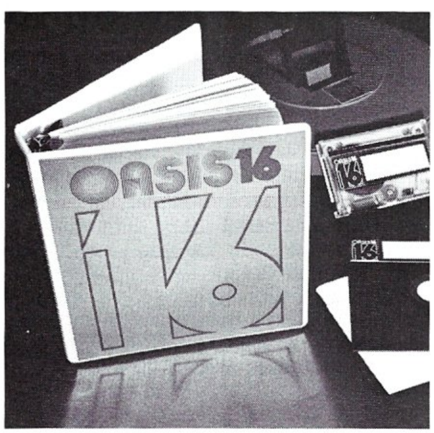

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LETTERS TO THE EDITOR

DMA Operations With SD Systems?

Dear Editor:

I certainly have enjoyed *Microsystems* since the first issue. Thanks for starting a magazine for the S-100 user.

I have a few questions to ask you—I hope you can help me with them.

I have a complete SD Systems set-up, consisting of the SBC200, Expandoram II, Versafloppy II, and VDB8024. I use the SDDS control program and SD Systems DDBIOS Prom. My problem is that while the SD Systems literature indicates that DMA operation is supported, the SDOS or the BIOS doesn't implement it.

Can you tell me of any source of information available and/or software support that would allow me to implement DMA using these boards?

I also have a suggestion for three articles I feel would be appropriate for *Microsystems* readers like myself. (I am a home computer enthusiast.)

1. An article on SDOS similar to those *Microsystems* often runs on CP/M.
2. An article on implementing DMA using the SD Systems boards and SDOS as above (if it can be done).
3. Finally, an article on how to use the Godbout CPU-Z to replace an existing Z-80 board, so as to be able to address more than 64K of memory. This article would explain the programming techniques required to use the extended 24-bit addresses, and how to combine existing memory with additional memory for more than 64K.

Thank you for any information you may be able to provide me.

R.W. Watts
18738 LeMarsh St.
Northridge, CA

Dear Robert: I do not own any SD Sales products and have not really had any contact with them. However, it has become apparent from letters and conversations that I have had from owners of SDS equipment that SDS has gone their own way. They do not appear to be interested in complying with the IEEE-696/S-100 standard nor interfacing their versafloppy disk controller to CP/M. Hence, purchasers of their equipment should be warned that there is a likelihood that they will encounter problems when using SD equipment with other S-100 products. It should be pointed out that the SIG/M library contains some versafloppy driver software. Further, we would be interested in publishing an article or two on coping with SDS interfacing problems. —Editor.

Information On Jade Big-Z CPU Card

Dear Editor:

I notice that you are planning language issues. Languages are important, but *Microsystems* could well leave them to *Byte* and concentrate on S-100/CP/M with more hardware articles. Don't emulate *Byte*, except in volume!

I have a Jade Big-Z cpu board which I can't get to operate properly. The symptoms are that on RESET it displays the initial message of my 2708 monitor, and then takes off into the unknown. It will occasionally go into the monitor properly, functioning properly until another RESET. It seems to be connected with JP(ix) with which the print routine ends. Do you know anyone who has had trouble with this board with whom I might correspond? Incidentally, the monitor itself might be of interest to *Microsystems* at a later date. The Big-Z board was bought "assembled and tested" but has never worked; initially it was found to have an i.c. with a bent-under pin and did not work at all. It now goes occasionally. Letters to Jade have produced no reply as of yet. I would appreciate feedback from any *Microsystems'* readers who could shed some light on this problem.

P.F. Ridler
Professor/Computer Science
University of Zimbabue
P.O. Box M.P. 167
Mount Pleasant
Salisbury, Zimbabue

More Coverage Of Disk-Related Problems

Dear Editor:

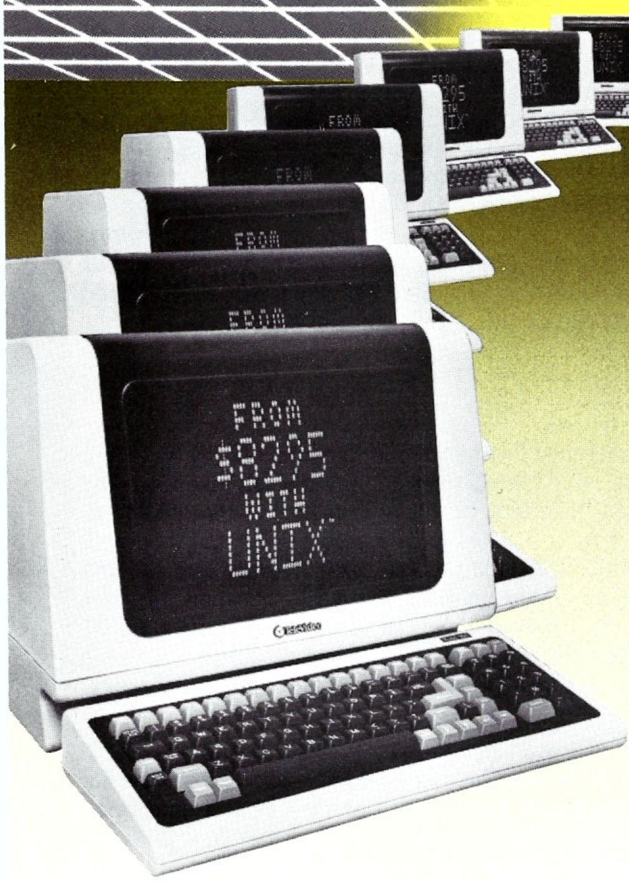
I own a Dynabyte DB8/2 (quad 5") and have been using it for about two years, mostly for word processing (Word Star) and keyword retrieval (Information Master, Island Cybernetics). Recently, I bought Microsoft Basic and finally am beginning to learn it, but still am a member of a minority group, understanding little about computers or language but using my own micro (I was one of the people noted in the recent Writers Digest pieces, dealing with the uses of micros for writing).

What I would like to see is a piece in your journal about disc drives, diskettes and errors; I am certain it would become a much sought about piece and be reprinted. I would like to know about the problems generated within drives and by various kinds of external things, e.g., whether poorly handled diskettes can not only give error messages but transmit them, how to analyze and deal with sources of errors. Something with charts would be much appreciated. Such a piece could probably become an expanded separate publication. Most people I have spoken to around here have had inscrutable problems with this area.

Another disk related problem deals with how individuals with, for example, 5" quad densities can use software available on other types.

Ben Singer
London, Canada

DUAL/68000



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The CP/M* Bus

by Anthony Skjellum

In this installment of "The CP/M Bus" I will discuss the use of the CP/M SUBMIT utility. A public domain SUBMIT facility with enhanced features will be discussed in the next issue.

The CP/M SUBMIT Facility

SUBMIT is a genuinely useful, but often ignored CP/M feature. The SUBMIT command causes CP/M to take command lines from a specially prepared input file instead of from the console. This allows command line sequences to be stored in a file and executed at will via SUBMIT. Not only does this eliminate the tedium of re-typing elaborate command line sequences, but it allows the system to execute a series of tasks without operator intervention.

Let's illustrate a basic use for SUBMIT with an example. Suppose several assemblies need to be done, followed by several file copies. For example:

```
ASM FIRST
ASM SECOND
ASM THIRD
PIP B:=A:*.HEX
PIP B:=A:*.PRN
```

This command line sequence causes the files FIRST, SECOND, and THIRD to be assembled after which all the .HEX and .PRN files on the A: disk are copied to the B: disk. If this is a frequently performed (and involved) operation, SUBMIT should be used. In order to do so, the above lines would be placed in a file of an appropriate name with the file extent .SUB (e.g. ASSEMBL.SUB). Then, with the A: disk as the default disk, the following command would be executed to begin the batch process:

```
SUBMIT ASSEMBL
```

SUBMIT will read the file ASSEMBL.SUB and write a specially formatted file called $$$.SUB. CP/M looks for this file on the A: drive after each warm and cold boot, and begins a batch process whenever the file is present. After SUBMIT completes its work, it will cause a warm boot and CP/M will produce the familiar A > prompt. However, input will now come from $$$.SUB, and command lines will be echoed on the console as if typed by the user. Typing any key while the CCP is handling SUBMIT input will cause termination of the batch process.

The file $$$.SUB is an internal format file with one command line per record. It cannot be produced with a standard CP/M editor; SUBMIT is responsible for this operation. A $$$.SUB file with read-only (R/O) attributes should never be created, since this will place the CCP in an infinite loop in which it continues to re-execute the job in $$$.SUB.

Parameter Substitution

In many cases, SUBMIT files will be general purpose, or at least contain some arguments which will be subject to change from execution to execution. It would be extremely inconvenient to re-edit the file for each batch entry. For example, imagine that we want a batch process which will compile a Fortran-80 source file and then link it with the linkage editor. We will want to use this for various source programs so it will have to use parameter substitution as follows:

```
F80 =$1                  # compile source program
L80 $1,FORLIB/S,$1/N/E   # link object modules
```

The dollar-sign ($) is a signal to SUBMIT that a formal parameter is being specified. Here we use one formal parameter, $1. The formal parameters are replaced by values at the time SUBMIT is executed. If "N" parameters are used in a given SUBMIT file, then execution proceeds as follows:

```
SUBMIT SUB-FILE P1 P2 P3 ... PN
```

where P1...PN replace the formal parameters $1 ... $N. Therefore, if the above Fortran batch process is in a file FORT.SUB, we could compile and link the Fortran program TEST.FOR as follows:

```
SUBMIT FORT TEST
```

Here the formal parameter $1 is replaced by TEST, and the actual SUBMIT job run is:

```
F80 =TEST                  # compile source program
L80 TEST,FORLIB/S,TEST/N/E  # link object modules
```

Finally, to place a literal "$" character in a SUBMIT file, the sequence $$ is used.

Control Characters

It is sometimes necessary to have control characters on command lines within a SUBMIT file. SUBMIT recognizes this need by performing substitutions of the form ^<CHAR> by the control character represent by this two letter ASCII sequence.

In my version of CP/M 2.2 (for Micropolis, by Lifeboat Associates), the SUBMIT program has a bug which made it impossible to use the control character replacement feature. For some reason, this version expected a lower case character instead of an upper case character when specifying the sequence ^<CHAR>. This is corrected by changing location 442H of a memory image from 61H to 41H using DDT or a similar facility (e.g., ZDM). Since SUBMIT is a standard feature of CP/M, the bug may well be present in other CP/M 2.2 distributions as well.

Use Of The 'Zero Program'

In some instances, batch processes will include repetitious execution of the same transient command (e.g., PIP). In cases where these transients are re-executable, the zero program technique may be employed to save disk access time. The zero program is a null length .COM file which allows the previously run program to be run again. The concept of the zero program was introduced in my article "GO: A Utility Program Under CP/M" (*Dr. Dobb's Journal* #41) and is also described in the CP/M Bus column found in *Microsystems*, Vol. 2, No. 2. It should be noted that some programs do not re-execute correctly. However, standard utilities including PIP do work correctly when re-executed. Thus, we could imagine performing several copy operations within a batch process as follows:

```
: PIP.SUB 11/81
:
PIP B:=A:*.ASM   # copy all .ASM files
@ B:=A:*.BAS     # copy all .BAS files (@.COM is the
                 # zero program)
@ A:=C:123*.*    # copy some files from C: to A:
...              # etc.
STAT A:          # status of A: drive
@ B:             # and B: drive
:
: done
```


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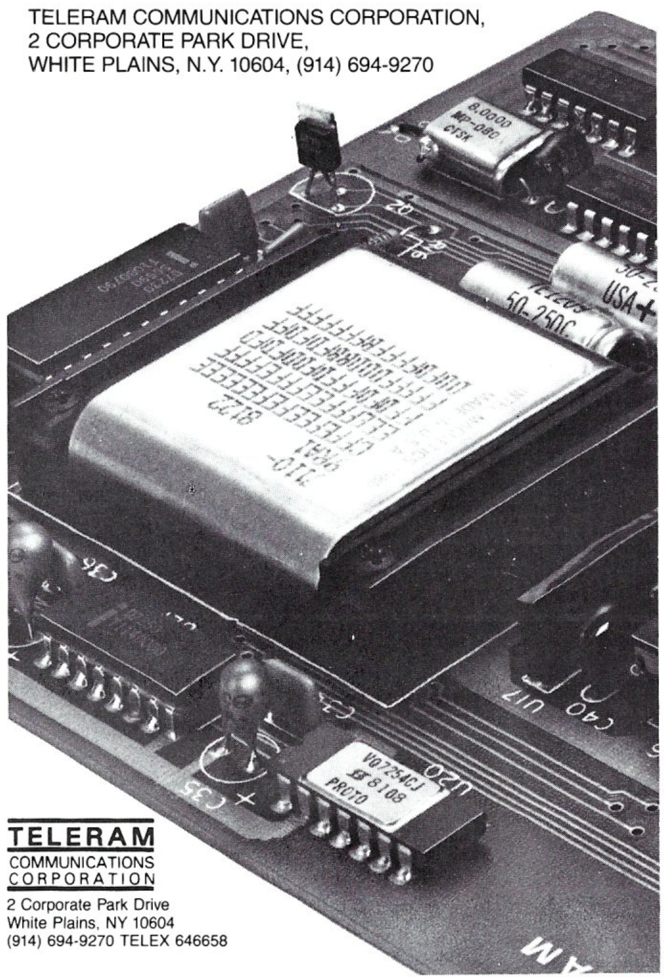

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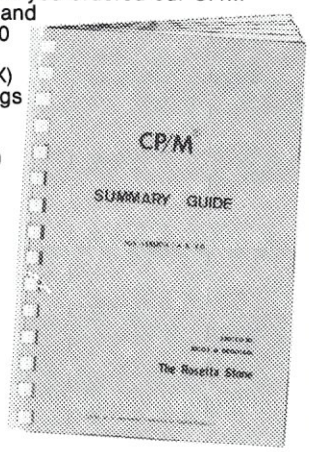

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CP/M Bus, continued...

While STAT 1.4 works correctly when re-executed, the STAT usr: feature of STAT 2.x does not work correctly upon re-execution. This is only a minor inconvenience.

Comments In SUBMIT Files

Comments are possible in SUBMIT files and are often useful for the sake of documentation. Both the semi-colon and colon characters initiate comments. However, as described by D. E. Cortesi in "Doctor Dobb's Clinic" (*Dr. Dobb's Journal* #57, p. 40), Digital Research supports the colon (:) character as the legitimate comment delimiter. Comments are used in several of the examples presented in this column. Here is an additional example:

```
: file: DIR.SUB created 11/81
: purpose: list directory of current
: disk.  List all .COM, .REL, .OVR files
: present
DIR *.COM : list command files
DIR *.REL : list relocatable object modules
DIR *.OVR : list overlay files
: done
```

Some commands will tolerate comments at the end of their command line (e.g., DIR). However, it is generally best to keep comments on separate lines. Note also that comments delimited by "#" characters in various examples are strictly explanatory and would not actually be included in a SUBMIT file.

Chaining SUBMIT Jobs

SUBMIT jobs may be chained in a limited fashion. The last command of any SUBMIT job may be another SUBMIT specification. Such an operation would be done as follows:

```
...        # submit operations
SUBMIT NEW-JOB <PARAMETER-LIST> # new submit job
```

Note that SUBMIT deletes any current $$$.SUB, so SUBMIT jobs may not be nested but only chained as shown here. The public domain program, Supersub, which will be discussed in the next issue, allows chaining of SUBMIT jobs.

The XSUB Facility

It is often necessary to run interactive programs in a batch processing environment. This is not easily done with CP/M 1.4 and its predecessors. However, CP/M2 provides a new utility, called XSUB, which makes this possible to some extent. XSUB is applicable to programs which use the BDOS function 10 (line input) for their input operations. When used, it will take input from the SUBMIT file instead of the console as is normally done. Imagine that we have the following SUBMIT file:

```
: file : EDIT.SUB
: enter line of input to the file $1
:
XSUB              : provide for input re-direction
ED $1             # edit file
I$2               # insert second argument into
                  # file
E                 # ed exit command...
...               # etc.
: done
```

The XSUB at the beginning alters the SUBMIT environment so that subsequent calls to BDOS function 10 will be provided with input directly from EDIT.SUB.

Conclusion

In this installment, we have discussed the features of the SUBMIT utility program. With proper use of SUBMIT, powerful and convenient batch processing may be performed in the CP/M environment. ■

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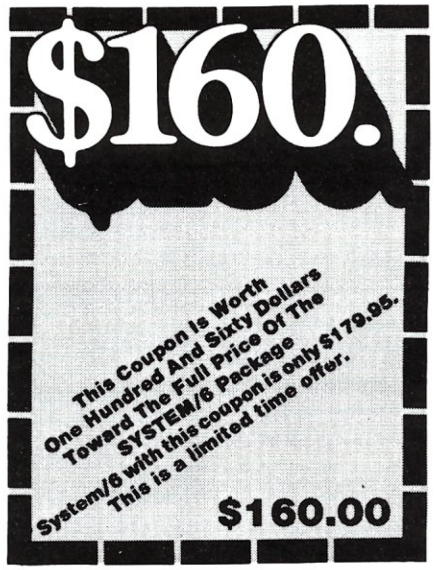

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Software Product Review

A Look At MP/M-80 II

by Kelly Smith

The Newest Release of Digital Research's Multi-user, Multi-Tasking OS

Getting It Going

Having already "brought-up" MP/M versions 1.0 and 1.1, I was surprised at how little effort was needed for the required changes to my existing software for the Loader Basic Input/Output System (LDRBIOS) and the system dependent Resident Extended Input/Output System (RESXIOS). The only changes required were to edit out the RESXIOS initial jump vector for COLDSTART, and in its place insert a JMP COMMONBASE (to terminate a running process). The routine COMMONBASE is nothing more than:

```
COMMONBASE: JMP   COLDSTART
;
SWTUSER:    JMP   $-$
SWTSYS:     JMP   $-$
PDISP:      JMP   $-$
XDOS:       JMP   $-$
SYSDAT:     DW
;
COLDSTART:
WBOOT:
;
            MVI   C,0; terminate process
            JMP   XDOS
```

The changes to the LDRBIOS were more for cosmetic effect at sign-on time (and also a 'bug'!), than changes actually required for upgrade to MP/M-80 II from the two earlier releases. The sign-on messages were for user familiarity only, to let the user know from *what* and *where* he or she had control of the system. The user would see:

```
        MP/M-Net (tm), System #1

   >> Multi-user Software Access <<

               [USER 1]

   Enter USER 0<cr>, if you require
   access to other MP/M facilities.

   ================================
    MP/M is a registered trademark
                  of
           Digital Research
   ================================

   Booting MP/M-80 Version II now...
```

Kelly Smith, 3055 Waco St., Simi Valley, CA 93063.

This demonstrates a customized sign-on message that can be sent to each user (in this case, USER 1) prior to actually booting MP/M into the system. This is easily added to your LDRBIOS by modifying the initial 'JMP 322' at location 100H of MPMLDR.COM to the base of your LDRBIOS (1700H), outputting the data to each console in the system, and then returning control to the MPMLDR by THEN DOING the 'JMP 322':.

This is a nice way to let each user know that he or she is loved, and that the system is "coming up." If you do not do this, there is an agonizing pause as the MPMLDR brings in the system.

MP/M-80 II System Generation

Once you have produced your RESXIOS.SPR file (page relocatable RESXIOS) with RMAC and LINK, you are ready to generate your MP/M. This is perhaps the easiest part of the whole process of getting MP/M up and running. The GENSYS program guides you through the entire configuration of your system, including default values if you care to accept them, with just a simple carriage return. For an idea of how it works refer to Figure 1. Figure 1A maps the MP/M memory system as generated by the co-efforts of GENSYS and myself.

As you can see, the Common Memory area takes up from 13 to 16K, to be shared by all users. The Banked Memory (Bank 0) area takes 48 to 51K bytes. These "sizes" are totally dependent upon the number of extras that you want added to your system at GENSYS time. If you can add bank-switched memory, *do so*. Keep in mind however, that even if you add more memory no one user can access more than 48K. This can be a very limiting system for certain applications requiring

Editors Note:

Kelly Smith's versions of the MP/M-80 II Loader BIOS (LRBIOS.ASM) and Resident Extended Input/Output System (RESXIOS.ASM) are available for non-commerical use via the SIG/M library or via modem from Kelly's RIBBS system (call 805-527-9321). Kelly can also furnish printout copies or copies on 8" disk at a nominal charge. Arrangements can be made for commercial use by contacting Kelly directly.

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Figure 1.

```
A0>gensys<cr> <--- envoke MP/M-80 II GENSYS.COM file
MP/M II V2.0 System Generation
Copyright (C) 1981, Digital Research


Default entries are shown in (parens).
Default base is Hex, precede entry with # for decimal

Use SYSTEM.DAT for defaults (Y) ? n<cr> <--- no, want to "roll-my-own"
Top page of operating system (FF) ? ef<cr> <--- I have 60K to work with
Number of TMPs (system consoles) (#4) ? 2<cr> <--- only two terminals
Number of Printers (#1) ? <cr> <--- if this was Mike Karas, it would be 4!
Breakpoint RST (06) ? 05<cr> <--- let's use RST 5 instead
Add system call user stacks (Y) ? <cr> <--- definitely, to run '.COM' files
Z80 CPU (Y) ? n<cr> <--- still using that same old IMSAI 8080 card.
Number of ticks/second (#60) ? 40<cr> <--- 40 'ticks' (little 'bugs'?)
System Drive (A:) ? <cr> <--- it works better than my flakey B: drive!
Temporary file drive (A:) ? <cr> <--- this is where SUBMIT will be.
Maximum locked records/process (#16) ? <cr> <--- reasonable value
Total locked records/system (#32) ? <cr> <--- maximum things going on
Maximum open files/process (#16) ? <cr> <--- sure, why not?
Total open files/system (#32) ? <cr> <--- use this, but be warned that
                                          this will block other files,
                                          when things get really busy!

Bank switched memory (Y) ? n <cr> <--- just a meager 60K system...sob!
Number of user memory segments (#3) ? 2<cr> <--- three is company, too
                                                 much company in 60K!

Dayfile logging at console (Y) ? <cr> <--- show me time and file executing
                                           every possible chance.

 RESERVED     F000H  1000H <--- chuga'ka chuga...GENSYS building up the
 SYSTEM  DAT  EF00H  0100H      MP/M system, for 'round one'.
 TMPD    DAT  EE00H  0100H
 USERSYS STK  ED00H  0100H
 XIOSJMP TBL  EC00H  0100H

Accept new system data page entries (Y) ? y<cr> <--- acceptable locations!

 RESBDOS SPR  E000H  0C00H <--- 'round two'...
 XDOS    SPR  BE00H  2200H

Select Resident and Banked System Processes:
 ABORT   RSP (N) ? y<cr> <--- short of 'pulling-the-plug', this may be
                              the only way to exit from some processes.

 MPMSTAT RSP (N) ? y<cr> <--- yah, nifty to see what the other user is doing.
 SCHED   RSP (N) ? y<cr> <--- sure, cute way to demo a task on the 'Q'.
 SPOOL   RSP (N) ? y<cr> <--- let the printer work in the background.

 ABORT   RSP  BD00H  0100H <--- 'round three'
 MPMSTAT RSP  BC00H  0100H
 SCHED   RSP  BB00H  0100H      (did you ever notice, that in the
 SPOOL   RSP  BA00H  0100H       movies there are always dramatic
                                 sound effects while the computer
 RESXIOS SPR  B500H  0500H       was blinking and flashing (?).
 BNKBDOS SPR  9200H  2300H       All I ever hear working at home,
 BNKXDOS SPR  9000H  0200H       is the sound of bad spindle bearings
 TMP     SPR  8C00H  0400H       in my floppys...and the 'chirp' of
                                 my acoustic modem!)
 MPMSTAT BRS  7E00H  0E00H
 SCHED   BRS  7900H  0500H
 SPOOL   BRS  7100H  0800H

 LCKLSTS DAT  6E00H  0300H
 CONSOLE DAT  6C00H  0200H <--- Gads! My available memory is
                                being consumed before my very
                                eyes...I had better make some
                                VERY WISE choices as to WHO gets
                                HOW MUCH remaining memory!

Enter memory segment table: <--- and here's my chance...
 Base,size,attrib (6C,94,80) ? <cr> <--- MP/M gets ALL of this.
 Base,size,attrib (00,C0,00) ? 50,ff,00<cr> <--- USER 1 starts at 5000,
                                                 and goes for all the
                                                 'gusto' he can get!
*** Memory conflict - segment trimmed *** <--- the 'ff' forced it!
 Base,size,attrib (50,1C,00) ? <cr> <--- accept what we can get (7K!)
 Base,size,attrib (00,C0,00) ? 00,50,00<cr> <--- USER 0 gets 20K remaining

 MP/M II Sys  6C00H  9400H <--- MP/M takes up 40K bytes.
 Memseg  Usr  5000H  1C00H <--- USER 1 gets a meager 7K bytes.
 Memseg  Usr  0000H  5000H <--- USER 0 gets to run SDIR (an 18K file!).

Accept new memory segment table entries (Y) ? y<cr> <--- do I have any choice?

** GENSYS DONE ** <--- whoopie...now we can boot'er up with MPMLDR, and play!
```

Figure 1A.

```
BA00 to EFFF - Common Memory Area; BDOS, XDOS, XIOS, DATA areas,
               and Resident System Processes.

6C00 to B9FF - Banked portions of the BDOS, XDOS, XIOS, DATA areas,
               TMP (consoles) and Banked Resident System Processes.

5000 to 6BFF - USER 1's play-ground (about the size of a 'cat box'!).

0000 to 4FFF - USER 0's play-ground (just enough to run SDIR for a demo!)
```


lots of memory (such as UCSD Pascal, which requires 56K to compile programs)—so keep your applications memory requirements in mind before deciding to use MP/M, or you may be sorely disappointed to find out that it just will not fit!

Well, the moment is almost at hand to see if it actually works. I took the option of SYSGENing a normal CP/M 2.2 diskette, which autoloaded the MPMLDR.COM file at cold boot time. This allowed me the ability to debug the MP/M loader with the Dynamic Debugging Tool (DDT) under control of CP/M, if I ran into trouble. So, insert the diskette in the A: drive, hit reset, and watch the lights blink on the front of my old Imsai 8080 system. Yes, all seems to be ready—I set this MP/M system up so that a remote caller initiates the system boot when my modem "hears" ring-detect. So, time to give it a call. I fire-up my Osborne-I with a communications program I wrote called "RCPMLINK" and... I get the customized sign-on message, then the booting message, and...amazing! Here comes the MP/M II Loader (Figure 2), just as Digital Research promised. I am astounded; this is the *first time* that I had any version of MP/M come up the *first* try. I then proceeded to set the time of day clock using the TOD.PRL program.

Figure 2.

```
MP/M II V2.0 Loader
Copyright (C) 1981, Digital Research
Nmb of consoles     =  2
Breakpoint RST #    =  5
Memory Segment Table:
SYSTEM   DAT  EF00H  0100H
TMPD     DAT  EE00H  0100H
USERSYS  STK  ED00H  0100H
XIOSJMP  TBL  EC00H  0100H
RESBDOS  SPR  E000H  0C00H
XDOS     SPR  BE00H  2200H
ABORT    RSP  BD00H  0100H
MPMSTAT  RSP  BC00H  0100H
Sched    RSP  BB00H  0100H
Spool    RSP  BA00H  0100H
BNKXIOS  SPR  B500H  0500H
BNKBDOS  SPR  9200H  2300H
BNKXDOS  SPR  9000H  0200H
TMP      SPR  8C00H  0400H
Mpmstat  BRS  7E00H  0E00H
Sched    BRS  7900H  0500H
Spool    BRS  7100H  0800H
LCKLSTS  DAT  6E00H  0300H
CONSOLE  DAT  6C00H  0200H
-------------------------
MP/M II  Sys  6C00H  9400H
Memseg   Usr  5000H  1C00H
Memseg   Usr  0000H  5000H

MP/M II V2.0
Copyright (C) 1981, Digital Research

1A>
1A>tod 12/24/81 09:36:00<cr>
00:00:31 A:TOD     .PRL
Strike key to set time<cr>
Thu 12/24/81 09:36:00
```

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MP/M-80 II Review, continued...

Here is a sample directory display (Figure 3), first from USER 1's directory, then USER 0's directory. Notice the "DAYFILE" display at the user invocation of the DIR command.

An impressive array of programs are available, but notice all the .PRL that have some very familiar CP/M names such as REN, ERA, DIR and TYPE. They are the same commands you have been using with one big difference—they are disk resident, *not* "built-in" commands to MP/M, and they take up valuable disk space (especially valuable if you are using 8" single density floppys). Let's face it, MP/M was not meant to run on 8" SD floppys (look at the SDIR display further on this article, for the amount of remaining disk space). However, they will do for an example until I get around to installing it on my 20Mbyte hard disk. The average hacker has *at least* that much storage just laying around waiting for MP/M, right? WRONG! But then MP/M-80 II is for the "big boys" anyway (on a *big* budget!), so I guess that I can't complain. But please, do not be misled into thinking that you will put MP/M up on your dinky 5" disk and have MP/M run. It won't.

New Utilities And Features: SDIR, SHOW, SET With HELP Displays

One nice, *new* feature added to release 2.0 for MP/M-80 is that some of the system utilities have built-in HELP summaries that give examples of various ways to invoke them. I wonder, however, if it might have made sense to have the HELP portions of the files as overlays that could be deleted from the directory (and take up less memory and disk) after the USER(s) were familiar with all of the command options. Refer to Figure 4 for an example.

The utility SDIR needs 18K of the system to be able to run. I was forced to GENSYS a 20K area for USER 0, just to see what it did, leaving only 7K for USER 1. It would have been nice to allow an equal amount of memory allocation for each user...oh well, on with the show!

After re-GENSYSing for a 20K USER 0 memory allocation, I am able to get SDIR to run. Let's try SDIR with HELP first (Figure 5).

Refer to the directory (Figure 6) to find the next file of interest, SHOW,

Figure 3.

```
file:
1A>dir<cr>                          <--- display the Directory for USER 1
06:40:09 A:DIR       .PRL
Directory for User  1:
A: USER      PRL : DIR          PRL <--- files I knew I would need here,
                                         and initially put them here with
                                         Bruce Ratoff's 'DUPUSER' utility

1A>user 0<cr>                       <--- switch to USER 0
06:40:19 A:USER      .PRL
User Number = 0

0A>dir<cr>                          <--- display the Directory for USER 0
06:40:27 A:DIR       .PRL
Directory for User  0:
A: BNKBDOS  SPR : BNKXDOS  SPR : RESBDOS  SPR : TMP      SPR
A: XDOS     SPR : ABORT    RSP : MPMSTAT  RSP : SCHED    RSP
A: SPOOL    RSP : MPMSTAT  BRS : SCHED    BRS : SPOOL    BRS
A: ABORT    PRL : ASM      PRL : CONSOLE  PRL : DIR      PRL
A: DSKRESET PRL : DUMP     PRL : ED       PRL : ERA      PRL
A: ERAQ     PRL : MPMSTAT  PRL : PIP      PRL : PRINTER  PRL
A: PRLCOM   PRL : RDT      PRL : REN      PRL : SCHED    PRL
A: SDIR     PRL : SET      PRL : SHOW     PRL : SPOOL    PRL
A: STAT     PRL : STOPSPLR PRL : SUBMIT   PRL : TOD      PRL
A: TYPE     PRL : USER     PRL : MPMLDR   COM : GENHEX   COM
A: GENMOD   COM : GENSYS   COM : LOAD     COM : MPM      SYS
A: RESXIOS  SPR : SYSTEM   DAT : DDT      COM
```

Figure 4.

```
0A>sdir *.*<cr> <--- let's look at the Sorted Directory display.
06:54:23
Reloc seg not free <--- oops...whats wrong? Relocation Segment Not Free?
```

NOTE: This bit of ignorance on my part that follows was *prior* to GENSYSing for a 20K user 0 memory allocation—just thought I would let you see what happens:

```
0A>stat sdir.*<cr> <--- let's look at SDIR info with STAT.
06:54:36 A:STAT     .PRL

 Recs  Bytes FCBs  Attributes       Name
  137   18k    2   Dir RW         A:SDIR     .PRL
----------------------------------------------
        18k    2   (1 file, 18-1k blocks) <--- Gads! An 18K file, and this
                                               USER has only 16K bytes for
                                               memory...need to give'm more
       Bytes Remaining On A: 14k               room to load SDIR!
```

Figure 5.

```
0A>sdir [help]<cr> <--- give me some HELP with SDIR.
09:30:42 A:SDIR     .PRL

                          SDIR EXAMPLES
sdir file.one                  (find a file on current user and default driv
sdir *.com d:*.pli             (find matching files on default and d: drive)
sdir [rw]                      (find files that are read/write)
sdir [ro dir sys]              (same for read/only, directory, system)
sdir [xfcb]                    (find files with XFCB's)
sdir [nonxfcb]                 (find files without XFCB's)
sdir [exclude] *.com           (find files that don't end in 'com')
sdir [nosort]                  (don't sort the files)
sdir [full]                    (show all file information)
sdir [size]                    (show name and size in kilobytes)
sdir [short]                   (show just the file names)
sdir [drive = all]             (search all logged in drives)
sdir [drive = (a,b,p)]         (search specified drives, 'disk' is synonym)
sdir [user = all]              (find files with any user number)
sdir [user = (0,1,15)]         (find files with specified user number)
sdir [length = n]              (print headers every n lines)
sdir [ff]                      (print form feeds between headers)
sdir [message user=all]        (show user/drive areas with no files)
sdir [help]                    (show this message)
sdir [dir sys rw ro sort xfcb nonxfcb full] d:*.*      (defaults)
```

Figure 7.

```
0A>show [help]<cr> <--- give me some HELP with SHOW.
09:30:20 A:SHOW     .PRL

Drive Status     : SHOW DRIVE:  SHOW d:DRIVE:
User Status      : SHOW USERS:  SHOW d:USERS:
Directory Label  : SHOW LABEL:  SHOW d:LABEL:
Free Disk Space  : SHOW SPACE:  SHOW d:SPACE:
```

Figure 6.

```
0A>sdir<cr> <--- displaytheSortedDirectoryandfile attributes.
00:00:26 A:SDIR    .PRL

Directory For Drive A:  User  0

    Name      Bytes   Recs   Attributes      Name      Bytes   Recs   Attribute
------------ ------ ------ ------------ ------------ ------ ------ ----------
ABORT    PRL     1k      5 Dir RW       ABORT    RSP     1k      5 Dir RW
ASM      PRL    10k     74 Dir RW       BNKBDOS  SPR    11k     81 Dir RW
BNKXDOS  SPR     1k      7 Dir RW       CONSOLE  PRL     1k      4 Dir RW
DDT      COM     5k     38 Dir RW       DIR      PRL     2k     14 Dir RW
DSKRESET PRL     1k      5 Dir RW       DUMP     PRL     1k      6 Dir RW
ED       PRL     9k     68 Dir RW       ERA      PRL     2k     15 Dir RW
ERAQ     PRL     4k     29 Dir RW       GENHEX   COM     1k      6 Dir RW
GENMOD   COM     2k     10 Dir RW       GENSYS   COM     9k     68 Dir RW
LOAD     COM     2k     14 Dir RW       MPM      SYS    32k    254 Dir RW
MPMLDR   COM     7k     54 Dir RW       MPMSTAT  BRS     5k     33 Dir RW
MPMSTAT  PRL     5k     33 Dir RW       MPMSTAT  RSP     1k      3 Dir RW
PIP      PRL    10k     77 Dir RW       PRINTER  PRL     1k      8 Dir RW
PRLCOM   PRL     3k     21 Dir RW       RDT      PRL     7k     50 Dir RW
REN      PRL     3k     19 Dir RW       RESBDOS  SPR     4k     29 Dir RW
RESXIOS  SPR     2k     13 Dir RW       SCHED    BRS     2k     12 Dir RW
SCHED    PRL     3k     20 Dir RW       SCHED    RSP     1k      3 Dir RW
SDIR     PRL    18k    137 Dir RW       SET      PRL     8k     60 Dir RW
SHOW     PRL     8k     60 Dir RW       SPOOL    BRS     3k     20 Dir RW
SPOOL    PRL     3k     17 Dir RW       SPOOL    RSP     1k      5 Dir RW
STAT     PRL    10k     78 Dir RW       STOPSPLR PRL     1k      5 Dir RW
SUBMIT   PRL     6k     42 Dir RW       SYSTEM   DAT     1k      2 Dir RW
TMP      SPR     2k     11 Dir RW       TOD      PRL     3k     20 Dir RW
TYPE     PRL     2k     11 Dir RW       USER     PRL     1k      8 Dir RW
XDOS     SPR    10k     79 Dir RW

Total Bytes     =    226k  Total Records =     1633  Files Found =    47
Total 1k Blocks =    226   Used/Max Dir Entries For Drive A:    52/  64
```

Figure 7A.

```
0A>show drive<cr> <--- SHOW the Drive Characteristics
06:52:24 A:SHOW    .PRL

         A: Drive Characteristics
     1,944: 128 Byte Record Capacity
       243: Kilobyte Drive  Capacity
        64: 32 Byte  Directory Entries
        64: Checked  Directory Entries
       128: Records / Directory Entry
         8: Records / Block
        26: Sectors / Track
         2: Reserved  Tracks

0A>show users<cr> <--- SHOW the USER and ACTIVE files.
06:52:47 A:SHOW    .PRL

A: Active User :  0
A: Active Files:  0  1

0A>show space<cr> <--- SHOW the remaining disk SPACE.
06:53:04 A:SHOW    .PRL

A: RW, Space:         14k
```

Figure 8.

```
0A>set [help]<cr> <--- give me some HELP with SET.
09:31:56 A:SET     .PRL

                         SET EXAMPLES

FOR FILES

set *.asm [rw, dir]                       (File Attributes)
set *.prl [ro, sys]
set *.dat [archive=on,f1=off,f2=on,f3=on]
set *.asm [time]                          (Time Stamping on ASM files)
set *.asm [password = xyz]                (Password Protection)
set *.asm [protect  = read]               (read, write, delete or none)

FOR DRIVES

set [password = xyz]                      (Label Password)
set [protect  = on]                       (Password Protection)
set [update   = on]                       (Update Time Stamps - on or off)
set [create   = on]                       (Creation Time Stamps - on or off)
set [access   = on]                       (Access Time Stamps - on or off)
set [make     = on]                       (Make XFCBs - on or off)
set [default  = xyz]                      (Default Password)
set a:[rw],    b:[ro]                     (Drive Status)
```

which is also an upgrade of the CP/M STAT utility. SHOW's HELP options are displayed in Figure 7.

So let's try a few. To see what happens look at Figure 7A.

Finally, the SET utility (Figure 8) contains some of the features of CP/M's STAT utility for setting various file or disk attributes, but goes beyond the simple $R/O or $R/W and $SYS or $DIR attributes of STAT.

It's worth noting that the MP/M II User's Guide describes a disk attribute control called NAME (see Section 7.4.5 Naming Disks, page 63)..."SET [NAME =labelname.type] does not appear in the HELP display and, if attempted, gives the following response:

```
0A>set [name=mp/m-net.sys]
09:48:49 A:SET     .PRL

ERROR:  ?
Invalid Value, Use ON or OFF
```

It is curious that Digital Research describes this feature in the SET documentation, while it does not appear to work—is this a "bug"?

Next try the time-stamping features that were described in the SET HELP command (Figure 9.) Note that time-stamping also works on CREATE and UPDATE when new files are created, or when a file is modified.

A User Application: SEND-MSG For Intra-User Communication

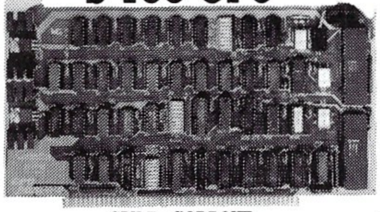
I though it might be interesting to be able to communicate between multiple users as a "message drop" for posted mail (posted on the 'Q', and visible to other users via MPMSTAT as a pending message if they care to read it). Such as it is, this does demonstrate what can be done for intra-user communication in a common user system environment—nothing fancy, but it gets the job done, allowing up to 80 characters in a message string. To see if you have any "mail," just enter MPMSTAT<cr> to see if a SEND-MSG is attached to your console from another user. If so, just enter Control-D to attach SEND-MSG to your console, and to finish the execution of the pending message from MP/M's CLI (Control Line Interpreter) buffer storage. If you want to send a message (say to USER 0, from USER 1), just enter:

```
A1>send-msg 0 Hello whats your
```

Well, that's how it works in theory. To see what happens, look at Figure 10.

PRIORITY ONE ELECTRONICS

S-100 CPU



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2/4 MHZ Z80 CPU 24 Bit Addressing WOW!

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SDGBT 160C	CSC 3-6 MHZ	$395.00	$375.00

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

SDGBT 1612A	A & T 6 MHZ	$425.00	$399.00
SDGBT 1612C	CSC 8 MHZ	$525.00	$498.00

SOLID STATE DISK DRIVE, 3500% FASTER!
Not Really, But the Next Best Thing For Godbout 8085/88 Users. Call for Details on M-Drive. See Page 340 of November **BYTE**

SDGBT MD 128K	$1,550.00
SDGBT MD 256K	$3,000.00

2810 Z80 CPU-CA. COMP. SYST.
2/4 MHZ Z80A CPU with RS232C Serial I/O Port complete with Monitor PROM for 2422 Disk Controller

SDCCS 2810A	A & T	$350.00	$280.00

CB2 Z80 CPU - S.S.M.
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SDSSMCB2K	Kit		$260.00
SDSSMCB2A	A & T	$344.00	$310.00
SDSSMZ80M	SSMZ80 Monitor		$89.00

CBIA 8080 CPU - S.S.M.
8080 CPU, 1K RAM, Holds 1 2708, 1 Bit parallel input port.

SDSSMCB1K	Kit		$183.00
SDSSMCB1A	A & T	$252.00	$225.00
SDSSM8080M	SM 8080 Monitor		$59.00

S-100 I/O BOARDS

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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
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SDGBT162C	CSC	$495.00	$460.00
SDGBT8231	Math Chip		$195.00
SDGBT8232	Math Chip		$195.00
SDGBT162AM1	A&T with 8231 Math Chip		$555.00
SDGBT162CM1	CSC with 8231 Math Chip		$655.00
SDGBT162AM2	A&T with 8232 Math Chip		$555.00
SDGBT162CM2	CSC with 8232 Math Chip		$655.00

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SDGBT150A	A & T	$249.00	$219.00
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SDSSMIO4K	Kit		$210.00
SDSSMIO4A	A & T	$290.00	$260.00

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2 Serial, 3 Parallel including 1 Centronics

SDSSMIO51	A & T	$329.00	$309.00

I/O 8 - SSM
8 Port Serial I/O with Timer

SDSSMIO8A	A & T	$550.00	$495.00

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2718 2 SERIAL & 2 PARALLEL - CCS
2 RS232 C ports, 2 8 bit parallel ports, & optional 2K ROM

SDCCS271801	A & T	$360.00	$325.00

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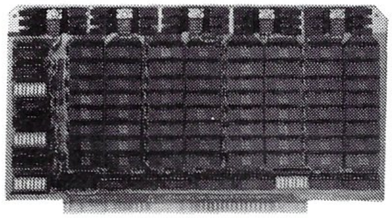

32K STATIC RAM - GODBOUT
RAM 20 10 MHZ, 4K byte block disable, bank select or 24 bit addressing available 8, 16, 24 or 32K

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SDGBT164AC8	8K CSC	$280.00	$260.00
SDGBT164AA16	16K A&T	$285.00	$260.00
SDGBT164AC16	16K CSC	$355.00	$325.00
SDGBT164AA24	24K A&T	$355.00	$325.00
SDGBT164AC24	24K CSC	$425.00	$385.00
SDGBT164AA32	32K A&T	$425.00	$299.00
SDGBT164AC32	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**.

64K CMOS STATIC RAM - GODBOUT
RAM 17, 10 MHZ, 2 Watt, DMA Compatable 24 Bit Addressing

SDGBT175A48	48K A&T	$650.00	$619.00
SDGBT175C48	48K CSC 200hr.	$750.00	$710.00
SDGBT175A64	64K A&T	$795.00	$755.00
SDGBT175C64	64K CSC 200hr.	$895.00	$850.00

NEW! 32K x 16 BIT CMOS STATIC RAM - GODBOUT
RAM 16 10 MHZ, 32K x 16 or 64K x 8 IEEE/696 16 BIT 2 Watt, 24 Bit Addressing

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SDGBT180C	64K CSC	$995.00	$945.00

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SDGBT144C	CSC	$449.00	$399.00
SDGBT2D	Sublogic Universal Graphics Interpreter Software		$35.00

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SDSSMVB3A24	80 x 24 A&T	$499.00	$440.00
SDSSMVB3UP	80 x 50 Line Upgrade		$ 39.00

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SDSSMVB2A	A & T	$269.00	$229.00

VBBB - S.S.M
Memory Mapped Video Board 64 x 16 character display or 64 x 16 graphics display

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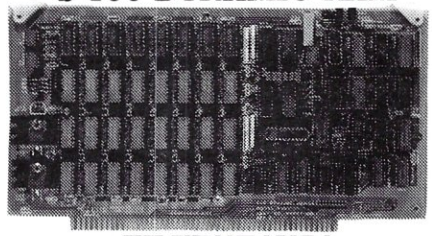
SDGBT153C	CSC 6 slot, 2 lbs.	$190.00	$175.00
SDGBT154A	A&T 12 slot, 3 lbs.	$175.00	$155.00
SDGBT154C	CSC 12 slot, 3 lbs.	$240.00	$220.00
SDGBT155A	A&T 20 slot, 4 lbs.	$265.00	$235.00
SDGTB155C	CSC 20 slot, 4 lbs.	$340.00	$310.00

S-100 DYNAMIC RAM



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I/O Mapped, controls 8", single or double density A&T with CPM 2.2 8" S.D.

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8" DBL Density/sided drives with cabinet Power supply controller, with CP/M 2.2 and Microsoft Basic

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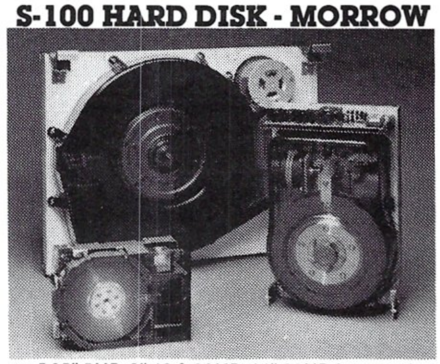
SDMDSF2228	Dual Drive System	$2495.00	$2050.00

S-100 HARD DISK - MORROW



5.25" 5MB, 8" 10 & 20MB, 14" 26MB formatted hard disk complete with cabinet, P.S., Controller, CP/M 2.2 and Microsoft MBASIC 80

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DM5012 - SANYO
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DM5112 - SANYO
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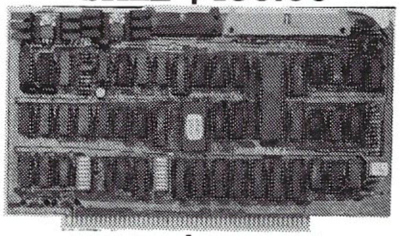
COLOR 13" 16 line x 64 character monitor

SDSYOVM6013	35 lbs	$550.00	$95.00

PRIORITY ONE ELECTRONICS

GODBOUT DMA DISK 1 WITH FREE CPM 2.2 SALE $450.00



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- Supports IBM 3740 soft sectored formats.
- 24 bit DMA addressing with data transfer across 64K boundaries for data transfer throughout the 16Mbyte memory map.

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SDGBT171C	CSC	$595.00	$555.00
SDGBTCPM80*	CP/M 2.2 for Z80/8085 with manuals & BIOS 8" S/D disk		$175.00
SDGBTOAS8S	Oasis 8 bit single user 8" S/D disk		$500.00
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S-100 SYSTEMS

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SDGBT1612A 6 MHz 8085/8088 Dual Processor Board
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SDGBT133A Interfacer 1 Dual Serial I/O
SD128K 10MHz Low Power Static Ram
SDGBTCP/M 86 16 Bit Operating System Ready to Load & Go
Cables and Documentation Three interfacer cables one disk I/O cable, complete documentator for all hardware, and manuals for both CP/M operating systems.
Compu Pro's famous **1 Year** limited warranty.

Now to the best part of all. If purchased separately, these quality components would list for $4,344.00. **BUT SuperSixteen's low package price is an amazing $3,495.00. You save $849.00!**(For boards qualified under the Certified System Component high-reliability program - with extended 2 year warranty, 200 hour burn-in and 8 MHz processors - add $600.00 to the package price. Sh. Wt. 15 lbs.

SDPDBGBTSJ	SuperSixteen A&T	$3495.00
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PRINTERS

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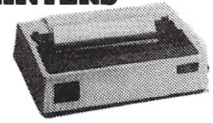

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SDOKIDAT83AT (37 lbs)	132 CPL @ 10 CPI	$1195.00	$750.00
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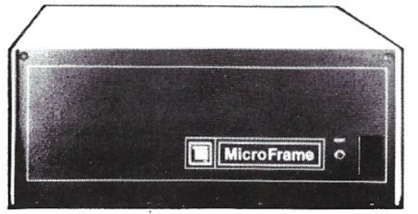

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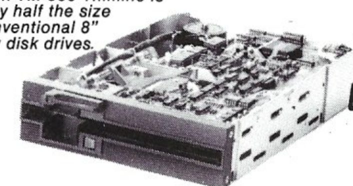

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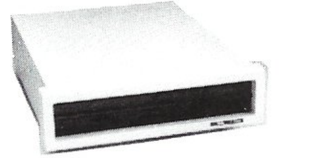

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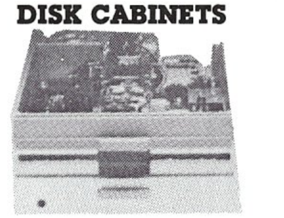

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Dual 8' cabinet with power supply

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MP/M-80 II Review, continued...

You can continue stacking as many SEND-MSG's as your user memory allocation allows (I obviously didn't have enough memory!). The "Send Message" program (Figure 11) may be assembled with RMAC and LINK, or as REL0 and REL1 '.HEX' files using GENMOD.

Conclusion

Digital Research's user documentation is perhaps the best that you could desire, including a comprehensive User's Guide, Programmer's Guide, and System Guide, all with complete glossaries and indexes, and even an acronyms and conventions list. This is a far cry from the original (terrible) CP/M 1.4 documentation. Also included are manuals for the LINK-80 linkage-editor, and MAC (as a reference document to the RMAC relocating macro assembler facilitfies. Incidentally, LINK-80, RMAC (and LIB-80 as well as XREF) are well worth the price of the diskette *without* MP/M-80 II!

MP/M-80 II is not for everyone, especially the casual user on a tight budget. In the hands of a good systems-type programmer, and given the hardware resources to properly support *all* of the features of MP/M, this is *the* multi-user/multi-tasking operating system to be using for running the myriad of CP/M-compatible applications programs that are available. I strongly recommend that you purchase both the "MP/M II User's Guide" and "MP/M-II System Guide" manuals before purchasing the MP/M diskettes themselves—you really need to get an overall view to make the best possible choice in applying MP/M to a particular application environment. ■

MP/M, MP/M II, RMAC and LINK-80 are trademarks of Digital Research.

KELLY SMITH is a senior engineer/programmer with Pertec Computer Corporation, developing diagnostic software for systems and system peripherals. He is the vice-president of the Valley Computer Club (Burbank, CA) and system operator of the CP/M-Net Remote CP/M System, in addition to editor and publisher of the CP/M-Net News. Activities and interests include contributing software to the SIG/M User Group library and West Coast SIG/M software distributor via modem.

Figure 9.

```
0A>set *.prl [time]<cr> <--- SET all '.PRL' files for time stamping
09:45:14 A:SET     .PRL

A:ABORT   .PRL  Time Stamps ON
A:ASM     .PRL  Time Stamps ON
A:CONSOLE .PRL  Time Stamps ON
A:DIR     .PRL  Time Stamps ON
A:DSKRESET.PRL  Time Stamps ON
:
: <--- and on and on 'ad nauseum'.
:

0A>set [access = on]<cr> <--- SET time stamping to any file accessed
09:46:19 A:SET     .PRL

Label for drive A:

Directory       Passwds  Make     Stamp    Stamp    Stamp
Label           Reqd     XFCBs    Create   Access   Update
--------------  -------  -------  -------  -------  -------
A:Label   .       off      on       off      on       off


0A>dir stat.*<cr> <--- access DIR as an experiment for time stamp
09:46:52 A:DIR     .PRL
Directory for User  0:
A: STAT     PRL
0A>stat<cr>         <--- also access STAT for time stamping.
09:47:12 A:STAT    .PRL

A: RW, Space:          24k

0A>sdir *.prl<cr> <--- SDIR should tell us if the two files were 'stamped'!
09:47:36 A:SDIR    .PRL

Directory For Drive A:  User  0

    Name       Bytes   Recs   Attributes   Prot      Update          Access
------------ ------ ------ ------------ ------ --------------  --------------
ABORT    PRL     1k      5 Dir RW        None
ASM      PRL    10k     74 Dir RW        None
CONSOLE  PRL     1k      4 Dir RW        None
DIR      PRL     2k     14 Dir RW        None                    12/24/81 09:46
DSKRESET PRL     1k      5 Dir RW        None
DUMP     PRL     1k      6 Dir RW
ED       PRL     9k     68 Dir RW
ERA      PRL     2k     15 Dir RW
ERAQ     PRL     4k     29 Dir RW
MPMSTAT  PRL     5k     33 Dir RW
PIP      PRL    10k     77 Dir RW
PRINTER  PRL     1k      8 Dir RW
PRLCOM   PRL     3k     21 Dir RW
RDT      PRL     7k     50 Dir RW
REN      PRL     3k     19 Dir RW
SCHED    PRL     3k     20 Dir RW
SDIR     PRL    18k    137 Dir RW
SEND-MSG PRL     1k      5 Dir RW        None
SET      PRL     8k     60 Dir RW
SHOW     PRL     8k     60 Dir RW
SPOOL    PRL     3k     17 Dir RW
STAT     PRL    10k     78 Dir RW
STOPSPLR PRL     1k      5 Dir RW
SUBMIT   PRL     6k     42 Dir RW
TOD      PRL     3k     20 Dir RW
TYPE     PRL     2k     11 Dir RW
USER     PRL     1k      8 Dir RW

Total Bytes     =    124k  Total Records =      891  Files Found =   27
Total 1k Blocks =    124   Used/Max Dir Entries For Drive A:   64/  64
```

Figure 10.

```
0A>send-msg 1 Hello from USER 0...Whats up?<cr> <--- set-up 1st message
09:37:45 A:SEND-MSG.PRL

0A>send-msg 1 I hope you got my message, BYE!<cr> <--- set-up 2nd message
09:38:11 A:SEND-MSG.PRL

0A>mpmstat<cr> <--- let's see if the messages are 'posted'
09:38:20 Msg Qued
:
: <--- I removed some info from MPMSTAT for brevity!
:
Process(es) Attached to Consoles:
  [0] - Tmp0
  [1] - MPMSTAT
Process(es) Waiting for Consoles:
  [1] -  Tmp1     [1] SEND-MSG[1] SEND-MSG[1] <--- there they are!
:
Memory Allocation:
  Base = 6C00H  Size = 9400H  Allocated to MP/M-80 [0]
  Base = 5000H  Size = 1C00H  Allocated to SEND-MSG[1] <--- 1st message
  Base = 0000H  Size = 5000H  Allocated to SEND-MSG[1] <--- 2nd message

0A>user 1<cr> <--- switch to USER 1.
09:39:04
Reloc seg not free <-- oops...no room to execute USER.PRL file!
0A>  <--- can't see it, but this is a Control-D to 'GET' the messages
Attach:SEND-MSG

This message is from console number: 1
HELLO FROM USER 0...WHATS UP?
  <--- another Control-D to get the remaining message
Attach:Tmp1

Attach:SEND-MSG

This message is from console number: 1
I HOPE YOU GOT MY MESSAGE, BYE!

Attach:Tmp1

0A>user 1<cr> <--- now that message are 'flushed' this should work!
09:39:29 A:USER    .PRL
User Number = 1 <--- and it does!
```

Figure 11.

```
base      equ       0               ; MP/M system absolute base address
xdos      equ       base+5h         ; MP/M XDOS entry address
buff      equ       base+80h        ; temporary command buffer

system$reset      equu    000h     ; MP/M system reset
print$string      equ     009h     ; MP/M print string function
raw$con$out       equ     004h     ; MP/M raw console output function
attach$con        equ     092h     ; MP/M attach console function
detach$con        equ     093h     ; MP/M detach console function
procc$desc$addr   equ     09ch     ; MP/M return process descriptor address

bel       equ       07h             ; ASCII bell code
lf        equ       0ah             ; ASCII line feed character
cr        equ       0dh             ; ASCII carriage return character

begin:    lxi       sp,stack; set system stack
          lxi       h,buff  ; point to CLI command buffer
          mov       a,m
          cpi       4       ; message string < 4 characters?
          jc        errexit
          inx       h       ; now point to console destination number
          push      h       ; save the pointer...
          mov       e,a     ; save string length in [e]
          mvi       d,0     ; put total string length in [hl]
          dad       d
          mvi       m,'$'   ; tag the end of string with string delimeter
          pop       h       ; point to console user number...
          inx       h
          mov       a,m     ; and get it
          cpi       '0'     ; < user 0?
          jc        errexit
          cpi       ':'     ; > user 9?
          jnc       errexit
          sui       '0'     ; subtract ASCII bias, and make hex digit
          mov       e,a     ; save for now in [de]
          push      d
          mvi       c,detach$con      ; detach console function
          call      xdos
          mvi       c,procc$desc$addr        ; get process descriptor address
          call      xdos
          lxi       d,14
          dad       d
          pop       d
          mov       a,m
          adi       '0'
          sta       usernum
          mov       m,e
          mvi       b,4     ; set counter to issue 4 bells to user console
sendch:   push      b
          mvi       e,bel   ; ASCII bell code
          mvi       c,raw$con$out   ; do raw console output
          call      xdos
          pop       b

          dcr       b
          jz        notify
          mvi       c,80    ; kill some time between bells...
delay1:   mvi       a,255
delay2:   dcr       a
          jnz       delay2
          dcr       c
          jnz       delay1
          jmp       sendch  ; send next bell character
;
notify:   mvi       c,attach$con      ; attach console function
          call      xdos
          lxi       d,crlfmsg
          mvi       c,print$string  ; print string function
          call      xdos
          lxi       d,usermsg
          mvi       c,print$string  ; print string function
          call      xdos
          lxi       d,buff+4          ; get destination console user number
          mvi       c,print$string  ; print string function
          call      xdos
          lxi       d,crlfmsg
          mvi       c,print$string  ; print string function
          call      xdos
exit:     mvi       c,system$reset  ; system reset (terminate calling program)
          jmp       xdos
;
errexit:mvi         c,print$string  ; print string function
          lxi       d,errmsg
          call      xdos
          jmp       exit
;
errmsg: db          cr,lf,'>>> Error in message line <<<',cr,lf,'$'

crlfmsg:db          cr,lf,'$'

usermsg:db          'This message is from console number: '

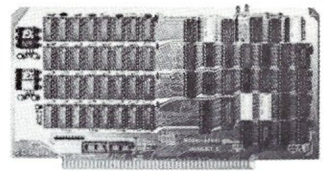
usernum:ds          1
          db        cr,lf,'$'

          ds        32      ; 16 level stack area
stack:    equ       $

          db        0       ; end of page relocatable module

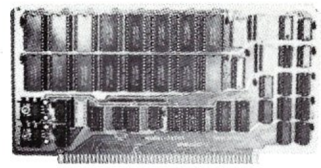
          end
```


S-100 Boards from S. C. Digital



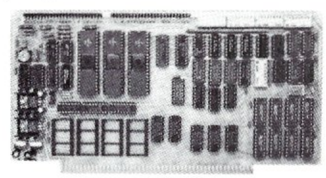
64K DYNAMIC RAM 'Uniselect: 2'

features: **Model 64KUS**
● 16 or 24 bit addressing. ● 8 bit data. ● Bank Select by SW settable Port, Bits in Two blocks. ● Two 32KB (or 128KB) addressing. ● Transparent refresh with delay lines, giving unlimited DMA, immune to Wait States, halts, resets. ● Fast access time - 220nsec from Smemr or Psync high, will run with Z80, Z8000 to 4mhz, 8080, 8085, 8088, 8086 to 5mhz without wait states. ● Provision to expand to 256KB using 64K by 1 chips.



32K Static Ram 'Uniselect: 3'

features: **Model 32KUS**
● Fully Static using 2k by 8 NMOS chips. ● 16 or 24 bit address. ● 8/16 bit wide data. ● Bank Select by port and bit in 32K block. ● Two 16K block addressing with window capability in 2k increments. ● EPROM can be mixed with RAM. ● Fast access - 250nsec from address valid -will run with Z80, Z8000 to 4mhz, 8080, 8085, 8088, 8086 or 68000 to 8mhz without Wait States. ● Provision for Battery Backup using NMOS or CMOS.



I/O, Memory Interface 'Interface: 1'

features: **Model 3SPC**
● 3 serials using UART, RS-232C or 20ma current loop. ● 1 Parallel I/O with hand shakes. ● 4k Ram, 4k EPROM (not supplied). ● Built in Kansas City Audio Cassette interface. ● Baud rate generator from 19.2kbaud to 110 baud.

2K Z80 Monitor Program available for M:3SPC

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Z80 CPU Board Model CPUI-Z80

features: ● 2 or 4mhz clock. ● Jump on Reset ● 2K of EPROM (not supplied). ● 8 levels of prioritized vectored interrupts.

16K Static Ram 'Uniselect: 1'

features: **Model 16KUS**
● Fully static using 2114L-2, 200nsec chips. ● Bank Select by port and bit. ● 8 bit data, 16 bit address.

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The OASIS Multi-User Operating System

by Michael J. Karas

Is this just another operating system?
And, a brief look at an S-100 multi-user hardware system.

The dictionary defines an "oasis" as a green, growing area in a desert or as a welcome change from the usual pace of life. "OASIS" is also the name of a microcomputer operating system that has gained a significant foothold in the microcomputer software marketplace. One has to wonder why a software product such as this was named OASIS. The microcomputer business is far from a desert. The hardware and software aspects are growing so rapidly that it is virtually impossible to keep ahead of new developments. As soon as products become available, we hear of new application areas for microprocessor hardware and software systems. The new needs then tend to foster development in a seemingly never-ending cycle. Thus, considering the state of the micro-marketplace, it must be that the OASIS operating system was introduced not as "green spot in the desert," but as a welcome change from the way things have been done. In the next few pages I will try to show why the OASIS operating system may very well be a new approach to the way microcomputer operating systems function.

As a first time user, I had never seen OASIS in operation. To become familiar with this product (or any other software product, for that matter) I had to use it, and compare it with other products in the marketplace performing a similar function. I am professionally involved in the systems end of the microprocessor business. My field of comparison for OASIS was to contrast the operational characteristics, human interface aspects, development tools, and end-user application possibilities. Access to an appropriate hardware system and the OASIS software was obtained such that I could "setup" the system to my specific requirements much as an end-user would in purchasing a microcomputer system for use in a business, scientific, or educational application.

Michael J. Karas, 2468 Hansen Court, Simi Valley, CA 93065.

An OASIS Hardware Configuration

The system hardware upon which the operating system evaluation was performed was the SYSTEM 80W, an S-100 machine produced by NNC Electronics. This high quality hardware product is a unitized computer/mass storage system measuring approximately 18 inches wide, 11 inches high, and 19 inches deep. The SYSTEM 80W is based upon the IEEE/S-100 Bus Standard with a 4MHz Z-80A CPU card and two 64K dynamic RAM boards providing a total of 128K of memory in a bank-switched configuration. The primary data storage is provided by a Shugart SA1004 Winchester Disk, with 8.4 Megabyte formatted data storage capacity in conjunction with the companion XCOMP Winchester disk controller. File backup and loading convenience is included via a Shugart 801R 8" double density and double-sided floppy disk drive. The drive, including features of AC motor on/off and a door lock, is controlled by an OEM version of the CCS floppy disk controller.

Peripheral I/O was via three RS-232 serial I/O ports accessible on the rear panel of the computer. Optional hardware can include parallel ports or more serial ports. The internal card cage could also accomodate user-

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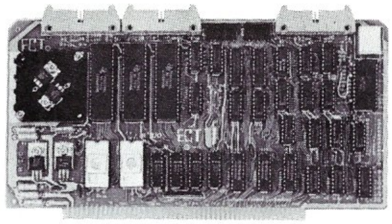

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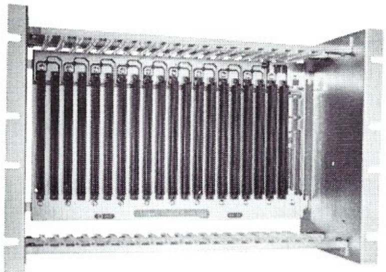

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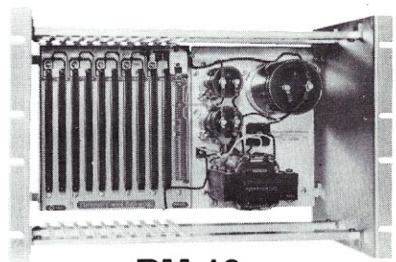

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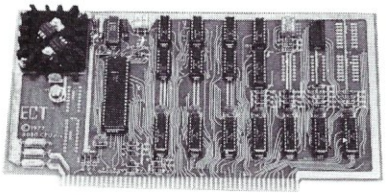

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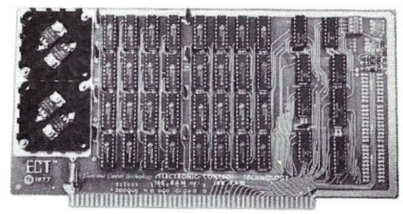

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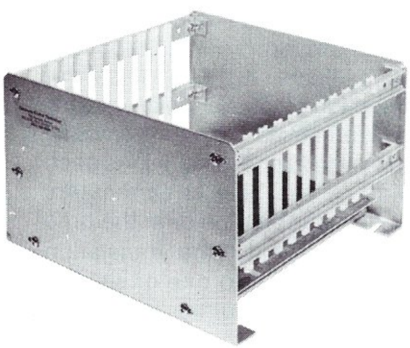

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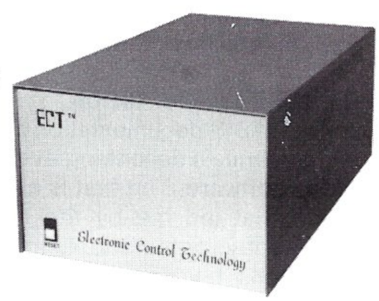

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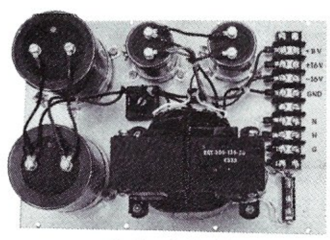

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specified hardware such as a modem board for communication or additional memory cards. This system is available from the manufacturer: NNC Electronics, 15631 Computer Lane, Huntington Beach, CA 92649; (714)895-8000, for $8,799 and $850 for OASIS.

Obtaining The Software

The system software, the latest Multi-user Version 5.5A of OASIS, was provided in a format properly configured for the NNC Electronics hardware through the courtesy of the product distributor, Phase One Systems, and NNC Electronics. The evaluation package included all system functional modules and others such as a Basic Interpreter/Compiler, Macro Assembler/Linker package, plus an impressive array of compatible utility packages that handle system maintenance and configuration chores. Complete documentation on the OASIS System was also provided. The OASIS product was written by a talented and enterprising fellow by the name of Timothy S. Williams, and is distributed and supported by Phase One Systems, Inc., 7700 Edgewater Drive, Suite 830, Oakland, CA 94621; (415)562-8085. OASIS is $850, and includes all the software described in this article.

Initial Observations

Once I had the system and software in place, the evaluation really began. My goal was to attach a Televideo 912 CRT as the system console at one serial port, (this was to be straightforward since the standard NNC configuration also utilizes a Televideo terminal), configure a second terminal for user two on another serial port, and connect a serial interface printer as the system hard copy device. The terminal for user two was a DEC VT100 and the printer a TI 820 dot matrix line printer. A review of the documentation was needed to learn how to go about the peripheral attachment process.

OASIS Documentation

The OASIS documentation consists of a well-organized set of manuals describing every aspect of the operation of the software. The first is a general system reference guide that led me by the hand through the OASIS philosophy, command entry formats, and command definitions. Each system command that may be used at the Command String Interpreter (CSI) control level has a complete section of description, option definition and *examples*!

Another feature of the manual (and all other OASIS documentation) that I have found extremely useful is the fact that commands, each in a separate chapter, are presented in alphabetical order with a topical index marker printed in the lower outside corner of each page. On the first trip through the documentation, the value of this index was not realized. It was only later at the "try and learn" phase when I would say "How did SHOW work?", that I realized the value of this indexing. "SHOW" was easily found in alphabetic order between "SHARE" and "SPOLLER."

Only one comment need be made on the physical attributes of the manual. There is a great deal of paper in the binder with only a limited binder size. The paper is very thin and could easily have been torn from the three binder rings. Printing of each manual in a separate softbound format would allow heavier paper to be used, and would probably allow the system documentaion to survive through months of use. Since the OASIS is generally intended to be multiuser, the three ring binder documention format might limit the "stay-in-one-piece" life—as many people require its use to learn system operation

The documentation package also includes complete operational and example-filled paperwork to describe the Basic, Macro Assembler, Linker, Executive Language and so on. Each manual has had the same care taken in its presentation to the user. The topics are presented and indexed for easy information access.

Another impressive feature of the system is an on-line help system. A file on the system disk contains a quick summary of the command formats and possible options for each OASIS command. Just in case the user needs a quick review on how to use a command such as BACKUP, he or she need only type the following:

```
>HELP BACKUP<cr>
```

and a screen full of information pops up to tell you how to use the BACKUP program. Many of the command programs that have their own operator prompt mode, such as the DEBUG program debugger, support an internal access mode to the help file. Such utility packages permit the word HELP to be typed at the command prompt for immediate display of the command options available for that utility.

Setting Up Terminal Two

As the system was made available, the default mode of operation for the system terminal was a "Class 7" console, meaning a Televideo. (A TVI-912 in my case.) In OASIS, all user console devices are driven by an appropriate assembly language driver package. An integral part of this driver package is the function of translating an internal "OASIS Standard" set of terminal controls to the actual control functions required by the user's terminal. As each user console is put on-line by the default parameters specified either at system generation time or at the time it is "ATTACH"ed via a system utility, the translation information is indicated by reference to one of several available "SYSTEM.CLASSnn" files. These files (on system disk) are each specified for a given class of terminals. In my case, the terminal I desired to attach as the second user console was a DEC VT-100.

None of the standard class code files supplied with the system matched the translation characteristics of the VT-100 or VT-52. (Note that the VT-100 may be configured to respond to the DEC VT-52 screen control codes. This subsequent control code set is more typical of the screen commands used by other terminals.) It is possible to use a terminal that appears as a TTY-like device, but many system functions, like the editor, console listing functions, and certain applications programs, work better with screen erase and cursor positioning capabilities. Thus I elected to get a taste of using the OASIS text editor and macro assembler by making up a new class code file for the VT-52 mode of the terminal. As seems to be normal for the OASIS documention, the process of setting up the class code file for a new terminal type was clearly explained.

The class code file was entered in source code format using the OASIS "EDIT" utility. This editor is a line mode editor in the sense that text is generally processed one line at a time. Entry of text proceeded in a fairly typical manner for this kind of utility. The surprising differences were that default tab stops in the input mode are designed for assembly language format (a pleasant surprise), and certain columns are default to upper case characters for the opcode field. Another feature that had taken the human element into account was the line modification mode. Once text is entered it may be modified, a line at a time, by invoking the line edit mode. The line of text is displayed on screen with the cursor at the beginning of the line. Certain command codes move the cursor, insert or delete a character, or split one line into two. The modification operation is very similar to a full video mode editor except that only one line is the field of control. The result is a powerful text editor that does not require the memorization of 59 screen control functions before editing can begin. I was successfully entering and modifying text in my class code source file in less than twenty minutes.

The following listing is the class code file which I used to configure the OASIS system to the VT-100 terminal. The listing also includes several features of the OASIS Macro Assembler.

```
==>File CLASS52.ASSEMBLE

        TITLE     'CLASS CODE 52 (DEC VT 52 MODE OF VT 100)'
;
;       ENTRY PARAMETERS:
;
;            (A) - Control Character to Translate
;            (B) - Console Device Number
;            (C) - same as (A)
;            (H) - Cursor address column counter
;            (L) - Cursor address line number
;
        MACLIB    CLASS               ;Get MACRO definitions
        INIT
        DCA                           ;Setup direct cursor address
                                      ; entry point
        LD        C,ESC               ;Send cursor position leadin
        SC        64
        LD        C,'Y'               ;Send cur pos code func letter
        SC        64
        LD        A,01FH              ;Cursor position bias
        ADD       A,L
        LD        C,A                 ;Send the ROW code out to device
        SC        64
        LD        A,C1FH              ;Cursor position bias again
        ADD       A,H
        LD        C,A                 ;Send the Column code out to device
        SC        64
;
        DEFINE    HOME,ESC,'H',08CH
        DEFINE    CLEAR,ESC,'H',ESC,'J',08CH
        DEFINE    EOS,ESC,'J',08CH
        DEFINE    EOL,ESC,'K',08CH
        DEFINE    LEFT,ESC,'D'
        DEFINE    RIGHT,ESC,'C'
        DEFINE    UP,ESC,'A'
        DEFINE    DOWN,LF
        DEFINE    EU                  ;Not available
        DEFINE    PON                 ;Not available
        DEFINE    POFF                ;Not available
        DEFINE    FON                 ;Not available
        DEFINE    FOFF                ;Not available
        DEFINE    BON                 ;Not available
        DEFINE    BOFF                ;Not available
        DEFINE    RVON                ;Not available
        DEFINE    RVOFF               ;Not available
        DEFINE    ULON                ;Not available
        DEFINE    ULOFF               ;Not available
;
        END
;
;
;...+++END OF FILE CLASS52.ASSEMBLE
```

The assembly language native to the OASIS system and processed by the Macro Assembler is a Z-80 utilizing ZILOG mnemonics. Notice from the listing that the assembler knows the values for control codes such as "ESC" and "LF." Also, the procedure of making a system call involves a simple macro invocation like "SC 64." This translates into a system call type 64 that sends the character in (C) to the device addressed by the (B) register. (For documentation purposes only, the PON, POFF, ... ULOFF are macro invocation parameters for control sequences not available on the VT-52 terminal. Typical controls possible via these codes, provided the terminal can interpret them, are underline on/off and reverse video on/off.)

The program file described above was converted to the appropriate relocatable object file by using the Macro Assembler and Linker programs. An interesting capability provided with the OASIS system is a command file "ASM.EXEC", a program similar to a job submittal function on other operating systems. In this case, "ASM.EXEC" is a command file that successively invokes the macro assembler and linker. To get all of the CLASS52 file put into the proper format, all I had to type was:

```
>ASM CLASS52<cr>
```

The executive command processor did the rest by calling in the assembler and linker in turn. The similarity of OASIS EXEC to job submittal functions on other microcomputer operating system ends at the capability to process predetermined sequences of operator commands. In the OASIS environment, the EXEC processor more closely resembles the JCL language that I used some years ago on an IBM 370 system. The EXEC processor will execute an ASCII command file in a somewhat interpretive mode. The command file may contain direct CSI commands and internal calculations based upon EXEC variables and system codes returned from the last executed program. Command statements include looping possibilities with "WHILE" and "UNTIL" constructs, direct console/printer I/O and operator parameter input query. Another feature includes the possibility of passing parameters from the EXEC command processing level to the next executing transient applications package. This feature allows for the passage of information between programs without having to write it to a disk file.

The process of making the VT 52 mode of the DEC terminal work was completed with shining success. I was immediately able to get the system to bring up the second console, using the system utility commands to define a second memory partition and start active execution of a second user. Attachment of the printer was also easy since the physical device drivers that allow connection of printer devices support a number of printer "BUFFER FULL" determination mechanisms. I chose to use the "Data Set Ready" hardware handshake mechanization due to the simple nature of getting it going. The NNC hardware implementation of all serial ports includes the data set ready input on pin 20 of the rear panel DB25 RS-232 connector. The TI 820 printer may conveniently be configured to assert a "reverse channel handshake" buffer full on a specific line. All I had to do was wire this line to the SYSTEM 80W connector pin 20, and the printer was up and going. The process took less than a third of the time typically expended in attaching a printer to an S-100 computer using another popular operating system.

Multiuser Processing

With the two consoles configured to the system, I was ready to try the multiuser aspects of OASIS. The multi-processing scheme of OASIS is based upon an internal real-time repeative interrupt that forces a system execution entry every few milliseconds. This interrupt interval, or multiples of it, create time slices during which alternating tasks are allowed to execute. If I booted up the system and didn't attach a second user, the system would then allocate every time slice to the main console, causing the system to appear to be single user. When I attached the second user, the system allocated every other time slot to alternate consoles and programs being run from those consoles.

The default time slice allocates 30 milliseconds to each user at a time. I found this time span to be adequate for most of my purposes. I did note, however, that a shorter time slice improved multiple terminal performance somewhat—if one user was creating a printout at the same time as another was doing a large amount of screen-oriented output. The OASIS system permits an easy means of dynamically changing the time slice to a value that optimizes system performance for a given execution environment with a simple command like:

```
>SET SLICE=nn<cr>     .. where nn is the time slice length
                         in milliseconds.
```

A time slice of ten milliseconds was found to give the best performance for program executions requiring huge amounts of serial I/O via the three serial ports. If the processing was generally CPU speed bound, then the time slice factor had little effect on the speed of program execution.

The table below shows representative numbers for program execution times in various modes to give an indication of system performance in the multi-user mode versus single-user mode. The example mode used was primarily CPU speed bound. I took the previously presented class code definition file, and made two copies of it names USER1TST.ASSEMBLE and USER2TST.ASSEMBLE. The Macro Assembler executive command file "ASM" was used at both user consoles to assemble the two identical programs. Note that the two assembly processors shared hard disk resources for source input, object output, and print file output. Also shared were the included macro file "CLASS", the assembler command file, and the linker command file.

In the examples, both users were running at a file access priviledge level of six (6) and had consoles at 9600 baud. The system time slice was at the default 30 millisecond value. The start time indicated was measured from depression of the carriage return key after the user's CSI command had already been typed in. Time measurements were made using a digital wrist watch with a one second resolution time.

The assembly times in Figure 1 are obviously limited by processing time. For two users to perform the same task, the execution time is almost exactly twice as long. Note that the last example was run to show that single-user operation of the system is very slightly lowered by having an attached and idle second user console.

Figure 1: *Assembly Time Comparisons on OASIS using class code file as input.*

Condition of Assembly	Time
Assemble from User 1 with User 2 idle in CSI Input wait. Both users logged to SYSTEM account.	1 min/7 sec
Assemble from User 2 with User 1 idle in CSI Input wait. Both users logged to SYSTEM account.	1 min/6 sec
Both users do same task at same time while logged to SYSTEM account.	
USER 1	2 min/6 sec
USER 2	2 min/7 sec
Assemble from console 1 with no active user 2 defined. Immediate system mode not logged to an account.	1 min/4 sec

Looking at OASIS Basic

The OASIS system includes a complete Basic language programming system that has some unique features. The Basic package is both an interpreter and a compiler. The interactive interpreter may be used for program development and debug, while the compiled mode may be invoked to produce a program that executes without needing the overhead of having the whole interpreter/compiler resident in the memory of the active user area. Also included with the system is a re-entrant version of the Basic that may be loaded such that multiple users may access the same image, from multiple active user areas. In reviewing the memory requirements to have Basic resident for each user versus having one re-entrant copy for all users, it appears that on a three-user system, more program memory space would be available for the second and third users than would be available on a two-user system, each with his own copy of Basic. This estimate was based upon the 128K memory configuration of the NNC SYSTEM 80W.

The functional capability of the OASIS Basic is roughly equivalent to other popular Basics from Compiler Systems or Microsoft. A number of special capabilities available appear to be due to the presence of the powerful host operating system file manager and real-time capabilities. Command functions within the language may include any valid system CSI level command, right in the middle of the Basic program! This allows full use of separately developed programs (in any language) to enhance the operation of a Basic program. (Couple this with the parameter-passing capability of the EXEC processor, and you have an extremely powerful vehicle upon which to develop sophisticated turn-key application packages.)

Direct Indexed file I/O is possible within the Basic, as this file format is directly supported by the operating system. For multi-user processing of files under the Basic (or other programs, if properly written), automatic file access record lockout is a feature that will guarantee data base integrity if multiple programs (users) are using the same data files. Many other systems do not provide this capability intrinsic to the operating system. Thus, incredible programming games must be played to achieve the same level of data access integrity.

A few other comments related to the Basic and its operation are in order here. During program development,

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the program syntax is checked (and can be corrected) as the statements are entered, not as they are executed. In addition, since syntax checking need not be done at interpretation/execution time, the user will see some improvement in execution speed. Another feature discovered in the Basic manual was something I had not seen in a high level computer language since I programmed on a main-frame computer. That feature is the capability of the Basic programmer to access the time and date routines of the system. I have illustrated the use of the time function in the Basic program listing that follows.

The program listing below shows a short program written to exercise the system execution times, as I did with the class file assembly times, using the system clock to time the program execution. Recall that the Basic interpreter was running on a 4 MHz Z-80, should the reader desire to compare execution time of this program against that of another Basic. The system time slice during these tests was at the default 30 millisecond value.

```
==> Execution Time Test BASIC Program (USES SQUARE ROOT FUNC)

    10 PRINT "START TIME    ",TIME$(0)
    20 FOR I% = 1 TO 10000
    30 J = SQR(I)
    40 NEXT I%
    50 PRINT "END TIME      ",TIME$(0)
    60 END
```

Figure 2: *Ten Thousand Square Roots Execution Time Tests.*

Execution Condition	Time
Executed by User 1 with attached printer in console echo mode. User 2 in prompt mode of Basic.	0 min/43 sec
Executed by User 2 with no attached devices. User 1 in Basic prompt mode with attached printer.	0 min/53 sec
Executed by User 1 with attached printer but no print echo on. User 2 in prompt mode of Basic.	0 min/43 sec
Executed by both users at same time with no printer echo on at User 1. Device still attached.	
USER 1:	1 min/26 sec
USER 2:	1 min/26 sec
Executed by both users at same time with printer echo on at User 1. User 2 startup delay due to User 1 printing.	
USER 1:	1 min/25 sec
USER 2:	1 min/25 sec

Random Comments

Other items of interest relate primarily to several of the utility packages furnished with OASIS. For a systems person such as myself, I feel that the Z-80 program debugger is a particularly nice package. Direct assembly/disassembly is permitted in complete ZILOG mnemonics. The on-line assembler does immediate syntax checking and program listing—just like an assembler output.

A disk backup utility furnished with the system called "ARCHIVE" makes the file backup process a breeze. One feature of OASIS is the direct indexed file format supported by the host file manager. As an applications program data base is built in a file of this type, much of the file may contain blanks in filling out records fields. Many records may also be inactive because of delete status, or may never have been allocated as active records. This leads to the situation where ARCHIVE is an especially powerful backup utility. The backup from an active system work disk (such as the hard disk) to floppy compacts the data files as they are transferred. This allows random access direct files larger than a whole floppy to be brought into reasonable backup storage size. Other features of the ARCHIVE system are backup of files by selected wild card names, by range of creation dates, or by range of most recent access dates. Multi-volume diskette ARCHIVE backup is also possible with operator prompting for insertion of the proper diskette(s).

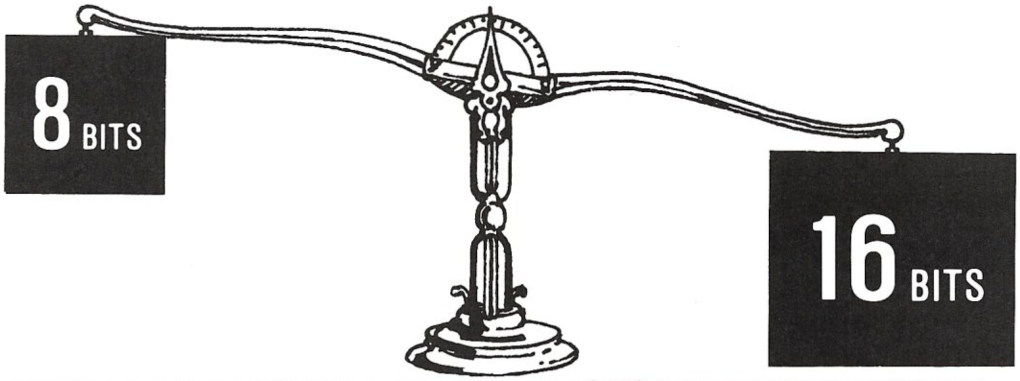
The hardware configuration utilized for the evaluation also deserves a final comment here. During the 45 day period that the NNC SYSTEM 80W was tested, it performed flawlessly. The reliability of the floppy system was evident in that *no* floppy read/write problems were encountered. The double density media conformance to IBM standard format compatibility was checked via format interchangeability with another computer system. No interchange problem was found despite the fact that the computers used entirely different types of floppy disk controllers. The SHUGART SA1004 8" Winchester disk system with the XCOMP controller seems to provide more than adequate media access speed and reliability for a multiuser system. Note from the previous assembly time tests (Figure 1) that two users building files at the same time in different areas of the hard disk did not degrade performance at all. The two-user assembly process took less than twice as long as one user, indicating that disk access performance is not generally a problem with multiple users on the NNC hardware configuration.

Conclusion

OASIS is an absolutely fresh approach to the way that 8-bit microcomputer operating systems have typically been implemented. The quality of the product is evident in several important areas:

- The quality of documentation allows anyone modestly serious about using a computer in professional applications to get into a productive mode of operation.
- Consistency of the operator interface at all levels of system usage provides for an easily learned system.
- Run-time error checking, error reporting, and the availability of the on-line HELP system make it almost impossible for the user to "mess up the system."
- Development tools that are standard with OASIS and optional packages available from the same source provide an OEM software development environment for sophisticated applications not found on other systems with "standard" operating systems.

No, Oasis is not just another operating system. And as a person just introduced to this system, all I can say is that I am impressed at the possibilities. Just for the record, OASIS 16, the 16-bit version, written in "C," will be in distribution by the time you read this evaluation. It promises to be everything that I've said to be true of the 8-bit Z-80 version—and more. Watch for it! ■



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Enhancing CP/M 2.2

by Ralph J. Jannelli

Enhance the performance of CP/M 2.2 in multi-user applications by setting up multiple-user directories.

Several enhancements have been made to CP/M since version 1.4. One of these enhancements, found in version 2.2, is the ability to have multiple user directories—an obvious lead-in to MP/M. However, as implemented, it offers little advantage to the user. In CP/M 2.2 each directory must contain all files that need to be accessed by that user. This is a colossal waste of disk space! Imagine having four or five users each using Basic and/or a word processor and the normal CP/M utility files (STAT, DDT, ASM, etc.). These files must be duplicated for each user on the disk. If each user had his own diskette there would be no need for separate user directories. User directories provide their greatest utility in hard disk environments, which are becoming more prevalent in today's micros. Although a hard disk has many times the capacity of a floppy, why waste disk space?

This article describes a modification to CP/M which may be made to the CCP (Console Command Processor) module, allowing any user to access all the files in user directory 0. Directory 0 (zero) can now be considered a utility or system directory. Only user specific files will need to be included in the user directory. Example: If I am user 5 and I want to run my Basic application program "SORT.BAS", I simply enter the CP/M command "BASIC SORT". CP/M, under control of the CCP, will search my user directory for BASIC.COM which, however, does not exist in my directory. Normally CP/M would return an error. By intercepting this error and interrogating the current user number a decision can be made. If the current user number is 0, then no other directory is searched for the requested file; control is therefore passed back to the CCP and the resulting error is sent to the user. If the current user number is not 0, the current user number is saved, the user number is changed to 0 and the search is re-initiated. If as a result of searching the user 0 directory the file is still not found, the user number is restored to its previous value and control is passed back to the CCP with the normal "file not found" error as a result. If the file is found in user directory 0, the file is loaded. After the file is loaded the user number is restored. Control is now passed to the CCP which in turn passes control to the program just loaded, in this case the Basic interpreter. Now the Basic interpreter will utilize the BDOS (Basic Disk Operating System) module of CP/M to search for the applications program SORT.BAS. If the Basic interpreter does not find the file under the current user directory it will return an error message. Note that only files invoked under control of the CCP will cause a search in both the user directory and directory 0.

A further modification to the CCP provides a much more convenient prompt for a multi-user environment. Normally the CCP prompt identifies only the currently logged disk drive (i.e., A> for disk A), but gives no indication of the current user directory. The modification will cause the prompt to be the user number followed by the normal prompt (i.e., 5A> for user 5 disk A).

These changes are implemented by modifying the BIOS (Basic I/O System) module of CP/M. I chose to implement my changes in the BIOS, rather than in the CCP module, because CP/M documentation normally includes a source listing or disk file of the BIOS program, whereas a source listing of the CCP module is not available to the system user. Three jump instructions in the CCP need to be patched, but are not modified until the GOCPM routine of

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Ralph J. Jannelli, 101 Cottonwood Dr., Jamestown, NC 27282.

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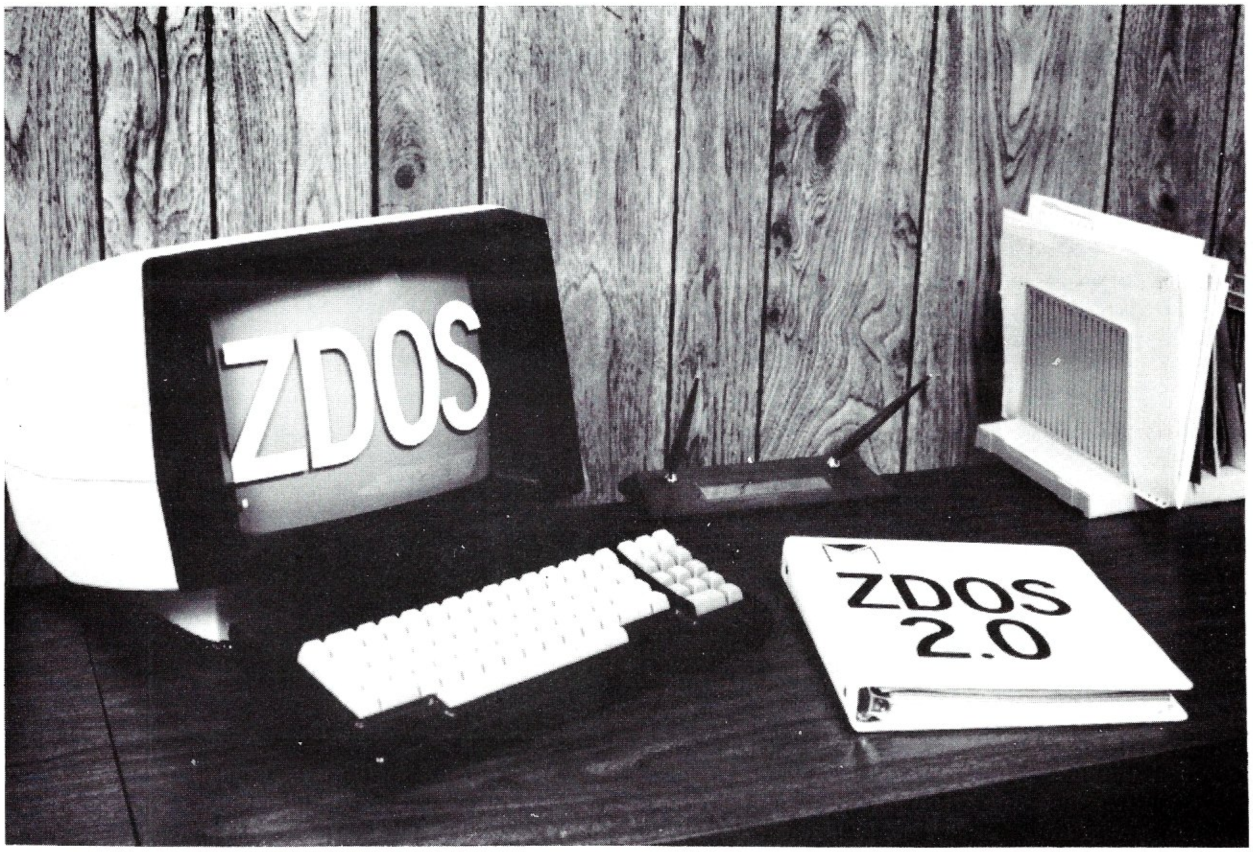

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____

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MY CURRENT SYSTEM 'CONFIGUATION:

HARDWARE: ______________________

____

OPERATING SYSTEM: ______________________

Enhancing CP/M 2.2, continued...

the BIOS is executed. The GOCPM routine is executed on both warm and cold boot operations. (Remember that BIOS itself is not reloaded except on a cold boot operation.) The patches are accomplished by loading the new jump address into the HL register and storing HL at the given location for each of the three patches. The equate statements at the beginning of the program are calculated from the MSIZE given at the beginning of the normal system BIOS program, allowing appropriate relocation of the patched addresses according to the system memory size. ■

```
MSIZE   EQU     56                      ;size of system memory
BIAS    EQU     (MSIZE - 20)*1024       ;calculation of offset
CCP     EQU     3400H + BIAS            ;start addr of CCP
PATCH1  EQU     CCP + 389H              ;addr of first patch
PATCH2  EQU     CCP + 6DCH              ;addr of second patch
PATCH3  EQU     CCP + 6EDH              ;addr of third patch
BIOS    EQU     CCP + 1600H             ;start addr of BIOS
BDOS    EQU     CCP + 806H              ;start addr of BDOS
        ORG     BIOS                    ;origin of BIOS
;***************************************************************
;*                                                             *
;*          NORMAL SYSTEM BIOS PROGRAM STARTS HERE             *
;*                                                             *
;***************************************************************
*** BIOS THE SAME AS SUPPLIED WITH SYSTEM UP TO THIS ROUTINE ***

GOCPM:  MVI     A,0C3H                  ;this is the normal code
                                        ;supplied with CP/M
        STA     0
        LXI     H,WBOOTE
        SHLD    1
        STA     5
        LXI     H,BDOS
        SHLD    6
        LXI     B,80H
        CALL    SETDMA
        EI
        LDA     CDISK
        MOV     C,A
                                        ;this begins the code added
                                        ;to the GOCPM portion of CP/M
                                        ;
                                        ;
        LXI     H,CHECK                 ;LOAD ADR OF CHECK ROUTINE
        SHLD    PATCH2                  ;STORE AT PATCH2
        LXI     H,USRRST                ;LOAD ADR OF USRRST ROUTINE
        SHLD    PATCH3                  ;STORE AT PATCH3
        LXI     H,PROMPT                ;LOAD ADR OF PROMPT ROUTINE
        SHLD    PATCH1                  ;STORE AT PATCH1
        JMP     CCP                     ;JUMP TO BEGINNING OF CCP
                                        ;
                                        ;
;*************************************************************
;*                                                           *
;*              START NEW ROUTINES AT END OF                 *
;*              EXISTING BIOS PROGRAM                        *
;*                                                           *
;*************************************************************
                                        ;
                                        ;
BDOSE   EQU     5                       ;ADR OF BDOS ENTRY POINT
                                        ;USED FOR SYSTEM CALLS
OPEN    EQU     CCP + 0D0H              ;CALL THIS LOCATION TO
                                        ;RE-INITIATE THE SEARCH
                                        ;FILE FOUND IN DIR 0
NFOUND  EQU     CCP + 76BH              ;ADR TO RETURN TO IF FILE NOT
                                        ;NOT FOUND
EOF     EQU     CCP + 701H              ;JUMP TO THIS ADR AFTER USER #
                                        ;RESTORE OPERATION
RFILE   EQU     CCP + 6DEH              ;JUMP TO THIS ADR TO READ FILE
PCHAR   EQU     CCP + 8CH               ;CALL THIS LOCATION TO PRINT
                                        ;USER # PROMPT CHARS
CPMPT   EQU     CCP + 1D0H              ;JUMP TO THIS LOCATION AFTER
                                        ;PRINTING USER # PROMPT
                                        ;
                                        ;
;*************************************************************
;*                                                           *
;*              ROUTINE TO MODIFY CP/M PROMPT                *
;*                                                           *
;*************************************************************
;
PROMPT: PUSH    B                       ;SAVE BC AND DE REGS
        PUSH    D
        MVI     C,20H                   ;SYSTEM CALL 20H (INTERROGATE
        MVI     E,0FFH                  ;USER NUMBER
        CALL    BDOSE                   ;RETURNS WITH CURRENT USER #
                                        ;IN THE A REG
        CPI     0AH                     ;IS THE USER # > 10 ?
        JNC     CHAR2                   ;IF SO MUST PRINT TWO #'S
PMT1:   ADI     30H                     ;OTHERWISE MAKE ASCII
        CALL    PCHAR                   ;OUTPUT # TO CONSOLE
EXIT1:  POP     D                       ;RESTORE BC AND DE REGS
        POP     B
        JMP     CPMPT                   ;RETURN CONTROL TO CCP @ CPMPT
CHAR2:  SUI     0AH                     ;USER # IS > 10 SO SUBTRACT 10
        PUSH    PSW                     ;SAVE RESULT ON STACK
        MVI     A,31H                   ;SEND A ASCII 1 TO CONSOLE
        CALL    PCHAR
        POP     PSW                     ;RECOVER REMAINDER
        JMP     PMT1                    ;JUMP TO OUTPUT REMAINDER
                                        ;
                                        ;
```

```
;***************************************************************
;*                                                             *
;*              ROUTINE TO CHECK DIR 0 FOR FILE                *
;*                                                             *
;***************************************************************
;
CHECK:  PUSH    D                       ;SAVE BC,DE AND AF REGS
        PUSH    B
        PUSH    PSW
        MVI     A,0                     ;RESET FLAG
        STA     FLAG
                                        ;FLAG INDICATES THAT USER #
                                        ;CHANGED IF FLAG IS SET
        MVI     E,0FFH                  ;INTERROGATE CURRENT USER #
        MVI     C,20H
        CALL    BDOSE
        STA     USER                    ;STORE CURRENT USER # IN TEMP
        ORA     A                       ;CHECK FOR USER 0
        JNZ     NUSER0                  ;JUMP IF CURRENT USER # NOT
                                        ;USER 0
        JMP     EXIT                    ;IF CURRENT USER # IS USER 0
                                        ;THEN RETURN CONTROL TO CCP
NUSER0: MVI     C,20H                   ;SET USER # TO USER 0
        MVI     E,0
        CALL    BDOSE
        CALL    OPEN                    ;RE-INITIATE SEARCH
        JNZ     FOUND                   ;IF A REG RETURNED NON 0 THEN
                                        ;FILE WAS FOUND IN USER 0 DIR
        LDA     USER                    ;OTHERWISE FILE WAS NOT FOUND
                                        ;SO RESTORE USER #
        MOV     E,A
        MVI     C,20H
        CALL    BDOSE
EXIT:   POP     PSW                     ;RESTORE DE, BC AND AF REGS
        POP     B
        POP     D
        JMP     NFOUND                  ;RETURN CONTROL TO CCP @
                                        ;NFOUND
FOUND:  POP     PSW                     ;FILE FOUND IN USER 0 DIR
        POP     B                       ;RESTORE DE, BC AND AF REGS
        POP     D
        MVI     A,1                     ;SET FLAG FOR RESTORE
                                        ;OPERATION AFTER FILE IS
                                        ;LOADED
        STA     FLAG
        JMP     RFILE                   ;RETURN CONTROL TO CCP @ RFILE
                                        ;
                                        ;

;***************************************************************
;*                                                             *
;*              ROUTINE TO RESTORE USER # AFTER                *
;*              LOADING FILE FROM USER 0 DIR                   *
;*                                                             *
;***************************************************************
                                        ;
                                        ;
USRRST: PUSH    D                       ;SAVE DE, BC AND AF REGS
        PUSH    B
        PUSH    PSW
        LDA     FLAG                    ;CHECK FLAG
        ORA     A
        JZ      RSTR1                   ;IF FLAG NOT SET NO RESTORE
                                        ;REQUIRED
        LDA     USER                    ;IF FLAG NON 0 THEN GET USER #
        MOV     E,A                     ;RESTORE USER #
        MVI     C,20H
        CALL    BDOSE
        MVI     A,0                     ;RESET FLAG
        STA     FLAG
RSTR1:  POP     PSW                     ;RESTORE DE, BC AND AF REGS
        POP     B
        POP     D
        JMP     EOF                     ;RETURN CONTROL TO CCP @ EOF
FLAG:   DB      0                       ;LOCATION OF FLAG
USER:   DB      0                       ;LOCATION OF TEMP USER #
                                        ;STORAGE
                                        ;USE DB INSTEAD OF DS TO
                                        ;TO ENSURE FLAG AND USER ARE
                                        ;SET TO 0 INITIALLY
LAST:   EQU     $ - BIOS                ;NOTE FOR SINGLE DENSITY 8"
                                        ;DISK USERS:
                                        ;IF LAST > 37FH THEN BIOS TOO
                                        ;BIG TO FIT ON SYSTEM TRACKS
                                        ;(TRACKS 0 AND 1) OF DISKETTE
                                        ;
                                        ;
;***************************************************************
;*                                                             *
;*          LOCATE NORMAL CP/M DIRBUF, ALLOCATION              *
;*          STORAGE AND CHECK VECTORS AFTER ADDED              *
;*          CODE                                               *
;***************************************************************
        END
```

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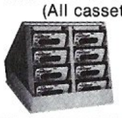

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The Unbanker

by Bob Weidemann

Increasing the system memory space on a two-user system.

Why is it that the solutions to nine of every ten computer dilemmas fall outside the system restraints? While installing an MP/M system into my S-100 system, I discovered that I had a BDOS (Basic Disk Operation System) 16½ Kbytes long logically, with only 16 Kbytes available physically. Simple arithmetic showed me to be 512 bytes short. My solution is simple and should be of interest to anyone who finds himself a little low on memory, whether he's using MP/M, or CP/M or any other operating systems.

Background

In a two-user MP/M system, each user has his own bank of memory. The maximum contiguous memory available to each user simultaneously or individually is 48K. To achieve this, one simply buys two 64K memory cards and leaves 16K of chips off each card. Each card is addressed by the 16 address lines of the CPU, and by one more bit supplied by an output port (typically port 40H). The eight bits of the port should only have one bit on at a time, so that only one board (out of a maximum of eight) is on at a time.

The nice part of the scheme is that the I/O port bit is latched, so that you only have to change the bank bit occasionally, such as when the processor services a different user.

The 48K available to each user is roughly equivalent to a CP/M 56K environment since the CP/M system would have a BDOS-BIOS area included in it; whereas MP/M's 48Kbytes is separate from the BDOS-XIOS (as it is called in MP/M environments).

The typical 8-bit microprocessor can address up to 64K of memory. 16K remains after we subtract the 48K in either bank. This 16K is special. It contains the MP/M operating system, and must be available to the processor no matter which bank is currently being used. This 16K is not banked; it doesn't look at the output port at all. Its physical address is the top 16K of memory, no matter which bank is on. The other two boards are located in the bottom 48K of memory and are turned on or off by flipping the bits in the port.

A simple way to implement this 16K is to use two old 8K cards that don't have bank select, or that have the bank select disabled. (By the way, most of those old 8K cards will work at 4 MHz even if you did not pay for "high speed" chips—so don't give them away!) Since you're not using bank select, this 16K of memory will always be addressable, regardless of which bank is on.

A better way to implement this 16K is to put 16K of chips back onto one of the two banked boards. But this 16K must be removed from the banking scheme, so that it is always selected.

The Problem

Remember when you first got CP/M and you decided to improve on the BIOS? Naturally, adding just one more little routine increased your BIOS size, so that you had to decrease your TPA (Transient Program Area). Typically, you did that by pretending your total memory was 1K less than it actually was, when you constructed (used MOVCPM) your CP/M system. Now suppose you are working with MP/M and your BDOS-XIOS goes just over 16K long. How can you keep a 16+K system in your non-banked memory when you've only got 16K available? Remember that the SYSTEM must always be in memory, no matter which bank (or user) is on. If you use a portion of the banked memory, you would lose part of your operating system when the "other" user comes on.

Bob Weidemann, 5 Bondsburry Lane, Melville, NY 11747.

After studying the MP/M manual, I realized that others must have the same problem since MP/M provides for a "banked BDOS." This feature allows you to increase your system to over 16Kbytes. MP/M does this by transferring the overage from bank to bank everytime you change banks. This feature may not be worth implementing because of the CPU time lost in doing the transfers. I did attempt to implement this feature, and suffered increased time delays. I might even have lived with this problem for a while, except that MP/M did not work properly when I invoked the "banked-BDOS" option. Only one user's bank worked correctly. The other bank did not get updated properly. I believe it to be a bug in the MP/M implementation, but I felt that this direction wasn't worth wasting time on.

My solution

Adding a half-K memory card that is always in the base page of memory (does not bank) deselects (phantoms out) any other memory cards whenever it is addressed. Also, MP/M allows a user to increase his non-banked system area, at the expense of losing that area from every user's memory space. So, the cost of my solution is the loss of one-half Kbyte from the TPA of each user, which is why I am not using the entire 1K available to me from this board.

It took six chips to implement what I call my "Unbanker" circuit, shown in Figure 1. I had two choices of memory to use, static or dynamic. For this small amount of memory, dynamic would increase the chip count (due to refresh requirements) and would otherwise complicate things unnecessarily. Ideally, I wanted a 512 x 8 bit chip. Second choice would be a 1024 x 8 bit chip. Neither of these were readily available, so I was forced to use two very common 2114's (1024 x 4); but I have extra memory for future expansion.

The memory is located from BE00 to BFFF hex. An 8 input NAND gate is used as an address decoder. ■

Editor's Note:

Although the circuitry shown works in the author's system, it may present some problems in other S-100 systems. Note the following:

1) If there is another device which can enable the Phantom line (67) then a tri-state gate should be used to generate the Phantom signal. The input to the gate should be grounded and the WRITE signal used to enable the gate.*

2) If memory read problems are encountered due to critical CPU read timing then the READ signal should be generated by NANDing pDBIN (78), sMEMR (47) and MEM SELECT*.*

BOB WEIDEMANN is totally immersed in computers. During the day he teaches programming at LaGuardia Community College; in the evening (ever since Altair sold the first S-100 computers) Bob's quest has been to develop the "perfect" S-100 system. He has put all this experience to good use by assisting many small businesses with the purchase and installation of microcomputers.

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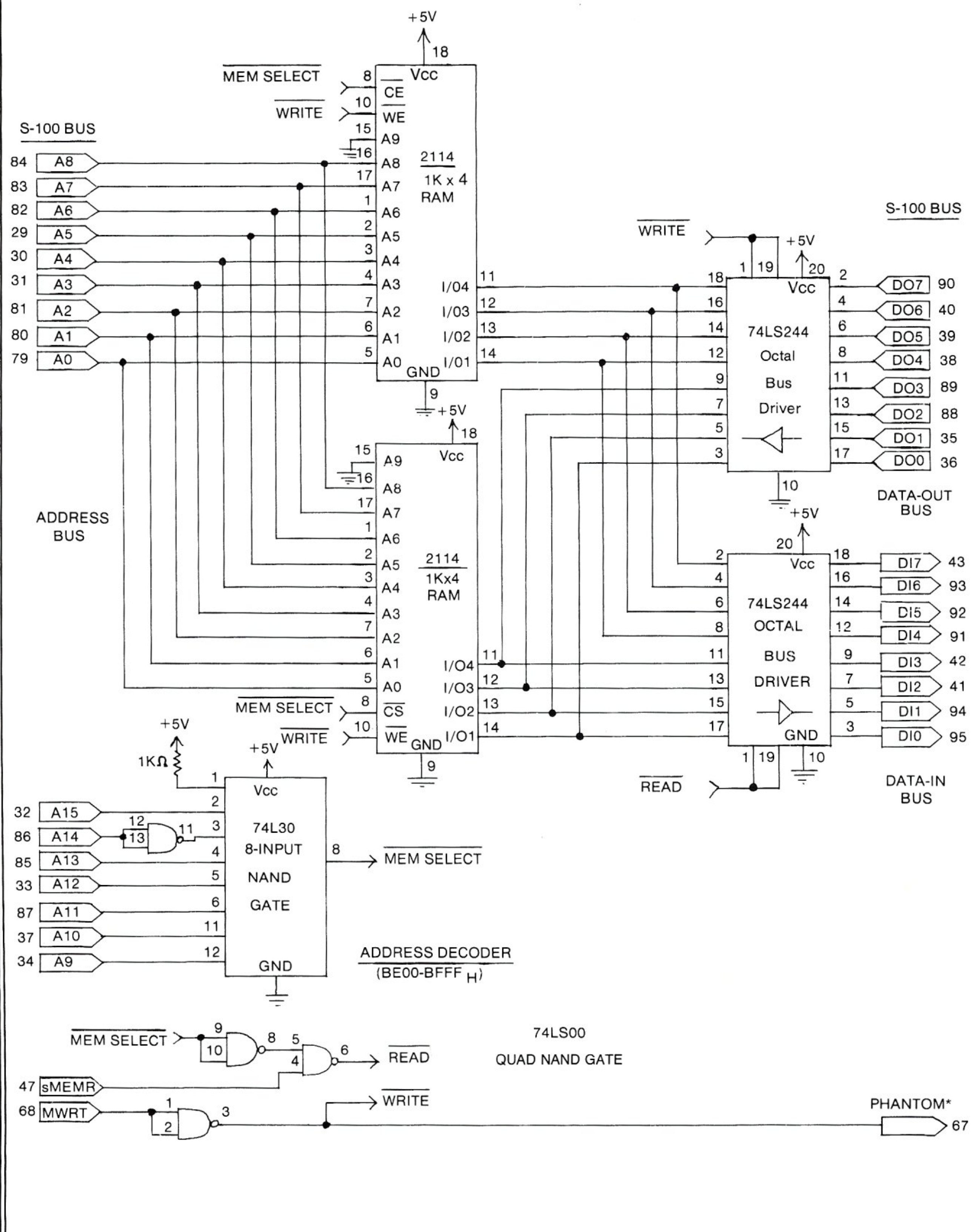
Figure 1.



+5V
MEM SELECT
WRITE
S-100 BUS
A8
A7
A6
A5
A4
A3
A2
A1
A0
CE
WE
Vcc
2114
1K x 4
RAM
I/04
I/03
I/02
I/01
GND
WRITE
+5V
S-100 BUS
74LS244
Octal
Bus
Driver
DO7
DO6
DO5
DO4
DO3
DO2
DO1
DO0
DATA-OUT
BUS
ADDRESS
BUS
2114
1Kx4
RAM
74LS244
OCTAL
BUS
DRIVER
DI7
DI6
DI5
DI4
DI3
DI2
DI1
DI0
DATA-IN
BUS
READ
MEM SELECT
CS
WRITE
1KΩ
A15
A14
A13
A12
A11
A10
A9
74L30
8-INPUT
NAND
GATE
MEM SELECT
ADDRESS DECODER
(BE00-BFFF H)
74LS00
QUAD NAND GATE
MEM SELECT
READ
sMEMR
MWRT
WRITE
PHANTOM*

Interfacing a Winchester Disk To MP/M

by Ira Gordon And Karl Wacker

With many manufacturers now advertising hard disks, we could not resist the temptation of interfacing one to an S-100 computer system. We priced the available units, and found that IMI (International Memories Inc.) was offering a 5-1/4", 6.7 Mbyte unit (unformatted), complete with intelligent controller, power supply, and cable set, for $1,900. This is the same disk system that Corvus uses in their Constellation System, so we felt it had reached a level of product maturity.

The price was justified because of the hard disk's cost effectiveness over multiple 8" quad density floppy disks yielding equivalent storage. The use of a multi-tasking, multi-user operating system, such as Digital Research's MP/M or Phase One's Oasis, would provide additional cost justification.

The IMI-5000's specifications were very impressive. The rotational speed of the twin platters is 4800 RPM compared to the Seagate ST-506's 3600. The byte transfer rate from drive to controller is 960,000 bytes/second and from controller to CPU is 500,000 bytes/second.

The IMI-5000's intelligent controller also performs automatic sector blocking/de-blocking and track sparing of the disk media. We expected to see at least a four- to five-fold increase in performance over a single density floppy disk drive environment.

We were interfacing the hard disk to a development system using Digital Research's MP/M version 1.1. Application programs were to be written in Pascal MT+ and Z80 assembly language.

The development system hardware consisted of:

- Zobex 4MHz, Z80A CPU.
- Zobex single density floppy disk controller.
- Two SD Systems 64K ExpandoRAM II cards.
- Three Shugart SA800 floppy disk drives.
- Electronic Control Technology Ten Slot S-100 rack mount S-100 chassis with power supply.
- Two ADDS Viewpoint CRT terminals, 9600 baud.
- Power one CP-1 floppy disk power supply.
- Diablo 1355 Daisy Wheel printer with parallel interface.
- S-100 IMI controller interface card. Circuit schematic furnished by IMI.
- IMI 5007 5-1/4" Winchester drive, with IMI 5000 controller, and IMI power supply module.

The MP/M Extended Input/Output System (XIOS) for the single density floppy-based system was developed by Frank MacLachlan of San Diego, CA under contract to Zobex. The XIOS.SPR, when gensysed with MP/M, came up instantly and performed perfectly.

Additional modifications were made to the floppy-based XIOS to include a list driver routine for the Diablo printer. Separate polling modules were implemented to test the status of the platten, carriage, and wheel signals. This polling technique greatly improved the printer's performance

Hardware Considerations

The MP/M implementation utilized bank-switched memory. The two SD Expandoram II memory cards, each set up for 48K byte memory partitions, performed perfectly. The Bank-0 memory card contained a non-bank switched memory partition located from C000H to FFFFH. This partition contained the MP/M operation system.

Our desire was to have the entire O/S, including the hard disk drivers, contained in this 16K byte partition—rather than use the banked BDOS file manager which would reduce system performance.

The SD Expandoram II memory cards also required that the XIOS be modified to use port FFH as the bank switch port. Outputting a selected bank number to port FFH would cause that bank to be selected. The Expandoram II has a dip switch which allows for the setting of unique bank addresses.

The Zobex Z80 S-100 CPU card was utilized to support the MP/M environment. It has a built-in prom monitor, located at F000H, which contained a debug monitor and disk bootstrap routine. The CPU card, in addition, has the following standard features:

- Zilog CTC—used to generate MP/M interrupt clock.
- Two Zilog darts — 4 ASYNC Serial I/O channels.
- Phantom prom monitor.
- AM9519 interrupt controller.
- Intel 8255 parallel port interface.
- 2 or 4 MHz operation.

The Zobex CPU, after executing the MP/M boot program, would phantom the prom monitor and allow the entire

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Karl Wacker, 100 Rockaway St., Islip Terrace, NY 11752.
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16Kbyte memory partition (C000H to FFFFH) to be utilized for the MP/M System.

The S-100 interface schematic supplied by IMI (see Figure 1) was found to have three deficiencies. First, the interface would not supply an I/O generated reset signal long enough to properly rest the IMI controller. Second, the IMI design did not use one address line in decoding the I/O address space. Third, separate I/O addresses were used for the four functions of the interface (data to controller, data from controller, status from controller and controller reset).

The first problem was solved by adding a one-shot (74123) and a buffer gate as a pulse stretcher. The second required the addition of another gate to the address decoding logic. The third problem was not serious in this application, and was not implemented.

The IMI 5007 drive has several major differences from other 5-1/4" Winchester drives:

- It rotates at 4800 rpm instead of 3600.
- It has a formatted capacity of 5.73 Mbytes instead of 5.01 Mbytes.
- It has the data separator, the most important part of the read/write logic, on the drive instead of on the controller.
- It uses plated media instead of conventional oxide-coated media.

The IMI 5000 controller operates the drives with 512 byte sectors, but allows you to operate as if you have 128 or 256 byte sectors (this was used to avoid the buffer space needed to do external blocking/deblocking). It also permits you to access the drives by several different methods—including absolute cylinder, head and sector numbering or, as was done in this application, by way of logical sector number. In addition, the drive does automatic track sparing for defective tracks. If the drive develops a bad track, a command sequence is provided to instruct the controller to spare that track. The controller maintains this information on the first track of the drive, using all the records on the track for maximum redundancy. The controller has a useful set of self-test features that help verify that the controller/drive combination is functionally independent of your interface.

A note of caution is in order; the drive, just like any Winchester unit, is sensitive to shock, because the heads rest on the media when the unit is powered down. For this reason, keep the drive in the shipping foam until you have shock mounted it in your system. The drive should be mounted with the disks in a vertical plane, so that if your system is bumped during transport, the heads will not clatter against the media. (IMI has a shock detector inside the drive, and the warranty is void if this has been tripped due to mishandling of the drive.)

The controller responds to the same command set as the IMI controller for the larger 8" drives, except it can only operate two drives instead of eight. The IMI power supply has sufficient capacity to operate both the controller and one 5-1/4" drive.

Software Considerations

Due to various external factors, the drive was brought up on an MP/M system, which proved to be a blessing in disguise, as it allowed one user to use DDT to debug the driver software while the other user did normal system operations to test the drive and software.

The S-100 interface and controller were initially tested with DDT. When they performed properly, the driver software was written and incorporated into the operating system.

The actual software consisted of several sections:

- The parameter tables needed by CP/M and MP/M to define the logical characteristics of the drive.
- The software driver for the controller.
- The intercept interface to the existing floppy driver.

The parameter tables were generated first and verified by using the STAT command.

The intercept interface was then written to test for the IMI drive number in the select routine. Then instead of returning to the floppy driver, it jumped to the IMI driver routine.

The IMI software driver did several sub-functions:

- Translation of the sector/track information generated by the operating system into a logical sector number for use by the controller.
- Verified the controller was in a known state by doing a null command, and reset the controller if necessary.
- Load the command block into the controller.
- If doing a write then load the write data.
- Wait for the controller to do the command.
- Verify completion status of the command and do error retries.
- Read in the data if it was a read command.

The actual data transfer was done using the block input and output instructions of the Z80. This type of transfer was not time critical with the interrupts enabled, and proved to be very useful in a real-time environment.

The parameter tables for standard 8" single density floppies and for the IMI are listed below for reference:

```
.Floppy
defw    26      ;# sectors/track
defb    3       ;block shift factor
defb    7       ;block mask
defb    0       ;extent mask
defw    242     ;disk size - 1
defw    63      ;# directorty entries - 1
defb    0c0h    ;alloc 0
defb    000h    ;alloc 1
defw    16      ;check size
defw    2       ;# reserved tracks (for boot, etc)

.IMI
defw    192     ;# pseudo-sectors/pseudo-track
defb    6       ;block shift factor
defb    63      ;block mask
defb    3       ;extent mask
defw    674     ;disk size - 1
defw    255     ;# directory entries - 1
defb    080h    ;alloc 0
defb    000h    ;alloc 1
defw    0       ;check size
defw    0       ;# reserved tracks
```

The following is the software listing for the IMI hard disk driver:

```
imio:   ; the long awaited imi routines  8/8/81
        ; enter with floppy command code in d
        ; note: several of the internal temps are only for debug
        ;
        pop     hl              ; get rid of r.a. (from select)
        sub     a               ; zero a
        ld      (imibsy),a      ; set imi busy flag
        ld      a,10            ; retry count for errors
        ld      (imitry),a      ; store in imitry
        ld      a,d             ; get command in a
        cp      wrtcmd          ; test if write command for floppy
        ld      a,imiwc         ; imi write command
        jr      z,imisav        ; skip next inst if write
        ld      a,imirc         ; imi read command
imisav: ld      (imido),a       ; save command in imido
```

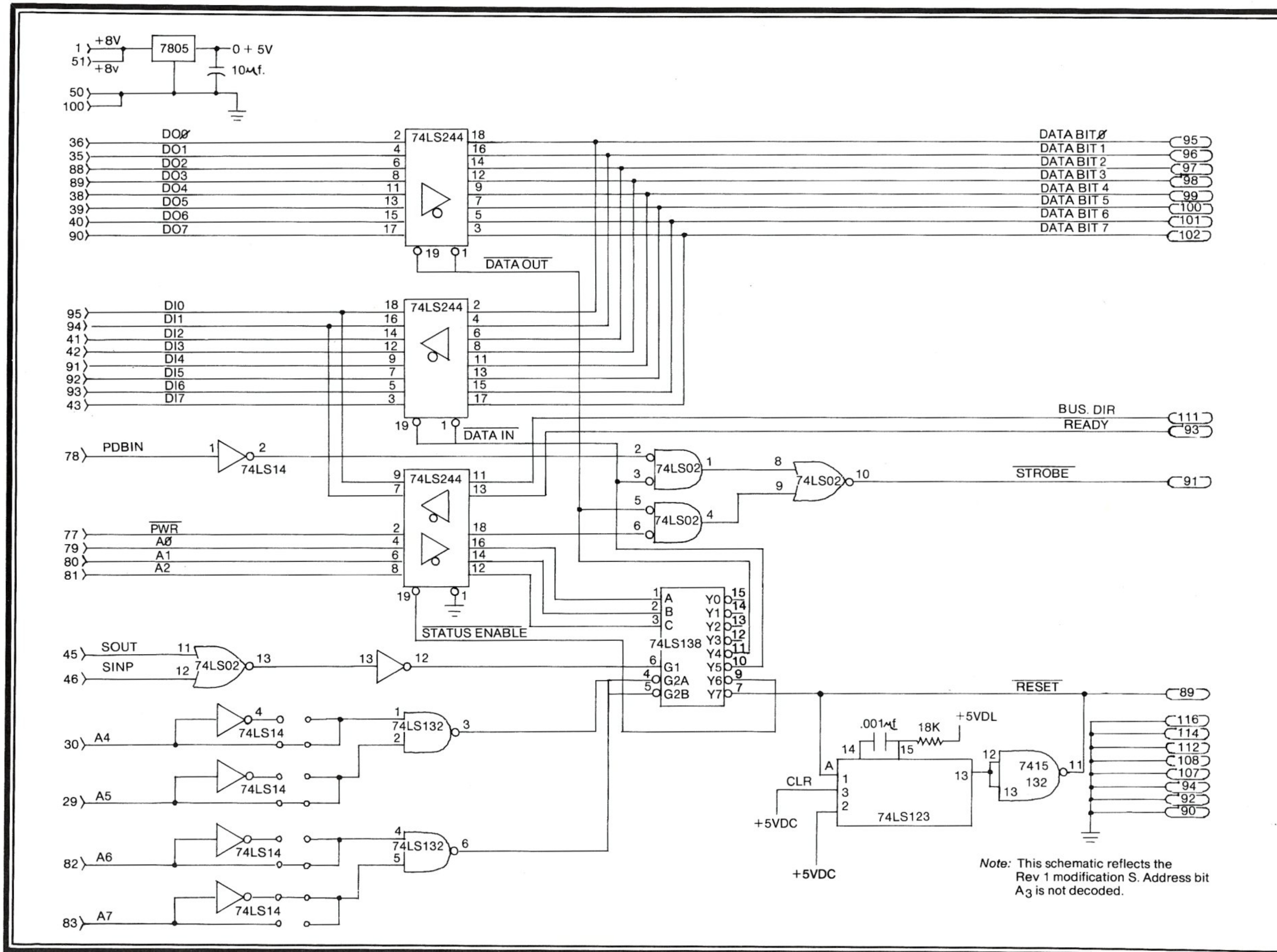

Figure 1: *Circuit for the IMI/S-100 Interface Adaptor.*

```
        in      a,(imista)      ; get status
        and     2               ; mask out ready bit
        call    z,imierr        ; if not ready on entry, error, reset
imigan: ld      a,iminc         ; null command
        call    imito           ; issue byte to controller
        sub     a               ; zero a
        call    imito           ; issue to controller
        call    imifrm          ; get polling byte
        or      a               ; was byte 0 (expected from null command)
        call    nz,imierr       ; no, call imierr
        ld      a,(imido)       ; get command code
        call    imito           ; issue to imi
        sub     a               ; zero a
        call    imito           ; issue to imi
        ld      a,(reqtrk)      ; get track # in a
        ld      l,a             ; copy to l
        ld      h,0             ; zero h
        ld      d,h             ; zero d
        ld      e,h             ; zero e
        add     hl,hl           ; multiply by 2
        add     hl,hl           ; by 4
        add     hl,hl           ; by 8
        add     hl,hl           ; by 16
        add     hl,hl           ; by 32
        add     hl,hl           ; by 64
        ex      de,hl           ; put it in d,e
        add     hl,de           ; back in h,l
        add     hl,hl           ; by 128
        add     hl,de           ; by 196
        ld      d,0             ; zero d
        ld      a,(imisec)      ; get sector # in a
        ld      e,a             ; put in e
        add     hl,de           ; form absoulte sector #
        ld      a,l             ; get low byte of sector # in a
        call    imito           ; issue to imi
        ld      a,h             ; get high byte of sector # in a
        call    imito           ; issue to imi
        ld      hl,(dmaadr)     ; pickup xfer address
        ld      b,128           ; transfer count
        ld      a,(imido)       ; get command in a
        cp      imiwc           ; a write
        jr      nz,imir         ; no, goto imir
;
        call    imirdy          ; wait for ready from imi
;
imiw:   ; write data to imi from (dmaadr)
        ld      a,(hl)          ; get a byte
        xor     40h             ; this changes data bit 6
        out     (imiout),a      ; output to imi
        inc     hl              ; kick pointer
        djnz    imiw            ; if not done, loop
        call    imifrm          ; wait for ready, read return code
        and     80h             ; mask out bad error bit
        call    nz,imierr       ; on error, call imierr
        jr      imixit          ; else, ok, goto imixit
;
imir:   ;
;
        call    imifrm          ; get return code from imi
        and     80h             ; mask out bad error bit
        call    nz,imierr       ; if bad error, retry
        call    imirdy          ; wait for ready from imi
;
imirl:  in      a,(imiin)       ; read byte
        xor     40h             ; xor with 40h
                                ; imi formats with e5h xor 40h = c5h
        ld      (hl),a          ; store it
        inc     hl              ; inc pointer
        djnz    imirl           ; loop if not done
;
imixit: call    imirdy          ; wait for imi ready bit
        in      a,(imistat)     ; read status
        and     1               ; test dir bit
        call    z,imierr        ; if not to imi, error
        ld      (imibsy),a      ; clear imi busy flag
        sub     a               ; zero a
        ret                     ; and exit, we did the i/o!
;
imido   defb    0               ; command we are doing put here
;
imisec: defb    0               ; sector address put here
;
;
imito:  ; output byte to imi after ready and
        ; if dir bit is correct for outputing
;
        ld      c,a             ; save byte to output
        call    imirdy          ; wait for ready
        in      a,(imistat)     ; read imi status
        and     1               ; mask out dir bit
        jr      z,imierr        ; if from imi, goto imierr
        ld      a,c             ; restore byte to output
        out     (imiout),a      ; output byte
        ret                     ; and return
;
imifrm: ; wait for ready, test dir, if ok, read
        ; byte and return, else jump to imierr
;
        call    imirdy          ; wait for ready
        in      a,(imistat)     ; get status
        ld      (imifmc),a      ; store it
        and     1               ; test dir bit
        jr      nz,imierr       ; if to imi, goto imierr
        in      a,(imiin)       ; read byte
        ret                     ; and return
;
imirdy: ; wait for ready bit from imi
;
        in      a,(imistat)             ; read status
        and     2                       ; mask out ready bit
        jr      z,imirdy                ; test again if not
        ret                             ; else return
;
imibsy  defb    0ffh                    ;imi busy flag
;
imifmc  defb    0                       ; status read im imifrm
;
imihl   defw    0                       ; error hl put here
imide   defw    0                       ; error de put here
imibc   defw    0                       ; error bc put here
imia    defb    0                       ; error a put here
;
imierr: ; pop r.a. off stack, dec retry counter
        ; and retry at imigan if not errored out
;
        ld      (imihl),hl
        ld      (imide),de
        ld      (imibc),bc
        ld      (imia),a
        pop     hl                      ; get rid of r.a.
        out     (imirst),a              ; issue reset to imi
        ld      hl,imitry               ; get retry counter addr
        dec     (hl)                    ; dec by 1
        jp      nz,imigan               ; retry if not errored out
        ld      a,1                     ; error exit code
        ld      (imibsy),a              ; claer imi busy flag
        ret                             ; and exit
;
imitry  defb    10                      ; retry counter for errors
```

Upon completion of the hardware interface and software driver design efforts, we reassembled the XIOS and performed the required genmod and gensys sequences.

The MP/M system was bootstrapped and the following load map appeared on the CRT screen:

```
                MP/M 1.1 Loader
                ================

        Number of consoles      = 2
        Breakpoint RST  #       = 5
        Z80 CPU
        Top of Memory           = FFFFH


                Memory Segment Table:

SYSTEM   DAT     FF00H       0100H
CONSOLE  DAT     FD00H       0200H
USERSYS  STK     FC00H       0100H
XIOS     SPR     F300H       0900H
BDOS     SPR     DF00H       1400H
XDOS     SPR     C000H       1F00H
-------------------------------------------------

        Memseg Usr 0000H C000H Bank 01H
        Memseg Usr 0000H C000H Bank 00H
```

The entire MP/M nucleus just fit into the 16Kbyte memory partition on the Bank-0 memory card.

The hard disk was assigned as the "D:" drive select, and responded correctly when selected. We proceeded to do a STAT DSK: operation on the hard disk and observed the following:

```
43200  :  128 byte record capacity
 5400  :  Kilobyte drive capacity
  256  :  32 byte directory entries
    0  :  Checked directory entries
  512  :  Records/extent
   64  :  Records/block
  192  :  Sector/track
    0  :  Reserved tracks
```

The next step in our testing phase required that we write and then read files to and from the hard disk. The PIP program was used to perform this operation. We copied most of the files (assembler, source, DDT, etc.) from the floppy drives. This worked correctly. The final test came when we assembled the XIOS directly on the hard disk itself. All was indeed well. STAT was used to verify that the storage space on the disk decreased or increased correctly when files were created and deleted.

The performance that was observed when we assembled the XIOS on the hard disk as compared to doing it on the floppy was approximately a 5 to 1 speed improvement.

Complete software details and listings for interfacing the IMI hard disk to the Zobex single or double density systems are available on 8" media from the author; 6 Lenox Road, Farmingdale, New York 11735. ■

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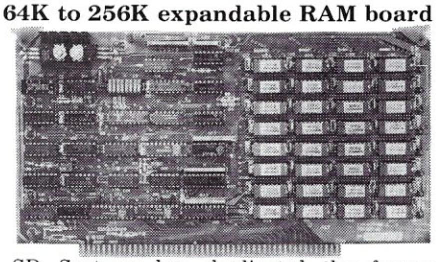

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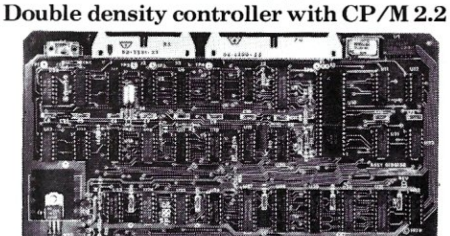

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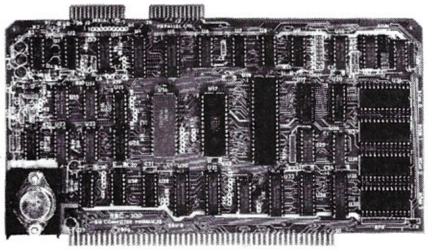

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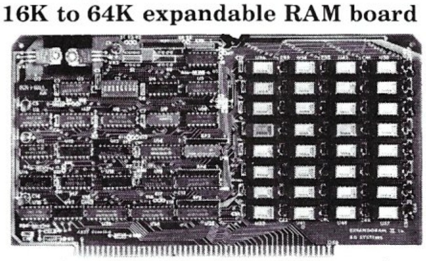

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-All boards are assembled and tested-

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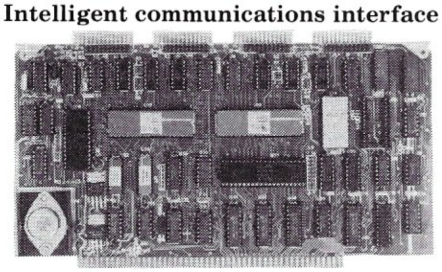

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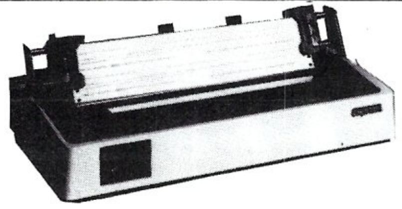

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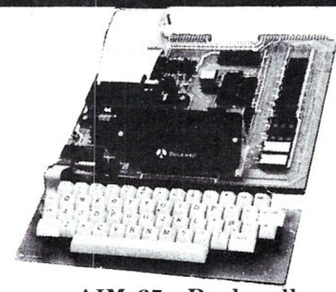

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IOI-1046A *A & T* **$299.95**
IOI-1045B *Bare board w/ manual* ... **$49.95**

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IOI-1010A *A & T* **$249.95**
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12 slot S-100 mainframe with 20 amp power supply

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ENC-112106 *A & T* **$399.95**

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ENS-112325 *with 25 amp p.s.* **$699.95**

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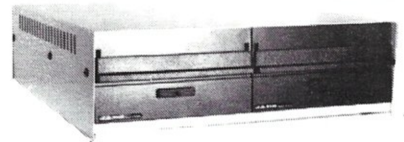

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Digiac CT-810 Multi-User Support Module

by Dennis Thovson

What capabilities and features should you look for in an I/O board? The answer to that question depends on your application. For example: How many peripheral devices (printers, terminals, modems, etc.) are required? Which of these devices require serial ports? Parallel ports? Do any of these peripherals require handshake signals such as RTS/CTS? Do you require interrupt capability, or is the program I/O sufficient? Is software control of parameters such as baud rate necessary? Any or all of these features and more can be obtained with I/O boards readily available today—for a price. Which brings us to the Digiac CT-810 Multi-User Support Module, an S-100 board designed expressly for systems running under Digital Research's MP/M operating system. This board provides the essential I/O features required by MP/M, plus some convenience operations that make life a little easier for the user.

First the basics. The board provides four RS-232C serial ports (75-19,200 baud) plus one input and one output parallel port. In addition, the board contains a clock which can be programmed to provide an interrupt every 16.7 milliseconds (or optionally, 33 milliseconds) as required by MP/M for task-switching and time-of-day functions. Also available are provisions for an on-board EPROM (2708 or 2716) and the necessary circuitry to jump-on-reset to the EPROM. Extended address capability is provided through an output port which controls address bits A16-A19. Now let's look at each of these major functions in a little more detail.

This is a hardware-configurable board with no provision for software control of the serial ports. All options are selected by jumpers on the board. Of the many options available, most are preselected on the board as received from the factory—except the baud rate for each serial port which must be selected by the user. (An advantage of hardware optioning such as used on this board is that no software initialization of the UARTS is required on power-up.) The port addresses on the board as delivered occupy a block from 80H through 87H. The block of port addresses can be changed to occupy any eight consecutive ports starting on either an X0 or X8 hex boundary (X = 0 - 0FH). There are essentially no provisions for any RS-232C handshake signals for the serial ports. (There are instructions in the manual for adding a handshake signal to one of the serial ports with some simple external circuitry.) By contrast, the input and output parallel ports can be configured to accommodate full handshake with the connected peripheral device. In addition, these ports provide or accept strobe pulses associated with the transmitted or received data respectively.

The Digiac CT-810 provides the essential I/O features required by MP/M, plus some convenience options that make life a little easier for the user.

The clock circuit provides the timed interrupt required by MP/M for task scheduling and time-of-day functions.

Dennis Thovson, 243 McMane Ave., Berkeley Hts., NJ 07922.

This is the only interrupt generated by this board—the I/O ports do not generate interrupts. The interrupt rate can be selected to provide either 60 Hz (16.7 msec.) or 30 Hz (33.3 msec.) interrupt intervals. In either the 8080 mode or the Z80 mode two interrupts can be used with the clock. The board also contains a counter which counts the unacknowledged interrupts. This provides a method for MP/M to keep its time-of-day clock accurate when a high priority interrupt, such as a disk operation, prevents acknowledging the clock interrupt for a few "ticks." The MP/M XIOS clock routine simply reads the counter (which automatically resets it to zero) and corrects the tick count accordingly.

The on-board EPROM, which is not provided, is normally addressed at 0FC00H (optionally 0F400H) for a 2708. The board contains a jump on reset to this location. Main system memory at 0 and that which may overlap the EPROM address space must respond to a Phantom signal from the board for these features to work properly. The EPROM can be made to disappear from the system address space by an output to port 87, and will remain out of the address space until the next system reset. Options are provided to change the EPROM address to 0F000H or 0F800H to accommodate a 2K 2716 (the jump on reset address can also be changed). Or, the EPROM and jump on reset can be permanently disabled if desired.

The CT-810 provides the features required by MP/M which may, in other implementations, require multiple boards (e.g., clock and extended addressing). It is an ideal board for systems which can be set to a given configuration at installation, and not require the flexibility provided by software control of its I/O functions. This is probably true of the majority of business systems in which MP/M is used.

Physically, the board appears to be well laid out and of good quality. The only minor complaint I have is that all option jumpers require soldering, although it looks like there is enough space available on the board to have provided some other method of optioning, particularly the baud rate selection. I have used the board in a Z80 system running a 4MHz for about one month with no problems. It does everything it is advertised to do without fuss or bother. I did not use the extended address capability of the board, but I have every reason to expect it works as stated. The unacknowledged interrupt counter is a simple but clever way to get around the annoyance of the time-of-day clock running late, as in a typical MP/M system which disables interrupts during disk read and write activity. It worked nicely in my system. The manual furnished with the CT-810 is complete and relatively good. However, it appears to have been written *by* an engineer *for* an engineer (which may be appropriate for a hardware products such as this). This is a definitely not a manual for someone unfamiliar with microcomputer hardware.

The CT-810 is available from the Digiac Corporation for $319 assembled and tested. Digiac also makes a full line of S-100 boards—CPU, memory, disk controllers, etc.—as well as complete systems that are ready to run. They are located at 175 Engineers Road, Hauppauge, NY 11788, telephone: (516)273-8600. ■

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The CompuTime/QT Clock Boards

by Leo Biese and Emilio Iannuccillo

At last fall's Boston Computer show we picked up what surely seemed a good bargain—a couple of QT "S100-Clock/Calendar+" kits (List $100 a kit/$150 A/T). Unfortunately, it turned out that the bargain boards did not quite work as implied by the designation "S-100," since they don't work with an 8080 CPU that meets the IEEE-696 standard! A letter to Don Smith, President of Q.T. Computer Systems, Inc. went unanswered for nearly one and a half months and, when received, indicated that he was unaware of this problem and would be interested in hearing about our fix. By this time the present review was underway and we did not follow-up his letter. While we were waiting for an answer we had noted the external similarity of the CompuTime ComputerWatch (their name is also on the QT board in small print, a point which we missed the first time around) and contacted them for further information. CompuTime president Gail Beaver was most helpful and kindly supplied their current board (marked S-100 880 REV B) for evaluation. CompuTime turned out to be the manufacturer of both boards and was well aware of the incompatibility problem, having revised the whole board some time ago. We will discuss the incompatability in this review, since many of the earlier versions are still around.

The Board

This full-function clock board is remarkably simple and requires only a backup battery and few support chips for the OKI MSM5832 monolithic "Microprocessor Real-Time Clock/Calendar" chip. This 18-lead CMOS integrated circuit contains its own oscillator and divider chain, 13 four-bit I/O registers for the seconds, minutes, hours, day-of-the-week, date, and year as well as the required chip-select, read, write, and test circuits and a +/- 30 sec. correction feature we use programatically. A "hold" input maintains the time while preventing rollover of the clock during a read. Leap year correction is automatic, and either 12- or 24-hour time format can be selected. Details of the registers are covered in the documentation and need not be discusssed here. The board requires four consecutive I/O ports which can conveniently be selected by a DIP switch over the entire range of 0-255.

This full-function clock board is remarkably simple and requires only a backup battery and few support chips for the OKI MSM5832 monolithic "Microprocessor Real-Time Clock/Calendar" chip.

The very low power dissipation of this chip (90 micro Watts @ 3V) allows safe battery backup for several months with as little as 2.2 volts, in this case supplied by a 3.6 volt G.E. "Data Sentry" miniature Ni-Cad battery with on-chip automatic power-loss switching. The oscillator is driven by an external 32.768 Hz crystal (about the size of a 1/8 watt resister!); and a trimming capacitor is provided to "pull" the oscillator frequency. The frequency stability for the 5832 crystal oscillator is given as +/-2 ppm for an approximate two-fold change in operating temperature or a voltage drop to as low as two volts from the nominal five volts. This is an order of magnitude of only about one second per week, so obviously there are factors that effect the clock stability other than oscillator frequency. Since the chip runs at five volts (from the standard 7805 regulator) and is warmer when on-line; and then drops to 3.6 volts and a cooler environment when on standby, the accuracy of the clock is significantly affected. This is not a real problem with our use, dating print-outs, but it would

Biese/Iannuccillo, RFD1 Murray Hill Rd., Hill, NH 03243.

have been a considerable enhancement to have the board designed so that the alternate power sources were more closely matched. One of the boards tested lost about ten seconds per day despite repeated "tweaking" of the variable capacitor. The second board lost over an hour when it was removed from the computer for about two months.

A significant design flaw is the use of a horizontal access trimmer capacitor. Since the oscillator must be touched-up daily over a period of a week or more to maintain accuracy, the board has to reside atop an extender board until this is done. A top-mounted capacitor would have been better.

In addition to the basic clock/calendar function of the 5832 chip, the CompuTime/QT boards provide four hardware interrupt times at one hour, one minute, one second, and one millisecond (approximately) which are potentially useful in real-time process control if the board is kept activated.

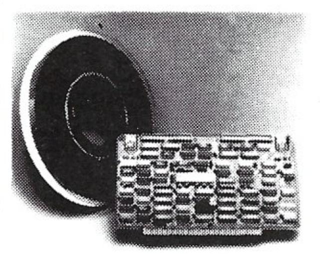
In addition to the basic clock/calendar function of the 5832 chip, the CompuTime/QT boards provide four hardware interrupt times at one hour, one minute, one second, and one millisecond (approximately) which are potentially useful in real-time process control if the board is kept activated. As long as the computer is turned on, the accuracy is very good; not a single second was lost during a six hour session with the National Bureau of Standards (WWV) time signals coming into the computer room. Accuracy suffers only when the computer is turned off and the board goes into the 3.6 volt stand-by mode.

The board as supplied is clean, solder-masked, silk-screened and quite up to current manufacturing standards. There is plenty of kludge area available for your own special projects. The 35 page manual supplied is, if anything, too simply written and redundant—the register descriptions are presented in the theory of operation, in the programming section, and again in the appendix. The schematic is poorly done, but usable. Potential users would benefit by obtaining the OKI MSM5832 data sheet which is not supplied. Board-level manufacturers should follow the lead of the disc-controller providers and include the data sheets for "uncommon" chips with their documentation, since these can sometime be very difficult to obtain.

Several redundant sample programs in Basic are provided in the manual to set and read the clock, but we prefer our own version given in Listing 1. The program, "SETCLOCK," allows the clock to be synchronized with the national standard when accurate time measurements are needed. The U.S. National Bureau of Standards broadcasts time signals continuously on the 2.5, 5, 10 and 15 MHz shortwave frequencies that are readily received by even the most simple receiver anywhere in the continental U.S. (station WWV) and in the Pacific (station WWVH in Hawaii). In addition, the Canadian government also broadcasts universal time signals over its CHU channels on 3.33, 7.335 and 14.67 Hz. The details of the format for these signals can be found in any one of the many amateur radio or shortwave listener's handbooks. Essentially, the world-wide time standard is kept very accurately and announced by a distinctive tone on the second, and by a voice on the minute. SETCLOCK is self-prompting, and makes use of the +/- 30 second adjust input (pin 15) provided on the clock chip. When pulsed high, this pin zeroes the seconds counter and, if over 30 seconds are on the clock, also adds one minute. First you must set the Year, Month, Day/Date, and Hours according to a menu selection, you are then advised to set the clock ahead at least one minute. Unlike the programs supplied with the board, the time is always visible on the screen (by using the direct cursor addressing of the ADM3a and similar terminals) while entries are being made. At this point you simply wait for the minute mark and hit the return key. We use a compiled version of this program. The delay (Line 1490) can be adjusted so that Line 950 rings the terminal bell synchronously with the time signals.

The main use we have for this board is to print the date on program listings and runs, thereby getting rid of some of the confusion we have been living with over the years (since we never can remember when anything was printed). While the Basic programs provided are adequate, we

S-100 USERS



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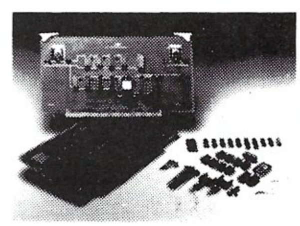

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also wanted this facility for assembly language listings and developed the program PTIME as a CP/M transient command given in Listing 2. Constant paranoia about whether or not the clock was correct led to a nearly identical program, directed to the console, which we incorporated into our CPM as an auto-load program (See cf. James J. Franz, "Turn-key CP/M Systems," *Creative Computing*, December 1979). With this modification, the time and the date is printed right below the CP/M sign-on message each time the system is brought up, and whenever a warm start is done. This allows, for example, correcting the clock if we have been on vacation and would have forgotten to reset it before printing.

Problems

The inability of this "S-100" board to work with many 8080 CPUs reminds us again that if the manufacturer doesn't say the board conforms to the IEEE-696 standard, it almost certainly doesn't and the potential user should proceed with caution.

Refer to this quote from the standard:

> "2.2.3 Status Bus. The status bus consists of eight lines which identify the nature of the bus cycle in progress, and qualify the nature of the address on the address bus."

One of the the status signals is sOUT. This signal, according to the standard, indicates the type of I/O in progress. Nowhere in the standard does sOUT 'time' the type of I/O.

Another excerpt from the standard:

> "2.7.5.2 The Write Strobe. The generalized write strobe, pWR*, is used to write data from the data bus into the addressed bus slave..... Data out on the data bus must be guaranteed valid for a specified period both before and after the activation of the write strobe. Hence, either the leading or the trailing edge of the write strobe may be used to strobe data into the addressed slave."

Herein lies the problem with the QT board (and the earlier CompuTime version). The design completely ignored the IEEE standard relating to the pWR* strobe, and does not even have that signal coming into the board. Instead, it uses the sOUT signal not only to indicate an OUT operation to the board, but also (and improperly) to time the data onto the board. Consequently an 8080, such as the Imsai which produces valid IEEE signals, cannot strobe the power data into the clock board. The 8080 needs both pWR* and sOUT to operate properly. The sOUT signal is latched by the 8212 (on the CPU board) from long before until long after the data is valid, but the pWR* signal is needed to indicate the period when the data is valid.

These timing problems should be obvious from the diagrams supplied by the IEEE standard and the CPU manufacturers. (We will not reproduce them here.) The pWR* signal is active for a much shorter time than sOUT. The clock board latches trigger on the release of sOUT; by this time pWR* has already gone away and the data is no longer stable. (For the non-hardware types, this means that you set the clock correctly, and the next day, it reads something ridiculous like: "December 66, 1999 18:48:91 PM"—because the data wasn't caught, or latched, at the proper time in the CPU cycle.)

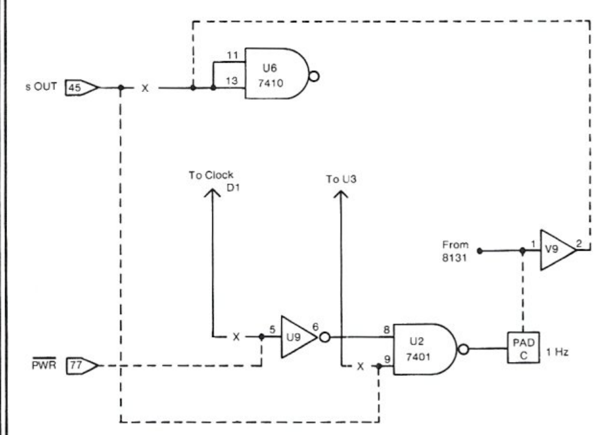
So why does it work with the Z80? It just so happens that the sOUT signal from the Z80 occurs at just about the same time as the pWR* signal. The Z80 has both signals and they look about the same. The Z80, however, does not latch the sOUT signal—in fact, the Z80 does not need to latch any signals, reminding us that while it may run 8080 code, the Z80 is an entirely different chip!

Note: *This problem does not apply to the "Revision B" board supplied by CompuTime. They have added an extra chip (U12) to pick up pWR* in a manner very similar to our Mod-2 below; the difference being that they AND pWR* with sOUT one step later. In addition they have provided pads for connection to the bus interrupt lines.*

Modifications

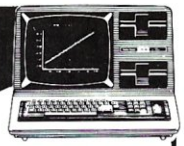
There are several ways to modify the board to make it IEEE compatible. (Note: while this article was in progress a board fix, without comment, was published by Zoso in *Lifelines* Vol.1, No.10. It is rather cryptic to say the least.)

Figure 1: *Modification #1; This requires no additional components but sacrifices the interrupt timers.*



MOD #1 (Figure 1): We had no need of the interrupt features, so the fix was quite easy, mainly because we then had 1/2 of U3 (7421) available as well as all of U2 (7401) and a section of U9 (7404).

1. Cut the trace from Bus #45 (sOUT) to U6 (11,13).
2. Cut the trace leading to U9 (5) at the chip.
3. Cut the traces to U2 (9) on both the top and bottom of the board next to the chip.
4. Run a wire from Bus #77 (pWR*) to U9 (5).
5. Connect Bus #45 (sOUT) to U2 (9).
6. Connect pad C to U9 (1).
7. Connect U9 (2) to U6 (11,13).



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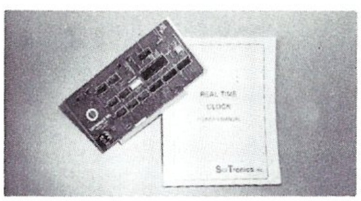

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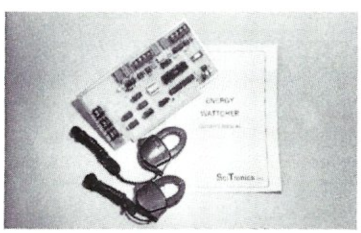

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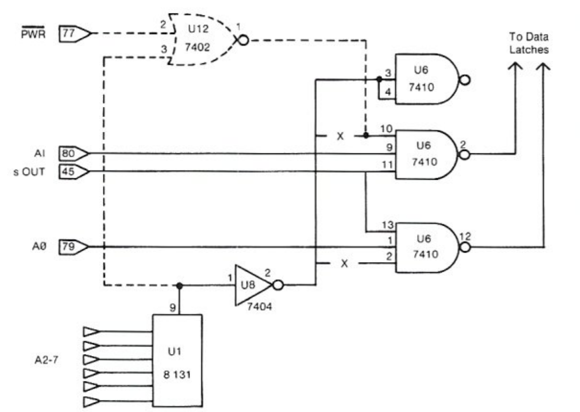
CompuTime/QT Clock Boards, continued...

MOD #2 (Figure 2): If you desire to keep all functions of the board intact you will have to add a gate. We used a 72LS02 and called it U12.

1. Tie U12 (14) to +5 volts and (8) to ground.
2. Cut the trace from U6 (2) to U6 (3) on the solder side of the board.
3. Cut the trace from U6 (10) to U6 (4). This trace is on the component side under the socket. It must be done before assembly or the socket will have to be removed.
4. Tie U12 (2) to Bus #77 (pWR*).
5. Tie U12 (3) to U1 (9).
6. Tie U12 (1) to U6 (10 and 2).

Figure 2: *Modification #2; All functions of the original board can be retained by adding a gate (U12).*



Summary

To reemphasize, the modifications pertain to the QT and earlier CompuTime boards only; the current CompuTime revision B works perfectly as is. Despite the problems we encountered, we consider each of the boards to be a bargain and a valuable addition to the system. After approximately six months of use, it is hard to think of using a computer without them. The assembled and tested boards are the same price but you can save $25 by getting the QT kit and making the changes suggested here.

For real-time process control the boards are highly accurate and it seeems hard to justify some of the other clock boards currently on the market for several hundred dollars. Indeed, Gail Beaver at CompuTime tells us that this is a major use of their board; for everything from timing rides at amusement parks to controlling grain elevators in Australia!

As a simple time/data board, it is a 'must' for every S-100 bus computer. Any sort of billing or reporting use of the microcomputer, such as a professional practice, requires the addition of at least a date—and many types of reports also require a time entry as well. This facility has long been standard on virtually all mini- and mainframe computers and is now available for the micro user at a reasonable cost.

For more information contact:

Compu/Time, P.O. Box 5343, Huntington Beach, CA 92646; (714)536-5000.

QT Computer Systems, Inc., 15620 Inglewood Ave., Lawndale, CA 90260; (800)421-5150.

OKI Semiconductor, 1333 Lawrence Expressway, Suite 104, Santa Clara, CA 95051.

SETCLOCK

```
100 'SETCLOCK: Program to set the parameters of the Computime/QT
110 '          Clock/Calendar boards
120 '
130 'Programed in Microsoft 5.2 BASIC by E.D.I and L.P.B. based
140 'on the manuals supplied (November 1980)
150 '
160 ' 2/01/81 Revised for better screen presentation and a more rapid
170 '         keyboard scan approximating realtime seconds. (LPB)
180 '
190 ' 2/14/81 Input for 'seconds' correction eliminated since BASIC
200 '         is not fast enough to keep up. The PROMPT$(X) now
210 '         begins at 3 (LPB)
220 '
230 ' 6/06/81 Universal time 'SYNC' revised with added prompting (LPB)

240 '========= SET PARAMETERS AND STORE TEXT FOR OUTPUT ===============

250 CLEAR.SCREEN$=CHR$(26)                  'Clear ADM3a screen code
260 RING.BELL$=CHR$(7)                      'Ring ADM3a terminal bell
270 ADDR=130                                'Clock input port
280 DAT =129                                'Clock output port
290 KEYBOARD=17                             'System (MITS 2SIO) port

300 DIM DAY$(6),MONTH$(12),PROMPT$(13),T(13),T$(13),U$(13)

310 FOR I=0 TO 6: READ DAY$(I): NEXT
320 FOR I=1 TO 12: READ MONTH$(I): NEXT
330 FOR I=2 TO 12: READ PROMPT$(I): NEXT

340 DATA SUNDAY,MONDAY,TUESDAY,WEDNESDAY,THURSDAY,FRIDAY,SATURDAY
350 DATA JANUARY,FEBRUARY,MARCH,APRIL,MAY,JUNE,JULY,AUGUST
360 DATA SEPTEMBER,OCTOBER,NOVEMBER,DECEMBER

370 DATA MINUTE UNITS,MINUTE TENS,HOUR UNITS,HOUR TENS
380 DATA DAY OF THE WEEK {Sunday=0  Monday=1  Sat=6}
390 DATA DAY UNITS,DAY TENS,MONTH UNITS,MONTH TENS
400 DATA YEAR UNITS,YEAR TENS

410 '============== PRINT THE CRT SCREEN ==============================

420 PRINT CLEAR.SCREEN$
430 PRINT TAB(12);
440 PRINT" ----------------------------------------------------"
450 PRINT TAB(12);
460 PRINT"|   To reset the system clock enter the function #   |"
470 PRINT TAB(12);
480 PRINT"|                                                    |"
490 PRINT TAB(12);
500 PRINT"|  #1 for MINUTES    #3 for DAYS       #5 for YEARS  |"
510 PRINT TAB(12);
520 PRINT"|  #2 for HOURS      #4 for MONTHS     #6  to SYNC   |"
530 PRINT TAB(12);
540 PRINT"|                                                    |"
550 PRINT TAB(12);
560 PRINT"|             #7 to END and return to CP/M           |"
570 PRINT TAB(12);
580 PRINT"|                                                    |"
590 PRINT TAB(12);
600 PRINT"|  Do NOT use CTR/C to end as it may stop the clock  |"
610 PRINT TAB(12);
620 PRINT" ----------------------------------------------------"
630 PRINT
640 PRINT TAB(12);STRING$(54,"=")

650 '================= READ THE CLOCK REGISTERS ======================

660 'The clock registers can be read directly,  unfortunatly we need
670 'to change them to ASCII text for the printout.  Converting puts
680 'in an obligatory leading blank (the implied sign) which must be
690 'stripped off.
700 '
710 ' Variables used:
720 '
730 '     T(x) = a matrix holding the numeric contents of the registers
740 '    U$(x) = temporary matrix holding the string values of T(x)
750 '    T$(x) = ASCII string values of the registers for printout
760 '
770 'See the product literature for register assignments

780 OUT DAT,16                                         'Stop the clock
790 I=0                                                'Set Register counter
800 FOR D=32 TO 44                                     'For all registers
810     OUT ADDR,D                                     '  point to register
820     T(I)=INP(ADDR)                                 '  read it
830     I=I+1                                          '  bump the counter
840     NEXT D                                         '  and get the next
850 OUT DAT,0                                          'Now restart the clock

860 '--- Each pass thru the read routine checks for a leap year flag
         and the 12/24 hour format request

870 IF T(8)>3 THEN T(8)=T(8)-4                         'Adjust for FEB 29
```

```
880 B=T(5):IF B >7 THEN P$=" ": T(5)=T(5)-8
890        IF B <8 AND T(5) >3 THEN P$=" PM" ELSE P$=" AM"
900        IF T(5) >3 THEN T(5)=T(5)-4

910 '--- Change numeric register data to string and strip off the
         obligatory leading blank

920 FOR I=0 TO 12:U$(I)=STR$(T(I)):T$(I)=RIGHT$(U$(I),1):NEXT

930 '============== PRINT THE CLOCK DATA =============================

940 PRINT CHR$(27)+CHR$(61)+CHR$(43)+CHR$(53)           'Set cursor
950 PRINT RING.BELL$                                    'Tick seconds
960 PRINT
970 PRINT TAB(14)"today is ";DAY$(T(6));"    ";
980 X=T(10)*10+T(9):PRINT MONTH$(X);" ";
990 PRINT T$(8);T$(7);",19";T$(12);T$(11);"    ";
1000 PRINT T$(5);T$(4);":";T$(3);T$(2);":";T$(1);T$(0);P$
1010 PRINT
1020 PRINT TAB(12);STRING$(54,"=")
1030 PRINT

1040 '================= CHANGE THE CLOCK REGISTERS ===================


1050 '--- Check keyboard for input

1060 X = INP(KEYBOARD)
1070 X = X AND 127 - 48
1080 IF X <> 6 THEN 1100

1090 PRINT TAB(12)"SYNC: Hit return just BEFORE zero tone ";:GOTO 1480

1100 PRINT TAB(12)"Enter function #                   ";:
1110 ON X GOTO 1140,1150,1190,1230,1240,1480,1520

1120 GOTO 780                               'Reprint clock till keypressed

1130 '--- Response to keboard entry:
          X = the register to change
          Y = the desired contents

1140 X=3: PRINT:PRINT TAB(7);:GOTO 1260                 'Get minutes

1150 PRINT
1160 X=5: INPUT "          AM or PM";PM$                 'Afternoon?
1170       IF PM$="PM" THEN PM=-1 ELSE PM=0             ' Flag it
1180       GOTO 1260                                    'Get hours

1190 PRINT:PRINT
1200 X=8: INPUT"       IS THIS LEAPYEAR ";LEAP$
1210       IF LEFT$(LEAP$,1)="Y" THEN LEAP= -1
           ELSE LEAP=0                                  ' Flag it
1220       GOTO 1260                                    'Get day

1230 X=10: GOTO 1260                                    'Get month

1240 X=12: GOTO 1260                                    'Get year

1250 '-------- Data input for the clock registers

1260 PRINT:PRINT TAB(8);PROMPT$(X);
1270 INPUT Y
1280 IF X = 5 AND PM THEN Y = Y + 4
1290 IF X = 8 AND LEAP THEN Y = Y + 4
1300 GOSUB 1400                              'Send it

1310 '--- Return and get the next register. We load them backwards
          ie. tens and then units

1320 X=X-1
1330 PRINT TAB(8);PROMPT$(X);
1340 INPUT Y
1350 GOSUB 1400                              'Send it

1360 IF X = 7 THEN GOTO 1320            'User wants to synch the clock
1370 OUT DAT,0
1380 GOTO 420

1390 '-------- The actual clock register is changed here

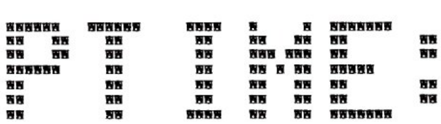
1400 OUT ADDR,X                         'Point to the register
1410 OUT DAT,Y + 16                     'Send it the new data
1420 OUT ADDR,X + 16
1430 OUT ADDR,X
1440 RETURN

1450 '======== ROUTINE TO SYNC THE CLOCK WITH WWV OR CHU =============

1460 '  On the west coast: WWV or WWVH on 5.0, 10.0, or 15.0 MHz
1470 '  On the east coast: CHU (Canada) on 3.33, 7.335 or 14.67 MHz

1480 OUT DAT,32                         'Raise the +/- 30 sec.
1490 FOR A=1 TO 20: NEXT A              'We need a delay here
1500 OUT DAT,0                          'Restart the clock
1510 GOTO 780                           'and read the clock again

1520 PRINT CHR$(26):OUT DAT,0:END
```



[LOG: JULY 13,1981 11:34:07 PM]

```
; PTIME: Prints time and calendar on the CP/M console (ADM3a)
; and lister (Diablo 1640) using the Computime/QT clock board
;
; By Emilio D. Iannuccillo, 825 Hope St, Bristol, R.I.02809
;     January 1981
;
; Restructured by L.P. Biese,Hill,N.H. 03243   May 24, 1981

CLEARSCREEN     EQU     26      ;ADM3
HOME            EQU     30      ;ADM3
CLOCKADDRESS    EQU     82H     ;Port for clock address
CLOCKDATA       EQU     81H     ;Port for clock data

; The following equates represent
; appropriate address to the clock chip.
; Invoked by outputting to port CLOCKADDRESS above.

YEARTENS        EQU     12
YEARUNIT        EQU     11
MONTHTENS       EQU     10
MONTHUNIT       EQU     9
DAYTENS         EQU     8
DAYUNIT         EQU     7
WEEKDAY         EQU     6
HOURTENS        EQU     5
HOURUNIT        EQU     4
MINUTETENS      EQU     3
MINUTEUNIT      EQU     2
SECONDTENS      EQU     1
SECONDUNIT      EQU     0

;To the above: ADD 32 to RAISE CLOCK READ LINE
;              ADD 16 to RAISE CLOCK WRITE LINE

READLINE        EQU     32
WRITELINE       EQU     16

;The CLOCKDATA port is used to read and write time,
;however, 16 must be added to Data port to stop clock
;from advancing while each register is being accessed.

HOLD            EQU     16


;-----------------------------------------------------
; The operation of this program is simply to:
;    a) Stop the clock from advancing
;    b) Read clock data into memory
;    c) Restart the clock
;    d) Convert clock data into ascii
;    e) Fill a print-buffer with the ascii data, and
;    f) Print out the buffer contents.
;    g) Exit back to CPM
;-----------------------------------------------------


; INITALIZE. Program begin here. Save old CPM stack for
; re-entry to system at conclusion of the program

        ORG     100H            ;beginning of CPM TPA area
        LXI     H,0             ;clear HL
        DAD     SP              ;load with CPM stack pointer
        SHLD    RETURNSTACK     ;and save it.
        LXI     SP,STACK        ;set up our own stack

; RAISE CLOCK HOLD LINE to stop the clock from advancing

        MVI     A,HOLD          ;get code
        OUT     CLOCKDATA       ;and send it

; READ CLOCK DATA. Set up a loop to latch the clock
; addresss, read the data and save it. Repeat until
; the 13 clock registers are read.

        MVI     B,32            ;Set B for 0, the first
                                ; clock register + 32 (for read)
        MVI     C,13            ;number of registers
        LXI     H,TIMETABLE     ;Area to store raw data
L1:     MOV     A,B             ;Start of the read loop
        OUT     CLOCKADDRESS    ;Output & latch register wanted
        PUSH    PSW             ;Need 6 microsec delay at 2mh for
        POP     PSW             ; clock chip to catch up
        IN      CLOCKDATA       ;Read the register
        MOV     M,A             ;Store it
        INX     H               ;Bump storage location
        INR     B               ;Bump to next register address
        DCR     C               ;One less to go!
        JNZ     L1              ;Get the next one
        XRA     A               ;Done.
        OUT     CLOCKDATA       ;Restart clock

; CONVERT raw data just read into asci and stuff it
; into a print buffer for later output to devices

        LXI     H,TIMETABLE     ;Start of raw data
        MOV     A,M             ;Pick up seconds
        ORI     30H             ;Convert to ascii
        STA     S1              ;Store at proper point in
        INX     H               ; print buffer
        MOV     A,M             ;Pick up tens digit of seconds
        ORI     30H             ;Convert to ascii
        STA     S10             ;Store in print buffer
        INX     H               ;Advance to minute units
        MOV     A,M             ;Get it
        ORI     30H             ;Convert it
        STA     M1              ;Store it
        INX     H               ;minute tens
        MOV     A,M             ;Repeat
        ORI     30H             ;for
        STA     M10             ;minute tens digit
        INX     H               ;oh,hum
        MOV     A,M
        ORI     30H
        STA     H1
        INX     H               ;ah, hour tens, a little
        MOV     A,M             ;more interesting because it
        ANI     3               ;contains am/pm or 24 hr flag
        ORI     30H             ;First set to ascii and
        CPI     30H             ;Check to see if it is a 0
        JNZ     OVER6           ;Go forward if not a 0, else
        XRA     A               ;wipeout 0 for sake of print looks
OVER6:  STA     H2              ;Store it
        MOV     A,M             ;Get hour tens data again
        ANI     8               ;check if 24 hr time
        JZ      NOT24HR         ;Go forward if not 24 hr,
        XRA     A               ;else if it is 24 hr format
        STA     AM$PM           ;then wipe out AM in the print
```

```
        STA     AM$PM+1         ; buffer. It's meaningless.
        JMP     DAY$ROUTINE

NOT24HR:
        MOV     A,M             ;If 12 hr format, then
        ANI     4               ;test if AM or PM
        JZ      DAY$ROUTINE     ;Ø=AM so leave as is
        MVI     A,'p'           ;else change 'A' in AM
        STA     AM$PM           ;to P

DAY$ROUTINE:
        INX     H               ;Pick up
        MOV     A,M             ;clock data for day
        RLC                     ;Adjust it to make a
        RLC                     ;table pointer
        LXI     D,DAYTABLE      ;Point to ascii day table
        ADD     E               ;Adjust pointer
        MOV     E,A             ;to point to proper day
        JNC     OVER2           ;Check to see if table
        INR     D               ;crossed a page boundry

OVER2:  LXI     B,DAY           ;Point to print buffer
        LDAX    D               ;and move
        STAX    B               ;the day
        INX     D               ;pointed to
        INX     B               ;into the
        LDAX    D               ;proper position
        STAX    B               ;in the
        INX     D               ;print buffer
        INX     B
        LDAX    D
        STAX    B
        INX     D
        INX     B
        LDAX    D
        STAX    B
        INX     H               ;Next point to and
        MOV     A,M             ;get day units
        ORI     3ØH             ;Here's ascii again
        STA     D1              ;And of course storage
        INX     H               ;Day tens is next
        MOV     A,M             ;Get it
        ANI     3               ;Only lower bits for day
        ORI     3ØH             ;Change to ascii
        CPI     3ØH             ;Check if Ø because we
        JNZ     OVER5           ;don't want a Ø to print
        XRA     A               ;wipe out the Ø, if any
OVER5:  STA     D1Ø             ;store it
        INX     H               ;Point to month units
        LXI     D,MONTHTABLE    ;Again we have
        MOV     A,M             ;a table for ascii month
        RLC                     ;Multiply data
        RLC                     ;by 16
        RLC                     ;Each month in monthtable
        RLC                     ;takes up 16 bytes
        ADD     E               ;This is more than really
        MOV     E,A             ;needed. But 16* makes for
        JNC     OVER4           ;ease in adjusting the
        INR     D               ;pointer

OVER4:  INX     H               ;While holding above
        MOV     A,M             ;position, get
        ORA     A               ;month tens,
        JZ      OVER3           ;If Ø go jump ahead
        MVI     A,16Ø           ;Else adjust pointer
        ADD     E               ;by a factor of 1Ø * 16
        MOV     E,A             ;Again check for
        JNC     OVER3           ;crossing page
        INR     D               ;boundry

OVER3:  LXI     B,MONTH         ;Point B to print buffer

MONTHLOOP:
        LDAX    D               ;Move
        CPI     Ø               ;ascii month
        JZ      MONTHDONE       ;pointed to
        STAX    B               ;by DE to
        INX     D               ;print buffer
        INX     B               ;position as
        JMP     MONTHLOOP       ;pointed to by BC

MONTHDONE:
        INX     H               ;For year, we're
        MOV     A,M             ;back to GET
        ORI     3ØH             ;Convert
        STA     Y1              ;Store

; PRINT IT. Print buffer is now the picture wanted
; for output. So send it to the console and lister

        LXI     D,THE$DATE      ;Point to print buffer
        MVI     C,9             ;Send entire line to console
        CALL    5               ;using CPM lineprint conventin
        MVI     E,ØDH           ;next for listing
        CALL    LISTER          ;device, first
        MVI     E,ØAH           ;output a
        CALL    LISTER          ;CRLF, then
        LXI     D,THE$DATE      ;reset pointer to print table

NEXTLETTER:
        LDAX    D               ;and loop
        CPI     '$'             ;through the buffer
        JZ      LISTERDONE      ;printing until $ is reached
        CPI     Ø               ;Also check for Ø
        JNZ     OK2PRINT        ;Do not print Ø
        INX     D
        JMP     NEXTLETTER

OK2PRINT:
        PUSH    D               ;Save print buffer pointer
        MOV     E,A             ;Get character to print
        PUSH    D               ;save it

;--------- Hardware specific for Diablo 164Ø ----------
; This block is code for my Diablo printer. It prints
; the character twice, but offset 1/12Ø of an inch
; from each other. It gives the appearance of being
; a bold print. For a straight forward listing on any
; CPM listing device, eliminate the code in this block
; down to End Diable Code.

; Put Diablo in 1/12Ø spacing mode by sending 'ESC 31 2'

        MVI     E,27
        CALL    LISTER
        MVI     E,31
        CALL    LISTER
        MVI     E,2
        CALL    LISTER

        POP     D               ;get print character
        PUSH    D               ;save chr again
        CALL    LISTER

; Restore Diablo to normal spacing mode

        MVI     E,27            ;Sequence is
        CALL    LISTER          ;ESC  83
        MVI     E,'S'
        CALL    LISTER

;--------------- End of Diablo 164Ø code -------------------


        POP     D               ;Get print character
        CALL    LISTER          ;Print it
        POP     D               ;and go on
        INX     D               ;to next character
        JMP     NEXTLETTER


;This is a subroutine that makes a CPM call
;to output byte in E register to the listing
;device.

LISTER: MVI     C,5
        CALL    5
        RET

LISTERDONE:
        MVI     E,ØDH           ;Now print a CRLF
        CALL    LISTER
        MVI     E,ØAH
        CALL    LISTER

BACK2CPM:
        LHLD    RETURNSTACK     ;Get CPM stack pointer
        SPHL                    ;Put it where it belongs
        RET                     ;and BACK TO CPM we go


;=====================================================
;               TABLES and STORAGE AREA
;=====================================================

DAYTABLE:
        DB      'Sun '  ;Ø as read
        DB      'Mon '  ;1 from clock
        DB      'Tue '  ;2
        DB      'Wed '  ;3
        DB      'Thu '  ;4
        DB      'Fri '  ;5
        DB      'Sat '  ;6

MONTHTABLE:
        DB      Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø ;ØØ as read
        DB      'January',Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø     ;Ø1 from the
        DB      'February',Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø      ;Ø2 two month
        DB      'March',Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø   ;Ø3 registers
        DB      'April',Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø   ;Ø4 on clock
        DB      'May',Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø ;Ø5
        DB      'June',Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø  ;Ø6
        DB      'July',Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø  ;Ø7
        DB      'August',Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø    ;Ø8
        DB      'September',Ø,Ø,Ø,Ø,Ø,Ø,Ø       ;Ø9
        DB      'October',Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø     ;1Ø
        DB      'November',Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø      ;11
        DB      'December',Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø      ;12

THE$DATE:

;---------------------------------------------------
;   Printing  format:
;       [LOG: SEPTEMBER 21, 1981  12:3Ø:3Ø PM]
;       Ø123456789ABCDEFØ123456789ABCEDFØ12345     << byte
;       Ø               1               2          << count
;---------------------------------------------------

        DB      '[LOG: '
MONTH   DB      Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,' '
D1Ø     DB      '2'
D1      DB      '1, 19'
Y2      DB      '8'
Y1      DB      '1   '
H2      DB      '1'
H1      DB      '2'
        DB      ':'
M1Ø     DB      '3'
M1      DB      'Ø'
        DB      ':'
S1Ø     DB      '3'
S1      DB      'Ø'
        DB      ' '
AM$PM   DB      'a'
        DB      'm'
        DB      ']'
        DB      '$'
DAY     DS      4               ;Day was not used
                                ;Simply put before $
                                ;if wanted in the printout


TIMETABLE       DS      16
                DS      128
STACK           EQU     $
RETURNSTACK     DS      2

                END
```

Dual Systems Clock/Calendar Board

by Ray Duncan

The CLK-24 from Dual Systems Control Corp. (1825 Eastshore Highway, Berkeley, CA 94710, 415-549-3854) is an S-100 board which can be interrogated by the computer to obtain month, day, year, day of the week, hours, minutes, and seconds. It can also generate vectored interrupts on every 0.97 msec, second, or hour. The board is I/O mapped and occupies two port addresses which are switch-selectable.

The board, which costs $250, is cleanly laid out and well constructed. The CLK-24 is based on the OKO Semiconductor MSM5832 CMOS chip, a derivative of the circuits used in digital watches. The clock interface is very simple, consisting of eleven integrated circuits, a few discrete components and a crystal oscillator. A particularly nice feature of the board is an on-board battery backup. Two penlight batteries continue to supply power to the clock chip when the microcomputer is turned off.

Setting and reading the clock is straightforward from either assembly language or Basic. Detailed examples in Basic are provided in the user manual which, when implemented, proved to work correctly without modification.

The manual consists of nine photocopied pages (including diagrams), and gives intelligible and well-organized guidance on the use of the board. Unfortunately, it does not include any technical information or a schematic.

Ray Duncan, 4147 Beethoven St., Los Angeles, CA 90066.

My field is microprocessor applications for laboratory and medical environments, and many of them need a reliable time base for data collection. I have tried most of the advertised S-100 clock and calendar boards and found them to be erratic to various degrees. In contrast, the CLK-24 board has been reliable, accurate, and easy to use. It has weathered all sorts of power fluctuations and interruptions without ever losing or altering the time and date. I would recommend this module to *Microsystems'* readers without any reservation.

The CLK-24 board has been reliable, accurate, and easy to use. It has weathered all sorts of power fluctuations and interruptions without ever losing or altering the time and date.

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A Timestamp For CP/M

by Chris Terry

A low-cost S-100 clock/calendar circuit and CP/M BIOS driver software.

Introduction

Although this article covers some of the same material as Fred Deadrick's clock/calendar article in the July/August 1981 issue of *Microsystems*, it breaks new ground in three areas:

- Discussion of generalized I/O ports circuitry.
- Alternative (and somewhat lower cost) interfacing to the MSM5832 clock/calendar chip.
- Modification of the CP/M BIOS to produce a date and time upon cold boot. The routine for this can be accessed by application programs.

Fred Deadrick's article describes an interface dedicated to one particular peripheral. The chip count is low and it presents no problems in construction. However, the 8131 magnitude comparator is becoming difficult to find; I have not seen this or the 8833 bus driver/receiver quoted in any advertisement *anywhere* in the last few months. Also, it has been my experience that a wire-wrap board, once purchased, gets used for a number of different interfaces, some of which become a permanent part of the system. Others are purely experimental and are removed (or at least disabled) when the experiment is finished. Thus, it is an advantage for as much of the circuitry as possible to be shared among the I/O ports, to avoid duplication.

Chris Terry, 324 E. 35th St., New York, NY 10016.

In this article I shall therefore present the basic address decoding and strobe circuits for eight input and eight output ports. All of the chips are readily available at prices between 25 cents and $1.50 from mail order houses such as Digi-Key or Jameco. Once the logic is understood, it can be implemented with chips other than those specified. None of these circuits are new—in one form or another, they can be found on almost any S-100 interface board on the market. However, it has been some time since any general article on interfacing has appeared, and I hope that newcomers to the S-100/IEEE-696 bus may benefit from the ideas and go on to bigger and better hardware experiments. Those who are already expert interfacers can skip right to the logic diagrams and software description.

Interface Circuitry

A complete interface can be functionally divided into three parts: the computer side, the peripheral side and the software. The computer side consists of the address decoding and strobe generation circuits. These are identical in form, regardless of the type of peripheral, and can therefore be common to all I/O ports on the board. The peripheral side consists of data and control registers for input and output; the number and timing of these depends on the requirements of each individual peripheral. Some peripherals may also require signal level converters to

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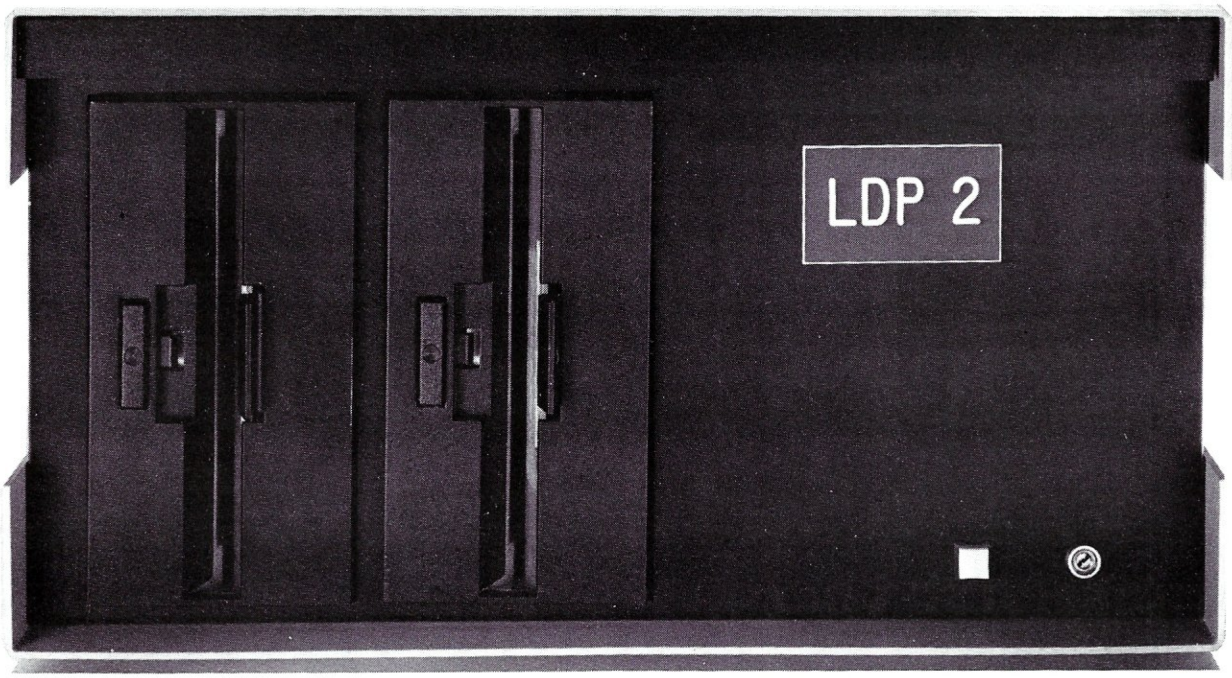

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be interposed between the registers and the device (e.g., TTL/RS232 drivers and receivers). As an illustration of the device side, I shall describe an assembly of flip-flops and tri-state buffers to control and read the MSM5832 clock/calendar chip. As an illustration of the software required, I shall describe a routine for incorporation into the CP/M BIOS so that the sign-on message (at cold boot) contains the current date and time, and a corresponding transient program for setting the date and time.

Address Decoding

Since we are considering a block of eight consecutively numbered ports, the common address circuitry should decode the upper five address lines (A7 through A3) to generate a board ENABLE signal. The three low-order address lines are decoded by strobe generation circuits to produce an input or output strobe for each of the eight ports. Conceptually, the simplest way to generate an ENABLE* is to wire the address lines (directly or through inverters) to five inputs of a 74LS30 8-input NOR gate (see Figure 1). However, changing the address of the first block of the port is then a problem, because DIP switches cannot be used—they are single-pole, single-throw switches that are either on or off. The scheme of Figure 1 requires jumpers from the gate inputs to the direct or inverted address lines. And while jumpers are feasible, they are inconvenient. With the jumpers shown, the port addresses are from 60H through 67H.

A more convenient method of decoding is to use a magnitude comparator such as the DM8131 (see Figure 2). This chip compares six bits. The level on the B inputs is set by the switches and pull-up resistors; an open switch allows the associated resistor to pull the corresponding B input high. The chip produces an active-low ENABLE* signal if—and only if—the bit pattern on the address lines matches the pattern set into the switches (again, 60H through 67H). Since we are only applying five address lines to the A input, the A6 and B6 inputs are both tied to ground so that they always match. (They could also both be tied to +5V.)

As mentioned above, you may not be able to obtain the DM8131. One alternative is to cascade two 4-bit magnitude comparators such as the 74LS85; another is to use exclusive-NOR gates such as the 74LS266 or 74L288 with open-collector outputs wired together (see Figure 3). Each section of the chip produces a low output if the two input lines are at *different* levels. If both inputs are high or both are low, the output of the chip is high. Since all five chip section outputs are hard-wired together, a line/switch mismatch on any one address line pulls the common output line low; the ENABLE line is high only if the bit pattern on the address lines matches the pattern set into the switches. Again, an open switch matches a high address line. The open-collector chip is preferred over the standard totem-pole chip for applications in which gate outputs are to be wired together, because the internal impedance of the totem-pole may be too high to pull several gate outputs below the 0.8V logic 0 threshold reliably. If an active-low ENABLE* signal is required, another section of chip G2 can be used as an inverter, as shown, or a spare section of a 74LS04 hex inverter chip may be used instead.

Figure 1: *Address Decoding with Gate.*

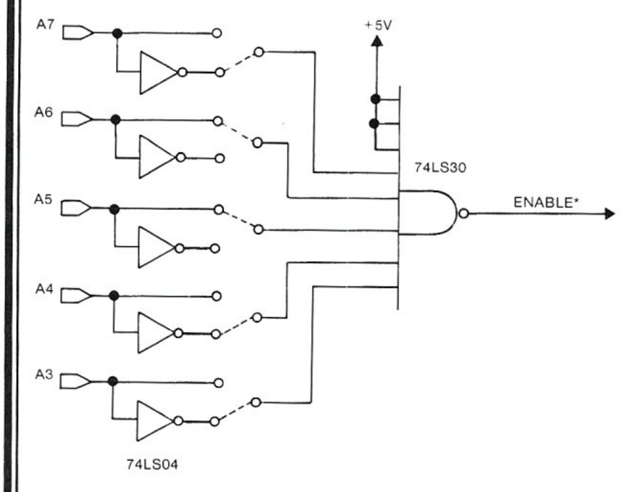


Figure 2: *Address Decoding with Magnitude Comparator.*

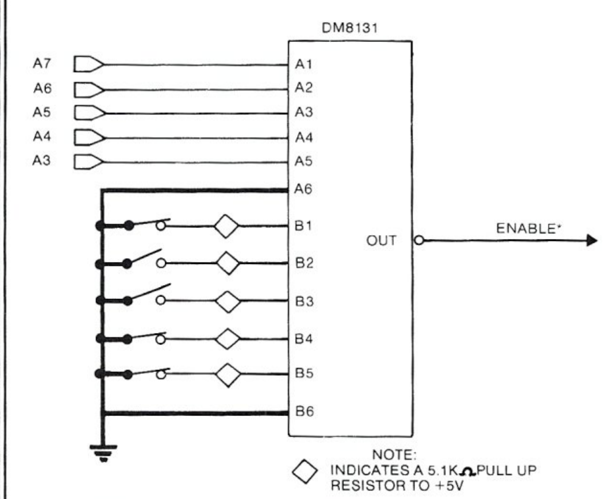
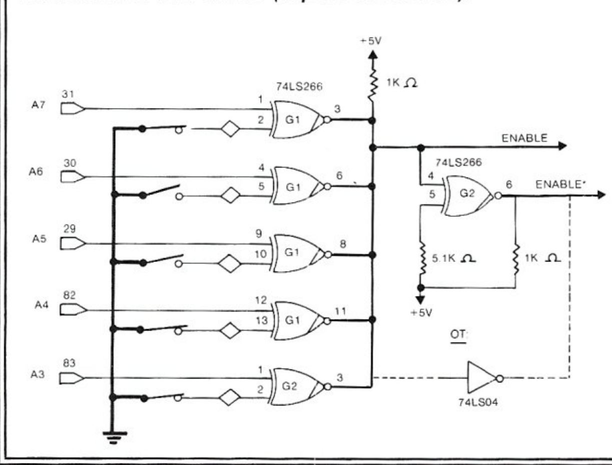


Figure 3: *Address Decoding with Switched Exclusive NOR Gates (Open Collector).*



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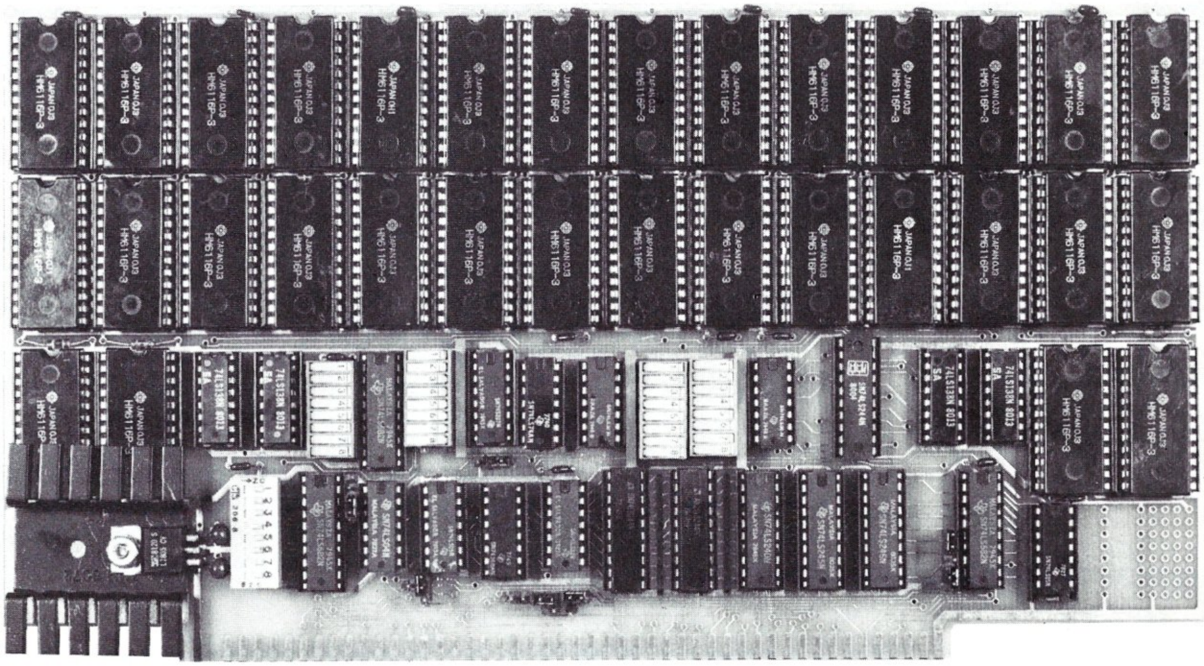

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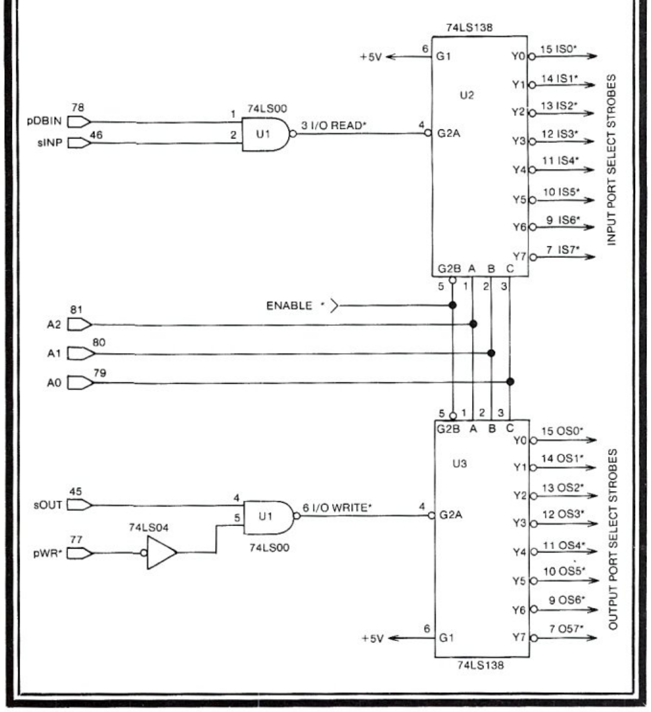
Figure 4: *I/O Port Strobe Generation.*

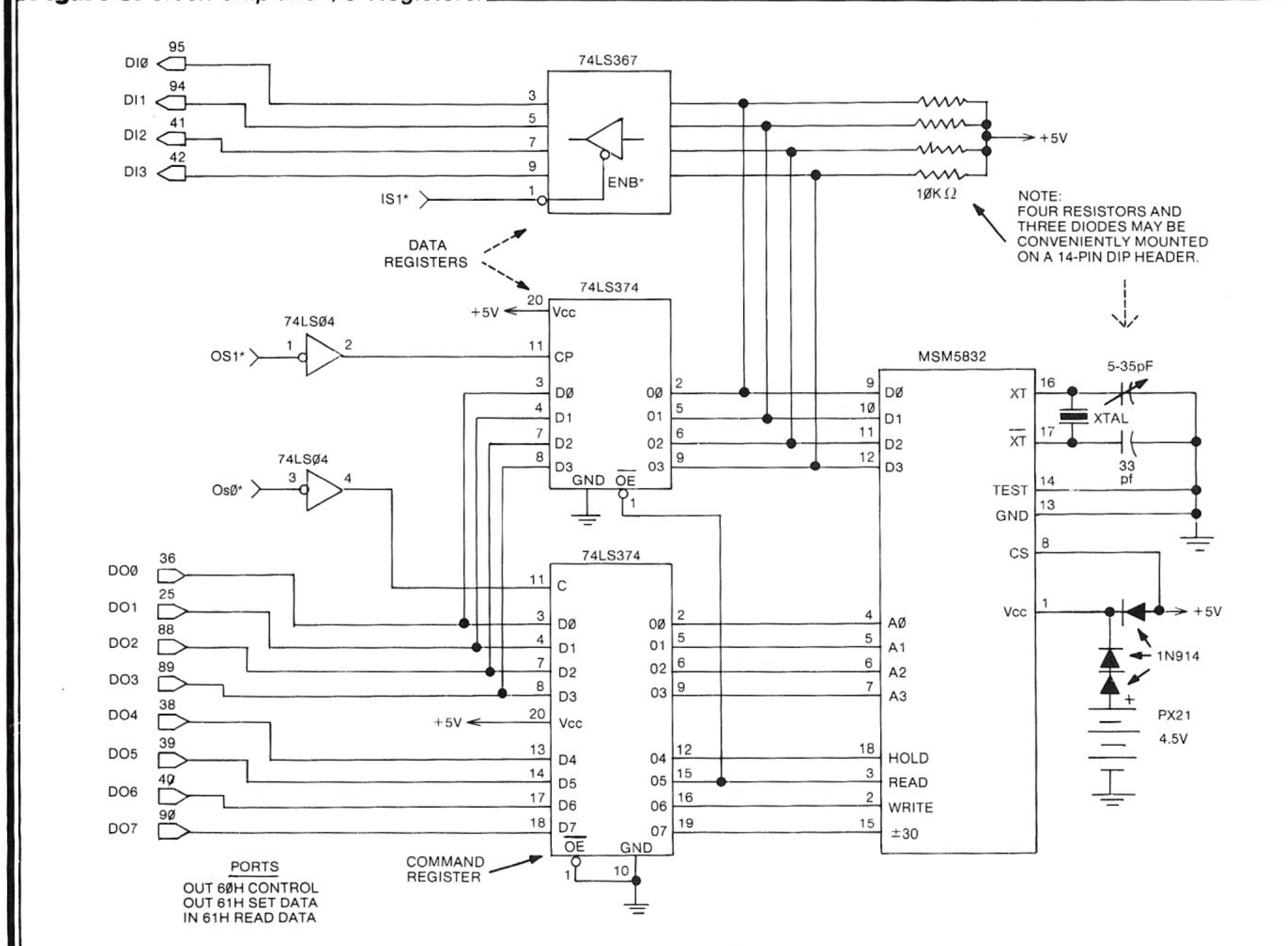


I/O Strobe Generation

A convenient method of generating I/O strobes is shown in Figure 4. A strobe is a pulse that can be used to open a set of gates for a limited time, or to load a register with data. This register may be a single flag bit that is set or reset to indicate some condition, or it may have multiple bits to hold some pattern such as a binary number or an ASCII character. In this particular article, we shall be considering an input strobe as a means of opening gates to transfer several bits of data from the peripheral (the clock chip) to the S-100/IEEE-696 DATA IN bus; and an output strobe as a means of loading a register with several bits of command or time-of-day data, which will continue to affect the peripheral (the clock chip) long after the bit pattern has vanished from the DATA OUT bus.

This definition tells us something about the conditions under which a strobe is generated. First, we are going to output commands, so we shall do so through an output port, using the OUT instruction with an address. Second, we are going to send data to the clock chip (to initialize or correct it if it runs fast or slow) and also read data from the clock chip. An I/O port at a given address can be used either for input or for output (though not both at the same

Figure 5: *Clock Chip and I/O Registers.*



time); since we are going to output both commands and time-of-day data, but to different parts of the clock chip, we had better use two separate ports—one for commands, the other for data. We could use either port for input from the clock chip; however, the chip has only four data lines, which are used for both input and output, depending on the current command. It therefore makes more sense to use one of our ports solely for outputting 8-bit commands, and the other for input and output of 4-bit time-of-day data. A common convention is to use the even-numbered port of a pair for status input and common output, and the odd-numbered port for data input and output. We shall therefore enable the board for addresses 60H through 67H, and use port 60H for command output and port 61H for data input and output.

The ENABLE* signal is generated by the five high-order bits of any one of these addresses. The lower three bits, which select one particular address out of the block of eight are applied to the A, B, and C address inputs of two 74LS138 3-to-8 line decoders. The ENABLE* signal is applied to the G2B enabling input line on both chips, and the G1 enabling input of each chip is tied to +5V. When the third enabling input (G2A) of either chip is pulled low, one of the eight output lines (selected by the three address bits) also goes low. Thus, if we activate the G2A input of one 74LS138 during an output instruction, and the G2A line of the other chip during an input instruction, we have a means of generating *either* an output strobe *or* an input strobe for each of the eight port addresses.

The timing of the strobe is important. It should be active only when the processor has placed valid data on the DATA OUT bus during an ouptut instruction, or when the processor is ready to accept data on the DATA IN bus during an input instruction. Fortunately, the S-100/IEEE-696 bus has signals from which we can derive the I/O READ* or I/O WRITE* signal to be applied to the G2A multiplexer inputs, and thereby ensure that the output pulses have proper timing and duration. Execution of the OUT instruction causes the processor to generate a status signal called sOUT; execution of the IN instruction produces a similar signal called sINP. Each is active high and appears when the address is stable on the address bus and before any data is transferred. These signals allow us to distinguish I/O instructions from memory read/write instructions. Likewise, when the processor has placed data from the A register on the DATA OUT bus, and it is stable, the processor generates the active-low pWR* signal. This signal in effect says "I've put data on the bus for you; take it now." When the processor is ready to accept data from a peripheral via the DATA IN bus, it generates the active-high signal pDBIN which says "I'm ready to take

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your data; put it on the bus now." Most microprocessors strobe the data into the A register of the CPU on the rising edge of Bus State 3 of the System Clock signal (Φ), which occurs toward the end of the pDBIN pulse.

By gating together the sINP and pDBIN signals to produce I/O READ*, which completes the activation of one 74LS138, we ensure that the input strobe line selected by the three low-order address bits goes low only during an input instruction, at a time and for a period that exactly corresponds to the pDBIN pulse. Likewise, by gating together sOUT and pWR (inverted pWR*) to generate I/O WRITE*, which completes the activation of the other 74LS138, we cause the selected output strobe line to go low at a time and for a period corresponding to the pWR* pulse, and thereby load data from the DATA OUT bus into a register located either on the interface or in the peripheral itself.

Simple peripherals that operate at TTL levels, such as the MSM5832 clock chip, require no other signals. We shall use the IS1* strobe directly for opening tri-state gates to connect the clock data lines to the DATA IN bus. We shall invert the OSO* and OS1* strobes and use the rising edge of the pulse to load data from the DATA OUT bus into commmand and data registers.

The Clock And I/O Registers

The clock chip and I/O registers are shown in Figure 5. The command lines (Hold, Read, Write, and 30-second ADJust) are connected to the four high-order bits of a 74LS374 command register; the four address lines, which select the internal clock register to be accessed, are connected to the four low-order bits of the register. This register is an MSI chip containing eight edge-trigged, D-type flip-flops. Data applied from the DATA OUT bus to the eight input terminals D0 through D7 is loaded into the register by the rising edge of a clock pulse; here we use the OSO* output strobe inverted. Thus, data on the bus is clocked into the register by the leading edge of OSO* (which corresponds also to the leading edge of pDBIN) during an output to port 60H.

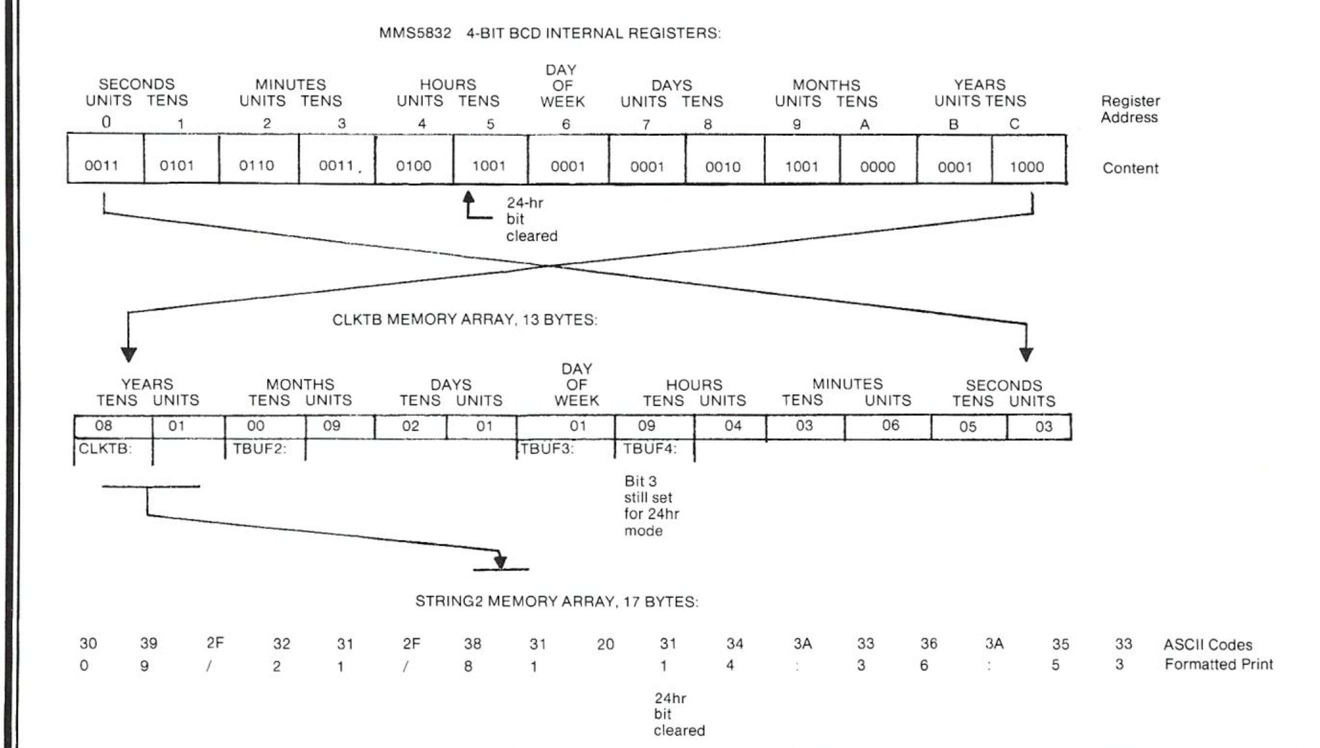
The clock data lines D0 through D3 are bidirectional. With HOLD and READ high, D0 through D3 carry a BCD (binary-coded decimal) number obtained from the internal register selected by register address lines A0 through A3. This number is gated onto DATA IN lines DI0 through DI3 by tri-state buffers which are enabled for the duration of the IS1* strobe generated by an input instruction addressing port 61H. DATA IN lines DI4 through DI7 are left unconnected, and the random data on them should be masked out by the software—additional tri-state buffers could be used to ground these lines, but it is hardly worth the effort of putting in the additional wiring.

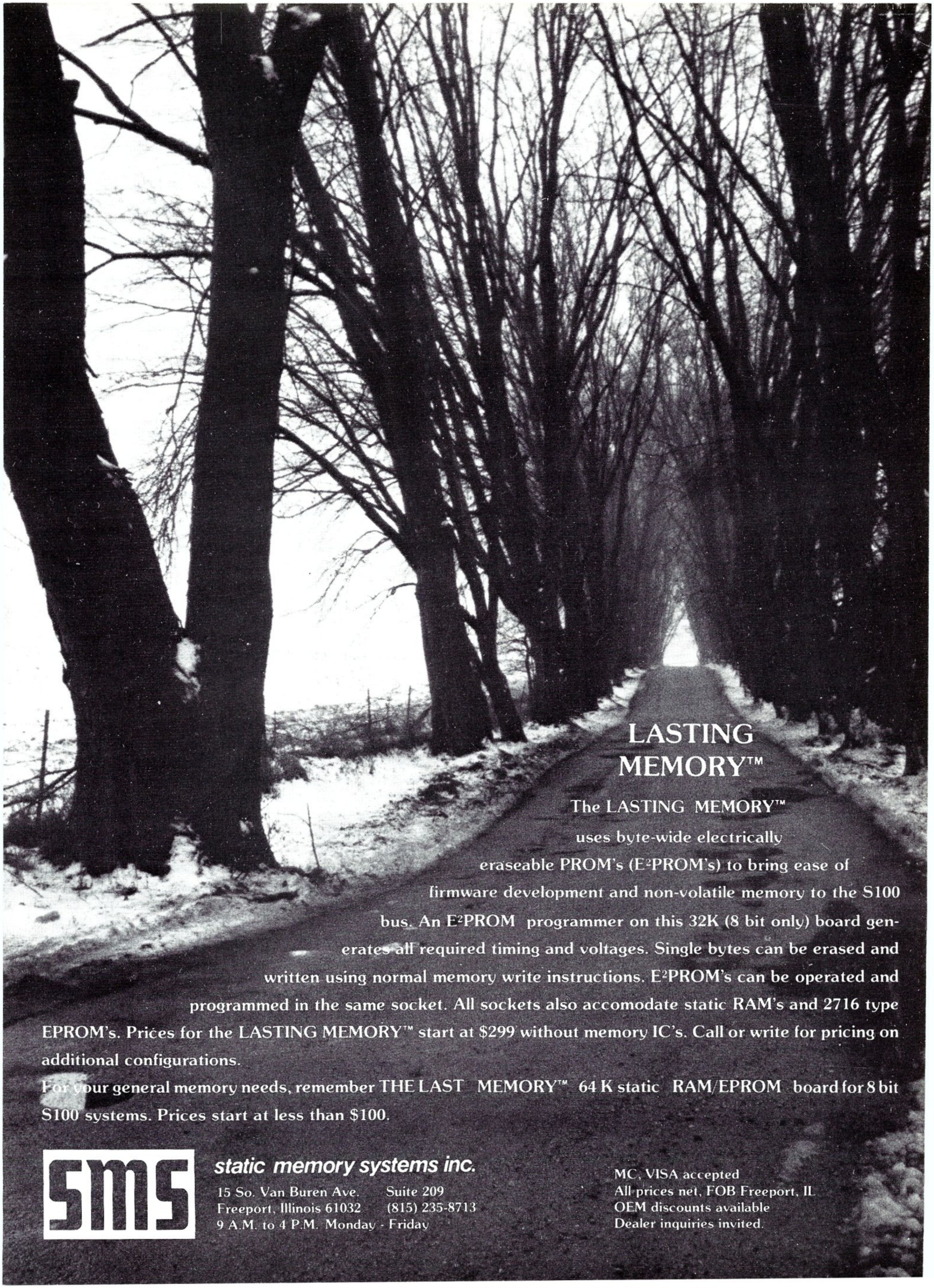
With HOLD and WRITE high, the selected internal register is set to the value placed on the data lines from DATA OUT lines DO0 through DO4 via half of another 74LS374 register. This register is loaded by the leading edge of pulse OS1* (inverted) during an output to port 61H. Note that the outputs of this register are tri-stated by the READ command; this is necessary to prevent the contents of the register interfering with the clock data.

Software

The software consists of a set of subroutines for reading the date and time, which form part of the CP/M CBIOS. A separate transient program is provided for initializing or resetting data and time; this program is resident on the

Figure 6: *Clock Data Manipulation & Formats.*

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diskette as a .COM file and is invoked from the CCP in the usual manner by giving the command:

```
A>CLKSET
```

The clock read routines are invoked by a CALL inserted into the cold boot portion of the CBIOS, or from application programs via an extra JMP instruction added to the end of the standard CP/M jump vector (after the jump to SECTRAN in CP/M 2.2, or after the jump to WRITE in CP/M 1.4). These routines first read the clock registers into a 13-byte numeric array; the BCD digits are then converted to ASCII code and transferred to a string array for printing. The formatting of the string is done by the transfer routine.

Reading the Clock Register

The CALL instruction at 0DABBH in the cold boot transfers control to the main clock subroutine called CLKRD at 0DCE4H in Listing 1. The first instruction in CLKRD is another subroutine RDCLK at 0DD1DH. To read the thirteen registers, at clock addresses 0 through C (see Figure 6), the HOLD line must first be asserted for at least 150 microseconds. This delay is produced by calling the DELAY subroutine. For a system with a 4 MHz clock, the delay constant NDELY should be increased from 15H to 30H or more. Upon return from the DELAY subroutine, register reading begins. For each digit, an OUT instruction to port 60H loads the command register with READ, HOLD, and a 4-bit block register address. Data from the currently addressed internal register appears on clock data lines D0 through D3 six microseconds later, and is read by an IN instruction to port 61H.

The addressing sequence of the clock registers is shown at the top of Figure 6. The obvious procedure would be to read the registers in ascending address sequence, but each pair of digits is then the reverse of the normal printing sequence—e.g., the year appears as 18 instead of 81. The LOOP1 portion of RDCLK therefore reads the registers into the CLKTB array in descending register address order, so that upon completion of the RDCLK subroutine the array will contain the digit pairs in the more convenient printing sequence. The Year/Month/Day sequence is usually reformatted for printing, but is convenient for application programs that sort records into date order. The Day of Week digit at TBUF3 can be directly used as entry into a table of day names. Note that at TBUF4, containing the tens-of-hours digit, bit 3 is set to indicate 24-hr format. This is later removed by subtracting 8 to obtain the true value.

Building The Timestamp String

CLKRD sets a pointer (in HL) to the start of the character array STRING2, and then makes repeated calls to the GET2 subroutine at 0DD3EH. GET2 fetches a pair of digits from M(BC) in the CLKTB array, adds 30H to convert them to the equivalent ASCII code, and deposits them at M(HL) in the string array starting at STRING2. The pointers are updated after each fetch and deposit. The sequence in which digit pairs are fetched can be changed by setting BC to point to the desired pair before each call to GET2. CLKRD inserts a delimiter between each digit pair ('/' between date pairs, ':' between time pairs, and spaces between the end of the date and the start of the time).

Using The Timestamp String

Listing 1 represents fragments of the CBIOS for a 56K CP/M 2.2 system using a Tarbell controller. The subroutine CALL to CLKRD is inserted into the cold boot routine at 0DABBH. The null terminator at the end of the sign-on message (SMSG at 0DC95H) is removed, and two further portions of message are added: "Logged on" at STRING (0DCB7H), and the STRING2 array, pre-initialized. CLKRD overwrites the string. The null terminator is placed at the end of STRING2. Thus, when the cold boot calls its printing routine PMSG, the timestamp is printed as part of the sign-on message (see Figure 7).

Figure 7: *Log-On Message.*

```
Tarbell 56K CPM 2.2 of 17-6-80
Logged on 09/23/81 14:36:53

A>
```

Care must be taken to keep the CLKTB array and STRING2 within the body of the CBIOS. If these items are included in the data area at the end of the CBIOS, they may be overwritten by BDOS.

Application programs may call CLKRD via an extra entry in the standard jump vector (placed after the jump to SECTRAN), and then copy either the BCD data or the string into a local data area for processing or printing. However, STRING2 does not end with a '$'. It is therefore better to include the clock reading routines and arrays in the application source code and reassemble. This procedure allows greater freedom in formatting and permits printing via a standard BDOS call to Write Buffer function.

Initializing and Adjusting the Clock

The CLOCKSET program is seldom used once the oscillator frequency has been correctly adjusted by means of the variable capacitor. However, a means of resetting the time is required when there is a change from summer to winter time and vice versa. CLOCKSET is therefore set up as a disk-resident utility executed in the TPA as and when required. As for the read, HOLD is raised for 150 microseconds to prepare the chip. WRITE is then raised, and eleven successive commands are issued, each consisting of HOLD, WRITE, and a register address. Each command is directly followed by a data transfer of the digit to be placed in that address. The command/data sequence takes place in writing loop WRLO: at 162H in Listing 2. The data are entered via the keyboard into a buffer, from which they are transferred to the clock when the space bar is hit on a time signal. The routine is given in Listing 2, and the prompts are shown in Figure 8. ■

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Listing 1.

```
FILE:  TARBI256PRN        09/14/81  09:18                PAGE 006


DAAB 77          BOOTL:  MOV   M,A           ;PUT ZERO IN MEMORY.
DAAC 23                  INX   H             ;INCREMENT POINTER.
DAAD 0D                  DCR   C             ;DECREMENT COUNTER.
DAAE C2ABDA              JNZ   BOOTL         ;LOOP TILL DONE.

DAB1 3EF2                MVI   A,0F2H        ;SET LATCH CODE = F2.
DAB3 3272DD              STA   LATCH
                               IN     CDATA       ;CLEAR CONSOLE STATUS.
                 ;
DAB6 0E1A                MVI   C,CLRC        ;LOAD CLEAR SCREEN CHARACTER
DAB8 CD24E0              CALL  MCONOT        ;DO THE CLEAR
DABB CDE4DC              CALL  CLKRD     <----    ADDED CALL
DABE 2195DC              LXI   H,SMSG        ;PRINT TIME & SIGN-ON MESSAGES.
DAC1 CD83DC              CALL  PMSG
                 ;
                 ; SET UP JUMPS INTO CP/M IN LOWER MEMORY.
                 ;

                             .
                             .
                             .
                             .
                             .
                             .
                             .
                             .

                 ;
                 ; PRINT THE MESSAGE AT H&L UNTIL A ZERO.
                 ;
DC83 7E          PMSG:   MOV   A,M           ;GET A CHARACTER.
DC84 B7                  ORA   A             ;IF IT'S ZERO,
DC85 C8                  RZ                  ;RETURN.
DC86 4F                  MOV   C,A           ;OTHERWISE,
DC87 CD1FDB              CALL  CONOT         ;PRINT IT.
DC8A 23                  INX   H             ;INCREMENT H&L,
DC8B C383DC              JMP   PMSG          ;AND GET ANOTHER.
                 ;
                 ;
DC8E 4552524F52ERRMSG:  DB     'ERROR.',0
DC95 0A0A546172SMSG:    DB     0AH,0AH,'Tarbell '
DC9F 3536               DB     MSIZE/10+'0',MSIZE MOD 10 +'0'
DCA1 4B2043504D         DB     'K CPM 2.2 of 17-6-80',0DH,0AH
DCB7 4C6F676765STRING:  DB     'Logged on '
DCC1 59592F4D4DSTRING2: DB     'YY/MM/DD HH:MM:SS',0DH,0AH,0 <--- Null Terminator Moved to here
DCD5 0000        CLKTB:  DW    0 ________
DCD7 0000        TBUF2   DW    0            CLKRD overwrites these characters
DCD9 0000                DW    0
DCDB 00          TBUF3   DB    0
DCDC 0000        TBUF4   DW    0
DCDE 0000                DW    0
DCE0 0000                DW    0
DCE2 0000                DW    0
                 ;
                 ;       READ THE CLOCK DATA AND CONVERT TO A STRING
                 ;
DCE4 CD1DDD      CLKRD:  CALL    RDCLK
DCE7 21C1DC              LXI     H,STRING2
DCEA 01D7DC              LXI     B,TBUF2
DCED CD3EDD              CALL    GET2            ;Month
DCF0 362F                MVI     M,'/'
DCF2 23                  INX     H
DCF3 CD3EDD              CALL    GET2            ;Day
DCF6 362F                MVI     M,'/'
DCF8 23                  INX     H
DCF9 01D5DC              LXI     B,CLKTB
DCFC CD3EDD              CALL    GET2            ;Year
DCFF 3620                MVI     M,' '
DD01 23                  INX     H
DD02 01DCDC              LXI     B,TBUF4
DD05 CD3EDD              CALL    GET2            ;Hour
DD08 363A                MVI     M,':'
DD0A 23                  INX     H
DD0B CD3EDD              CALL    GET2            ;Minutes
DD0E 363A                MVI     M,':'
DD10 23                  INX     H
```

```
FILE:  TARBI256PRN        09/14/81  09:18                PAGE 013

DD11 CD3EDD              CALL    GET2            ;Seconds
                 ;
DD14 3ACADC              LDA     STRING2+9
DD17 DE08                SBI     8               ;Remove 24-hr bias
DD19 32CADC              STA     STRING2+9
                 ;
DD1C C9                  RET
                 ;
                 ;       RDCLK TRANSFERS CLOCK DATA TO A 13-CHARACTER BUFFER IN BCD
DD1D E5D5C5      RDCLK:  PUSH H ! PUSH D ! PUSH B
DD20 21D5DC              LXI     H,CLKTB         ;Point to clock buffer
DD23 063C                MVI     B,CRHLD+12      ;Set up Read, Hold, & point to Y10.
DD25 3E10                MVI     A,CHLD          ;First, load Hold bit
DD27 D360                OUT     CTRLA           ;and turn it on.
DD29 CD52DD              CALL    DELAY           ;Wait 150 usec.
                 ;
DD2C 78          LOOP1:  MOV     A,B             ;Load Read, Hold, and Y10 address
DD2D FE2F                CPI     CRHLD-1         ;Check whether done;
DD2F CA4BDD              JZ      HLDOF           ;if so, exit,
DD32 D360                OUT     CTRLA           ;else write address
DD34 DB61                IN      CLOKA           ;and read selected clock register.
DD36 E60F                ANI     0FH             ;Mask off upper nibble (not used).
DD38 77                  MOV     M,A             ;Put the data in the buffer,
DD39 05                  DCR     B               ;bump the clock address (down)
DD3A 23                  INX     H               ;and the buffer pointer (up),
DD3B C32CDD              JMP     LOOP1           ;and loop for more.
                 ;
                 ;
                 ;       GET2 SUBROUTINE FETCHES 2 CHARS FROM BUFFER
                 ;       AND CONVERTS TO ASCII IN THE STRING.
DD3E 1E02        GET2:   MVI     E,2             ;Counter for characters.
DD40 0A          GETLP:  LDAX    B               ;Fetch BCD from buffer,
DD41 C630                ADI     30H             ;Add ASCII bias,
DD43 77                  MOV     M,A             ;and put in the string.
DD44 03                  INX     B
DD45 23                  INX     H
DD46 1D                  DCR     E               ;Check whether done.
DD47 C8                  RZ                      ;If so, return,
DD48 C340DD              JMP     GETLP           ;else get 2nd character of pair.
                 ;
DD4B AF          HLDOF:  XRA     A               ;Turn off command and address bits.
DD4C D360                OUT     CTRLA
DD4E C1D1E1              POP B ! POP D ! POP H   ;Restore cpu state
DD51 C9                  RET                     ;and exit.
                 ;
DD52 0E15        DELAY:  MVI     C,NDELY         ;Wait 150 usec.
DD54 0D          CWAIT:  DCR     C
DD55 C254DD              JNZ     CWAIT
DD58 C9                  RET
                 ;
                 ;*******************END OF CLOCK ROUTINES****************
                 ;
DD59 AF          PRSTAT: XRA   A   ;NOT SUPPORTED.
DD5A C9                  RET
                 ;
                 ; PUNCH AND READER ARE NOT SUPPORTED.
                 ;
DD5B C330E0      PUNCH:  JMP   MPUN
DD5E C320E0      READER: JMP   MRDR
                 ;
DD61 C333E0      LIST:   JMP   LISTC
                 ;
                 ;
                 ;THE LAST ADDRESS BEFORE THIS POINT SHOULD BE NO
                 ;GREATER THAN THE CBIOS STARTING ADDRESS + 037F (HEX).
                 ;THIS WILL NORMALLY BE XD7F (HEX).
                 ;
                 ;***********************************************************************
                 ;
                 ;                       BIOS SCRATCH AREA.
                 ;
DD64             TRK:    DS    1           ;CURRENT TRACK NUMBER.
DD65             SECT:   DS    1           ;CURRENT SECTOR NUMBER.
DD66             DMAADD: DS    2           ;DISK TRANSFER ADDRESS.
                 ;
```

Listing 2.

```
FILE: CLKSET  .PRN                    PAGE 001


                   ;         CLOCK READING ROUTINES
                   ;
                   ;         DEFINE PORT PARAMETERS
0060 =             CTRLA     EQU     60H      ;CLOCK CONTROL, OUTPUT ONLY
0061 =             CLOKA     EQU     CTRLA+1  ;DATA PORT, READ OR WRITE
                   ;
                   ;         DEFINE CLOCK CHIP PARAMETERS
0000 =             S1        EQU     00H      ;ADDRESS FOR SECONDS
0010 =             HOLD      EQU     10H      ;HOLD BIT
0020 =             READ      EQU     20H      ;READ BIT
0040 =             WRITE     EQU     40H      ;WRITE BIT
0080 =             ADJ30     EQU     80H      ;30-SEC ADJUST BIT
0030 =             RDHLD     EQU     READ+HOLD
0050 =             WRHLD     EQU     WRITE+HOLD
0015 =             NDELY     EQU     15H      ;150-USEC DELAY
                   ;
                   ;         DEFINE SYSTEM PARAMETERS
E003 =             MONT      EQU     0E003H
E006 =             CRLF      EQU     0E006H
E015 =             SCRN      EQU     0E015H
E077 =             READ1     EQU     0E077H
FE6B =             IBUF      EQU     0FE6BH
E02A =             CI        EQU     0E02AH
                   ;
0000 =             BOOT      EQU     0000H
0005 =             BDOS      EQU     0005H
                   ;
                   ;
0100                         ORG     100H
                   ;
                   ;         DUMMY DRIVER
                   ;*****************************************************************
                   ;         CLOCK INITIALIZATION ROUTINE
                   ;
0100 E5D5C5        CLKSET:   PUSH H ! PUSH D ! PUSH B
0103 218B01                  LXI     H,MSG1   ;Sign on message
0106 CD15E0                  CALL    SCRN
0109 CD06E0                  CALL    CRLF
010C 23                      INX     H
010D CD15E0                  CALL    SCRN     ;Instructions
0110 CD06E0                  CALL    CRLF
0113 23                      INX     H
0114 CD15E0                  CALL    SCRN     ;Prompt line
0117 CD06E0                  CALL    CRLF
011A CD77E0                  CALL    READ1    ;enter the data
                   ;
                   ;         Transfer the data from IBUF to the clock buffer
                   ;         in the proper order for the clock.
011D 016BFE        MOVTM:    LXI     B,IBUF   ;Start reading buffer forward
0120 211A02                  LXI     H,CLKTB  ;Same order for clock buffer
0123 0A            MOVT1:    LDAX    B        ;Get a character
0124 FE20                    CPI     ' '      ;Check for delimiter.
0126 CA3201                  JZ      MOVT2    ;If there, go do next group.
0129 FE0D                    CPI     0DH      ;Check for CR
012B CA3601                  JZ      HRS24    ;If so, done.
012E E60F                    ANI     0FH      ;Else strip off ASCII bias (top nibble).
0130 77                      MOV     M,A      ;Put stripped byte in clock buffer.
0131 23                      INX     H        ;Bump
0132 03            MOVT2:    INX     B        ;pointers,
0133 C32301                  JMP     MOVT1    ;and loop for more.
                   ;
0136 AF            HRS24:    XRA     A        ;Set 0
0137 77                      MOV     M,A      ;into S10 location
0138 23                      INX     H        ;and into
0139 77                      MOV     M,A      ;S1 location.
013A 3A2102                  LDA     CLKTB+7  ;Get the H10 byte,
013D F608                    ORI     8        ;set the 24-hr bit,
013F 322102                  STA     CLKTB+7  ;and put it back in buffer.
                   ;
                   ;
0142 CD06E0        PAUSE:    CALL    CRLF
0145 21EC01                  LXI     H,MSG4   ;Ready message
0148 CD15E0                  CALL    SCRN
014B CD2AE0                  CALL    CI       ;Wait for a Space.
014E FE20                    CPI     20H
FILE: CLKSET  .PRN                    PAGE 002


0150 C24201         JNZ      PAUSE    ;Not an SP, re-prompt.
0153 CD06E0                  CALL    CRLF     ;Got it, set the clock chip.
                   ;
0156 211A02        WRCLK:    LXI     H,CLKTB  ;Point to clock buffer.
0159 061C                    MVI     B,1CH    ;Set up Hold, Clock address Y10.
                   ;
                   ;         NOW START WRITING THE BUFFER INTO THE CLOCK CHIP.
015B 3E10          WRCK1:    MVI     A,HOLD   ;Turn on
015D D360                    OUT     CTRLA    ;the Hold bit.
015F CD8401                  CALL    DELAY    ;Wait 150 usec.
0162 78            WRLOP:    MOV     A,B      ;Get Hold+clock address
0163 FE0F                    CPI     HOLD-1   ;check for end,
0165 CA7B01                  JZ      HLDOF    ;if so, exit,
0168 D360                    OUT     CTRLA    ;else write the address.
016A 7E                      MOV     A,M      ;Get data from buffer,
016B D361                    OUT     CLOKA    ;and write it to the clock chip.
016D 78                      MOV     A,B      ;Get Hold+addr,
016E F640                    ORI     WRITE    ;add the Write bit,
0170 D360                    OUT     CTRLA    ;and do the write.
0172 E61F                    ANI     1FH      ;Turn off Write, but keep Hold on.
0174 D360                    OUT     CTRLA    ;Do it.
0176 23                      INX     H        ;Bump buffer pointer
0177 05                      DCR     B        ;and clock address,
0178 C36201                  JMP     WRLOP    ;and loop for next digit.
                   ;
017B AF            HLDOF:    XRA     A        ;Turn off Read, Write, Hold bits.
017C D360                    OUT     CTRLA    ;Do it.
017E C1D1E1                  POP B ! POP D ! POP H
0181 C30000                  JMP     BOOT
                   ;
                   ;
0184 0E15          DELAY:    MVI     C,NDELY ;Wait 150 usec.
0186 0D            WAIT      DCR     C
0187 C28601                  JNZ     WAIT
018A C9                      RET
                   ;
                   ;
                   ;*************************************************************
                   ;         MESSAGE AREA
018B 436C6F636BMSG1:         DB      'Clock-Calendar Initialization:',0DH
01AA 456E746572MSG2:         DB      'Enter Date, day of week, & time under prompt marks:',0DH
01DE 59594D4D44MSG3:         DB      'YYMMDD D HHMM',0DH
01EC 5768656E20MSG4:         DB      'When ready, press Space to initialize clock  ',0DH
                   ;
                   ;*************************************************************
                   ;         CLOCK BUFFER
021A               CLKTB     DS      13
                   ;
0227                         END     100H
```

PROM monitor routines in my system. READ1 collects keyboard data in a buffer; SCRN outputs a line to the screen. BDOS calls could be substituted.

Figure 8: *Clock Initialization and subsequent Time Request.*

```
A>CLKSET
Clock-Calendar Initialization:
Enter Date, day of week, & time under prompt marks:
YYMMDD D HHMM
810923 3 2145
When ready, press Space to initialize clock

A>


A>TIME

09/23/81 21:45:11

A>
```

Operator entry terminated by a Return

Note: when initializing the clock, seconds are automatically set to 00.

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Speed Up Your Diablo Printer

by Gary Sabot

Increase the speed of a Diablo printer by 50% by using the ETX/ACK protocol.

One of the most widespread applications for microcomputers today is word processing. A word processing program, such as the Electric Pencil or Word Star, allows text to be written, added to, deleted from, and hammered into shape on a video display. The text may then be printed out. Word processing systems often include a daisy wheel printer, such as the Diablo, because of the excellent print quality that these printers offer. However, many of the systems that use the Diablo are not making efficient use of the Diablo's capabilities. This article will show how the speed of a Diablo may be increased by 50%, using a method described in the Diablo manual.

How the Diablo Operates

The Diablo is capable of receiving 120 CPS (characters per second) from a computer. These characters are stored by the Diablo, which then proceeds to print them at 45 CPS. As a result of the discrepancy between these rates, the Diablo must store any characters which it is not yet ready to print. The storage area is called the *print buffer*. The Diablo 1610/1620 is capable of storing 158 characters. If too many characters are sent to the Diablo too quickly, a *buffer overflow* will occur. The last 158 characters sent to the printer (being stored in the print buffer) are erased, and not printed. The computer is not informed of such a buffer overflow. Thus, an overflow can result, as in the loss of the middle of paragraph in a paper, or by wreaking havoc in a computer that is printing out bills or checks.

As you can see, a computer that is operating the Diablo at full speed must take precautions to prevent a print buffer overflow. The computer cannot constantly transmit to the printer at 120 CPS—it must allow time for the printer to "catch up."

The method used by many computer vendors to prevent buffer overflow is to run the printer at only 30 CPS. This means that the computer can send a maximum of thirty characters per second to the printer. The reason that this method is used in many systems utilizing the Diablo is that it is so simple. Because the computer is transmitting characters at a rate *slower* than the printing rate of the Diablo, there is no way that a buffer overflow can occur. However, this method wastes the Diablo's high speed capability, since it operates the Diablo at two-thirds of its full speed.

One of the best methods of preventing the buffer from overflowing is called ETX/ACK proctol. In this method, a program transmits the information to be printed in fixed length, 158 characters long, "messages." The reason for this specific message length is that the print buffer in the Diablo (the place where messages to be printed are stored) is capable of holding a maximum of 158 characters. Each of these messages must end up with a special character called ETX. ETX is a character, just like any letter or number. ETX stand for "End of Transmission." When the Diablo receives an ETX, it does not print out "ETX"—ETX is not a "printing character." Rather, it transmits a character called ACK back to the computer. ACK stands for "Acknowledge"—the printer is informing the computer that it received the message sent to it and has finished printing it. The computer may now send the next message to be printed.

The computer does not have to send the 158 characters of a message consecutively. For example, it may send thirty characters, then three characters, then eighty characters, and so on. So long as the computer transmits ETX after every 157th character and waits for receipt of ACK, the print buffer in the Diablo cannot overflow. As you can see, this method is independent of the baud rate—it does not matter how fast characters are being sent to the printer. The print buffer never overflows, yet the Diablo can be operated at its maximum rate.

The Hardware Modifications

To utilize the Diablo at its full speed, two hardware modifications must be made. One is made in the Diablo, the other is made within the computer. First, I will describe the change that must be made in the Diablo.

Gary Sabot, 38 Woodlawn Rd., Roslyn, NY 11576.

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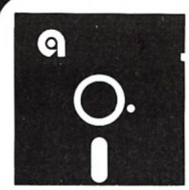

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Diablo Printer, continued...

Initially, the Diablo must be "informed" that it will be receiving characters at 1200 CPS. If you own a Diablo 1640/1650, this is quite easy to do. Remove the front panel with the label on it. Immediately below, there are several rows of DIP switches. Turn on the switch adjacent to the caption "1200 Baud" and turn off any other baud rate switch, such as "300 Baud."

If you happen to own the older Diablo 1610/1620, this change will be more difficult. The entire top of the Diablo must be taken off and a specific circuit board removed. A jumper must then be installed and the Diablo reassembled. Because the exact location of the jumper will vary depending on how old your Diablo is (older models have the jumper in a different location), I suggest that you refer to your Diablo manual for specifics. Section 5.5.2, "Jumper Installation/Removal," explains how to open the Diablo and gain access to the circuit boards, and section 5.5.2.1, "1200 Baud," indicates the proper location for the jumper. In my Diablo, the jumper location is on the left-front circuit board (see Figure 1). I used a short piece of bare wire as a jumper and taped it into place instead of soldering; consequently, I can easily remove the jumper at a future time. If you prefer, you can order a jumper-plug, Diablo part no. 10634, instead of making your own.

The second hardware change is made inside your computer. You must change the baud rate of the serial interface that is connected to the Diablo to 1200 Baud. The procedure used to make this change is different for each computer. In some computers, it is done by changing the position of DIP switches within the computer, while the others require jumpers to be soldered. Unless you own a NorthStar Horizon (for which I will detail the required procedure), you will have to refer to your computer's manuals. A local computer store, or your computer's manufacturer, should be able to offer assistance if you run into problems in this area.

In my computer, the NorthStar Horizon, the baud rates of each of the two built-in serial ports are controlled by a "DIP header" that may be found at location 2D. (See Figure 2.) Some of the wires on the DIP header control the baud rate of the left serial interface (the one closest to the left side of the computer, away from the disk drives) and others control the baud rate of the right serial interface (the one closest to the disk drives). (See Figure 3.)

Figure 1. *Jumper location on Diablo circuit board.*

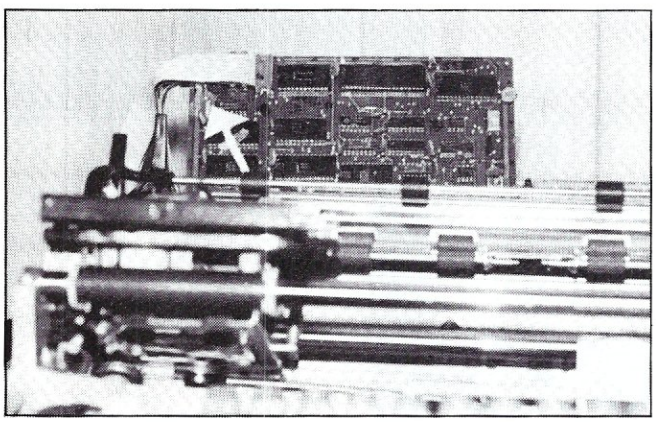


Figure 2. *DIP location on North Star Motherboard.*

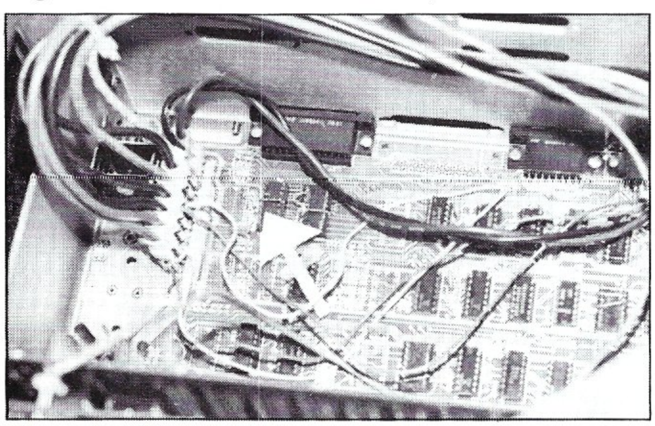
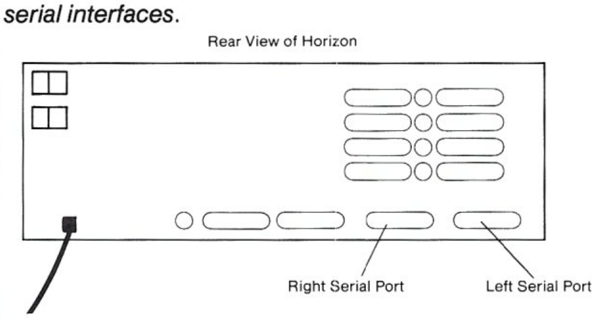


Figure 3. *Diagram labeling the North Star serial interfaces.*



If you are using a video terminal, such as the Hazeltine 1500, then it will probably be connected to the left serial port and the Diablo will be connected to the right serial port. However, if you are using a memory-mapped video board rather than a video terminal, then the Diablo will probably be connected to the left serial port (the right serial port may not even be installed!). Follow the cable that connects the Diablo to your computer to determine which port is connected to the Diablo in your system. Then, remove the DIP header from the location 2D in the computer.

If the Diablo is connected to the left port, remove (desolder) the wire which presently connects pins 3, 4, and 11. Solder in a new wire connecting pins 3, 4, and 13. Return the DIP to the Horizon.

If the Diablo is connected to the right serial port, remove (desolder) the wire which presently connects pins 5, 6, and 11. Solder in a new wire connecting pins 5, 6 and 13. Return the DIP to the Horizon.

The Software Modifications

If you use the Electric Pencil for word processing, then your system is now ready. ETX/ATX protocol is automatically used by all of the Diablo versions of the Electric

Figure 4. *A BIOS sample printer output routine.*

```
HOROUT1:
        IN      3           ;READY TO SEND YET?
        ANI     1
        JZ      HOROUT1
        MOV     A,C         ;YES
        OUT     2           ;OUTPUT CHARACTER
        RET
```

Pencil. If you wish to use Word Star (another word processing program), you must first run the INSTALL program that comes with Word Star, and when INSTALL shows its "Communications Protocol Menu," select choice "E," for ETX/ACK protocol. Then, a routine that can input characters from the printer must be patched into Word Star—the required procedure is described in the Word Star Manual.

The preceeding paragraph indicated how to modify two word processing programs so that they use ETX/ACK protocol. If word processing is the sole use of your system, then no further changes need be made. If, however, other programs will be using the printer (i.e., MBasic, which may send program listing to the printer), then the Input/Output routines (BIOS) within CP/M itself must be modified so that they use ETX/ACK protocol. This is easier than attempting to separately modify each of the programs that your system may run. Remember that this modified CP/M should be used only with programs that do not already incorporate ETX/ACK protocol (i.e., do not use it with Electric Pencil).

Figure 5. *Modified BIOS printer output routine with ETX/ACK protocol.*

```
HOROUT1:
        LXI     H,CHRCOUNT      ;DECREMENT CHARACTERS LEFT UNTIL
                                ;NEXT ETX MUST BE SENT
        DCR     M
        JNZ     CONT            ;IF NOT TIME YET, OUTPUT NORMAL CHARACTER
NREADY: IN      3               ;ELSE, GET READY TO SEND ETX
        ANI     1
        JZ      NREADY
        MVI     A,3
        OUT     2               ;SEND ETX
SNREADY: IN     3               ;GET RESPONSE
        ANI     2
        JZ      SNREADY
        IN      2
        ANI     7FH
        CPI     6               ;IS IT AN ACK
        JNZ     SNREADY         ;NO, DISCARD AND TRY AGAIN
        MVI     M,158           ;YES, RESET COUNT
CONT:   IN      3               ;OUTPUT CHARACTER
        ANI     1
        JZ      CONT
        MOV     A,C
        OUT     2
        RET
        -
        -
        -
        -
HORCINIT:                       ;INITIALIZATION ROUTINES
                                ;ADD THIS
        MVI     A,158
        STA     CHRCOUNT        ;INITIALIZE CHR. COUNTER
        -
        -
        -
        -
CHRCOUNT    DS  1               ;AND ADD THIS TO END OF INITIALIZATION
```

The first step in modifying the BIOS is to obtain an assembly language listing for the BIOS of your particular CP/M. Then, where the printer output routine appears (such as the sample in Figure 4), substitute a routine like the one contained in Figure 5, which incorporated ETX/ACK protocol. Remember to substitute the correct port numbers for your system (the sample has been set up for the Horizon's left serial port). Now, assemble the new BIOS and insert into your CP/M. The exact method for "inserting" the BIOS into CP/M may be found in the CP/M manual and the CP/M user's notes for your system. If you are not familiar with CP/M or machine language programming, you should be able to receive help in this last modification from the store that originally configured CP/M for your system.

Although the modifications that I have detailed may seem complicated, they are actually not difficult to implement. The end product, a printer that runs at least 50% faster, is a joy to work with and a pleasure to behold. ■

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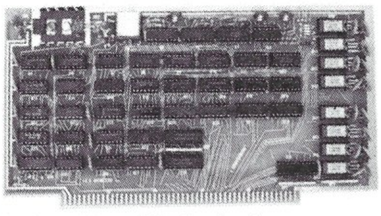

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Little-Ada* (Part IV)

by Ralph E. Kenyon, Jr.

Editor's Note:

In this installment, the last in a four-part series, the author presents the Little-Ada compiler and object code. Parts I, II, and III were published in the Sep/Oct 1981, Nov/Dec 1981, and Jan/Feb 1982 issues, in that order. Refer to Part I for introductory reading on Little-Ada, Part II for a discussion of the run-time interpreter and compiler, and Part III for the presentation of Little-Ada's run-time interpreter and source code.

```
        Drive #   02       Name  COMPILER.L1
        Address 0065       Size  0024
        La      0000       Sa    ADA1
        CKsm    0E41       # Bad 0000

0065 |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

0000 | 00 06 90 8C 91 8C A1 8F B7 D1 8F A1 8F A1 8F A1 |................|
0010 | 8F A1 8F A1 8F B3 30 8F A1 8F AB 8F AB 8F A1 8F |......0.........|
0020 | A1 8F A1 8F A1 8F AB 8F A1 8F B0 52 8F AB 8F AB |...........R....|
0030 | 8F A1 8F A1 8F A1 8F A1 8F A1 8F B0 C6 8F A1 8F |................|
0040 | A1 8F A1 8F A1 8F A1 8F A1 8F A1 8F A1 8F A1 8F |................|
0050 | A1 8F A1 8F A1 8F 23 01 A1 8F 00 5C C2 00 00 B0 |......#....\....|
0060 | 20 8E D2 00 04 C2 00 00 B0 2A 8E D2 00 04 C2 00 | ........*......|
0070 | 00 B0 2A 8E D2 00 04 C2 00 00 B0 2A 8E D2 00 04 |..*........*....|
0080 | C0 00 03 C1 0B 9C 8D A1 82 8E C0 00 03 8D A0 89 |................|
0090 | 87 40 95 00 AA C2 00 00 B0 20 8E D2 00 04 C0 00 |.@....... ......|
00A0 | 03 C0 00 03 8D A1 82 8E 00 8A C2 00 00 B0 2A 8E |..............*.|
00B0 | D2 00 04 C2 00 00 B0 20 8E D2 00 04 C2 00 00 C1 |....... ........|
00C0 | 0C 66 8D AA 84 B0 30 81 8E D2 00 04 C2 00 00 C1 |.f....0.........|
00D0 | 0C 66 8D AA 85 B0 30 81 8E D2 00 04 C2 00 00 AD |.f....0.........|
00E0 | 8E D2 00 04 C1 0C 67 C1 0C 67 8D A1 81 8E 8C A1 |......g..g......|
00F0 | 8F 00 F3 C2 00 00 B0 20 8E D2 00 04 C2 00 00 B0 |....... ........|

0066 |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

0100 | 3F 8E D2 00 04 C2 00 00 B0 3F 8E D2 00 04 C2 00 |?........?......|
0110 | 00 B0 3F 8E D2 00 04 C0 00 03 C1 0B 9C 8D A1 82 |..?.............|
0120 | 8E C0 00 03 8D A0 89 87 41 2C 01 41 C2 00 00 B0 |........A,.A....|
0130 | 20 8E D2 00 04 C0 00 03 C0 00 03 8D A1 82 8E 01 | ...............|
0140 | 21 C2 00 00 B0 3F 8E D2 00 04 C2 00 00 B0 20 8E |!....?........ .|
0150 | D2 00 04 C2 00 00 C1 0C 66 8D AA 84 B0 30 81 8E |........f....0..|
0160 | D2 00 04 C2 00 00 C1 0C 66 8D AA 85 B0 30 81 8E |........f....0..|
0170 | D2 00 04 C2 00 00 AD 8E D2 00 04 C1 0C 68 C1 0C |.............h..|
0180 | 68 8D A1 81 8E 8C 01 88 C1 00 03 8D B7 D0 8A 87 |h...............|
0190 | 41 A1 C1 00 03 A1 8E C1 0C 66 A1 8E D1 00 58 01 |A........f....X.|
01A0 | A1 C1 07 D5 8D A5 88 87 41 D8 C1 00 04 C1 00 03 |........A.......|
01B0 | 8D 81 C1 07 D7 8D B1 00 84 8E C1 00 04 C1 00 03 |................|
01C0 | 8D A1 81 81 C1 07 D7 8D B1 00 85 8E C1 00 03 C1 |................|
01D0 | 00 03 8D A2 81 8E 02 10 C1 07 D5 8D A4 88 87 42 |...............B|
01E0 | 12 C1 00 04 C1 00 03 8D 81 C1 07 D7 8D B1 00 84 |................|
01F0 | B0 40 81 8E C1 00 04 C1 00 03 8D A1 81 81 C1 07 |.@..............|

0067 |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

0200 | D7 8D B1 00 85 8E C1 00 03 C1 00 03 8D A2 81 8E |................|
0210 | 02 35 C1 07 D5 8D A0 88 87 42 37 C1 00 04 C1 00 |.5.......B7.....|
0220 | 03 8D 81 C1 07 D7 8D B0 80 81 8E C1 00 03 C1 00 |................|
0230 | 03 8D A1 81 8E 02 DB C1 07 D5 8D A1 88 87 42 DD |................|
0240 | C1 07 D7 8D B0 10 89 87 42 66 C1 00 04 C1 00 03 |........Bf......|
0250 | 8D 81 C1 07 D7 8D B0 A0 81 8E C1 00 03 C1 00 03 |................|
0260 | 8D A1 81 8E 02 A0 C1 07 D7 8D B8 08 00 89 87 42 |...............B|
0270 | A2 C1 00 04 C1 00 03 8D 81 C1 07 D7 8D B1 00 84 |................|
0280 | B0 B0 81 8E C1 00 04 C1 00 03 8D A1 81 81 C1 07 |................|
0290 | D7 8D B1 00 85 8E C1 00 03 C1 00 03 8D A2 81 8E |................|
02A0 | 02 DB C1 00 04 C1 00 03 8D 81 B0 B8 8E C1 00 04 |................|
02B0 | C1 00 03 8D A1 81 81 C1 07 D7 8D B1 00 84 8E C1 |................|
02C0 | 00 04 C1 00 03 8D A2 81 81 C1 07 D7 8D B1 00 85 |................|
02D0 | 8E C1 00 03 C1 00 03 8D A3 81 8E 03 24 C1 07 D5 |............$...|
02E0 | 8D A2 88 87 43 26 C1 00 04 C1 00 03 8D 81 C1 07 |....C&..........|
02F0 | D6 8D B0 C0 81 8E C1 00 04 C1 00 03 8D A1 81 81 |................|

0068 |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

0300 | C1 07 D7 8D B1 00 84 8E C1 00 04 C1 00 03 8D A2 |................|
0310 | 81 81 C1 07 D7 8D B1 00 85 8E C1 00 03 C1 00 03 |................|
0320 | 8D A3 81 8E 03 64 C1 00 04 C1 00 03 8D 81 C1 07 |.....d..........|
0330 | D6 8D B0 D0 81 8E C1 00 04 C1 00 03 8D A1 81 81 |................|
0340 | C1 07 D7 8D B1 00 84 8E C1 00 04 C1 00 03 8D A2 |................|
0350 | 81 81 C1 07 D7 8D B1 00 85 8E C1 00 03 C1 00 03 |................|
0360 | 8D A3 81 8E 8C 03 67 C1 00 04 C1 07 D8 8D 81 8D |......g.........|
0370 | B0 40 84 A0 88 87 43 8A C1 00 04 C1 07 D8 8D 81 |.@....C.........|
0380 | C1 07 D9 8D B1 00 84 8E 03 AE C1 00 04 C1 07 D8 |................|
0390 | 8D 81 8D B0 40 84 A1 88 87 43 B0 C1 00 04 C1 07 |....@....C......|
03A0 | D8 8D 81 C1 07 D9 8D B1 00 84 B0 40 81 8E 03 B8 |...........@....|
03B0 | C1 0C 66 A2 8E D1 00 58 C1 00 04 C1 07 D8 8D A1 |..f....X........|
03C0 | 81 81 C1 07 D9 8D B1 00 85 8E 8C A1 8F A1 8F A1 |................|
03D0 | 8F 03 D3 C0 00 04 A0 8E C0 00 05 A0 8E C0 00 03 |................|
03E0 | C1 00 04 C0 00 04 8D 81 8D B0 10 84 8E C0 00 03 |................|
03F0 | 8D A9 8A 87 44 05 C2 00 00 C0 00 03 8D AA 82 B0 |....D...........|

0069 |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

0400 | 41 81 8E 04 10 C2 00 00 C0 00 03 8D B0 30 81 8E |A............0..|
0410 | D2 00 04 C0 00 03 C1 00 04 C0 00 04 8D 81 8D B0 |................|
0420 | 10 85 8E C0 00 03 8D A9 8A 87 44 3B C2 00 00 C0 |..........D;....|
0430 | 00 03 8D AA 82 B0 41 81 8E 04 46 C2 00 00 C0 00 |......A...F.....|
0440 | 03 8D B0 30 81 8E D2 00 04 C0 00 04 C0 00 04 8D |...0............|
0450 | A1 81 8E C0 00 04 8D C1 00 03 8D 8A 87 44 61 04 |.............Da.|
0460 | 76 C0 00 05 C0 00 05 8D A1 81 8E C0 00 05 8D A2 |v...............|
0470 | 85 A0 88 87 44 78 04 7A 03 DD C0 00 04 8D C1 00 |....Dx.z........|
0480 | 03 8D 8A 87 44 88 04 9A C2 00 00 B0 20 8E D2 00 |....D....... ...|
0490 | 04 C0 00 05 8D B0 18 89 44 9C 04 9E 03 DD C2 00 |........D.......|
04A0 | 00 AD 8E D2 00 04 C0 00 04 8D C1 00 03 8D 8A 87 |................|
04B0 | 44 B4 04 B6 03 D8 8C A1 8F A2 04 BC C0 00 03 C1 |D...............|
04C0 | 0B 0A 8D 8E C1 0B 25 A1 81 8D C1 07 DA C0 00 03 |......%.........|
04D0 | 8D B0 10 83 81 A1 81 8D 88 87 45 24 C0 00 04 A2 |..........E$....|
04E0 | 8E C1 0B 25 C0 00 04 8D 81 8D C1 07 DA C0 00 03 |...%............|
04F0 | 8D B0 10 83 81 C0 00 04 8D 81 8D 88 45 00 05 13 |............E...|

006A |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

0500 | C0 00 04 C0 00 04 8D A1 81 8E C0 00 04 8D AA 8A |................|
0510 | 87 45 15 05 17 04 E1 C0 00 04 8D AA 8A 87 45 22 |.E............E"|
0520 | 05 36 05 24 C0 00 03 C0 00 03 8D A1 82 8E C0 00 |.6.$............|
0530 | 03 8D A0 8A 45 38 05 3A 04 C4 C1 0B 30 C0 00 03 |....E8.:....0...|
0540 | 8D 8E 8C A1 8F A1 8F A1 8F 05 FA A1 8F A1 8F 05 |................|
0550 | 51 C1 00 05 A1 8E C2 0B 30 8D A0 8A 45 6D C2 0C |Q.......0...Em..|
0560 | 66 A3 8E D2 00 58 C1 00 05 A0 8E 05 F9 C0 00 04 |f....X..........|
0570 | C2 07 DA C2 0B 30 8D B0 10 83 81 AC 81 8D 8E C0 |.....0..........|
0580 | 00 04 8D A5 88 87 45 D4 C0 00 03 C2 07 DA C2 0B |......E.........|
0590 | 30 8D B0 10 83 81 AE 81 8D 8E C0 00 03 C0 00 03 |0...............|
05A0 | 8D C2 07 DA C2 0B 30 8D B0 10 83 81 AD 81 8D 82 |......0.........|
05B0 | 8E C0 00 03 C0 00 03 8D A1 81 C2 07 DA C2 0B 30 |...............0|
05C0 | 8D B0 10 83 81 AF 81 8D 83 8E C1 00 05 C0 00 03 |................|
05D0 | 8D BE 05 EF C0 00 04 8D A4 88 87 45 F1 C1 00 05 |............E...|
05E0 | C2 07 DA C2 0B 30 8D B0 10 83 81 AF 81 8D 8E 05 |.....0..........|
05F0 | F9 C2 0C 66 A4 8E D2 00 58 8C C0 00 03 C1 0B 0A |...f....X.......|

006B |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

0600 | 8D A1 81 8E C0 00 03 8D B0 32 8A 87 46 22 C0 00 |.........2..F"..|
0610 | 03 C0 00 03 8D AA 82 8E C1 0C 66 A5 8E D1 00 58 |..........f....X|
0620 | 06 22 C1 0B 0A C0 00 03 8D 8E C0 00 04 A1 8E C1 |."..............|
0630 | 07 DA C0 00 03 8D B0 10 83 81 C0 00 04 8D 81 C1 |................|
0640 | 0B 0B C0 00 04 8D 81 8D 8E C0 00 04 C0 00 04 8D |................|
0650 | A1 81 8E C0 00 04 8D AA 8A 87 46 5E 06 60 06 2F |..........F^.`./|
0660 | C0 00 04 A1 8E C1 0B 25 C0 00 04 8D 81 C1 0B 16 |.......%........|
0670 | C0 00 04 8D 81 8D 8E C0 00 04 C0 00 04 8D A1 81 |................|
0680 | 8E C0 00 04 8D AA 8A 87 46 8C 06 8E 06 65 D1 04 |........F....e..|
0690 | B7 C1 07 DA C0 00 03 8D B0 10 83 81 AB 81 C1 0B |................|
06A0 | 30 8D 8E C1 07 DA C0 00 03 8D B0 10 83 81 AC 81 |0...............|
06B0 | C1 0B 21 8D 8E C1 0B 21 8D A1 88 87 46 D2 C1 07 |..!....!...F....|
06C0 | DA C0 00 03 8D B0 10 83 81 AD 81 C1 0C 65 8D 8E |.............e..|
06D0 | 07 5B C1 0B 21 8D A2 88 87 47 5D C1 07 DA C0 00 |.[..!....G].....|
06E0 | 03 8D B0 10 83 81 AD 81 C1 0B 22 8D 8E C1 07 DA |.........".....|
06F0 | C0 00 03 8D B0 10 83 81 AE 81 C1 0C 6F 8D 8E C1 |.............o..|

006C |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

0700 | 0C 64 8D A1 88 87 47 29 C1 0C 6F C1 0C 6F 8D A1 |.d....G)..o..o..|
0710 | 81 8E C1 07 D5 A1 8E C1 07 D6 A0 8E C1 07 D7 C1 |................|
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While serving as a lieutenant in the U.S. Navy, RALPH KENYON completed Master's Degrees in both Human Resources Management and Computer Science. With interests ranging from artificial intelligence through Zen, and as a self-styled "extrapolator," he believes that more "generalists" are needed to successfully coordinate and compassionately use man's knowledge.

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0720 | 0C 65 8D 8E D1 01 86 07 5B D0 05 4B C1 0C 6F C1 |.e......[..K..o.|
0730 | 0C 6F 8D C0 00 05 8D 81 8E C1 07 D5 A1 8E C1 07 |.o..............|
0740 | D6 A0 8E C1 07 D7 C0 00 05 8D 8E D1 01 86 C1 07 |................|
0750 | D5 A0 8E C1 07 D7 AF 8E D1 01 86 07 8A C1 0B 21 |...............!|
0760 | 8D A3 88 87 47 8C C1 07 DA C0 00 03 8D B0 10 83 |....G...........|
0770 | 81 AD 81 C1 0B 22 8D 8E C1 07 DA C0 00 03 8D B0 |....."..........|
0780 | 10 83 81 AE 81 C1 00 03 8D 8E 07 CE C1 0B 21 8D |..............!.|
0790 | A5 88 87 47 D0 C1 07 DA C0 00 03 8D B0 10 83 81 |...G............|
07A0 | AD 81 C1 0B 23 8D 8E C1 07 DA C0 00 03 8D B0 10 |....#...........|
07B0 | 83 81 AE 81 C1 0B 24 8D 8E D0 05 4B C1 07 DA C0 |......$....K....|
07C0 | 00 03 8D B0 10 83 81 AF 81 C0 00 05 8D 8E 07 D0 |................|
07D0 | 8C A1 8F A1 8F 08 C8 A1 8F 07 DB C2 0B 9C 8D C2 |................|
07E0 | 0B 9D 8D 88 87 48 B0 C2 0B 9D A0 8E C2 0B 9C A0 |.....H..........|
07F0 | 8E C3 00 00 B0 20 8E D3 00 04 C0 00 03 C2 00 03 |..... ..........|

006D |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

0800 | 8D 8E C3 00 00 C0 00 03 8D B3 E8 84 B0 30 81 8E |.............0..|
0810 | D3 00 04 C0 00 03 C0 00 03 8D B3 E8 85 8E C3 00 |................|
0820 | 00 C0 00 03 8D B0 64 84 B0 30 81 8E D3 00 04 C0 |......d..0......|
0830 | 00 03 C0 00 03 8D B0 64 85 8E C3 00 00 C0 00 03 |.......d........|
0840 | 8D AA 84 B0 30 81 8E D3 00 04 C0 00 03 C0 00 03 |....0...........|
0850 | 8D AA 85 8E C3 00 00 C0 00 03 8D B0 30 81 8E D3 |............0...|
0860 | 00 04 C3 00 00 B0 20 8E D3 00 04 C2 0B 9D C2 0B |...... .........|
0870 | 9D 8D A1 81 8E C2 0B 9D 8D B0 51 8A 87 48 81 08 |..........Q..H..|
0880 | 9B D3 00 02 D3 00 04 C3 00 00 8D AD 88 87 48 9F |..............H.|
0890 | C2 0B 31 C2 0B 9D 8D 81 B0 20 8E 08 AE 08 9F C2 |..1...... ......|
08A0 | 0B 31 C2 0B 9D 8D 81 C3 00 00 8D 8E 08 6B 08 B0 |.1...........k..|
08B0 | C2 0B 9C C2 0B 9C 8D A1 81 8E C2 0B 99 C2 0B 31 |...............1|
08C0 | C2 0B 9C 8D 81 8D 8E 8C C1 0B 99 8D B0 20 88 48 |............. .H|
08D0 | D3 08 D8 D0 07 D7 08 C8 C1 0B 99 8D B0 28 88 87 |.............(..|
08E0 | 48 ED C1 0B 9A B0 14 8E D0 07 D7 09 00 C1 0B 99 |H...............|
08F0 | 8D B0 29 88 87 49 02 C1 0B 9A B0 15 8E D0 07 D7 |..)..I..........|

006E |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

0900 | 09 15 C1 0B 99 8D B0 2A 88 87 49 17 C1 0B 9A B0 |.......*..I.....|
0910 | 16 8E D0 07 D7 09 2A C1 0B 99 8D B0 2B 88 87 49 |......*.....+..I|
0920 | 2C C1 0B 9A B0 17 8E D0 07 D7 09 3F C1 0B 99 8D |,..........?....|
0930 | B0 2C 88 87 49 41 C1 0B 9A B0 18 8E D0 07 D7 09 |.,..IA..........|
0940 | 71 C1 0B 99 8D B0 2D 88 87 49 73 C1 0B 9A B0 19 |q.....-..Is.....|
0950 | 8E D0 07 D7 C1 0B 99 8D B0 2D 88 87 49 71 C1 0B |.........-..Iq..|
0960 | 9C C1 0B 9D 8D 8E C1 0B 99 B0 20 8E D1 07 D1 09 |.......... .....|
0970 | 71 09 9B C1 0B 99 8D B0 2E 88 87 49 9D C1 0B 9A |q...........I...|
0980 | B0 1A 8E D0 07 D7 C1 0B 99 8D B0 2E 88 87 49 9B |..............I.|
0990 | C1 0B 9A B0 1B 8E D0 07 D7 09 9B 09 C5 C1 0B 99 |................|
09A0 | 8D B0 2F 88 87 49 C7 C1 0B 9A B0 1C 8E D0 07 D7 |../..I..........|
09B0 | C1 0B 99 8D B0 3D 88 87 49 C5 C1 0B 9A B0 1D 8E |.....=..I.......|
09C0 | D0 07 D7 09 C5 09 EF C1 0B 99 8D B0 3A 88 87 49 |............:..I|
09D0 | F1 C1 0B 9A B0 1E 8E D0 07 D7 C1 0B 99 8D B0 3D |...............=|
09E0 | 88 87 49 EF C1 0B 9A B0 1F 8E D0 07 D7 09 EF 0A |..I.............|
09F0 | 04 C1 0B 99 8D B0 3B 88 87 4A 06 C1 0B 9A B0 20 |......;..J..... |

006F |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

0A00 | 8E D0 07 D7 0A 2E C1 0B 99 8D B0 3C 88 87 4A 30 |...........<..J0|
0A10 | C1 0B 9A B0 21 8E D0 07 D7 C1 0B 99 8D B0 3D 88 |....!........=.|
0A20 | 87 4A 2E C1 0B 9A B0 22 8E D0 07 D7 0A 2E 0A 43 |.J....."......C|
0A30 | C1 0B 99 8D B0 3D 88 87 4A 45 C1 0B 9A B0 23 8E |.....=..JE....#.|
0A40 | D0 07 D7 0A 6D C1 0B 99 8D B0 3E 88 87 4A 6F C1 |....m.....>..Jo.|
0A50 | 0B 9A B0 24 8E D0 07 D7 C1 0B 99 8D B0 3D 88 87 |...$.........=..|
0A60 | 4A 6D C1 0B 9A B0 25 8E D0 07 D7 0A 6D 10 84 C1 |Jm....%.....m...|
0A70 | 0B 99 8D B0 30 89 50 86 C1 0B 99 8D B0 39 8A 4A |.....0.P......9.J|
0A80 | E1 C1 0B 9A B0 13 8E C1 0B 9B A0 8E C1 0B 9B 8D |................|
0A90 | B8 0C CC 8A 87 4A A1 C1 0C 66 A6 8E D1 00 58 0A |.....J...f....X.|
0AA0 | B3 C1 0B 9B C1 0B 9B 8D AA 83 C1 0B 99 8D B0 30 |...............0|
0AB0 | 82 81 8E D0 07 D7 C1 0B 99 8D B0 5F 88 87 4A C5 |..............J.|
0AC0 | D0 07 D7 0A C5 C1 0B 99 8D B0 30 89 87 4A D1 0A |...........0..J..|
0AD0 | DB C1 0B 99 8D B0 39 8A 87 4A DD 0A DF 0A 8C 10 |.......9..J......|
0AE0 | 77 C1 0B 99 8D B0 41 89 50 79 C1 0B 99 8D B0 5A |w.....A.Py.....Z|
0AF0 | 8A 50 6C C1 0B 9A B0 12 8E C0 00 03 A0 8E C0 00 |.Pl.............|

0070 |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

0B00 | 03 8D AA 89 87 4B 2D C0 00 03 C0 00 03 8D A1 81 |.....K-.........|
0B10 | 8E C1 0B 83 C0 00 03 8D 81 C1 0B 99 8D 8E C1 0B |................|
0B20 | 8E C0 00 03 8D 81 C1 0B 99 8D 8E 0B 2D D0 07 D7 |............-...|
0B30 | C1 0B 99 8D B0 30 89 87 4B 3E 0B 53 0B 47 C1 0B |.....0..K>.S.G..|
0B40 | 99 8D B0 39 8A 4B 49 0B 55 C1 0B 99 8D B0 41 89 |...9.KI.U.....A.|
0B50 | 87 4B 57 0B 6E 0B 60 C1 0B 99 8D B0 5A 8A 4B 62 |.KW.n.`.....Z.Kb|
0B60 | 0B 6C C1 0B 99 8D B0 5F 88 87 4B 6E 0B 70 0B 72 |.l....._..Kn.p.r|
0B70 | 0A FE C0 00 04 C0 00 03 8D 8E C0 00 03 8D AA 89 |................|
0B80 | 4B 84 0B A6 C0 00 03 C0 00 03 8D A1 81 8E C1 0B |K...............|
0B90 | 83 C0 00 03 8D 81 B0 20 8E C1 0B 8E C0 00 03 8D |....... ........|
0BA0 | 81 B0 20 8E 0B 7A C0 00 04 8D A2 88 87 4C 06 C1 |.. ..z.......L..|
0BB0 | 0B 8E A1 81 8D B0 49 88 87 4B E3 C1 0B 8E A2 81 |......I..K......|
0BC0 | 8D B0 46 88 87 4B CE C1 0B 9A A8 8E 0B DF C1 0B |..F..K..........|
0BD0 | 8E A2 81 8D B0 53 88 87 4B E1 C1 0B 9A A9 8E 0B |.....S..K.......|
0BE0 | E1 0C 02 C1 0B 8E A1 81 8D B0 4F 88 87 4C 04 C1 |..........O..L..|
0BF0 | 0B 8E A2 81 8D B0 46 88 87 4C 02 C1 0B 9A AD 8E |......F..L......|

0071 |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

0C00 | 0C 02 0C 04 0C 6D C0 00 04 8D A3 88 87 4C 6F C1 |.....m.......Lo.|
0C10 | 0B 8E A1 81 8D B0 45 88 87 4C 3E C1 0B 8E A2 81 |......E..L>.....|
0C20 | 8D B0 4E 88 87 4C 3C C1 0B 8E A3 81 8D B0 44 88 |..N..L<.......D.|
0C30 | 87 4C 3A C1 0B 9A A6 8E 0C 3A 0C 3C 0C 6B C1 0B |.L:......:.<.k..|
0C40 | 8E A1 81 8D B0 4D 88 87 4C 6D C1 0B 8E A2 81 8D |.....M..Lm......|
0C50 | B0 4F 88 87 4C 6B C1 0B 8E A3 81 8D B0 44 88 87 |.O..Lk.......D..|
0C60 | 4C 69 C1 0B 9A AB 8E 0C 69 0C 6B 0C 6D 0E 09 C0 |Li......i.k.m...|
0C70 | 00 04 8D A4 88 87 4E 0B C1 0B 8E A1 81 8D B0 45 |......N........E|
0C80 | 88 87 4C E4 C1 0B 8E A2 81 8D B0 4C 88 87 4C B3 |..L.........L..L.|
0C90 | C1 0B 8E A3 81 8D B0 53 88 87 4C B1 C1 0B 8E A4 |.......S..L.....|
0CA0 | 81 8D B0 45 88 87 4C AF C1 0B 9A A4 8E 0C AF 0C |...E..L.........|
0CB0 | B1 0C E0 C1 0B 8E A2 81 8D B0 58 88 87 4C E2 C1 |..........X..L..|
0CC0 | 0B 8E A3 81 8D B0 49 88 87 4C E0 C1 0B 8E A4 81 |......I..L......|
0CD0 | 8D B0 54 88 87 4C DE C1 0B 9A A7 8E 0C DE 0C E0 |..T..L..........|
0CE0 | 0C E2 0D 1F C1 0B 8E A1 81 8D B0 4C 88 87 4D 21 |...........L..M!|
0CF0 | C1 0B 8E A2 81 8D B0 4F 88 87 4D 1F C1 0B 8E A3 |.......O..M.....|

0072 |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

0D00 | 81 8D B0 4F 88 87 4D 1D C1 0B 8E A4 81 8D B0 50 |...O..M........P|
0D10 | 88 87 4D 1B C1 0B 9A AA 8E 0D 1B 0D 1D 0D 1F 0D |..M.............|
0D20 | 5C C1 0B 8E A1 81 8D B0 4E 88 87 4D 5E C1 0B 8E |\........N..M^...|
0D30 | A2 81 8D B0 55 88 87 4D 5C C1 0B 8E A3 81 8D B0 |....U..M\.......|
0D40 | 4C 88 87 4D 5A C1 0B 8E A4 81 8D B0 4C 88 87 4D |L..MZ.......L..M|
0D50 | 58 C1 0B 9A AC 8E 0D 58 0D 5A 0D 5C 0D C9 C1 0B |X......X.Z.\....|
0D60 | 8E A1 81 8D B0 54 88 87 4D CB C1 0B 8E A2 81 8D |.....T..M.......|
0D70 | B0 48 88 87 4D 99 C1 0B 8E A3 81 8D B0 45 88 87 |.H..M........E..|
0D80 | 4D 97 C1 0B 8E A4 81 8D B0 4E 88 87 4D 95 C1 0B |M.........N..M..|
0D90 | 9A AF 8E 0D 95 0D 97 0D C7 C1 0B 8E A2 81 8D B0 |................|
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0DA0 : 59 88 87 4D C9 C1 0B 8E A3 81 8D B0 50 88 87 4D :Y..M........P..M:
0DB0 : C7 C1 0B 8E A4 81 8D B0 45 88 87 4D C5 C1 0B 9A :........E..M....:
0DC0 : B0 10 8E 0D C5 0D C7 0D C9 0E 07 C1 0B 8E A1 81 :................:
0DD0 : 8D B0 57 88 87 4E 09 C1 0B 8E A2 81 8D B0 48 88 :..W..N.......H.:
0DE0 : 87 4E 07 C1 0B 8E A3 81 8D B0 45 88 87 4E 05 C1 :.N........E..N..:
0DF0 : 0B 8E A4 81 8D B0 4E 88 87 4E 03 C1 0B 9A B0 11 :......N..N......:

0073 : 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F  :0123456789ABCDEF:

0E00 : 8E 0E 03 0E 05 0E 07 0E 09 0E F5 C0 00 04 8D A5 :................:
0E10 : 88 87 4E F7 C1 0B 8E A1 81 8D B0 41 88 87 4E 5F :..N........A..N_:
0E20 : C1 0B 8E A2 81 8D B0 52 88 87 4E 5D C1 0B 8E A3 :.......R..N]....:
0E30 : 81 8D B0 52 88 87 4E 5B C1 0B 8E A4 81 8D B0 41 :...R..N[.......A:
0E40 : 88 87 4E 59 C1 0B 8E A5 81 8D B0 59 88 87 4E 57 :..NY.......Y..NW:
0E50 : C1 0B 9A A1 8E 0E 57 0E 59 0E 5B 0E 5D 0E A8 C1 :......W.Y.[.]...:
0E60 : 0B 8E A1 81 8D B0 42 88 87 4E AA C1 0B 8E A2 81 :......B..N......:
0E70 : 8D B0 45 88 87 4E A8 C1 0B 8E A3 81 8D B0 47 88 :..E..N.......G.:
0E80 : 87 4E A6 C1 0B 8E A4 81 8D B0 49 88 87 4E A4 C1 :.N.........I..N..:
0E90 : 0B 8E A5 81 8D B0 4E 88 87 4E A2 C1 0B 9A A2 8E :......N..N......:
0EA0 : 0E A2 0E A4 0E A6 0E A8 0E F3 C1 0B 8E A1 81 8D :................:
0EB0 : B0 45 88 87 4E F5 C1 0B 8E A2 81 8D B0 4C 88 87 :.E..N.........L..:
0EC0 : 4E F3 C1 0B 8E A3 81 8D B0 53 88 87 4E F1 C1 0B :N........S..N...:
0ED0 : 8E A4 81 8D B0 49 88 87 4E EF C1 0B 8E A5 81 8D :.....I..N.......:
0EE0 : B0 46 88 87 4E ED C1 0B 9A A5 8E 0E ED 0E EF 0E :.F..N...........:
0EF0 : F1 0E F3 0E F5 0F 5A C0 00 04 8D A6 88 87 4F 5C :......Z.......O\:

0074 : 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F  :0123456789ABCDEF:

0F00 : C1 0B 8E A1 81 8D B0 50 88 87 4F 5A C1 0B 8E A2 :.......P..OZ....:
0F10 : 81 8D B0 52 88 87 4F 58 C1 0B 8E A3 81 8D B0 41 :...R..OX.......A:
0F20 : 88 87 4F 56 C1 0B 8E A4 81 8D B0 47 88 87 4F 54 :..OV.......G..OT:
0F30 : C1 0B 8E A5 81 8D B0 4D 88 87 4F 52 C1 0B 8E A6 :.......M..OR....:
0F40 : 81 8D B0 41 88 87 4F 50 C1 0B 9A B0 26 8E 0F 50 :...A..OP....&..P:
0F50 : 0F 52 0F 54 0F 56 0F 58 0F 5A 0F DA C0 00 04 8D :.R.T.V.X.Z......:
0F60 : A8 88 87 4F DC C1 0B 8E A1 81 8D B0 43 88 87 4F :...O........C..O:
0F70 : DA C1 0B 8E A2 81 8D B0 4F 88 87 4F D8 C1 0B 8E :........O..O....:
0F80 : A3 81 8D B0 4E 88 87 4F D6 C1 0B 8E A4 81 8D B0 :....N..O........:
0F90 : 53 88 87 4F D4 C1 0B 8E A5 81 8D B0 54 88 87 4F :S..O........T..O:
0FA0 : D2 C1 0B 8E A6 81 8D B0 41 88 87 4F D0 C1 0B 8E :........A..O....:
0FB0 : A7 81 8D B0 4E 88 87 4F CE C1 0B 8E A8 81 8D B0 :....N..O........:
0FC0 : 54 88 87 4F CC C1 0B 9A A3 8E 0F CC 0F CE 0F D0 :T..O............:
0FD0 : 0F D2 0F D4 0F D6 0F D8 0F DA 10 68 C0 00 04 8D :...........h....:
0FE0 : A9 88 87 50 6A C1 0B 8E A1 81 8D B0 50 88 87 50 :...Pj.......P..P:
0FF0 : 68 C1 0B 8E A2 81 8D B0 52 88 87 50 66 C1 0B 8E :h.......R..Pf...:

0075 : 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F  :0123456789ABCDEF:

1000 : A3 81 8D B0 4F 88 87 50 64 C1 0B 8E A4 81 8D B0 :....O..Pd.......:
1010 : 43 88 87 50 62 C1 0B 8E A5 81 8D B0 45 88 87 50 :C..Pb.......E..P:
1020 : 60 C1 0B 8E A6 81 8D B0 44 88 87 50 5E C1 0B 8E :`.......D..P^...:
1030 : A7 81 8D B0 55 88 87 50 5C C1 0B 8E A8 81 8D B0 :....U..P\.......:
1040 : 52 88 87 50 5A C1 0B 8E A9 81 8D B0 45 88 87 50 :R..PZ.......E..P:
1050 : 58 C1 0B 9A AE 8E 10 58 10 5A 10 5C 10 5E 10 60 :X......X.Z.\.^.`:
1060 : 10 62 10 64 10 66 10 68 10 6A 10 77 C1 0C 66 A7 :.b.d.f.h.j.w..f.:
1070 : 8E D1 00 58 D0 07 D7 10 84 C1 0C 66 A8 8E D1 00 :...X.......f....:
1080 : 58 D0 07 D7 10 91 C1 0C 66 A9 8E D1 00 58 D0 07 :X.......f....X..:
1090 : D7 8C A1 8F A1 8F A1 8F 20 02 10 9C C2 0B 9A 8D :........ .......:
10A0 : B0 20 88 87 50 A8 10 AD D2 07 D1 10 9C 8C A1 8F :. ..P...........:
10B0 : 13 6E A1 8F 13 01 A1 8F 10 BA C4 0B 9A 8D B0 13 :.n..............:
10C0 : 88 87 50 F8 C4 0B 9B 8D B8 7F FF 8A 87 50 DE C4 :..P...........P..:
10D0 : 0C 66 AA 8E D4 00 58 C4 0B 9B A0 8E 10 DE C4 07 :.f....X..........:
10E0 : D5 A1 8E C4 07 D6 A0 8E C4 07 D7 C4 0B 9B 8D 8E :................:
10F0 : D4 01 86 D4 07 D1 12 C9 C4 0B 9A 8D B0 12 88 87 :................:

0076 : 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F  :0123456789ABCDEF:

1100 : 52 CB C0 00 03 A1 8E C4 0B 25 C0 00 03 8D 81 C4 :R.........%......:
1110 : 0B 83 C0 00 03 8D 81 8D 8E C0 00 03 C0 00 03 8D :................:
1120 : A1 81 8E C0 00 03 8D AA 8A 87 51 2E 11 30 11 07 :..........Q..0..:
1130 : D4 04 B7 C0 00 03 C4 0B 30 8D 8E C0 00 03 8D A0 :........0.......:
1140 : 8A 51 4D C4 0C 66 AB 8E D4 00 58 12 C9 C4 07 DA :.QM..f....X.....:
1150 : C0 00 03 8D B0 10 83 81 AC 81 8D A1 88 87 51 7F :..............Q.:
1160 : C4 07 D5 A1 8E C4 07 D7 C4 07 DA C0 00 03 8D B0 :................:
1170 : 10 83 81 AD 81 8D 8E D4 01 86 D4 07 D1 12 BF C4 :................:
1180 : 07 DA C0 00 03 8D B0 10 83 81 AC 81 8D A2 88 87 :................:
1190 : 52 C1 C4 07 D5 A2 8E C4 07 D6 C3 00 05 8D C4 07 :R...............:
11A0 : DA C0 00 03 8D B0 10 83 81 AD 81 8D 82 8E C4 07 :................:
11B0 : D7 C4 07 DA C0 00 03 8D B0 10 83 81 AE 81 8D 8E :................:
11C0 : D4 01 86 D4 07 D1 C4 0B 9A 8D B0 14 83 51 D1 12 :.............Q..:
11D0 : AD D4 07 D1 D3 10 AE C0 00 03 C4 07 DA C0 00 03 :................:
11E0 : 8D B0 10 83 81 AB 81 8D 8E C0 00 03 8D A0 88 87 :................:
11F0 : 51 FC C4 0C 66 AC 8E D4 00 58 12 94 C4 07 DA C0 :Q...f....X......:

0077 : 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F  :0123456789ABCDEF:

1200 : 00 03 8D B0 10 83 81 AD 81 8D A0 88 52 3C C4 07 :............R<..:
1210 : D5 A1 8E C4 07 D6 A0 8E C4 07 D7 C4 07 DA C0 00 :................:
1220 : 03 8D B0 10 83 81 AD 81 8D 8E D4 01 86 C4 07 D5 :................:
1230 : A0 8E C4 07 D7 A2 8E D4 01 86 12 3C C4 07 DA C0 :...........<....:
1240 : 00 03 8D B0 10 83 81 AF 81 8D A1 8A 87 52 82 C4 :.............R..:
1250 : 07 D5 A1 8E C4 07 D6 A0 8E C4 07 D7 C4 07 DA C0 :................:
1260 : 00 03 8D B0 10 83 81 AF 81 8D 8E D4 01 86 C4 07 :................:
1270 : D5 A0 8E C4 07 D6 A0 8E C4 07 D7 A3 8E D4 01 86 :................:
1280 : 12 82 C4 07 D5 A0 8E C4 07 D6 A0 8E C4 07 D7 A1 :................:
1290 : 8E D4 01 86 C4 0B 9A 8D B0 15 88 87 52 A3 D4 07 :............R...:
12A0 : D1 12 AB C4 0C 66 AD 8E D4 00 EF 11 C6 C4 07 D5 :.....f..........:
12B0 : A0 8E C4 07 D6 A0 8E C4 07 D7 AD 8E D4 01 86 12 :................:
12C0 : C9 C4 0C 66 AE 8E D4 00 58 12 F2 C4 0B 9A 8D B0 :...f....X.......:
12D0 : 14 88 87 52 F4 D4 07 D1 D3 10 AE C4 0B 9A 8D B0 :...R............:
12E0 : 15 88 87 52 EA D4 07 D1 12 F2 C4 0C 66 AF 8E D4 :...R.........f...:
12F0 : 00 EF 13 00 C4 0C 66 B0 10 8E D4 00 58 D4 07 D1 :......f.....X...:

0078 : 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F  :0123456789ABCDEF:

1300 : 8C D0 10 B6 C3 0B 9A 8D B0 16 88 87 53 10 13 1A :.............S...:
1310 : C3 0B 9A 8D B0 1C 88 87 53 1C 13 25 C3 0B 9A 8D :.........S..%....:
1320 : AB 88 87 53 27 13 29 13 6D C0 00 03 C3 0B 9A 8D :...S'.).m.......:
1330 : 8E D3 07 D1 D0 10 B6 C3 07 D5 A0 8E C3 07 D6 A0 :................:
1340 : 8E C0 00 03 8D B0 16 88 87 53 52 C3 07 D7 A3 8E :.........SR.....:
1350 : 13 61 C0 00 03 8D B0 1C 88 87 53 63 C3 07 D7 A4 :.a.........Sc....:
1360 : 8E 13 68 C3 07 D7 A5 8E D3 01 86 13 04 8C C2 0B :..h.............:
1370 : 9A 8D B0 17 88 87 53 80 D2 07 D1 D0 10 B2 13 A2 :......S.........:
1380 : C2 0B 9A 8D B0 19 88 87 53 A4 D2 07 D1 D0 10 B2 :........S.......:
1390 : C2 07 D5 A0 8E C2 07 D6 A0 8E C2 07 D7 A6 8E D2 :................:
13A0 : 01 86 13 A7 D0 10 B2 C2 0B 9A 8D B0 17 88 87 53 :...............S:
13B0 : B3 13 BD C2 0B 9A 8D B0 19 88 87 53 BF 13 C1 13 :............S....:
13C0 : F4 C0 00 03 C2 0B 9A 8D 8E D2 07 D1 D0 10 B2 C2 :................:
13D0 : 07 D5 A0 8E C2 07 D6 A0 8E C0 00 03 8D B0 17 88 :................:
13E0 : 87 53 EA C2 07 D7 A1 8E 13 EF C2 07 D7 A2 8E D2 :.S..............:
13F0 : 01 86 13 A7 8C A1 8F 13 F9 D1 10 AE C0 00 03 C2 :................:

0079 : 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F  :0123456789ABCDEF:

1400 : 0B 9A 8D 8E D2 07 D1 D1 10 AE C2 07 D5 A0 8E C2 :................:
1410 : 07 D6 A0 8E C0 00 03 8D B0 23 88 87 54 28 C2 07 :.........#..T(..:
1420 : D7 A8 8E D2 01 86 14 42 C0 00 03 8D B0 1D 88 87 :.......B........:
1430 : 54 44 C2 07 D7 A8 8E D2 01 86 C2 07 D7 A7 8E D2 :TD..............:
1440 : 01 86 14 56 C0 00 03 8D B0 21 88 87 54 58 C2 07 :...V.....!..TX..:
1450 : D7 A9 8E D2 01 86 14 72 C0 00 03 8D B0 25 88 87 :.......r.....%..:
1460 : 54 74 C2 07 D7 A9 8E D2 01 86 C2 07 D7 A7 8E D2 :Tt..............:
1470 : 01 86 14 86 C0 00 03 8D B0 24 88 87 54 88 C2 07 :.........$..T...:
1480 : D7 AA 8E D2 01 86 14 A2 C0 00 03 8D B0 22 88 87 :.............."..:
1490 : 54 A4 C2 07 D7 AA 8E D2 01 86 C2 07 D7 A7 8E D2 :T...............:
14A0 : 01 86 14 AD C2 0C 66 B0 11 8E D2 00 58 8C A1 8F :......f.....X...:
14B0 : A1 8F A1 8F 19 48 A1 8F 14 BA C3 07 D5 A2 8E C3 :.....H..........:
14C0 : 07 D6 C2 00 05 8D C3 07 DA C3 0B 30 8D B0 10 83 :...........0....:
14D0 : 81 AD 81 8D 82 8E C3 07 D7 C3 07 DA C3 0B 30 8D :..............0.:
14E0 : B0 10 83 81 AE 81 8D 8E D3 01 86 C0 00 03 C3 0B :................:
14F0 : 30 8D 8E D3 07 D1 C3 0B 9A 8D B0 14 88 55 01 15 :0............U..:

007A : 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F  :0123456789ABCDEF:

1500 : D9 D3 07 D1 D2 10 AE C0 00 03 C3 07 DA C0 00 03 :................:
1510 : 8D B0 10 83 81 AB 81 8D 8E C0 00 03 8D A0 8A 55 :...............U:
1520 : 2C C3 0C 66 B0 12 8E D3 00 58 15 BF C3 07 DA C0 :,..f.....X......:
1530 : 00 03 8D B0 10 83 81 AD 81 8D A0 88 55 6C C3 07 :............Ul..:
1540 : D5 A1 8E C3 07 D6 A0 8E C3 07 D7 C3 07 DA C0 00 :................:
1550 : 03 8D B0 10 83 81 AD 81 8D 8E D3 01 86 C3 07 D5 :................:
1560 : A0 8E C3 07 D7 A2 8E D3 01 86 15 6C C3 07 DA C0 :...........l....:
1570 : 00 03 8D B0 10 83 81 AF 81 8D A1 8A 87 55 AD C3 :.............U..:
1580 : 07 D5 A1 8E C3 07 D6 A0 8E C3 07 D7 C3 07 DA C0 :................:
1590 : 00 03 8D B0 10 83 81 AF 81 8D 8E D3 01 86 C3 07 :................:
15A0 : D5 A0 8E C3 07 D7 A3 8E D3 01 86 15 AD C3 07 D5 :................:
15B0 : A0 8E C3 07 D6 A0 8E C3 07 D7 A1 8E D3 01 86 C3 :................:
15C0 : 0B 9A 8D B0 15 88 87 55 CE D3 07 D1 15 D7 C3 0C :.......U........:
15D0 : 66 B0 13 8E D3 00 EF 14 F6 C3 0B 9A 8D B0 1F 88 :f...............:
15E0 : 87 55 E8 D3 07 D1 15 F1 C3 0C 66 B0 14 8E D3 00 :.U.........f.....:
15F0 : 58 D2 10 AE C3 07 D5 A0 8E C3 07 D6 A0 8E C3 07 :X...............:

007B : 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F  :0123456789ABCDEF:

1600 : D7 AE 8E D3 01 86 8C A1 8F A1 8F A1 8F 16 0F C0 :................:
1610 : 00 03 C3 0C 69 8D 8E C3 0B 9A 8D A8 88 87 56 25 :....i.........V%:
1620 : D3 07 D1 16 2E C3 0C 66 B0 15 8E D3 00 58 D2 13 :.......f.....X..:
1630 : F5 C3 0B 9A 8D AF 88 87 56 3F D3 07 D1 16 48 C3 :........V?....H.:
1640 : 0C 66 B0 16 8E D3 00 58 C3 07 D5 A0 8E C3 07 D6 :.f.....X........:
1650 : A0 8E C3 07 D7 A7 8E D3 01 86 C0 00 04 C3 00 03 :................:
1660 : 8D 8E C3 07 D5 A4 8E C3 07 D6 A0 8E C3 07 D7 A0 :................:
1670 : 8E D3 01 86 C3 0C 6A C1 00 03 8D 8E C3 0C 6C C0 :......j.......l.:
1680 : 00 03 8D 8E D2 14 AE C0 00 03 C3 0C 6C 8D 8E C0 :............l...:
1690 : 00 05 C3 00 03 8D 8E C3 07 D5 A5 8E C3 07 D6 A0 :................:
16A0 : 8E C3 07 D7 A0 8E D3 01 86 C3 07 D8 C0 00 04 8D :................:
16B0 : 8E C3 07 D9 C3 00 03 8D 8E D3 03 65 C3 0B 9A 8D :...........e....:
16C0 : A5 88 87 56 CA D3 07 D1 16 CC 17 6F D2 13 F5 C3 :...V........o....:
16D0 : 0B 9A 8D AF 88 87 56 DD D3 07 D1 16 E6 C3 0C 66 :......V.........f:
16E0 : B0 17 8E D3 00 58 C3 07 D5 A0 8E C3 07 D6 A0 8E :.....X..........:
16F0 : C3 07 D7 A7 8E D3 01 86 C0 00 04 C3 00 03 8D 8E :................:

007C : 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F  :0123456789ABCDEF:

1700 : C3 07 D5 A4 8E C3 07 D6 A0 8E C3 07 D7 A0 8E D3 :................:
1710 : 01 86 C3 0C 6A C1 00 03 8D 8E C3 0C 6C C0 00 03 :....j.......l...:
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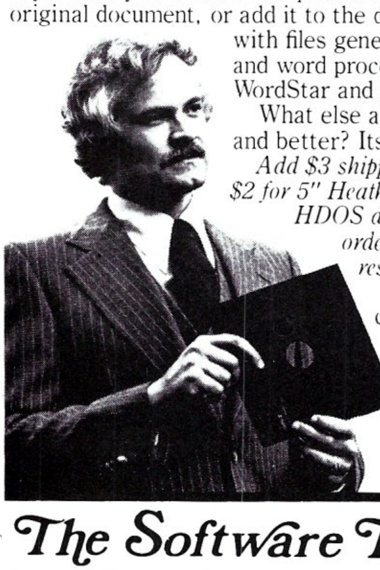

Developer of SPELL, Dr. Robert Wesson, professional computer scientist.

The Software Toolworks™

14478 Glorietta Drive, Sherman Oaks, CA 91423 (213) 986-4885

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1720 ; 8D 8E D2 14 AE C0 00 03 C3 0C 6C 8D 8E C3 07 D8 ;...........l.....;
1730 ; C0 00 05 8D 8E C3 07 D9 C3 00 03 8D 8E D3 03 65 ;...............e;
1740 ; C0 00 05 C3 00 03 8D 8E C3 07 D5 A5 8E C3 07 D6 ;................;
1750 ; A0 8E C3 07 D7 A0 8E D3 01 86 C3 07 D8 C0 00 04 ;................;
1760 ; 8D 8E C3 07 D9 C3 00 03 8D 8E D3 03 65 16 BC C3 ;............e...;
1770 ; 0B 9A 8D A4 88 87 57 98 D3 07 D1 C3 0C 6A C1 00 ;......W.......j..;
1780 ; 03 8D 8E C3 0C 6C C0 00 03 8D 8E D2 14 AE C0 00 ;.....l..........;
1790 ; 03 C3 0C 6C 8D 8E 17 98 C3 0B 9A 8D A6 88 87 57 ;...l...........W;
17A0 ; A6 D3 07 D1 17 AF C3 0C 66 B0 18 8E D3 00 58 C3 ;........f.....X.;
17B0 ; 0B 9A 8D A8 88 87 57 BD D3 07 D1 17 C6 C3 0C 66 ;......W........f;
17C0 ; B0 19 8E D3 00 58 C3 07 D8 C0 00 05 8D 8E C3 07 ;.....X..........;
17D0 ; D9 C3 00 03 8D 8E D3 03 65 C3 0C 69 C0 00 03 8D ;........e..i....;
17E0 ; 8E 8C A1 8F A1 8F 17 E8 C3 0B 9A 8D AA 88 87 57 ;...............W;
17F0 ; F6 D3 07 D1 17 FF C3 0C 66 B0 1A 8E D3 00 58 C0 ;........f.....X.;

007D ;  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F ;0123456789ABCDEF;

1800 ; 00 03 C3 00 03 8D 8E C0 00 04 A0 8E C3 0C 6A A1 ;..............j.;
1810 ; 8E C3 0C 6C C0 00 04 8D 8E D2 14 AE C0 00 04 C3 ;...l............;
1820 ; 0C 6C 8D 8E C3 0B 9A 8D A6 88 87 58 32 D3 07 D1 ;.l.........X2...;
1830 ; 18 3B C3 0C 66 B0 1E 8E D3 00 58 C3 0B 9A 8D AA ;.;..f.....X.....;
1840 ; 88 87 58 49 D3 07 D1 18 52 C3 0C 66 B0 1F 8E D3 ;..XI....R..f....;
1850 ; 00 58 C3 07 D5 A5 8E C3 07 D6 A0 8E C3 07 D7 C0 ;.X..............;
1860 ; 00 03 8D 8E D3 01 86 C0 00 04 8D A0 88 58 84 C3 ;.............X..;
1870 ; 07 D8 C0 00 04 8D 8E C3 07 D9 C3 00 03 8D 8E D3 ;................;
1880 ; 03 65 18 8D C3 0C 66 B0 20 8E D3 00 EF 8C A1 8F ;.e....f. .......;
1890 ; A0 18 93 C0 00 03 C3 0C 6D 8D 8E C3 0B 9A 8D A7 ;........m.......;
18A0 ; 88 87 58 A9 D3 07 D1 18 B2 C3 0C 66 B0 21 8E D3 ;..X........f.!..;
18B0 ; 00 58 C3 0B 9A 8D B0 11 88 87 58 EB D3 07 D1 D2 ;.X.........X.....;
18C0 ; 13 F5 C3 07 D5 A0 8E C3 07 D6 A0 8E C3 07 D7 A7 ;................;
18D0 ; 8E D3 01 86 C0 00 04 C3 00 03 8D 8E C3 07 D5 A4 ;................;
18E0 ; 8E C3 07 D7 A0 8E D3 01 86 18 EB C0 00 03 8D A0 ;................;
18F0 ; 88 59 08 C3 07 D8 C0 00 03 8D 8E C3 07 D9 C3 00 ;.Y..............;

007E ;  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F ;0123456789ABCDEF;

1900 ; 03 8D 8E D3 03 65 19 08 C0 00 03 C3 00 03 8D 8E ;.....e..........;
1910 ; C3 07 D5 A5 8E C3 07 D6 A0 8E C3 07 D7 A0 8E D3 ;................;
1920 ; 01 86 C0 00 04 8D A0 88 59 3F C3 07 D8 C0 00 04 ;.........Y?......;
1930 ; 8D 8E C3 07 D9 C3 00 03 8D 8E D3 03 65 19 3F C3 ;............e.?.;
1940 ; 0C 6D C0 00 03 8D 8E 8C C0 00 03 C2 0C 6A 8D 8E ;.m...........j..;
1950 ; C0 00 04 C2 0C 6C 8D 8E C2 0B 9A 8D B0 26 88 87 ;.....l.......&..;
1960 ; 59 67 D1 10 9A 1A 38 C2 0B 9A 8D B0 12 88 87 5A ;Yg....8........Z;
1970 ; 3A C0 00 05 A1 8E C2 0B 25 C0 00 05 8D 81 C2 0B ;:.......%.......;
1980 ; 83 C0 00 05 8D 81 8D 8E C0 00 05 C0 00 05 8D A1 ;................;
1990 ; 81 8E C0 00 05 8D AA 8A 87 59 9D 19 9F 19 76 D2 ;.........Y....v.;
19A0 ; 04 B7 C0 00 05 C2 0B 30 8D 8E C0 00 05 8D A0 8A ;.......0........;
19B0 ; 59 CE C2 0C 66 B0 23 8E D2 00 58 C2 0B 9A 8D B0 ;Y...f.#...X.....;
19C0 ; 20 88 87 59 C7 19 CC D2 07 D1 19 BB 19 E4 C2 07 ; ..Y.............;
19D0 ; DA C0 00 05 8D B0 10 83 81 AC 81 8D A2 88 87 59 ;...............Y;
19E0 ; E6 D0 14 B6 1A 2D C2 07 DA C0 00 05 8D B0 10 83 ;.....-..........;
19F0 ; 81 AC 81 8D A3 88 87 5A 2F C2 07 D5 A3 8E C2 07 ;.......Z/.......;

007F ;  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F ;0123456789ABCDEF;

1A00 ; D6 C1 00 05 8D C2 07 DA C0 00 05 8D B0 10 83 81 ;................;
1A10 ; AD 81 8D 82 8E C2 07 D7 C2 07 DA C0 00 05 8D B0 ;................;
1A20 ; 10 83 81 AE 81 8D 8E D2 01 86 D2 07 D1 1A 38 C2 ;..............8.;
1A30 ; 0C 66 B0 24 8E D2 00 58 1A 56 C2 0B 9A 8D A8 88 ;.f.$...X.V......;
1A40 ; 87 5A 58 C2 0C 69 C0 00 04 8D 8E D0 16 07 C0 00 ;.ZX..i..........;
1A50 ; 04 C2 0C 69 8D 8E 1A 64 C2 0B 9A 8D AA 88 87 5A ;...i...d.......Z;
1A60 ; 66 D0 17 E2 1A 96 C2 0B 9A 8D A7 88 87 5A 98 C0 ;f............Z..;
1A70 ; 00 03 8D A1 88 87 5A 8D C2 0C 6D C0 00 04 8D 8E ;......Z...m.....;
1A80 ; D0 18 8E C0 00 04 C2 0C 6D 8D 8E 1A 96 C2 0C 66 ;........m......f;
1A90 ; B0 25 8E D2 00 58 1A A4 C2 0B 9A 8D AC 88 87 5A ;.%...X.........Z;
1AA0 ; A6 D2 07 D1 1A A8 1A C2 C2 0B 9A 8D B0 20 88 87 ;............. ..;
1AB0 ; 5A B7 D2 07 D1 1A C0 C2 0C 66 B0 26 8E D2 00 58 ;Z.........f.&...X;
1AC0 ; 19 58 C2 0C 6C C0 00 04 8D 8E 8C A1 8F 1E 97 1D ;.X..l...........;
1AD0 ; CF A1 8F 1A D5 C4 0B 9A 8D B0 10 88 87 5A E4 D4 ;..............Z..;
1AE0 ; 07 D1 1A ED C4 0C 66 B0 27 8E D4 00 58 C4 0B 9A ;......f.'...X...;
1AF0 ; 8D B0 12 88 87 5B 2A C0 00 03 A1 8E C4 0B 0B C0 ;.....[*..........;

0080 ;  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F ;0123456789ABCDEF;

1B00 ; 00 03 8D 81 C4 0B 83 C0 00 03 8D 81 8D 8E C0 00 ;................;
1B10 ; 03 C0 00 03 8D A1 81 8E C0 00 03 8D AA 8A 87 5B ;...............[;
1B20 ; 23 1B 25 1A FC D4 07 D1 1B 33 C4 0C 66 B0 28 8E ;#.%......3..f.(.;
1B30 ; D4 00 58 C4 0B 9A 8D A9 88 87 5B 41 D4 07 D1 1B ;..X.......[A....;
1B40 ; 4A C4 0C 66 B0 29 8E D4 00 EF C4 0B 9A 8D A1 88 ;J..f.)..........;
1B50 ; 87 5B 58 D4 07 D1 1B 61 C4 0C 66 B0 2A 8E D4 00 ;.[X....a..f.*...;
1B60 ; EF C4 0B 9A 8D B0 14 88 87 5B 70 D4 07 D1 1B 79 ;..........[p....y;
1B70 ; C4 0C 66 B0 2B 8E D4 00 EF C4 0B 9A 8D B0 13 88 ;..f.+...........;
1B80 ; 87 5B 90 C4 0B 23 C4 0B 9B 8D 8E D4 07 D1 1B 9E ;.[...#..........;
1B90 ; C4 0C 66 B0 2C 8E C4 0B 23 A0 8E D4 00 EF C4 0B ;..f.,...#.......;
1BA0 ; 9A 8D B0 1B 88 87 5B AD D4 07 D1 1B B6 C4 0C 66 ;......[........f;
1BB0 ; B0 2D 8E D4 00 EF C4 0B 9A 8D B0 13 88 87 5B CD ;.-.............[.;
1BC0 ; C4 0B 24 C4 0B 9B 8D 8E D4 07 D1 1B DB C4 0C 66 ;..$............f;
1BD0 ; B0 2E 8E C4 0B 24 AA 8E D4 00 EF C4 0B 9A 8D B0 ;.....$..........;
1BE0 ; 15 88 87 5B EA D4 07 D1 1B F3 C4 0C 66 B0 2F 8E ;...[.........f./.;
1BF0 ; D4 00 EF C4 0B 9A 8D AD 88 87 5C 01 D4 07 D1 1C ;...........\.....;

0081 ;  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F ;0123456789ABCDEF;

1C00 ; 0A C4 0C 66 B0 30 8E D4 00 EF C4 0B 9A 8D B0 12 ;...f.0..........;
1C10 ; 88 87 5C 4F C0 00 03 A1 8E C4 0B 16 C0 00 03 8D ;..\O............;
1C20 ; 81 C4 0B 83 C0 00 03 8D 81 8D 8E C0 00 03 C0 00 ;................;
1C30 ; 03 8D A1 81 8E C0 00 03 8D AA 8A 87 5C 40 1C 42 ;............\@.B;
1C40 ; 1C 19 C4 0B 21 A5 8E D4 05 43 D4 07 D1 1C 58 C4 ;....!....C....X.;
1C50 ; 0C 66 B0 31 8E D4 00 58 8C A0 A1 8F 1C 5E C0 00 ;.f.1...X......^..;
1C60 ; 04 A1 8E C4 0B 9E C0 00 03 8D AB 83 81 C0 00 04 ;................;
1C70 ; 8D 81 C4 0B 83 C0 00 04 8D 81 8D 8E C0 00 04 C0 ;................;
1C80 ; 00 04 8D A1 81 8E C0 00 04 8D AA 8A 87 5C 91 1C ;.............\..;
1C90 ; 93 1C 63 D4 07 D1 C4 0B 9A 8D B0 18 88 5C A1 1D ;..c..........\..;
1CA0 ; 02 D4 07 D1 C0 00 03 C0 00 03 8D A1 81 8E C0 00 ;................;
1CB0 ; 03 8D B0 11 8A 87 5C C8 C4 0C 66 B0 32 8E D4 00 ;......\...f.2...;
1CC0 ; 58 C0 00 03 A1 8E 1C C8 C0 00 04 A1 8E C4 0B 9E ;X...............;
1CD0 ; C0 00 03 8D AB 83 81 C0 00 04 8D 81 C4 0B 83 C0 ;................;
1CE0 ; 00 04 8D 81 8D 8E C0 00 04 C0 00 04 8D A1 81 8E ;................;
1CF0 ; C0 00 04 8D AA 8A 87 5C FB 1C FD 1C CD D4 07 D1 ;.......\........;

0082 ;  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F ;0123456789ABCDEF;

1D00 ; 1C 96 D4 07 D1 C4 0B 9A 8D A3 88 87 5D 18 C4 0B ;.............]...;
1D10 ; 21 A1 8E D4 07 D1 1D 1D C4 0B 21 A2 8E C0 00 04 ;!.........!.....;
1D20 ; A1 8E C4 0B 16 C0 00 04 8D 81 C4 0B 83 C0 00 04 ;................;
1D30 ; 8D 81 8D 8E C0 00 04 C0 00 04 8D A1 81 8E C0 00 ;................;
1D40 ; 04 8D AA 8A 87 5D 49 1D 4B 1D 22 D4 07 D1 C4 0B ;.....]I.K.".....;
1D50 ; 9A 8D B0 1F 88 87 5D 6D C4 0C 64 A1 8E D4 07 D1 ;......]m..d.....;
1D60 ; C4 0C 65 C4 0B 9B 8D 8E D4 07 D1 1D 77 C4 0C 64 ;..e..........w..d;
1D70 ; A0 8E C4 0C 65 A0 8E C0 00 03 8D A0 89 87 5D 82 ;....e..........].;
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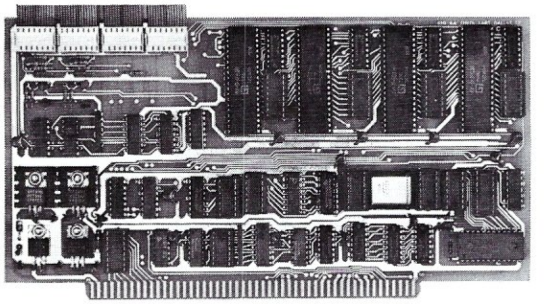

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```
1D80 | 1D CE C0 00 04 A1 8E C4 0B 0B C0 00 04 8D 81 C4 |................|
1D90 | 0B 9E C0 00 03 8D AB 83 81 C0 00 04 8D 81 8D 8E |................|
1DA0 | C0 00 04 C0 00 04 8D A1 81 8E C0 00 04 8D AA 8A |................|
1DB0 | 87 5D B5 1D B7 1D 87 C4 0B 22 C3 00 05 8D 8E D4 |.]......."......|
1DC0 | 05 43 C0 00 03 C0 00 03 8D A1 82 8E 1D 77 8C C3 |.C...........w..|
1DD0 | 0B 9A 8D B0 26 88 87 5D DE D2 10 9A 1D EB C3 0B |....&..]........|
1DE0 | 9A 8D B0 10 88 87 5D ED D0 1A D1 1D FA C3 0B 9A |......].........|
1DF0 | 8D B0 12 88 87 5D FC D0 1C 59 1D FE 1E 18 C3 0B |.....]...Y......|

0083 |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

1E00 | 9A 8D B0 20 88 87 5E 0D D3 07 D1 1E 16 C3 0C 66 |... ..↑........f|
1E10 | B0 33 8E D3 00 58 1D CF C1 00 03 C3 00 03 8D 8E |.3...X..........|
1E20 | C3 07 D5 A5 8E C3 07 D6 A0 8E C3 07 D7 A0 8E D3 |................|
1E30 | 01 86 C3 07 D8 C1 00 03 8D 8E C3 07 D9 C3 00 03 |................|
1E40 | 8D 8E D3 03 65 C3 0B 9A 8D B0 26 88 87 5E 54 D2 |....e.....&..↑T.|
1E50 | 10 9A 1E 90 C3 0B 9A 8D AE 88 87 5E 92 C3 0C 6B |...........↑...K|
1E60 | C2 00 05 8D 8E C3 0C 6E C3 0B 0A 8D 8E D3 10 92 |.......n........|
1E70 | C3 0B 0A C3 0C 6E 8D 8E C3 0B 9A 8D B0 20 88 87 |.....n....... ..|
1E80 | 5E 87 D3 07 D1 1E 90 C3 0C 66 B0 34 8E D3 00 58 |↑........f.4...X|
1E90 | 1E 94 1E 96 1E 45 8C C1 00 05 8D AF 8A 87 5E B5 |.....E........↑.|
1EA0 | C2 0C 66 B0 35 8E D2 00 58 C1 00 05 C1 00 05 8D |..f.5...X.......|
1EB0 | A2 82 8E 1E B5 C2 0C 6F A3 8E D0 1A CF C2 07 D8 |.......o........|
1EC0 | C0 00 03 8D 8E C2 07 D9 C2 00 03 8D 8E D2 03 65 |...............e|
1ED0 | C2 0B 9A 8D B0 26 88 5E DB 1E EF D1 10 9A C2 0B |.....&.↑........|
1EE0 | 9A 8D B0 20 88 87 5E ED D2 07 D1 1E ED 1E D0 C2 |... ..↑.........|
1EF0 | 0B 9A 8D A2 88 87 5E FD D2 07 D1 1F 06 C2 0C 66 |......↑........f|

0084 |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

1F00 | B0 36 8E D2 00 58 C2 0C 6A A0 8E C2 0C 6C A0 8E |.6...X..j....l..|
1F10 | D1 14 AE C2 0B 9A 8D A6 88 87 5F 21 D2 07 D1 1F |..........←!....|
1F20 | 2A C2 0C 66 B0 37 8E D2 00 58 C2 07 D5 A0 8E C2 |*..f.7...X......|
1F30 | 07 D6 A0 8E C2 07 D7 AC 8E D2 01 86 8C A1 8F 1F |................|
1F40 | 41 C2 0B 9A 8D B0 26 88 5F 4C 1F 60 D1 10 9A C2 |A.....&.←L.`....|
1F50 | 0B 9A 8D B0 20 88 87 5F 5E D2 07 D1 1F 5E 1F 41 |.... ..←↑....↑.A|
1F60 | C2 0B 9A 8D AE 88 87 5F 6E D2 07 D1 1F 77 C2 0C |.......←n....w..|
1F70 | 66 B0 41 8E D2 00 58 C2 0B 9A 8D B0 12 88 87 5F |f.A...X........←|
1F80 | D4 C0 00 03 A1 8E C2 0B 0B C0 00 03 8D 81 C2 0B |................|
1F90 | 83 C0 00 03 8D 81 8D 8E C0 00 03 C0 00 03 8D A1 |................|
1FA0 | 81 8E C0 00 03 8D AA 8A 87 5F AD 1F AF 1F 86 C2 |.........←......|
1FB0 | 0B 0A C1 00 04 8D 8E C2 0B 21 A3 8E C2 0B 22 C1 |.........!....".|
1FC0 | 00 03 8D 8E D2 05 43 C1 00 04 C2 0B 0A 8D 8E D2 |......C.........|
1FD0 | 07 D1 1F DD C2 0C 66 B0 42 8E D2 00 58 C2 0B 9A |......f.B...X...|
1FE0 | 8D A9 88 87 5F EB D2 07 D1 1F F4 C2 0C 66 B0 43 |....←........f.C|
1FF0 | 8E D2 00 58 C1 00 05 C1 00 03 8D A1 81 8E D1 1A |...X............|

0085 |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

2000 | CB 8C C0 00 03 C1 0C 6B 8D 8E C0 00 04 C1 0C 6E |.......k.......n|
2010 | 8D 8E D0 1F 3D C1 0C 6E C0 00 04 8D 8E 8C 20 20 |....=..n......  |
2020 | C1 00 03 A0 8E C1 07 D5 A5 8E C1 07 D6 A0 8E C1 |................|
2030 | 07 D7 A0 8E D1 01 86 C1 07 DA A1 B0 10 83 81 A1 |................|
2040 | 81 B0 49 8E C1 07 DA A1 B0 10 83 81 A2 81 B0 4E |..I............N|
2050 | 8E C1 07 DA A1 B0 10 83 81 A3 81 B0 54 8E C1 07 |............T...|
2060 | DA A1 B0 10 83 81 A4 81 B0 45 8E C1 07 DA A1 B0 |.........E......|
2070 | 10 83 81 A5 81 B0 47 8E C1 07 DA A1 B0 10 83 81 |......G.........|
2080 | A6 81 B0 45 8E C1 07 DA A1 B0 10 83 81 A7 81 B0 |...E............|
2090 | 52 8E C1 07 DA A1 B0 10 83 81 A8 81 B0 20 8E C1 |R............ ..|
20A0 | 07 DA A1 B0 10 83 81 A9 81 B0 20 8E C1 07 DA A1 |.......... .....|
20B0 | B0 10 83 81 AA 81 B0 20 8E C1 07 DA A1 B0 10 83 |....... ........|
20C0 | 81 AC 81 A4 8E C1 07 DA A1 B0 10 83 81 AF 81 A1 |................|
20D0 | 8E C1 07 DA A2 B0 10 83 81 A1 81 B0 4C 8E C1 07 |............L...|
20E0 | DA A2 B0 10 83 81 A2 81 B0 4F 8E C1 07 DA A2 B0 |.........O......|
20F0 | 10 83 81 A3 81 B0 57 8E C1 07 DA A2 B0 10 83 81 |......W.........|

0086 |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

2100 | A4 81 B0 5F 8E C1 07 DA A2 B0 10 83 81 A5 81 B0 |...←............|
2110 | 43 8E C1 07 DA A2 B0 10 83 81 A6 81 B0 48 8E C1 |C............H..|
2120 | 07 DA A2 B0 10 83 81 A7 81 B0 41 8E C1 07 DA A2 |..........A.....|
2130 | B0 10 83 81 A8 81 B0 52 8E C1 07 DA A2 B0 10 83 |.......R........|
2140 | 81 A9 81 B0 20 8E C1 07 DA A2 B0 10 83 81 AA 81 |.... ...........|
2150 | B0 20 8E C1 07 DA A2 B0 10 83 81 AC 81 A2 8E C1 |. ..............|
2160 | 07 DA A2 B0 10 83 81 AD 81 A0 8E C1 07 DA A2 B0 |................|
2170 | 10 83 81 AE 81 A0 8E C1 07 DA A3 B0 10 83 81 A1 |................|
2180 | 81 B0 4C 8E C1 07 DA A3 B0 10 83 81 A2 81 B0 4F |..L............O|
2190 | 8E C1 07 DA A3 B0 10 83 81 A3 81 B0 57 8E C1 07 |............W...|
21A0 | DA A3 B0 10 83 81 A4 81 B0 5F 8E C1 07 DA A3 B0 |.........←......|
21B0 | 10 83 81 A5 81 B0 49 8E C1 07 DA A3 B0 10 83 81 |......I.........|
21C0 | A6 81 B0 4E 8E C1 07 DA A3 B0 10 83 81 A7 81 B0 |...N............|
21D0 | 5F 8E C1 07 DA A3 B0 10 83 81 A8 81 B0 43 8E C1 |←............C..|
21E0 | 07 DA A3 B0 10 83 81 A9 81 B0 48 8E C1 07 DA A3 |..........H.....|
21F0 | B0 10 83 81 AA 81 B0 20 8E C1 07 DA A3 B0 10 83 |....... ........|

0087 |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

2200 | 81 AC 81 A3 8E C1 07 DA A3 B0 10 83 81 AD 81 A0 |................|
2210 | 8E C1 07 DA A3 B0 10 83 81 AE 81 C1 00 03 8D 8E |................|
2220 | C1 07 D5 A0 8E C1 07 D7 B0 10 8E D1 01 86 C1 07 |................|
2230 | D7 AC 8E D1 01 86 C1 07 DA A4 B0 10 83 81 A1 81 |................|
2240 | B0 4C 8E C1 07 DA A4 B0 10 83 81 A2 81 B0 4F 8E |..L...........O.|
2250 | C1 07 DA A4 B0 10 83 81 A3 81 B0 57 8E C1 07 DA |...........W....|
2260 | A4 B0 10 83 81 A4 81 B0 5F 8E C1 07 DA A4 B0 10 |........←.......|
2270 | 83 81 A5 81 B0 4F 8E C1 07 DA A4 B0 10 83 81 A6 |.....O..........|
2280 | 81 B0 55 8E C1 07 DA A4 B0 10 83 81 A7 81 B0 54 |..U............T|
2290 | 8E C1 07 DA A4 B0 10 83 81 A8 81 B0 5F 8E C1 07 |............←...|
22A0 | DA A4 B0 10 83 81 A9 81 B0 43 8E C1 07 DA A4 B0 |.........C......|
22B0 | 10 83 81 AA 81 B0 48 8E C1 07 DA A4 B0 10 83 81 |......H.........|
22C0 | AC 81 A3 8E C1 07 DA A4 B0 10 83 81 AD 81 A0 8E |................|
22D0 | C1 07 DA A4 B0 10 83 81 AE 81 C1 00 03 8D 8E C1 |................|
22E0 | 07 D7 B0 11 8E D1 01 86 C1 07 D7 AC 8E D1 01 86 |................|
22F0 | C1 07 D8 A0 8E C1 07 D9 C1 00 03 8D 8E D1 03 65 |...............e|

0088 |  0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F |0123456789ABCDEF|

2300 | 8C D0 20 1E C0 0C 67 A0 8E C0 0C 68 A0 8E C0 0B |.. ...g....h....|
2310 | 9D A0 8E C0 0B 9C A0 8E C0 0B 99 B0 20 8E D0 07 |............ ...|
2320 | D1 C0 0C 6B A0 8E C0 0C 6E A0 8E D0 10 92 C0 0B |...k....n.......|
2330 | 9A 8D B0 20 88 87 63 5C C1 00 00 AD 8E D1 00 04 |... ..c\........|
2340 | C1 00 00 B0 2A 8E D1 00 04 C1 00 00 B0 2A 8E D1 |....*........*..|
2350 | 00 04 C1 00 00 AD 8E D1 00 04 23 65 C0 0C 66 B0 |..........#e..f.|
2360 | 44 8E D0 00 EF C0 0C 67 8D A0 88 63 BB C1 00 00 |D......g...c....|
2370 | B0 2A 8E D1 00 04 C1 00 00 B0 2A 8E D1 00 04 C1 |.*........*.....|
2380 | 00 00 B0 20 8E D1 00 04 C1 00 00 C0 0C 67 8D AA |... ........g...|
2390 | 84 B0 30 81 8E D1 00 04 C1 00 00 C0 0C 67 8D AA |..0.........g...|
23A0 | 85 B0 30 81 8E D1 00 04 C1 00 00 B0 2A 8E D1 00 |..0.........*...|
23B0 | 04 C1 00 00 AD 8E D1 00 04 23 BB D0 03 CB C1 00 |.........#......|
23C0 | 00 AD 8E D1 00 04 8C 00 00 00 00 00 00 00 00 00 |................|
23D0 | 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |................|
23E0 | 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |................|
23F0 | 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |................|
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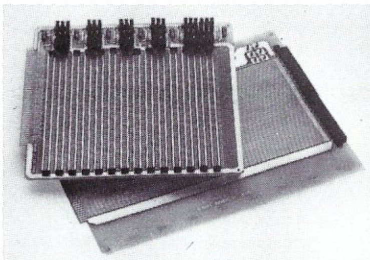

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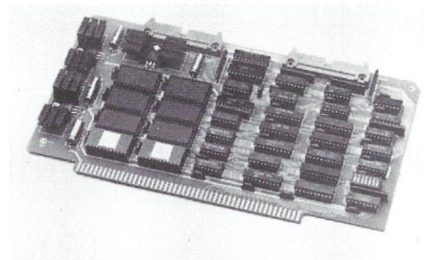

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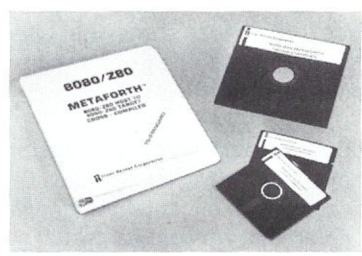

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Printer Control With CP/M And MBasic

by Leo P. Biese and Emillio Iannuccillo

While CP/M and the various versions of Microsoft Basic are undoubtedly the most widely used operating system and language available for the microcomputer today, the printer facilities in both can be very frustrating. Consider the following practical problem: You have just made a minor change in your master file copy of CBIOS and want to print only page fourteen. Not a chance! You can do a control-P and TYPE the whole thing. If you try to use 'TYPE' to go through the first thirteen pages on the screen and stop the listing with control-S, you are in for trouble. As soon you hit control-P to switch to the printer, CP/M thinks you are negating the previous control-S and promptly dumps the remainder of the program on the screen. A related problem occurs when you are printing a listing and want to stop before the bottom of the page. At 300 baud and up, human dexterity is just not fast enough to hit that control-S at the end of a line.

You usually end up leaving off the last few letters or printing out the first few letters of the following line, both of which end in curses, wasted paper and starting over. A friend of ours thought he had this problem licked by adding forty wait states after a carriage return. This gave a nice usable pause, but he was somewhat chagrined to learn that the lines were indeed printed out at the specified 300 baud, while the overall throughput was about 10 baud!

With Microsoft Basic the problem is even worse. Back in the "good old days" (1978) Microsoft had a CONSOLE statement that for some inexplicable reason was left out of later versions. Even this was only a partial solution at best. Several recently published schemes for implementing printer control involve POKEing the CP/M IOBYTE and retrieving the CONSOLE statement. This is a valuable help when you have a program that you may wish to direct to the printer one time and the screen the next. This solution is of no help when you have to debug a long program that you will eventually want to go to the printer. This was forcibly illustrated during the recent development of an accounting system requiring many lengthy reports. Each change in the program required printing out four or more identical pages while the next page was being "cleaned." One alternative was to write the whole thing in PRINT statements and then go back and change them to LPRINTS. Another solution was to go back to school, learn structured programming, buy a compiler and do it right the first time. Neither seemed very attractive.

Leo P. Biese and Emillio Iannuccillo, RFD #1 Murray Hill Road, Hill, NH, 03243.

All these problems were quite easily solved with two minor changes to the BIOS. Simply alter the BIOS to recognize front panel switch #8 (arbitrary) to toggle the printer only at the end of the current line being printed. These changes simply involve sandwiching six lines into CP/M's character output routine, forcing it to first look at the front panel, and if switch #8 is on, to send output to the assigned Console and Lister devices *simultaneously*. Once this is accomplished the lister routine must look at panel switch #9 and, if on, halt temporarily at the first carriage return encountered.

Listing 1: *Changes to the CP/M console output routines to check if panel switch #8 is on and send output to both the console and the list device if TRUE.*

```
        ;
        ; WRITE A CHARACTER TO THE CONSOLE DEVICE
        ;
CONOT:  MVI     A,ØDH           ;IF IT'S A CR
        CMP     C               ;THEN HOP OUT
        JZ      CONUL           ;TO NULL ROUTINE
        ;
        ; ** MOD FOR FRONT PANEL CONTROL OF LISTER
        ;
        CALL    CONOT1          ;** FIRST PRINT THE BYTE
        JMP     SWITCH8         ;** THEN CHECK PANEL
CONOT1: {LEAVE AS IS}
CONUL:  {LEAVE AS IS}
CONUL1: CALL    CONOT1          ;PRINT A CARRIAGE RETURN
        MVI     C,Ø             ;GET NULL CHARACTER
        DCR     B               ;DECREMENT COUNTER
        JNZ     CONUL1          ;AND DO THE NEXT NULL
        POP     B               ;RESTORE B & C
SWITCH8: IN     ØFFH            ;** TEST FRONT PANEL
        ANI     Ø1              ;**
        MOV     A,C             ;** RESTORE A
        JNZ     LIST            ;** TO LISTER IF #8 ON
        RET
```

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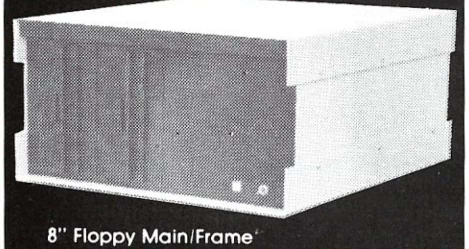

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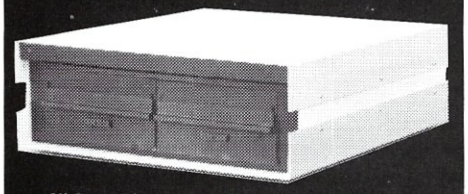

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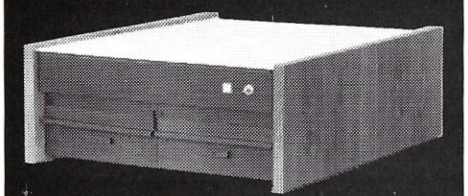

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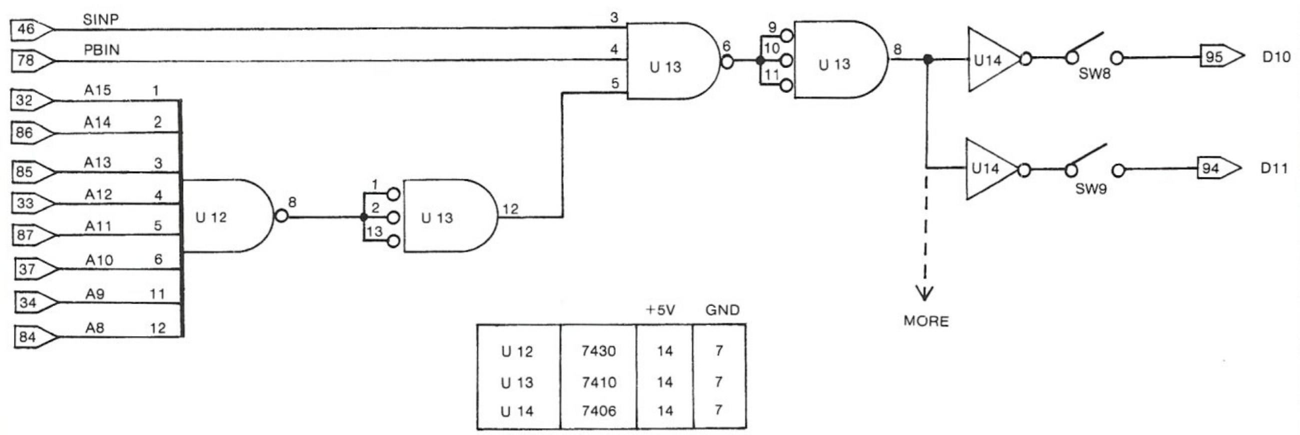
Figure 1: *Circuit to replace front-panel switches #8-15 on the S-100 Bus.*



Listing 2: *Additions to the CP/M BIOS to force the Lister device to look at front panel switch #9 and halt at the first carriage return if TRUE.*

```
LINUL1:   CALL      LIST1        ;PRINT CR FIRST
          MVI       C,0          ;GET NULL CHARACTER
          JNZ       LINUL1       ;AND GET THE NEXT NULL
          ;
          ; ** ROUTINE TO HALT PRINTOUT AT THE END OF THE
          ;    CURRENT LINE IF PANEL SWITCH #9 = TRUE
          ;
SWITCH9:  IN        0FFH      ;** LOOK AT FRONT PANEL
          ANI       02        ;**
          JNZ       SWITCH9   ;**
          POP       B         ;RESTORE B&C
          RET
```

The additions are given in Listings 1 and 2, and are indicated by a [**] in the remarks column. The unmarked code is as received in the Tarbell version of CP/M CBIOS Version 1.4 with all labels preserved.

No Front Panel?

The software alteration has been eminently satisfactory for the past two years. Recently, however, we acquired an S-100 machine without a front panel and trashed our "Impossible Dream" [the Imsai front panel] after years of arbitrary problems. After most of the difficulties were solved, or at least accepted, it developed the curious habit of halting the CPU for no apparent reason. Plus, it almost always stopped just before the operator could save a long program. The front panel was replaced with a clean, brushed aluminum one and a Z-80 CPU was installed along with a monitor with a monitor program in ROM that did everything the panel did—better and faster. After living without printer control for a few months, the situation became unbearable and the hardware modification shown in Figure 1 was constructed.

This substitute for front panel switches is a simple, one-evening project (with readily available parts), and can be constructed on a blank S-100 prototype board or a small perf-board attached directly to the front panel, which is probably why we never got around to it! A much better solution is to kludge it onto an existing board and steal the power and bus signals, thus obviating the installation of yet another board, five-volt regulators, etc. We attached a 10-pin strip connector to the top of the board and, as can be seen from the diagram, switches #8 to #15 can be implemented provided you have enough sections to spare in an available hex-driver. Since only three chips are needed, it will easily fit on an Imsai or MITS CPU or I/O board and many others. Our "easy" solution developed when we acquired several QT Computer Systems Clock/Calendar boards which have enough room left to add the whole computer. If you wish to go this route, check your existing CPU, CLOCK, I/O, D/A converter, or other boards, as there are often unused chip sections available and the hex-driver (U14) may not even be needed. ■

LEO P. BIESE, M.D. is a pathologist and medical director of New England Clinical Laboratories, Inc., a reference laboratory located in New Hampshire. He also serves as software editor and vice-chairman of the College of American Pathologists Microcomputer Committee and its Software Exchange. His principal interests are in the application of microcomputers to the clinical laboratory, computer-assisted interpretive reporting and teaching programming to laboratory scientists.

EMILIO D. IANNUCCILLO is an attorney with a private practice in Rhode Island. He is Town Solicitor for Bristol, and specializes in municipal-law, commercial-law and realty-law. His interests are in systems software for the legal profession and municipal government, data retrieval, and legal application programming.

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```

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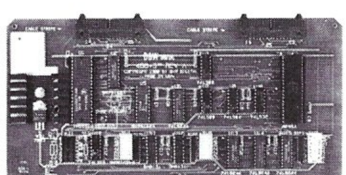

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Interfacing To S-100/IEEE 696 Microcomputers

by Chris Terry

Interfacing To S-100/IEEE 696 Microcomputers, by S. Libes and M. Garetz. Osborne/McGraw-Hill, 321 pp, $15.00 1981.

This book is a "must" for anyone who wishes to construct a custom interface between an S-100 microcomputer and almost any type of peripheral device. It is a goldmine of useful information new and old, much of which has never before been collected in one place. The writing is a model of what such manuals should be but seldom are; the authors say exactly what they mean—simply, understandably, and with no ambiguity. An enormous amount of hard work must have gone into not only mastering the subject matter, but also into communicating it so admirably; yet they make it look easy and read so well. In the sense that "art is the concealment of art," the authors are artists as well as technologists.

The material falls into two main classes:

- Description of the S-100 Bus.
- Applications—How to use the bus features.

Each chapter has a short but useful bibliography of further information sources, and there is an excellent index.

Description Of The S-100 Bus

The proposed IEEE-696 Standard, reprinted from the July, 1979 issue of *Computer*, is included as an appendix and provides the technical definition of the current S-100 Bus. The average reader, however, will be far more enlightened by the discussions of the bus contained in Chapters 2 through 4.

Chapter 2 contains a brief history of the S-100 bus, the mechanical description of the circuit boards and motherboard, a description of the signal groups of the bus, and power supply considerations. This chapter also introduces the important concepts of a *Bus Master*, which has absolute control of the bus, and a *Slave*, which uses the bus only at the behest of the Master. The Master is normally the CPU board, but it may release control of the bus to Temporary Masters.

Chapters 3 and 4 provide the essentials for understanding the S-100 bus. Chapter 3 gives detailed description of each of the signals, grouped by function. Particular attention is paid to the differences between the original MITS version of the bus and the new IEEE-696 definition. Chapter 4 describes the timing relationships of the bus. In particular, it contains a beautifully clear description of the bus cycle, consisting of several bus states, and the purpose of each state. There is a detailed analysis of what occurs on the bus during each state of a read cycle and a write cycle, and a discussion of how a bus cycle can be extended by wait states.

This book is a "must" for anyone who wishes to construct a custom interface between an S-100 microcomputer and almost any type of peripheral device.

The book would be well worth its price for these chapters alone. After reading them, I felt that for the first time I understood not only *what* takes place on the bus, but *why*. It is impossible for the average user to get this kind of understanding from manufacturers' documentation and timing diagrams.

Applications

Chapters 5 through 16 contain a compendium of circuits, device driver routines and useful information for interfacing a wide variety of devices. If you want to connect a special device to your system, look through the table of contents of this book before you start reinventing the wheel. There is almost certain to be a circuit that you can use or adapt.

Chapter 5 deals with decoding, buffering, and wait state generation. Chapter 6 is a comprehensive interfacing guide for static RAM and EPROM—useful if you want to add, say, 1K of workspace for a PROM monitor. Dynamic RAM is not discussed; the authors point out that timing problems are horrendous and are affected by board layout, so that a wire-wrapped dynamic RAM board would be unreliable—if it worked at all.

Chapter 7 discusses the general principles of I/O ports, handshaking, and I/O channels (a combination of ports to handle status, commands and data for one peripheral). Programmable I/O port IC's, which combine all functions for one or more channels into a single chip, are briefly

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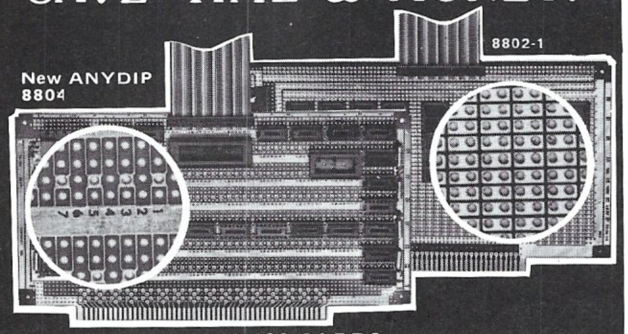

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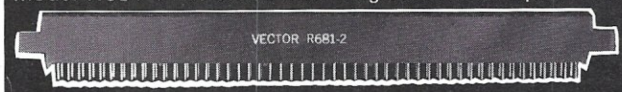

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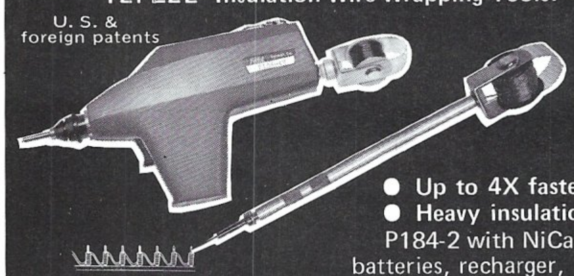

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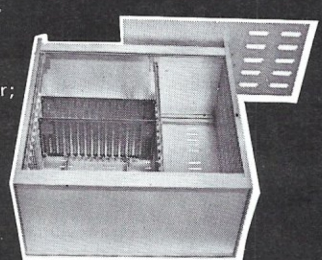

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Book Review, continued...

discussed with specific reference to the Intel 8255 PPI (Programmed Peripheral Interface) and the Motorola 6820 PIA (Peripheral Interface Adaptor). Chapter 8 gives specific examples of simple parallel interfaces with and without handshaking, and typical software drivers for them. In both chapters there are brief discussions of memory-mapped I/O, in which an I/O port occupies a location in the memory space. This type of I/O is used exclusively by 6502 and 680X microprocessors which must use memory reference instructions to perform I/O; it is an alternative mode in the Z80/808X microprocessors, though here one must consider the trade-off between the improved I/O speed and the loss of addressable memory space entailed by memory-mapped I/O.

Chapters 9 and 10 are called "Interfacing to the Real World," and cover input from keyboards and various kinds of sensors, and control of lamps, motors, sound generators, and other non-digital devices.

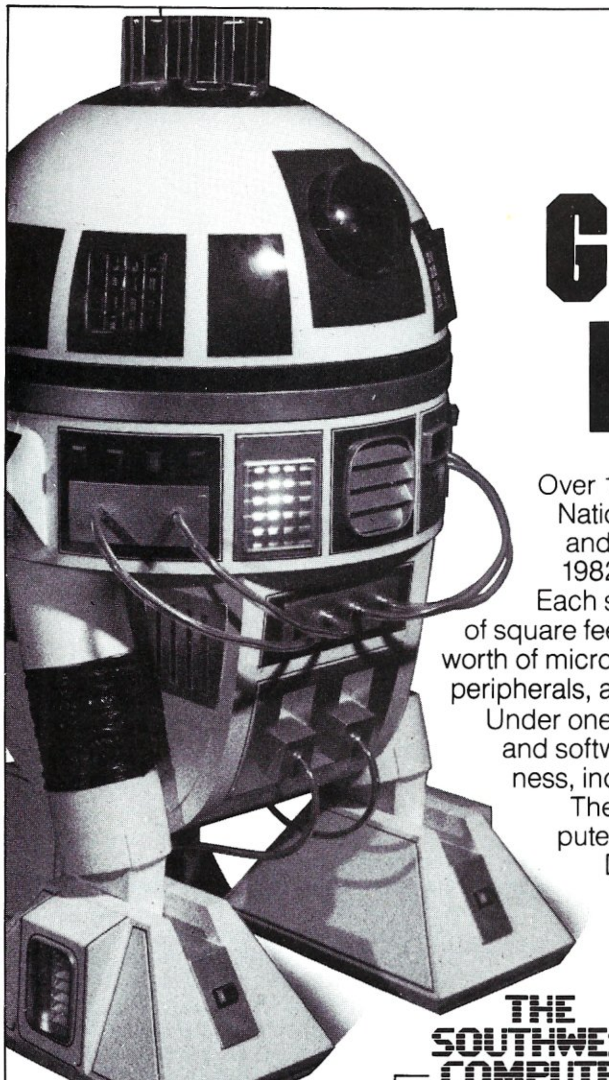
Chapter 11 is a brief, though excellent discussion of serial interfaces, with specific reference to some commonly used serializer/deserializer chips: the AY-5-1013 and 8250 UARTs, and the 8251A and 2651 USARTs. Since micro-computer software generally assumes asynchronous transmission over communication networks, there is no discussion of the synchronous transmission features of the USARTs; however, the bibliography cites sources for such information.

Chapter 12 covers the basics of interfacing to digital/analog and analog/digital converters. Chapter 13 is a full and very helpful discussion of interrupts and how to use them. Chapter 14 deals with programmable timer/counters (specifically the 8253) and their applications.

Chapter 15, on TMA (Temporary Master Access), deserves special mention. Its topic is the release of the bus by the primary Bus Master (usually the CPU) to some other device which becomes a Temporary Bus Master. This is a technique which in minicomputers used to be called DMA (Direct Memory Access), though that term is not appropriate on the S-100 bus. The object is to allow the Temporary Bus Master to take control of the bus for a limited time or specific task. Applications include high-speed data transfers between memory and a peripheral (such as a disk controller), or transfer of control to a different CPU (as on the Godbout 8085/8088 dual processor). The timing considerations and special requirements of TMA circuits are clearly explained, and logic diagrams illustrate several implementations for various purposes.

The last two chapters describe miscellaneous but useful interface circuits (such as a jump-on-reset circuit), and justify the deliberate omission of several types of interface. The grounds for omission were mainly complexity of the device side of the interface (e.g., video and disk controllers), software complexity (e.g., non S-100 computers), or irrelevance to the S-100 context (e.g., cassettes). ■

CHRIS TERRY became involved with micros when he built an Altair 8800 in 1975; he still uses this, mainly for word processing. He is fascinated with the potential of the micro as a tool for living (and as the greatest toy in the world!). Other interests include the Arthurian legends, science fiction, and both classical and electronic music.



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Thursday-Sunday
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11 AM to 6 PM Daily

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SOFTWARE DIRECTORY

Program Name: Jools
Hardware System: CP/M 8" SD or NorthStar DD
Minimum Memory Size: 48K
Language: Machine Code
Description: UNIX-style software tools specially adapted for the CP/M environment. The sixteen tools include VSORT—high-speed internal/external sorting on either fixed- or variable-length fields; SELECT—line extraction from a file based on the values of fixed- or variable-length fields; FIND and REPLACE--search for and replace text within files based on regular expression patterns; and REARRANG—reorder fields of a line to a user-specified format. Jools provides a modular problem-solving facility for the CP/M programmer without requiring special programming. The manual details how Jools can maintain mailing lists and biliographic databases, generate permuted indexes, and monitor changes made to a file.
Release: December 1981
Price: $95.00 (manual only, $20.00)
Included with price: One 8" IBM SD or two 5-1/4" NorthStar DD diskettes, 66-page manual and quick reference guide.
Where to purchase it:
Pluto Research Group
P.O. Box 50444
Palo Alto, CA 94303-0444
(415)323-5654

Program Name: Solomon Series II
Hardware System: Z-80 with CP/M
Minimum Memory Size: 64 RAM, 1 Mb of disk storage minimium.
Description: General Accounting with Job Management. A fully integrated system utilizing a single database manager. Includes General Ledger, Accounts Receivable, Accounts Payable, Payroll, Invoicing, Cash Receipts/Disbursements, Fixed Assets (depreciation), Address maintenance (mailing list), and Job Costing.
Release: December 1981
Price: $3,495
Included with price: Compiled PL/I code in executable form, and user reference manual.
Where to purchase it:
TLB ASSOCIATES, INC
P.O. Box 414
Findlay, Ohio 45840
(419)424-0422

Program Name: REFORMATTER CP/M—IBM File Conversion Program
Hardware System: Multi-drive CP/M-based system
Minimum Memory Size: 24K
Language: Assembly Language (8080)
Description: REFORMATTER is an intelligent bi-directional file conversion program. Reads and writes IBM 3740 formatted disks (IBM Diskette 1, Basic Data Exchange Format) and gives CP/M users the ability to exchange data on floppy disk with IBM equipment, or any equipment accepting an IBM 3740 disk. Handles all conversion functions such as file reorganization and ASCII to EBCDIC character translation. Gives CP/M user access to all IBM diskette file attributes and provides facilities for examining and altering all data areas, directory entries, and fields within each IBM data set label.
Release: June 1978
Price: $195.00
Included with price: 8" disk, manual, and telephone consultation if required.
Where to purchase it:
MicroTech Exports, Inc.
467 Hamilton Avenue
Palo Alto, CA 94301
(415)324-9114

Program Name: PASS System
Hardware System: NorthStar system, 2-DD or QD drives
Minimum Memory Size: 32K
Description: Assembly language program development system. Includes: PASS assembler with interactive input editing, built in cross reference listing and macro capability, improved mnemonics and syntax, e.g., "STM A,HL" instead of "LD(HL),A"; STEP, debugging trace, with capability to set displays to field changes and echo to printer. And BLDMACRO to assist in adding macros to provided macro library.
Release: November 1981
Price: $40.00
Included with price: Object code and manual (and program to print manual) on 5-1/4" DD or QD, ten hard sector disks. Source code $160 extra, $200 total, requires signed agreement.
Where to purchase it:
PASS
P.O. Box 1382
Lafayette, CA 94549
(415)945-7911

Program Name: Solomon I
Hardware System: Z-80 with CP/M
Minimum Memory Size: 64K RAM, 1 Mbyte of disk storage min.
Language: PL/I
Description: The Solomon I is an accounting package designed around the MDBS database management system. It includes several accountinng modules which access the same database. The result is increased ease of use—there are no sorts to run, batches of transactions to post and all functions are available from a single master menu. Solomon I includes General Ledger, Payroll, Accounts Payable, Invoicing, Accounts Receivable,

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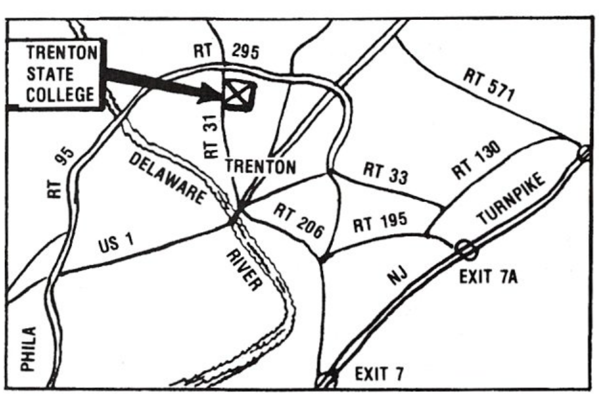

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Fixed Assets, and Address Maintenance.
Release: October 1981
Price: $2,595
Included with price: Compiled PL/I code and user reference manual.
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Program Name: Spellbinder
Hardware System: CP/M-compatible systems
Minimum Memory Size: 32K
Language: Machine Language
Description: Offers both the novice and experienced user complete word processing and office management capabilities. Includes a hierarchy of Macro commands for such tasks as que and zip sorting, mail merge, forms generation, and line numbering. Operates in two modes: edit mode and command mode. Extremely simple to learn.
Release: July 1981
Price: $450
Included with price: Disk and special Spellbinder keytops
Where to purchase it:
Data Technology Industries
700 Whitney Street
San Leandro, CA 94577
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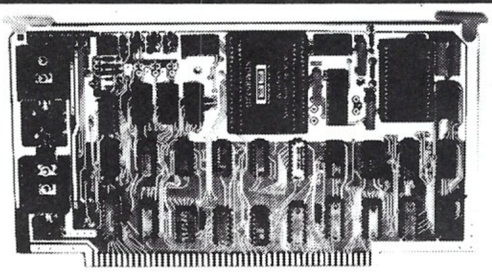

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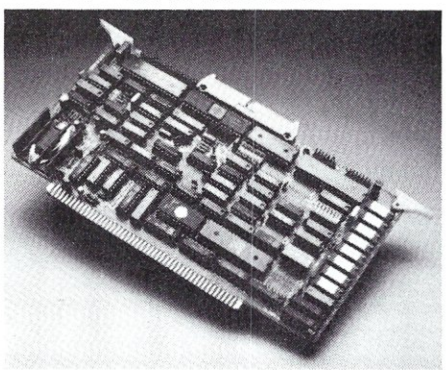
Complete System On A Single S-100 Board

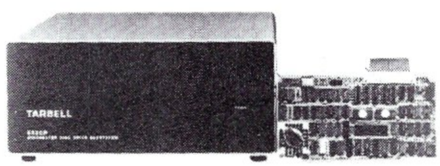
SUPER/NET, a single board S-100 system contains a 64K bank select dynamic RAM, Z-80A CPU, 2716 (2K) monitor EPROM, 5-1/4" and 8" floppy disk controller, two serial and two parallel ports and Z-80A CTC for real-time interrupts. Full DMA operation is supported. SUPER/NET meets full IEEE-696/S-100 specifications and operates under both CP/M and MP/M software.



Price is $1125.00; available from Advanced Micro Digital Corp., 7201 Garden Grove Blvd., Suite #E Garden Grove, CA 92641 (714)891-4004.

Winchester Disk System For S-100

Tarbell Electronics has introduced a new series of S-100 Winchester subsystems allowing expansion from 10 to over 200Mb. Their ATTACH program provides a way to get up-and-running quickly. Users can start with a small system, then add up to three additional drives of any capacity. All Tarbell hard-disk subsystems 33Mbytes and above use a voice-coil actuator which provides an average access time of 50 milliseconds. Data comes off the disk into the deblocking



buffer at the maximum possible speed of 1Mb/Sec, meaning that a 24K file can be loaded into memory in about one second! Additional features of the subsystems include on-board CRC performed data, automatic alternate sector assignment, 512-byte on-board deblock buffer and the use of only one S-100 board slot. The subsystem includes S-100 interface, drive cabinet, power supply, cables, software and all documentation. Tarbell Electronics, 950 Dovlen Place, Suite B, Carson, CA 90746; (213)538-4251.

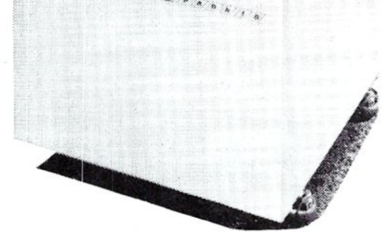
64K S-100 Static RAM Board

SSM Microcomputer Products Inc., has announced a new high performance, low power 64K static RAM memory board, the MB64. It operates at up to 6MHz offering two 32K blocks, and up to 8K of EPROM. It also includes extended addressing of up to 16Mb of memory. Power consumption is typically less than 600 MA.

Price is less than $850; contact SSM Microcomputer Products Inc., 2190 Paragon Dr., San Jose, CA 95131; (408)946-7400.

S-100 Mainframe

Para Dynamics Corp., has announces the PRONTO mainframe/disk in a free-standing 26"H x 20"D x 18"W with casters. It will hold up to two 8" floppy disk drives plus one 8" rigid disk drive, or one 8" floppy disk, one 8" rigid disk and streamer tape backup. The power supply allows changing input and output voltages. The IEEE Standard S-100 motherboard uses high quality gold-plated edge card connections and accomodates up to 18 cards, including the new 10"x10" cards.



The motherboard compartment is cooled with a forced air filtered system that funnels air evenly and effectively over and through the PC cards. Other features include motherboard jumpers so that the 220 ohm load termination on various signal lines may be grounded, left open or made high with the installation of a 7805 voltage regulator in the position provided on the motherboard. The unit also includes a double pole circuit breaker, a dual AC convenience outlet on the rear of the cabinet, a double-bitted on/off key switch and a power "on" indicator and "reset."

Para Dynamics, 7740 E. Redfield Rd., Scottsdale, AZ 85260, (602)991-1600.

Microsystems — the CP/M* and S-100 User's Journal

CP/M is the software bus!+ S-100 is the hardware bus for sophisticated microcomputer users!

If you are a CP/M user, on any system—S-100, Apple, TRS-80, Heath, Ohio Scientific, Onyx, Durango, Intel MDS, Mostek MDX, etc—after all CP/M is the Disk Operating System that has been implemented on more computer systems than any other DOS—then *Microsystems* magazine is the "only" magazine published specifically for you!

Or, if you use an S-100/IEEE-696 based computer—and the most sophisticated microcomputer systems available use the S-100/IEEE-696 hardware bus—then *Microsystems* magazine is the "only" magazine published specifically for you!

We started publishing *Microsystems* almost two years ago to fill the void in the microcomputer field. There were magazines catering exclusively to the TRS-80, Apple, Pet, Heath, etc. system users. There were also broad based publications that cover the entire field but no one system in depth. But no magazine existed for CP/M users—nor did one exist for S-100 users.

The why and what of a software bus

First of all what is a "bus?" And why do we call CP/M "the software bus?"

A "bus" is a technique used to interface many different modules. Examples are the "S-100/IEEE-696 Bus" and the "IEEE-488 Bus." These are hardware buses that permit a user to plug a bus-compatible device into the bus without having to make any other hardware modifications and expect the device to operate with little or no modification.

CP/M is a Disk Operating System (DOS). It was first introduced in 1974 and is now the oldest and most mature DOS for microcomputer systems. CP/M has now been implemented on over 250 different computer systems. It has been implemented on hard disk systems as well as floppy disk systems. It is supported by two user groups (CP/M-UG and SIG/M-UG) that have released over 80 volumes containing over 2,000 public domain programs that can be loaded and run on systems using the CP/M DOS. Add to this another 1,500 commercially available CP/M software packages and you have the largest applications software base in existence.

CP/M is the only DOS for micros that has stood the test of time (seven years) with the highest level of compatibility from version to version. And over the years this compatibility has been maintained as new features have been added.

This is why we say "CP/M is the software bus" and why *Microsystems* magazine is vital to providing CP/M users with technical information on using CP/M, interfacing to CP/M, new CP/M compatible products and for CP/M users to exchange ideas.

Why support the S-100 bus?

S-100 is currently the most widely used microcomputer hardware bus. It offers advantages not available with any other microcomputer system. Here are a few of the advantages:

S-100 is processor independent. There are already thirty different S-100 CPU cards that can be plugged into an S-100 bus computer. Nine 8-bit microprocessors are available: 6502, 6800, 6802, 6809, 2650, F8, 8080, 8085 and Z80. Eight 16-bit microprocessors are available: 8086, 8088, 9900, Z8000, 68000, Pascal Microengine, Alpha Micro (similar to LSI-11) and even the AMD2901 bit slice processor. Take your pick from the incredible offerings.

S-100 has the greatest microcomputer power. What other microcomputer system has direct addressing of up to 16 megabytes of memory, up to 65,536 I/O ports, up to 10 vectored interrupts, up to 16 masters on the bus (with priority) and up to 10 Mhz data transfer rate? You will have to go a long way to use up that computing power.

S-100 is standardized. The S-100 bus has been standardized by the IEEE (Institute of Electrical and Electronic Engineers) assuring the highest degree of compatibility among plug-in boards from different manufacturers. And, *Microsystems* has published the complete IEEE S-100/696 standard (all 26 pages).

S-100 has the greatest hardware support. There are now over sixty different manufacturers of about 400 different plug-in S-100 boards. Far greater than any other microcomputer system.

With all these advantages is it any wonder that S-100 systems are so popular with microcomputer users who want to do more than just play games?

For the serious computer user.

Each issue of *Microsystems* brings you the latest in the CP/M and S-100 world. Articles on applications, tutorials, software development, product reviews, and lots more, to keep you on top of the ever changing microcomputer scene.

And if you are an S-100 system user using other operating systems (e.g. North Star) *Microsystems* also supports you.

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Bring the flavor of Unix To your Z80-based CP/M system with Unica

"Unicum: a thing unique in its kind, especially an example of writing. Unica: the plural of unicum."

The Unica: a unique collection of programs supporting many features of the Unix operating system never before available under CP/M. The Unica are more than software tools; they are finely crafted instruments of surgical quality. Some of the Unica are:

bc - binary file compare
cat - catenate files
cp - copy one or more files
dm - disk map and statistics
hc - horizontal file catenation
ln - create file links (aliases)
ls - directory lister
mv - move (rename) files, even across users
rm - remove files
sc - source file compare, with resynchronization
srt - in-memory file sorter
sr - search multiple files for a pattern
sp - spelling error detector, with 20,000 word dictionary

Each Unicum understands several flags ("options" or"switches") which control program alternatives. No special"shell" is needed; Unica commands are typed to the standard CP/M command interpreter. The Unica package supports several Unix-like facilities, like filename user numbers:
sc data.bas;2 data.bas;3
(compares files belonging to user 2 and user 3);
Wildcard patterns:
rm *tmp* -v
(types each filename containing the letters TMP and asks whether to delete the file);
I/O redirection:
ls -a ►list
(writes a directory listing of all files to file"list");
Pipes:
cat chap* ! sp ! srt ►lst:
(concatenates each file whose name starts with"chap", makes a list of mispelled words, sorts the list, and prints it on the listing device).

The Unica are written in XM-80, a low level language which combines rigorously checked procedure definition and invocation with the versatility of Z80 assembly language. XM-80 includes a language translator which turns XM-80 programs into source code for MACRO-80, the industry standard assembler from Microsoft. It also includes a MACRO-80 object library with over forty "software components", subroutine packages which are called to perform services such as piping, wildcard matching, output formatting, and device-independent I/O with buffers of any size from 1 to 64k bytes.

The source code for each Unicum main program (but not for the software component library) is provided. With the Unica and XM-80, you can customize each utility to your installation, and write your own applications quickly and efficiently. Programs which you write using XM-80 components are not subject to any licensing fee.

Extensive documentation includes tutorials, reference manuals, individual spec sheets for each component, and thorough descriptions of each Unicum.

Update policy: each Unica owner is informed when new Unica or components become available. At any time, and as often as you like, you can return the distribution disk with a $10 handling fee and get the current versions of the Unica and XM-80, with documentation for all new or changed software.

The Unica and XM-80 (which requires MACRO-80) are priced at $195, or $25 for the documentation. The Unica alone are supplied as *.COM executable files and are priced at $95 for the set, or $15 for the documentation. Software is distributed on 8" floppy disks for Z80 CP/M version 2 systems.

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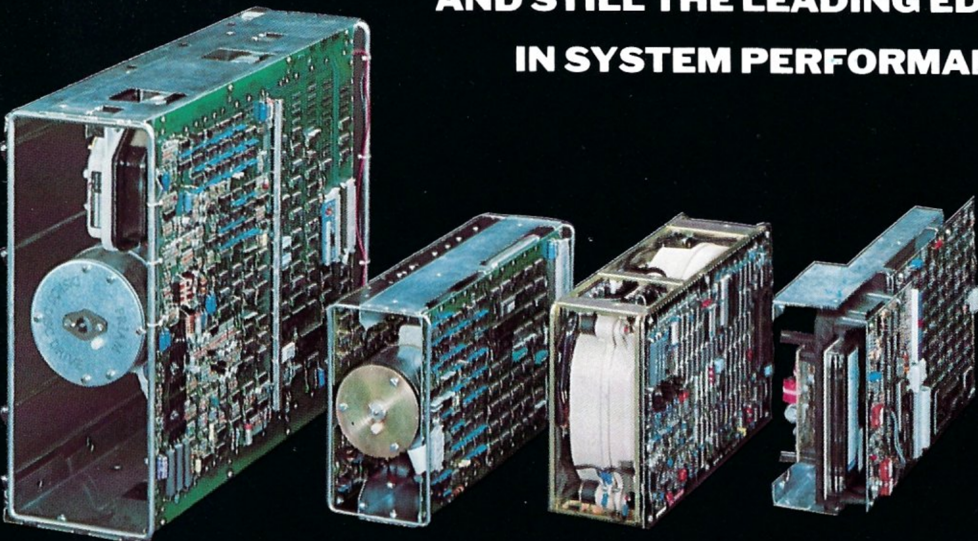

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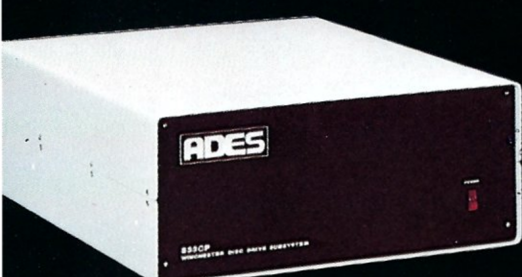

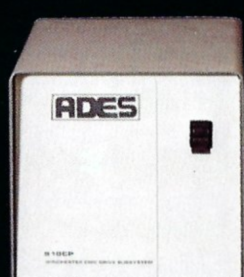

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