



CP/M[®] 2.2

Technical Manual & Installation Procedures

**Single-User Operating System
for 8 Bit Operation**

CP/M 2.2 Technical Manual
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CP/M® TECHNICAL/INSTALLATION GUIDE

INTRODUCTION

There is one diskette included with your CP/M 2.2 system. It includes a bootable CP/M system for operation with the **DISK 1** or **DISK 1A** floppy disk controller the **CPU 8085/88** or **CPU Z** and a number of ".COM" files which will be described later. It also contains all of the system command files, utility programs and BIOS source files. This document will describe how to get CP/M "up and running" with a minimum amount of trouble.

The enclosed version of CP/M requires the following hardware for proper operation:

HARDWARE REQUIREMENTS

- (1) An operational S-100 mainframe.
- (2) A CompuPro CPU 8085/88 (with swap port at OFDh) or CPU Z
- (3) A CompuPro SYSTEM SUPPORT 1

You could also use an INTERFACER 3 or 4 addressed at 10h or an INTERFACER 1 or 2 addressed at 0 as your console.

- (4) A CompuPro DISK 1 floppy controller addressed at 0COH and J17 jumpered.
- (5) At least 64K of 24 bit address RAM in the first 64K page.
- (6) An operational disk drive subsystem.

MAKING A BACKUP SYSTEM

The first thing that must be done when trying to bring up and configure your CP/M system is to make two backup copies for alteration. This will require two diskettes formatted in double density with 1024 byte sectors.

To format the two blank diskettes, boot up the CP/M diskette and invoke the format utility by typing: **FORMAT(cr)**. Insert a blank diskette into the B drive. Select the B drive for formatting and 1024 byte sectors. When the format is done, repeat for the rest of the diskettes.

To copy the system disk onto the formatted diskettes, type: **COPY(cr)** with the blank formatted diskette in the B drive and the system master in the A drive. Choose the source on A and the destination on B. The COPY utility will then copy the master disk track-for-track. Repeat with the second blank diskette.

The foregoing method will leave the copies in the same format (1024 byte sectors) as the master. If you wish to change densities to 256 or 512 byte sectors, or if you want to modify the loader, you will have to use the SYSGEN utility. To use the SYSGEN utility, put your CP/M diskette in the A drive and a formatted diskette in the B drive. Invoke the SYSGEN utility by selecting the "A" drive as the source and typing: **SYSGEN (cr)**. Then select the destination drive to be "B". Repeat for as many diskettes as necessary. Then you may PIP as many files as necessary onto the copies.

FORMATTING THE HARD DISK - DISK 2 & DISK 3

If you have a hard disk or disks, you must run the DISK2 or DISK3 formatter/diagnostic. The DISK2 and DISK3 programs are included on your CP/M diskette. They should be run as follows:

```
A>disk2 [drive type] all
```

or

```
A>disk3 [drive type] all
```

and press the RETURN ([RET]) key. If you have a DISK 2 the "drive type" is either M10 or M20, depending upon whether your hard disk holds 10 or 20 megabytes; the drive type is Q540 if you have a DISK 3 and the 40 megabyte Quantum. This test takes two hours or more to complete. It begins by formatting the tracks, which is evidenced by something like the following display:

```
Formatting Track : NNN   Hard NNN   Soft NNN
```

The track number (NNN) and number (NNN) of hard and soft sector errors are displayed to the right of each entry. If 12 or more errors are reported, consult the Disk 2 or Disk 3 Technical Manuals.

The test continues with:

```
Verifying Track
```

```
Data Test Track
```

and ends with:

```
Seek Test
```

There are 12 "passes" through the sectors in this last test. Upon completion, a bad sector report is given. Any bad sectors found are "mapped out" or effectively blocked from use.

REASSEMBLING THE CP/M 2.2 CBIOS (Background information)

To reassemble this CBIOS, you should use Digital Research's RMAC and LINK80. (NOTE: RMAC and LINK80 are not included with CP/M 2.2. They can be obtained from your Systems Center or Digital Research.) MAC or ASM could also be used, however there are some library files RMAC uses to assemble the BIOS, they should be edited into the CBIOS source and the macros must be expanded. The library files have the extension ".LIB" and are as follows:

ASCII.lib	Some handy ASCII equates
COMPUPRO.lib	CompuPro hardware equates
CPMDISK.lib	CP/M BDOS equates
ACTIVE.lib	Sets up a particular configuration
BOOTSCPM.lib	Cold boot routines

The file ACTIVE.lib is the one that contains all of the equates to set up a particular system (i.e.: turning hard disk on, etc). Be sure you look at all of the equates in this file. An important equate is the BDISK. This is the drive letter that the system will try to warm boot from. This should be set to the letter of the first floppy (drive 0) in the system. If there is no hard disk this will be "A", if there is a Disk 2, the first floppy becomes "I" and the BDISK should be set to "I". Drive designations are set in the MAKDPH macros. Currently, different DPH's are invoked depending on what devices are turned on. For instance, if there is a hard disk, the hard disk has drives "A", "B" and "C" and the floppies are drives "I" and "J". If there is no hard disk, the floppies are drives "A" and "B". Equates are provided to include multiple "like" hard disks (i.e.: two 20 meg hard disks or two 10 meg hard disks, but not a 10 meg disk and a 20 meg disk).

This bios does support 5 1/4 inch floppies on the special 5 1/4" DISK1 addressed at 0CCh. However be forewarned, there are many different 5 1/4" floppy formats and types out there. Also the 2-sided line (pin 10) on the 34 pin cable that goes to the floppies must be pulled to ground if your drives are 2 sided. Also be sure to set the equate TRK5 to the number of tracks on your drives, usually 40, 77, or 80.

There are actually two bios source files included- HMX1BIOS.ASM and HMX2BIOS.ASM. HMX1BIOS.ASM contains I/O drivers for all CompuPro I/O boards for both console and printer. Space in this bios is very tight, so you cannot turn all devices on. For instance, only 2 floppies, 1 hard disk and one memory drive will fit on the boot tracks. If you desire more physical devices, you can use HMX2BIOS.ASM which contains only minimal console I/O drivers. Then the program HMX2IO.COM is executed at cold boot. HMX2IO.ASM is a program that will relocate an extensive I/O system into a reserved space in the bios. This I/O system is easily modifiable and comes supporting IOBYTE, a special IO control byte, interrupts, XON/XOFF

and much more. This allows you to put more device drivers on the boot tracks. If you use HMX2IO, you must set the equate "XLOADZ" to be at least 400h and use MOVCPM to move your BDOS and CCP down by 1K. Still, be careful of space in both the BIOS and the I/O file.

There are two RAM disks supported in this bios. The first is the old M-DRIVE that uses the 8088 to move data in and out of extended system memory, called in the bios XMDRIVE. XMBOOT can be turned on also so that warm boots will be done from system memory instead of the floppy. XMBOOT can be on independent of whether or not XMDRIVE is on. The second RAM disk is the M-DRIVE/H, called HMDRIVE in the bios. If only one of HMDRIVE or XMDRIVE are turned on, it will be set to letter if "M". If both memory drives are turned on, HMDRIVE is drive "H" and XMDRIVE is drive "M".

REASSEMBLING THE COMPUPRO CP/M 2.2 SYSTEM

The first thing that must be done is to create a CCP and BDOS that have been relocated to the right memory address for this version of the BIOS. BIOS HMX1BIOS wants to start at E800H, therefore, the BDOS must start at D00H and the CCP must start at D200H (CCP always starts 1600h bytes below the BIOS). Step one is to tell MOVCPM the size of the BIOS, then MOVCPM will relocate the CCP and BDOS to the right place. Once the file ACTIVE.LIB as been set for your system, the system is built as follows (enter the underlined words):

A>>STAT MOVCPM.COM

```
  Recs  Bytes  Ext Acc
    100   14K   1 R/W A:MOVCPM.COM
Bytes Remaining On A: xK
```

A>;MOVCPM must be 14K bytes long.

A>>DDT MOVCPM.COM

DDT VERSION 2.2

NEXT PC

3300 0100

-S806

806 14 18 (Use 19 for HMX2BIOS)

807 00 .

-^C

A>>SAVE 50 MOVCPM.COM

A>>MOVCPM 64 *


```
CONSTRUCTING 64K CP/M Vers 2.2
READY FOR "SYSGEN" OR
"SAVE 43 CPM64.COM"
A>SAVE 43 CPM64.COM
A>RMAC HMX1BIOS (or RMAC HMX2BIOS)
CP/M RMAC ASSEM 1.1
F3AF      ( These numbers may change )
04FH USE FACTOR
END OF ASSEMBLY
```

```
A>LINK HMX1BIOS [LE800] (or LINK HMX2BIOS)
LINK 1.3
```

```
ABSOLUTE      OBAF (E800-F3AE) ( These numbers may change )
CODE SIZE      0000
DATA SIZE      0000
COMMON SIZE    0000
USE FACTOR     00
```

```
A>RMAC HMXFBOOT
CP/M RMAC ASSEM 1.1
0200      ( These numbers may change )
016H USE FACTOR
END OF ASSEMBLY
```

```
A>LINK HMXFBOOT
LINK 1.3
```

```
ABSOLUTE      0100 (0100-01FF) ( These numbers may change )
CODE SIZE      0000
DATA SIZE      0000
COMMON SIZE    0000
USE FACTOR     00
```

```
A>DDT CPM64.COM
NEXT PC
2C00 0100
-IHMXFBOOT.COM
-R800
NEXT PC
2C00 0100
-IHMX1BIOS.COM (or IHMX2BIOS.COM)
-R900
NEXT PC
2C00 0100
-^C
```

```
A>SAVE 43 CPM.COM
A>SYSGEN CPM.COM
SYSGEN Version 2.2D
Destination drive name (or RETURN to terminate).B
Function complete.
Destination drive name (or RETURN to terminate).cr
```

```
A>;Now your "B" disk should boot up
```

USING THE COMPUPRO M-DRIVE/H MEMORY DISK

The CompuPro CP/M BIOS includes drivers for an M-DRIVE/H memory disk, containing up to **4 megabytes** of fast memory disk on drive "M", and a "soft" M-DRIVE that uses the 8088 and extended address RAM (memory beyond 64K) on a very fast memory disk.

The CompuPro CP/M BIOS will automatically determine how many M-DRIVE/H boards are present, if any, or how much memory is there for the 8088 and set the disk parameter blocks accordingly. The sizing routine is exactly like the memory sizing, and no data is destroyed at boot. The system sign on will tell you how many M-DRIVE/H boards it found. If that number does not equal the number of M-DRIVE/H boards in your system, you should check your switch settings.

Once the system is booted up, the MFORM program is automatically invoked to format only the M-DRIVE/H. You can copy any files that you want to access very fast onto drive "M" with a "SUBMIT" file or with "PIP" and get ready to fly!

If the MFORM program sees that the M-DRIVE/H has already been formatted, it will not reformat the drive. So, data on the memory disk is not destroyed when reset is pushed.

MFORM can also be used to format the soft M-DRIVE, but you must tell it which drive to format. (It will not automatically format the soft M-DRIVE. See the MFORM.com instructions in the Software section of this manual.)

SOFTWARE SECTION

INTRODUCTION

The purpose of this section is to describe the software supplied with CP/M 2.2 and the CompuPro DISK 1 Floppy Disk Controller for the Standard IEEE 696 (S-100) bus.

This manual is written for purchasers who are familiar with the CP/M BIOS customizing techniques. If CP/M 2.2 was purchased with the Disk 1 controller then all corrective patches have been installed. On the other hand if the CP/M was purchased for a different controller then be sure to obtain and install all CP/M corrective patches.

The information contained within the document is divided as follows:

- a. Software User's Guide
- b. Software Features
- c. Software Internal Design
- d. CBIOS Customization Guide

The Software User's Guide describes how to use these software packages:

- a. FORMAT.com --disk formatter
- b. COPY.com -- disk copy utility
- c. SYSGEN.com -- system track copy utility
- d. DISK2.com/DISK3.com -- hard disk formatters
- e. MFORM.com -- memory disk formatter

The next section describes the external features of the supplied software. This section describes the enhancements and assumptions made by the CompuPro CBIOS routines and utility routines.

The Software Internal Design section describes the design of the supplied software. This section should help the user understand how the software components work; thus enabling the purchaser to modify the software for his hardware configuration.

APPLICABLE DOCUMENTS

The reader should be familiar with the following documents.

- a. NEC uPD765 Floppy Disk Controller Application Note
- b. INS2651 Programmable Communications Interface Note
- c. CompuPro DISK 1 Floppy Disk Controller Description
- d. An Introduction to CP/M Features and Facilities
- e. CP/M Operating System Users Guide
- f. CP/M Operating System System Guide
- g. CP/M Operating System Programmers Guide

SOFTWARE USER'S GUIDE

The following paragraphs describe the operating features of the supplied utility programs.

FORMAT.com — Floppy Disk Format Utility

The FORMAT.com utility program is supplied so that purchasers of the Disk 1 board can change the density of his disk (data is destroyed). The FORMAT.com utility formats floppy disk in IBM compatible formats; not all disk controllers are IBM compatible.

The FORMAT utility contains the Disk 1 board interface routines allowing the user to run under a current IEEE 696 CP/M system.

The FORMAT utility has simple and straight forward operating instructions. The user is prompted for input as needed to control the utilities flow. The user initiates the FORMAT utility by entering the following:

```
FORMAT
```

```
or
```

```
FORMAT drive
```

If the drive is not specified on the command line then the FORMAT utility prompts the user with the following line:

```
Specify drive (A: - P:) :
```

The user now enters the drive (A thru P) and the FORMAT utility proceeds.

After the user has specified the drive to be formatted, FORMAT attempts to determine the specified disks format. The disk format or lack thereof is displayed for the user and a message requesting the new format selection is displayed. The format of these displays are as follows:

```
8" disk: 77 tracks, 1 sided, format #0, 128 byte sectors.
```

Track 0,	All other tracks,	Density,	Format type:
128/SD,	26 x 128 bytes,	Single = 0	IBM 1 (3740)
128/SD,	26 x 256 bytes,	Double = 1	
128/SD,	15 x 512 bytes,	Double = 2	
128/SD,	8 x 1024 bytes,	Double = 3	

```
Select Disk format type (0-3):
```

```
0 = 128          2 = 512  
1 = 256          3 = 1024  > _
```

The user now enters the disk formatting selection and the FORMAT utility begins formatting the disk. As each track is formatted an F appears on the screen (total of 77). After formatting all the tracks the FORMAT utility begins a verify operation. This verify operation informs the user of possible bad spots on the floppy disk. These displays and a description of the output follow:

Confirm ready for format on disk drive B (y)_

1	2		6	7
012345678901234567890		.	012345678901234567	
FFFFFFFFFFFFFFFFFFFFF		.	FFFFFFFFFFFFFFFFFFFFF	
VVVVVVSSSVVVVEEVVVV		.	VVVVVVVVSVVSVVEEE	

Symbol meaning: F -- successful format operation.
V -- read verified.
S -- error occurred but retry worked.
E -- hard failure.

After the verification, the FORMAT utility asks the user if another disk is to be formatted. The user response will result in one of three actions as follows:

1. Return to CP/M.
2. Formatting another disk with the same parameters.
3. Change formatting parameters.

The FORMAT utility uses a lot of user interactions to control the utilities flow. The user can get a general idea of the inputs required by entering the following command line:

FORMAT ?

This will result in the following display:

FORMAT will format a diskette to be used with the CompuPro disk subsystem. The FORMAT command has several optional arguments, all associated with any logical drive connected to a DISK 1 controller or Memory drive.

FORMAT d: # will format Drive "d:", with type "#", and is primarily intended for batch formatting.

FORMAT d? will display the format of Drive "d:".

FORMAT d* will re-write the directory of "d:" with all entries marked as "not in use" (repaired).

FORMAT d! is specifically for Memory drives: - IF - it has not already been formatted, then the "d:" directory will be reformatted as above, otherwise the drive will not be affected.

COPY.com — Disk Copy Utilities

The COPY.com utility program performs diskette copy functions.

This program is intended to be used to copy an entire diskette to another diskette. It performs this by reading in a track of data, writing it out, reading it back in and comparing.

The user must tell this program the following information:

1. Area of diskette to be copied.
2. Source drive.
3. Destination drive.

These programs get this information by prompting the user with the following messages:

CompuPro COPY Utility Version 2.X.

Select one:

- (A) All tracks
- (D) Data tracks only
- (S) System tracks only
- (X) Return to CP/M
- (?) Provide helpful information

Selection:

Source drive (a-p):

Destination drive (a-p):

Enter newline to start copying (cr)

As with the FORMAT program, the following is available:

COPY ?

This will result in the following display:

Copy will copy disks on the CompuPro
disk subsystem. To start, type:

COPY <portion><cr>

Where <cr> is the Carriage Return
and <portion> is S = system, D = data or
A = all. If not entered, a prompting message
will be output.

The source and destination drive prompts occur.

SYSGEN.com — System Tracks Copy Utility

The SYSGEN program is used to put the BOOT routines and CP/M system on the system tracks (0 and 1) of a disk drive formatted in any of the MFM modes. SYSGEN will put a BOOT program on track 0 that is written in 8080 code.

The SYSGEN program may be given a source CPM.COM file as part of the command line as shown below:

```
SYSGEN CPM.COM
SYSGEN Version 2.2D
Destination drive name (or return to terminate). B
```

or SYSGEN will get the CP/M system for a specified source drive as follows:

```
A> SYSGEN
SYSGEN Version 2.2D
Source drive name: A
Destination drive name (or return to terminate):
Function complete
```

The user now enters a drive name. The program will put the BOOT 8080 routine and the CPM.COM file on the system tracks (0 and 1) of the "B" drive. The SYSGEN utility will continue to ask for a destination drive until only a return is pressed.

DISK2.com — Hard Disk Format/Test Utility.

Before using your hard disk, you must format it with the "DISK 2" utility provided with all CompuPro S100 systems. The "DISK 2" program will format, verify and test your hard disk drive. Any bad places on the disk that are found will be reported and "blocked" or remapped so the operating system will not use them. The different options that can be used are listed below.

Usage: DISK 2 {options}

At least one option must be specified such as the drive type. You can mix any of the options. Options consist of:

m10	Set drive type to Fujitsu 10 Mbyte
m20	Set drive type to Fujitsu 20 Mbyte
f40	Set drive type to Fujitsu 40 Mbyte BE
drive #	Format selected drive
format	Format headers
data	Write out data fields with E5H
test	Perform a data field test
seek	Perform a seek test
all	Perform format, data test, seek test
skew #	Set skewing of disk to specified number
	This option goes along with hardware settings.

Defaults:

If an option is not specified then the following defaults are used:

M20
skew of 2
sector size 1024
drive 0
no tests or formatting

Examples:

disk2 format data
disk2 m20 all
disk2 data
disk2 format data drive 1 skew 3 m10

DISK3.com - Formatting the DISK 3

Use this utility program to format the DISK 3. The "DISK 3" program will format, verify and test your hard disk drive. Any bad places on the disk that are found will be reported and "blocked" or remapped so the operating system will not use them. The different options that can be used are listed below.

Usage: DISK 3 {options}

At least one option must be specified such as the drive type. If a drive type is not specified, D3FMT will query the user for all of the needed drive specifications. You can mix any of the options.

Options consist of:

q540	Set drive to Quantum 540 40Mbyte CompuPro standard
st506	Set drive to Seagate 506 5Mbyte
help	Print list of commands and options
format	Format headers and data
drive #	Format selected drive
test	Perform a data field test
seek	Perform a seek test
all	Perform format, data test, seek test
verify	Verify sector headers
sector size	Set sector size for drive

The defaults for this program are:

q540
skew of 1
sector size of 1024
drive 0
no tests or formatting

MFORM.com - Memory Disk Format Utility

The MFORM program will format any size CompuPro M-DRIVE/H memory disk, using a format compatible with all of the CompuPro CP/M M-DRIVE/H implementations. This means that you can transfer files between CP/M 2.2 and CP/M 86 by putting files on the M-DRIVE/H memory disk.

The CompuPro BIOS uses the auto-vector feature of CP/M to invoke MFORM at cold boot. If the MFORM program sees that a memory drive has already been formatted, it will not reformat the memory disk. Thus data on the memory disk is not destroyed when reset is pushed.

You can force a reformat of the memory drive by typing:

A>MFORM M

The program will prompt you and ask if you really want to proceed and destroy all the data.

Once the memory disk is formatted, you can use it just like any other disk drive.

SOFTWARE FEATURES

This section describes the features and the assumptions made in the following routines:

- DISK 1 ROM / BOOT
- DISK 1 LOADER
- DISK 1 CBIOS
- DISK 1 FORMAT
- COPY Program
- SYSGEN Program

The above programs assure a disk which has been formatted by the DISK 1 FORMAT utility. The DISK 1 FORMAT utility always formats side 0 cylinder 0 in 128 bytes sectors, FM, 26 sectors per track. The rest of the disk is formatted in one of the following optional formats:

- 128 byte sectors, FM, 26 sectors per track.
- 256 byte sectors, MFM, 26 sectors per track.
- 512 byte sectors, MFM, 15 sectors per track.
- 1024 byte sectors, MFM, 8 sectors per track.

Also note that due to the size of the DISK 1 CBIOS; a CP/M System disk must be recorded in one of the MFM modes.

CompuPro DISK 1 ROM/BOOT

The CompuPro DISK 1 ROM code must reside within 256 bytes and contain no memory data referances. The ROM code is therefore straight line code performing the following functions:

- Reads the first four sectors (BOOT program).
- Disables the ROM.
- Begin executing the BOOT program.

The BOOT program resides in the first four sectors of the disk (512 bytes). It is read by the ROM code into location 0100h and performs the following functions:

- Reads in the CP/M LOADER.
- Sends the SPECIFY command to all floppy disk controllers in the system.
- Initializes all serial I/O ports.
- Jumps to the Cold Start entry of the LOADER.

The CBIOS resides in the 3rd thru 26th sectors of the disk. The code for the ROM and BOOT is very similar and assumes FM disk read (side 0 head 0 is always FM).

CompuPro COLD BOOT

The CompuPro CP/M COLD BOOT does the system initialization, displays a sign on message, perform a cold start which loads the CP/M BDOS and CCP file into memory and transfers control to the CCP.

Cold Start

The Cold Start code performs the following functions:

- Initialize, System Segment Location 3 -- IOBYTE
- System Segment Location 4 -- Current Flexible disk
- Performs the Warm Boot function.
- Transfer control to CCP
- Size both types of M-DRIVE
- Load the CCP and BDOS off of the system disk
- Move a copy of the CCP & BIOS to very high RAM for warm boots (if 8088 switch is on)

CompuPro DISK 1 CBIOS

The CompuPro DISK 1 CP/M CBIOS implements all of the jump vectors described in the CP/M 80 Operating System System Guide.

Since the CompuPro CBIOS uses Blocker / Deblocker code to handle the MFM recorded disks; assumptions are required because CP/M 2.2 does not inform the CBIOS when to flush the disk buffer. Floppy disks are removable media and before a disk can be safely removed the disk buffer must be flushed. Before a change of disk is performed one of the following sequences must be performed:

1. A warm start.
2. Closing all files and a disk reset.
3. Call the CBIOS HOME routine.

Failure to perform one of the above sequences might result in disk data being written on the newly inserted disk.

Warm Boot

The Warm Boot code loads the CP/M CCP and BDOS modules and transfer control to the CCP.

Unit Record

The Standard Unit Record Input / Output routines are:

Console Status.	List Output.
Console Input.	List Status.
Console Output.	Punch Output.
	Reader Input.

The code included in the CompuPro DISK 1 CBIOS assumes the purchaser has a CompuPro INTERFACER 1,2,3,4 or SYSTEM SUPPORT 1. The default console, reader, punch, and list port assignments are shown in the table below:

INTERFACER 1 or 2:	Console -- ports 0 & 1 List -- ports 2 & 3 Reader,Punch -- ports 2 & 3 UL1 -- not supported
SYSTEM SUPPORT 1:	Console -- ports 05CH & 05DH List -- port 10, user 4 Reader,Punch -- not supported UL1 -- port 10, user 5
INTERFACER 3 or 4:	Console -- port 10, user 7 List -- port 10, user 4 Reader,Punch -- not supported UL1 -- port 10, user 5

Other serial Input/Output controllers are quite similar and usually require very little modification, however, parallel or memory mapped video is a different subject and extensive modifications might be required.

Home

The HOME routine flushes the BLOCKER / DEBLOCKER buffer and sets the selected track to zero (0).

Select Disk

The Select Disk routine performs the following functions:

- o Checks for valid drive selection.
- o Computes the specified drive's DPH address.
- o If this is a "first time call" then the disk type is determined.

Set Track

Sets the selected track to the specified value for a subsequent disk transfer.

Set Sector

Sets the selected sector to the specified value for subsequent disk transfer.

Set Disk Memory Address

Sets the disk memory buffer address for the next disk transfer.

Set Extended Address

This routine allows the user to set the high order byte of the DMA address. This allows the CP/M user to access the entire memory address range available on the IEEE 696 bus.

Set Number of Sectors

This routine allows the user to access more than one sector on a track at a time. This feature is only useful for individuals who perform direct transfers with the CompuPro CBIOS.

Read from Disk

A 128 byte record is transferred from the disk previously specified by the Select Disk, Set Track, and Set Sector routines, into the memory buffer defined by the Set Disk memory address routine.

Write to Disk

A 128 byte record is transferred from the memory buffer to the previously selected disk track and sector.

Translate Sector Number

A sector translation function is performed on the specified sector using the translation table specified the the caller.

DISK 1 FORMAT

The DISK 1 FORMAT utility has some important features. One of these features is the automatic determination of the number of sides the disk supports. The FORMAT utility will adjust the formatting parameters for a two-sided disk.

Another feature of the DISK 1 FORMAT utility is to perform a read verify which gives the user a check on the ability of the disk to retain data. We have found disks which will have read errors at one density but not a another. If a disk has hard or soft errors at all densities, then this could indicate one of the following problems:

1. Disk media is bad.
2. Drive heads are dirty.
3. Drive is out of adjustment.
4. Controller is out of adjustment.

A third feature of the FORMAT program is its ability to format CompuPro M-Drive disks.

By typing A>Format ?, a help message will be displayed that discusses all of the format options.

The ability of the FORMAT program to repeat the identical format on another disk saves time when formatting batches of flexible disks.

Features the purchaser might want to add to the DISK 1 FORMAT utility are:

- o Formatting System Tracks only.
- o Formatting Selected Tracks only.

COPY Utility

The COPY routine performs a track by track copy of the source disk to the user specified destination disk.

COPY uses the standard CBIOS call formats for reading and writing the data. The only known restriction with this program is that the format of the disk must be compatible with the NEC definition for FM and MFM and the source and destination disks must be exactly the same format and contain the same number of sides.

SYSGEN Utilities

The SYSGEN program will put the BOOT and CP/M 2.2 System onto the system tracks (0 & 1) of a user specified destination disk.

The SYSGEN routine will write to either single or double sided disks, and since the system tracks are always FM, SYSGEN can put the BOOT and LOADER onto a disk formatted in any of the standard MFM formats.

MFORM Utility

The MFORM Utility will format any size CompuPro M-DRIVE/H memory drive. MFORM is invoked automatically at power on, but will not reformat when just the reset button is pressed. So as long as power remains on, the system can be reset without destroying the data on the memory drive.

SOFTWARE INTERNAL DESIGN

This section describes the general flow and philosophy of the supplied components.

CompuPro DISK 1 ROM/BOOT

The DISK 1 ROM and BOOT routines are very straightforward. They are both straight line code routines with few loops. The important item to remember when reviewing the listing is the following system disk layout:

Cylinder 0, Head 0 -- FM recording; 128 byte sectors 0-1 reserved for CompuPro DISK 1 BOOT. Sectors 2-23 reserved for CompuPro DISK 1 CBIOS. Sector 25 reserved for RESTART code loaded at FFF8:0070 (actual location OFFF0).

Cylinder 0, Head 1 -- MFM recording; 256, 512, or 1024 byte sectors. Sectors 1-n - not used.

Cylinder 1, Head 0 -- MFM; 512 byte sectors. Sectors 0-3 reserved for CCP. Sectors 4-11 reserved for BDOS. Sectors 12-15 reserved.

Cylinder 1, Head 0 -- MFM; 1024 byte sectors. Sectors 0-1 reserved for CCP. Sectors 2-5 reserved for BDOS. Sector 6,7 reserved.

Cylinder 1, Head 1 -- MFM; 256, 512, or 1024 byte sectors. Sectors 1-n not used.

The value of n which equals sectors per track is: 26 for 256 byte sectors, 15 for 512 byte sectors, 8 for 1024 byte sectors.

CompuPro DISK 1 LOADER

The CompuPro DISK 1 LOADER's basic function is to initialize any hardware that requires it, to load in the CBIOS (located on cylinder 0) and transfer execution to the CBIOS cold start.

CompuPro DISK 1 CBIOS

The CompuPro DISK 1 CBIOS quite literally makes CP/M work. The CompuPro DISK 1 CBIOS uses a modified version of the CP/M DEBLOCK routines. The modification stems from the fact that multiple sector formats are supported. All CP/M disk transfers are 128 bytes in length, and a method for combining the 128 byte transfers into a single transfer is required.

The description of tables and variables used in the CompuPro DISK 1 CBIOS are key to its understanding; therefore the following paragraphs describe the key tables and variables.

The DPBASE table contains a CP/M Disk Parameter Header (DPH) for each logical disk drive. The DPH is described in the CP/M 80 Operating System System Guide, but a few comments here are appropriate. The DPH is used mostly by CP/M, but five entries are of interest to the CompuPro DISK 1 CBIOS -- the relative drive number, the Translation Table Address, the Disk Parameter Block (DPB) Address, the Check Vector Address, and the Allocation Vector Address. The Check Vector Address and Allocation Vector Address are mentioned here, because storage within the CompuPro DISK 1 CBIOS must be reserved for these CP/M tables.

The relative drive number tells the CBIOS which drive on a particular controller is being accessed.

The Translation Table Address is used to translate CP/M consecutive sectors into software interlaced external sectors. In order to maintain compatibility between single density disks, a six sector interlace table is used; but for other sector formats different tables are used.

The most important entry within the DPH is the Disk Parameter Block. This address points to a table -- one table for each disk type -- which describes the storage characteristics of associated disk type. The CP/M 2.2 Operating System System Guide, describes the entries within the DPB, but the Guide does not describe why the CompuPro DISK 1 CBIOS has defined the DPB values. The format of the CompuPro DISK 1 CBIOS DPBs follows:

Disk type definition blocks for each particular mode. The format of these areas are as follows:

- 8 bit = Disk type code
- 16 bit = Sectors per track
- 8 bit = Block shift
- 8 bit = BS mask
- 8 bit = Extent mask
- 16 bit = Disk size/1024 - 1
- 16 bit = Directory size
- 16 bit = Allocation for directory
- 16 bit = Check area size
- 16 bit = Offset to first track

The Sector translation tables contain values which are CP/M compatible or compatible with other popular CP/M implementations.

Now that the description of the tables is complete, the key variables need to be described. The variables contain information about various stages of a disk transfer. The following variables:

- ACTDSK -- Disk Selection Value
- ACTTYP -- Disk Type
- ACTTRK -- Track Number
- ACTSEC -- Sector in Track

The information about the data contained within the host disk deblocking buffer is contained in a corresponding set of variables called HSTDSK, HSTTYP, HSTTRK, and HSTSEC. The SEKxxx variables contain the initial CP/M data transfer request. The variables might result in an actual physical transfer, or the data requested could be contained in the host disk deblocking buffer. Each time CP/M calls the WRITE routine, the C register contains a value which indicates one of the following:

- 0 -- Write to an allocated block
- 1 -- Write to the directory
- 2 -- First write to a previously unallocated block

How the CompuPro DISK 1 CBIOS uses these values and other variables reduces the number of unnecessary pre-reads.

The following paragraphs describe the differences between the CBIOS described in the CP/M 2.2 and the CompuPro DISK 1 CBIOS implementation. The reader should be especially familiar with Sections 6 and 12.

The SECTRAN routine differs from the Alteration Guide by testing register DE. If register DE is zero, then no sector translation is performed. Otherwise, DE contains the translation table address.

Since the CompuPro DISK 1 CBIOS attempts to detect the density and number of sides of a floppy disk contains, the SELDSK diverges significantly from the Alteration Guide. When the SELDSK is invoked by CP/M, the disk selection value is saved. SELDSK calculates the DPH address, and the least significant byte of DE is tested for zero. If the bit is non-zero, then the disk type is extracted and saved, and the DPH address is returned.

The more complicated process begins when the bit is zero. The SELDSK routine calls TREAD to try and determine the floppy disk type. If TREAD returns with the zero flag set, then the type was determined. SELDSK then computes the appropriate DPB address and initializes the translation table and DPB address in the DPH.

The READ routine appears simplified, but this is a result of modularizing its code. This routine first calls for the CHKBKD, which checks the disk type for single density floppy. If the disk is a single density floppy, then the READ routine jumps to the physical sector reading routine FINAL. If the disk is not a single density floppy, then the host buffer is filled by the FILL routine, and the appropriate 128 byte sector is moved to the user's buffer.

The WRITE routine is significantly more complicated than the READ routine. This complication results from the attempt to reduce the number of unnecessary pre-reads of the disk.

The WRITE routine calls CHKBKD to determine the disk type. If the disk type is a single density floppy, a jump to the physical WRITE routine is performed. If the disk type is not a single density, then the logic parallels the WRITE routine documented in the Alteration Guide.

CompuPro DISK 1 CBIOS is written fairly straight forward, and only two places are "tricky". The first sneaky portion is in the FILL routine. The FILL routine returns two parameters on the stack: the host buffer address, and the caller's buffer address. The code to place these two addresses into the stack starts with the XTHL instruction. The other "sneaky" code is in SETUP. SETUP pushes the transfer routine address onto the stack so that the EXEC routine jumps directly to the appropriate disk transfer routine.

This concludes the description of the CompuPro DISK 1 CBIOS. If you want more detailed information, refer to the listings and source of the supplied CompuPro DISK 1 CBIOS.

HARDWARE SECTION

TROUBLESHOOTING YOUR SYSTEM

The following table has been designed to aid you in the event your system does not operate correctly:

Problem	Probable Cause	Remedy
	FLOPPY DISK	
Fan off, power indicator not lit:	Power cord not plugged in.	Plug in cord.
	Power cord not plugged into rear panel of system.	Plug in cord.
	Wall outlet not live.	Check outlet. Check circuit breaker.
	Main circuit breaker has tripped.	Check system for shorts; turn breaker OFF, then back ON.
Fan on, power Indicator not lit	Indicator light bad.	Contact dealer.
	Internal connection loose.	Contact dealer.
	Power supply connection loose.	Contact dealer.
Power on, but disk drive indicator light does not blink:	Disk drive not plugged in.	Plug it in.
	Power cord not plugged in.	Plug it in.
	Floppy disk drive breaker switch not ON.	Turn it ON.
	Circuit breaker on disk drive rear panel tripped.	Check connections for shorts; turn breaker OFF, then back ON.

Problem	Probable Cause	Remedy
Disk drive indicator light does not blink:	Cable improperly connected.	Re-connect it.
	System not initialized.	Push RESET on Enclosure 2 front panel.

Drive head loads, seeks, but system does not power up:	Floppy diskette inserted incorrectly.	Insert diskette with label facing up and away from slot.
	Incorrect diskette inserted.	Insert CP/M boot diskette.
	Cables and plugs incorrectly connected.	Refer to board manuals.
HARD DISK		

Drive does not initialize	Data or control cable connected incorrectly.	Methodically change cable connections.
	Power supply connection loose.	Contact dealer.
	Drive head not unlocked.	Unlock head.
	CPU switch settings incorrect.	Reset switches.
	Internal drive cable unplugged.	Check cable connections.
	Internal drive cable disconnected.	Undo cover of drive cabinet and re-connect.
	Error in tracks 0 and 1.	Contact dealer.

Problem	Probable Cause	Remedy
	TERMINAL I/O	
System sounds like it booted up but no message on the terminal:	Cable incorrectly connected.	Check cable connections.
	Terminal incorrectly set.	Check baud rate and word size settings.
	Terminal not powered up.	Plug in terminal and turn on.
	I/O board switches not set properly.	Reset switches.
	I/O board headers not wired correctly.	Recheck connections on headers.
	Bad RS232 cable.	Try another cable.

HARDWARE SETTINGS FOR CP/M

CPU 8085/88 - Switch Settings:

S1		S2		S3	
OFF	ON	OFF	ON	OFF	ON
==		==		==	
	==		==		==
==		==		==	
==		==		==	
==		==		==	
	==	==		==	
==		==		==	

CPU Z80 - Switch Settings:

S1		S2		S3	
OFF	ON	OFF	ON	OFF	ON
==		==		==	
==		==		==	
==		==		==	
==		==		==	
==		==			==
==		==		==	
==		==		==	
==		==		==	

SYSTEM SUPPORT 1 - Switch Settings:

S1		S2		S3	
OFF	ON	OFF	ON	OFF	ON
==			==	==	
==			==	==	
==			==	==	
	==		==	==	
==		==			==
==		==		==	
	==	==			==
==		==		==	

Jumpered Settings:

- J1 -- Serial port connection.
- J2 -- Insert a dip shunt, shunting lines 1, 2 and 3-wire, no handshaking.
- J3 -- Plug an auxiliary battery cable into this connector, red wire toward the left.
- J13 -- Insert shorting plug onto prongs 8 and C (if you have a CPU 8085/88).
Insert shorting plug onto prongs C and Z (if you have a CPU Z).

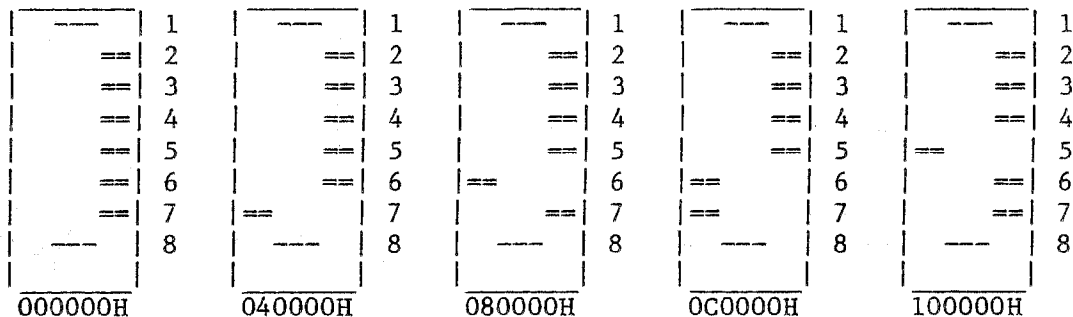
Remaining jumpers are left unconnected.

ROM Sockets:

- U16 -- Install a 6116 RAM chip or "GO 86" EPROM (if you have a CPU 8085/88).

RAM 22 MEMORY BOARD - Switch settings

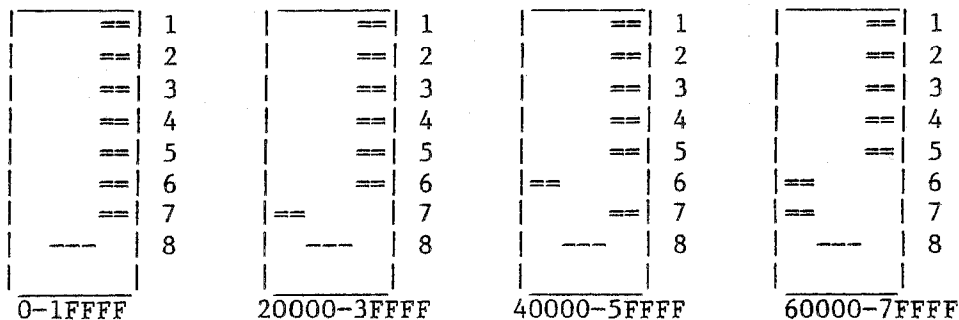
1st 256K	2nd 256K	3rd 256K	4th 256K	5th 256K
OFF ON	OFF ON	OFF ON	OFF ON	OFF ON



NOTE: This board does not allow any of the four 64K blocks on the board to be disabled.

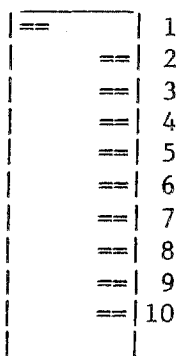
RAM 21 MEMORY BOARD - Switch Settings for S1:

1st 128K	2nd 128K	3rd 128K	4th 128K
OFF ON	OFF ON	OFF ON	OFF ON



RAM 17 MEMORY BOARD - Switch settings for S1:

OFF ON



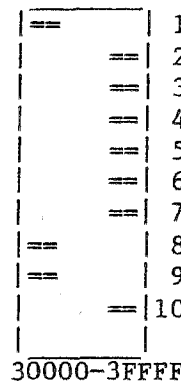
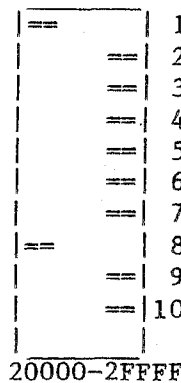
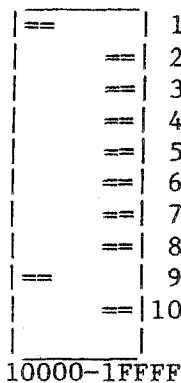
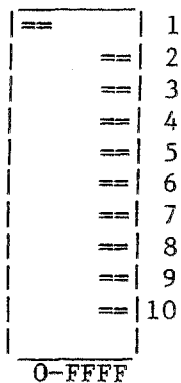
Switch Settings for S2:

1st 64K
OFF ON

2nd 64K
OFF ON

3rd 64K
OFF ON

4th 64K
OFF ON



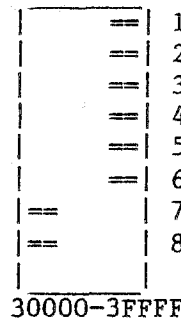
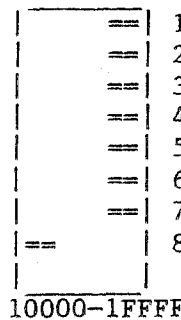
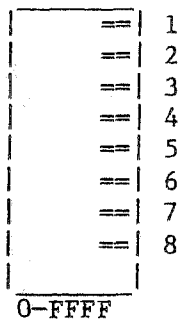
RAM 16 MEMORY BOARD - Switch Setting for S1:

1st 64K
OFF ON

2nd 64K
OFF ON

3rd 64K
OFF ON

4th 64K
OFF ON



DISK 1 FLOPPY DISK CONTROLLER

Switch Settings for 8" drives: (Disk 1-8)

S1			S2		
OFF	ON		OFF	ON	
	==	1		==	1*
==		2		==	2*
==		3	==		3
==		4~	==		4
==		5		==	5
==		6		==	6
==		7		==	7
==		8		==	8

~ OFF to BOOT from a Floppy Disk, ON to BOOT from a Hard Disk.

* Paddles 1 & 2 ON for INTERFACER 1 & 2; Paddle 1 OFF, Paddle 2 ON for SYSTEM SUPPORT 1; Paddle 1 & 2 OFF for INTERFACER 3 & 4

- Jumpered Settings: J16 -- Install a jumper on B-C
J17 -- Jumper A-C

Switch Settings for 5.25" drives: (Disk 1-5)

S1			S2		
OFF	ON		OFF	ON	
	==	1		==	1
==		2		==	2
==		3	==		3
	==	4	==		4
==		5		==	5
==		6		==	6
==		7	==		7
==		8	==		8

* Paddles 1 & 2 ON for INTERFACER 1 & 2

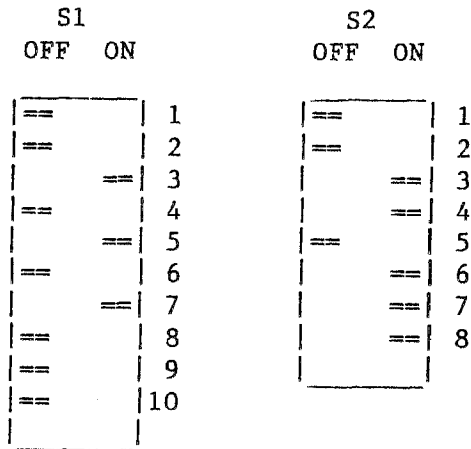
- Jumpered Settings:

If your minifloppy does not drive the READY* line, install a jumper on J15 between "A" and "B". If your minifloppy does drive the READY* line, install a jumper between "A" and "C".

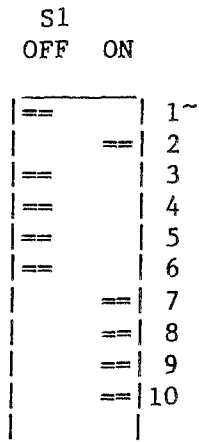
If you are using double-sided diskettes in your minifloppy, you must ground the "TWO-SIDED" line on the Disk 1-5 board.

DISK 2/SELECTOR CHANNEL HARD DISK CONTROLLER

DISK 2 Switch Settings:



SELECTOR CHANNEL Switch settings:

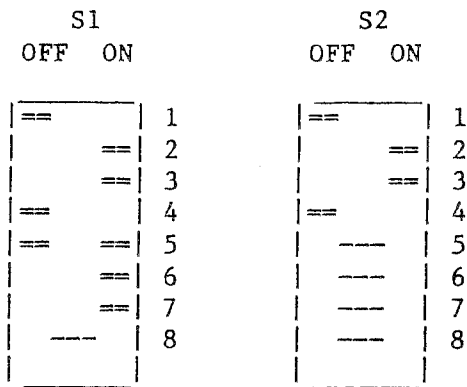


~ OFF to BOOT from Floppy Disk: On to BOOT from Hard Disk

Jumper settings:

- J8 Jumper installed on "+" if INTERFACER 3 or INTERFACER 4
Jumper installed on "G" if SYSTEM SUPPORT 1 or INTERFACER 1
- J9 Jumper installed on "+" if INTERFACER 3, INTERFACER 4, or
SYSTEM SUPPORT 1
Jumper installed on "G" if INTERFACER 1
- J10 Jumper installed on "G"

DISK 3 Switch Settings:

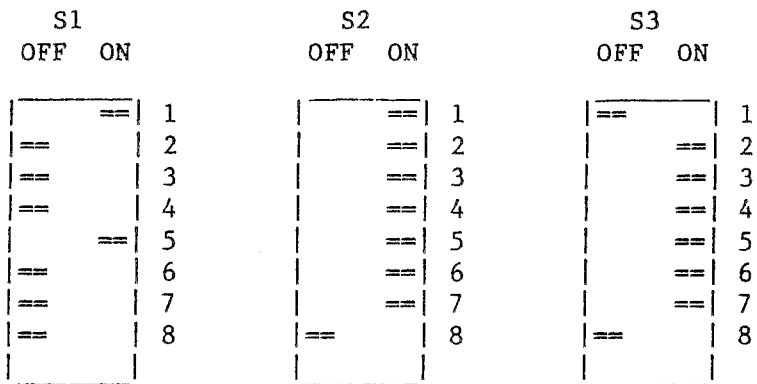


Jumper Settings:

- J1 Connector for drive 1 radial cable.
- J2 Connector for drive 2 radial cable.
- J3 Connector for drive 3 radial cable.
- J4 Connector for drive 4 radial cable.
- J5 Connector for daisy chained cable cable for all drives.
- J6 (Not currently used.)
- J7 B-C
- J8 A-C
- J9 Jumper position 1.
- J10 Jumper top position.

INTERFACER 1

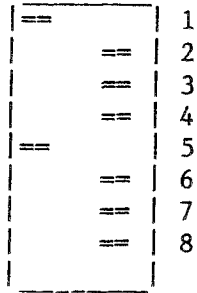
S1 -- Set paddles according to baud rate settings described in Technical Manual (example is for 9600 baud).



- Jumpered Settings:**
- J3 & J5 -- Pin 1 to 15
Pin 2 to 16
 - J4 & J6 -- Pin 6 to 7

INTERFACER 3 - Switch Settings for S1:

OFF ON



Jumpered Settings:

J1 -- Insert a dip shunt, shunting lines 1, 2 and 3 for 3-wire, no handshaking. Consult manual for hardware handshaking.

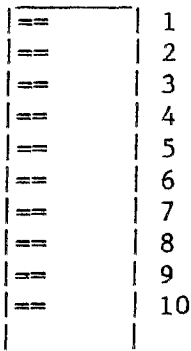
J2 -- Insert a dip shunt, shunting lines 1, 2 and 3 for 3-wire, no handshaking. Consult manual for hardware handshaking.

J17 -- Jumper top two pins.

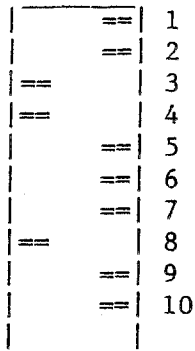
Remaining jumpers unconnected.

INTERFACER 4: - Switch Settings:

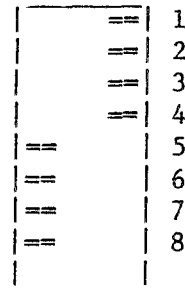
S1
OFF ON



S2
OFF ON



S3
OFF ON



Jumpered Settings

- J1 -- No shunt need be installed
- J2 -- Bottom installed with Multiline 10 printer /
No shunt otherwise
- J3 -- Top installed with Multiline 10 / No shunt
otherwise
- J4 -- Bottom installed with both Epson and Centronics
- J5-J25 -- Removed
- J26 -- Jumper A-B and C-D for the CENTRONICS CHANNEL
as user 4.
Jumper A-C and B-D for the CENTRONICS CHANNEL
as user 6.
- JS1,JS2,JS3 -- Install shunt, shorting all 8 lines.
- JS4-JS6 -- No connections.

M-DRIVE/H - Switch settings

S1		Board Number	Switch Number*			
OFF	ON		8	9	10	
==		1	1st	ON	ON	ON
==		2	2nd	ON	ON	OFF
	==	3	3rd	ON	OFF	ON
	==	4	4th	ON	OFF	OFF
	==	5	5th	OFF	ON	ON
==		6	6th	OFF	ON	OFF
==		7	7th	OFF	OFF	ON
	==	8*	8th	OFF	OFF	OFF
	==	9*				
	==	10*				

*Switches 1 thru 7 are the set
the same on all boards.

CP/M 2.2

CompuPro

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