CompuPro®

CP/M-86®

Technical Manual
& Installation Procedures

CP/M-86 TECHNICAL MANUAL

Hayward, CA 94545

Filename: CPM86A.MAN
Document #15039

First Edition: August 1982
Second Edition: March 1984

CONTENTS

HARDWARE SECTION

INTRODUCTION

There are two diskettes included with your CP/M-86 1.1 system. Diskette number 1 contains a bootable CP/M-86 system for operation with the DISK 1 or DISK 1A floppy disk controller and the CPU 8085/88, and a number of ".SYS" files which will be described later. Diskette number 2 contains a bootable CP/M-86 system for operation with the DISK 1 or Disk 1A floppy disk controller and the CPU 86/87 or CPU 286, and most of the system command files, utility programs and BIOS source files. This document will describe how to get CP/M-86 "up and running" with a minimum amount of trouble.

The enclosed version of CP/M-86 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), a CPU 86/87 or CPU 286.

(3) A CompuPro SYSTEM SUPPORT 1 with a 6116 RAM chip or the G086 EPROM installed in socket U16 and addressed at location OFF000H, and the serial channel with the I/O block addressed at 50H.

    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 or Disk 1A floppy disk controller addressed at 0C0H.

(5) At least 128K of 24 bit address RAM in the first two pages of memory.

(6) An operational disk drive subsystem.

ATTENTION: ARE YOU UPDATING AN EXISTING DISK2 HARD DISK SYSTEM? Starting with version R of CP/M-86, we have changed the method of doing bad sector relocation. This means that any DISK2 hard disk system using any previous release of any CompuPro software MUST be reformatted with the DISK2 format program from one of the newer operating systems. Give the "ALL" option to the DISK2 program to reformat the hard disk.

MAKING A BACKUP SYSTEM

The first thing that must be done when trying to bring up and configure your CP/M-86 system is to make two backup copies for alteration. This will require four diskettes formatted in double density with 1024 byte sectors.

To format the four blank diskettes, boot up the appropriate CP/M-86 diskette and call up 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. Then change masters and copy the second master. Please note that the COPY utility assumes the diskettes are either both single-sided or both double-sided, and of the same format. COPY will not work otherwise.

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 with the appropriate loader file LDR88.CMD for the CPU 8085/88, or LDR86.CMD for the CPU 86/87 or CPU 286. If you are familiar with CP/M 80, the SYSGEN.CMD utility is almost identical to SYSGEN.COM. To use the SYSGEN utilities, put your CP/M-86 diskette in the A drive and a formatted diskette in the B drive. Invoke the SYSGEN utility by typing: **SYSGEN LDR88.CMD (or LDR86.CMD)(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. NOTE: PIP the file CPM.SYS file first to minimize boot time.

Keep in mind that there are two different loader files. The one on disk number one is for the CPU 8085/88 processor and is called LDR88.CMD, and the one on disk number 2 is for the CPU 86/87 or CPU 286 processors and is called LDR86.CMD. Be sure to use the one that is for your processor.

NOTE: SYSGEN.CMD is our version of the file called LDCOPY.CMD in the Digital Research documentation, and it performs the same function.

Once you have your system copies in hand, proceed to the next section if you have a hard disk, if not, skip it and follow the instructions under "Configuring the CP/M-86 System".

FORMATTING THE HARD DISK - DISK 2

If you have a hard disk and a DISK 2 controller, you must run the DISK 2 formatter/diagnostic. It should be run as follows:

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

and press the RETURN ([RET]) key. The "drive type" is either M10, M20, M20BE or M40BE, depending on whether your hard disk holds 10, 20 or 40 megabytes. (BE refers to the models modified for a faster data rate.) 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 Technical Manual.

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. After the test is complete, **DO NOT** reformat the disk as this will destroy the bad sector map.

- DISK 3

If you have an ST506 compatible hard disk drive and a DISK 3 controller, run the DISK 3 formatter/diagnostic.

This test will take about 17 hours, but it is very important to let it run till it is completed to make sure that any bad sectors will be found and mapped. The bad sector relocation is done at the end of the test.

Type: A>**DISK3 ALL** then press the carriage return.

The screen will show you a list of parameters for the drive. These parameters assume that you are using a CompuPro HD40 subsystem.

```
are all the above values correct (Y or N):
```

Answer (Y) if you have the CompuPro 40M hard disk, (N) if you don't. You can then fill in the correct parameters for your

drive. The test formats the drive, verifies its contents, and performs the data and seek tests. You may hear a lot of noise during the seek test, but this is normal. DO NOT STOP THE TEST! Completing this test is your best guarantee that your DISK 3 and the hard disk will work properly. After the test is complete, **DO NOT** reformat the disk as this will destroy the bad sector map.

If you are getting errors on every cylinder during the verify, the 20-pin cable is probably reversed. Stop the test by pushing the RESET button. Check your cable to make sure it is correctly attached. If it is not, attach it properly and start the test again. If the test does not work at all, the 34-pin cable is probably reversed. Check your cable and start the test again.

CONFIGURING THE CP/M-86 SYSTEM

As shipped, CP/M-86 is configured with drive "A" as the first floppy drive and there is no hard disk, the memory drive is drive M. The console I/O can be either a serial port on an INTERFACER 1, 2, 3, 4 or the serial port on the SYSTEM SUPPORT 1. The list device is configured for a serial INTERFACER 1 or 2 or relative user 4 on an INTERFACER 3 or 4. Note that the "Bit Banger" serial port on the DISK 1 is not implemented. The floppy disk drive step rate is 3 milliseconds track-to-track.

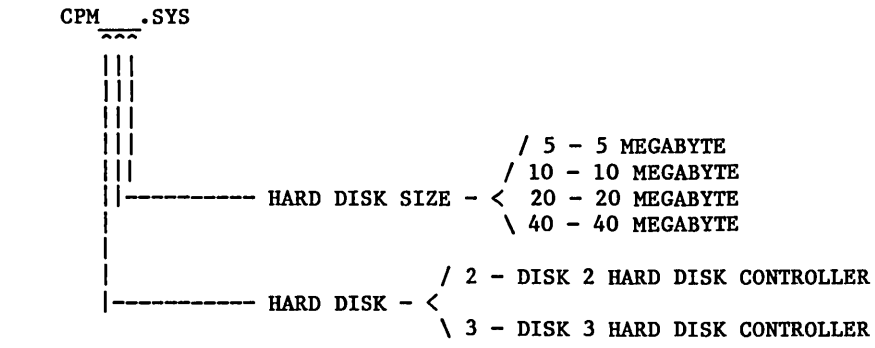
There are many different ways a CP/M system can be configured to use combinations of hard and floppy disks. You must decide whether you want the "A" drive to be on the hard disk or on the floppy disk, which hard disk controller you will use, the Disk 2 or Disk 3, what size hard disk you will use, and which interfacer board you want for the console. Configuring a BIOS for your system could be done by setting equates in the BIOS source, assembling it with Digital Research, Inc.'s ASM86 assembler, and overlaying a new BIOS. Refer to page 9 of this manual for further instructions. We have already pre-assembled almost every possible configuration for you and put them on your master disk number 1 in the form "CPM?XX.SYS", where the "?" represents the hard disk controller you are using, and the "XX" represents the size of your hard disk, as shown in the chart below. After you have formatted the Winchester drive to be used with your system you must install the desired version of CP/M. With CP/M-86 this is quite easy since the system is read in to memory from a file on the disk called "CPM.SYS".

The floppy disk only version is included on Disk #1 as simply CPM.SYS, so that the master boots up as a floppy-only system. To make a copy of a floppy system you may either use the COPY utility to make a track-to-track copy, or combine SYSGEN with PIP as in:

```
PIP B:=A:CPM.SYS[VROW]
```

To configure for a hard disk refer to the following key:

KEY



Once you have determined the above variables, look for the appropriate CP/M system file on your copy of the master distribution diskette by using the directory command DIR CPM?XX.SYS where the '?' and the 'x's' represent the above variables. A response should follow which will have the floppy and hard disk BIOS revision numbers where the variables were. Then the desired system can be generated using the "PIP" command as shown below.

EXAMPLE: PIP CPM.SYS=CPM340.SYS

This will create a CP/M system which will find the 40 M byte CompuPro HD40 hard disk as drives A - E, using the Disk 3 hard disk controller.

The final step is to make a system disk with your "CPM.SYS" file and all of the system commands on it. This should be done with "SYSGEN" and "PIP" as described above.

Note that although there are many types of ST506 hard disk drives which are the same size, they may have different parameters (number of heads, number of platters, etc.). The only ST506 drives currently supported by CompuPro software with the Disk 3 are the 5 Megabyte drive and the CompuPro HD 40.

Currently, although the "A" drive can be on the hard disk, the system still must boot up off the floppy drive. After the system is up and running, the "boot" floppy can be removed, since CP/M-86 does not go to the disk on a warm boot.

USING CP/M-86 IN DIFFERENT MEMORY SIZES

Unlike CP/M 80, which needs to be reassembled (or MOVCPMed) every time you want to change the memory size, CP/M-86 determines how much memory it can use by a table called MRT for Memory Region Table. The MRT and its function is described in your CP/M-86

documentation. The CompuPro implementation of CP/M-86 will "self-size" the system every time it boots up and fill in the MRT table accordingly. The end of memory is found by reading the data right above the system, changing that location, and reading it again. If the location was changed, a location 16 bytes higher is tried. This is repeated until a location is found that cannot be changed, (no memory or ROM). So you can add any increment of memory, by just putting it in the system and booting it up!! The system will immediately know about it!

The system sign on message should tell you how much memory was found. If this number does not agree with the amount of memory in your system, you should check the switch settings on the memory boards.

Note that due to the self-sizing feature of CompuPro's CP/M-86 1.1, it will not boot up in "global" memory (memory that does not respond to all 24 IEEE 696 address lines).

USING THE COMPUPRO MDRIVE/H MEMORY DISK

The CompuPro CP/M-86 BIOS includes drivers for an MDRIVE/H memory disk, containing up to 4 megabytes of fast memory disk on drive "M".

The CompuPro CP/M-86 BIOS will automatically determine how many MDRIVE/H boards are present, if any, 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 MDRIVE/H boards it found. If that number does not equal the number of MDRIVE/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 the memory drive. So you can just 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!

INTRODUCTION

The purpose of this section is to describe the software supplied with CP/M-86 1.1 and the CompuPro DISK 1 or DISK 1A Floppy Disk Controller for the Standard IEEE 696 (S-100) bus.

This section is written for purchasers who are familiar with the CP/M BIOS customizing techniques. If CP/M-86 1.1 was purchased with the DISK 1 or DISK 1A 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 this document is divided as follows:

a. Software User's Guide
b. Software Internal Design
c. CompuPro CBIOS Overview

The Software User's Guide describes how to reassemble the CP/M-86 BIOS and loader to change parameters, make corrective patches using DDT86, and how to use these software packages:

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

The Software Internal Design and Overview sections describe 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. CP/M-86 Operating System Programmer's Guide
e. CP/M-86 Operating System Users Guide
f. CP/M-86 Operating System System Guide

As shipped, CP/M-86 is configured so that the floppy disk drive step rate is 3 msec. (appropriate for the Qume 842 disk drives used in a CompuPro disk subsystem --- if you have Shugart type 850 drives, this should be set to 8 msec.). The parameters for the programmable USART's (I/O 3, 4, and System Support boards) are initialized by the Loader before CP/M is loaded or executed; these are set for 9600 baud, 8 data bits, 2 stop bits, and no parity bits. The list device is preset to relative user #4 (LST:)on the Interfacer 3 or 4, and the UL1: device is set to relative user #5. And of these parameters may be changed by the user.

CREATING A CP/M-86 "SYSGENABLE" LOADER FILE

The loader image is made up of 4 parts and laid out on a standard 8" disk as follows:

CYLINDER	HEAD	LOGICAL SECTOR	NAME
0	0	1..4	TMXFBOOT
0	0	5..24	TMXLOAD
0	0	25	GROUP HEADER
1	0	1..6	LDCPM
1	0	7..26	LDBDOS

TMXFBOOT only has enough code to read in the LOADER header record off of sector 25, use it to determine where to put the loader bios, and read the BIOS into its appropriate location. If a CPU 8085/88 is being used, the 8088 restart vector is also put into the proper address. Control is then transfered to the LOADER BIOS, which reads in LDCPM and LDBDOS. LDCPM, LDBDOS and LDRBIOS then form a mini-CP/M which only knows enough to read in the file CPM.SYS from the "A:" drive.

Included with your CP/M system are two loader images, LDR88.CMD for a CPU 8085/88, and LDR86.CMD for a CPU 8086/87 or CPU 286. Either one of these files can be put on a boot disk with the SYSGEN utility as follows:

```
A>SYSGEN LDR88.CMD
```

Since all initialization is done in the loader, and you may want to reassemble the loader files, we have included a submit file called MAKLDR??.SUB, where "??" is either "88" for a CPU 8085/88 or "86" for a CPU 86/87 or CPU 286. The MAKLDR88.SUB file is listed below:

```
;Make LOADER.CMD file for CP/M-86
ASM86 TMXLOAD $$$1
PIP LOADER.H86=LDCPM.H86,LDBDOS.H86,TMXLOAD.H86
GENCMD LOADER 8080 code[A800]
PIP LDR88.CMD=TMXFBOOT.88,LOADER.CMD
ERA LOADER.CMD
;SYSGEN LDR88.CMD
```

Normally you would only need to reassemble TMXLOAD, since that is where all of the initialization takes place. If you must reassemble TMXFBOOT, first decide which TMXFBOOT you need. TMXFBOOT is the only part of the loader process that needs to know if you are using a CPU 8085/88 or a CPU 8086/87 or CPU 286. If you are using a CPU 8085/88 you should assemble the file TMXFBOOT.ASM. This file requires Digital Research's ASM assembler and is built as follows:

```
A>ASM TMXFBOOT
A>LOAD TMXFBOOT
A>REN TMXFBOOT.88=TMXFBOOT.COM
```

If you have a CPU 86/87 or CPU 286, making the TMXFBOOT.86 file is a little more complicated and requires Digital Research's ASM86 assembler as follows:

```
A>ASM86 TMXFBOOT
A>GENCMD TMXFBOOT 8080
A>DDT86
DDT86 1.1
-RTMXFBOOT.CMD
    Start       End
xxxx:0000   xxxx:????
-WTMXFBOOT.86,180,380
-^C
A>
```

Now make any modifications to TMXLOAD and run the makldr submit file.

REASSEMBLING THE CP/M-86 SYSTEM

The CP/M 86 BIOS for the CompuPro Disk 1 was assembled using Digital Research Inc.'s ASM86 assembler, which is supplied with every CP/M-86 disk and system. Therefore, we recommend that any changes you make to the BIOS be made in the source code called TMXBIOS, reassembling the BIOS to implement the desired changes. The "submit" files, MAKSYS.SUB and MAKLDR.SUB, have been included to make this easier. For those who prefer the 'quick patch' approach, instructions on how to find the relevant addresses follow this section.

To make the assembly process easier, the BIOS has been divided into a number of INCLUDE files that are linked together at assembly time. There are two main source files: TMXBIOS.A86 is the CP/M BIOS file, and TMXLOAD.A86 is the loader file. Both files use the same INCLUDE files so that changes need only be made in one place. Each INCLUDE file contains drivers for a particular hardware board of software function, and are usually denoted by the name of the hardware board as in TMXDISK3.DVR. File types that end in "DVR" are the driver routines, file types that end in "TBL" are the data areas, and files that end in "INI" are the initialization code for that board. File types ending in "EQU" are system wide equates and are as follows:

ACTIVE.EQU	—	Equates that make up a configuration
COMPUPRO.EQU	—	CompuPro hardware equates
ASCII.EQU	—	Some useful ASCII equates
CPMDISK.EQU	—	Some useful CP/M equates

To set up a configuration for any standard CompuPro system, you will only have to set the desired equates in ACTIVE.EQU. Usually only the following equates need to be changed.

CPM816	Set to true if assembling for CP/M 8-16
FLOPPY8	Set to true if using 8 inch floppy drives
FPY8X4	Set to true if four 8" drives are desired
FLOPPY5	Set to true if using 5.25 inch floppy disks and a 5.25" DISK1 or DISK 1A
FPY5X4	Set to true if four 5.25" floppy drives
FDXBUF	Set to true if floppy disk directory buffering is desired
D2xxx*	Set desired hard disk type to true for a DISK 2
DISK2X	Set to true for two hard disks of the same type
D3xxxx*	Set desired hard disk type to true for a DISK 3
NDISK3	Set to the number of DISK3 hard disks online
HDXBUF	Set to true to use directory buffering for a hard disk (either DISK2 or DISK3)
INTERACT	Set to true to use interrupts for character I/O

* 'x' refers to the size of the hard disk.

Be aware that FDXBUF and HDXBUF will use 32K of memory each, so at least 194K will be needed to run 8 bit programs with all of the buffering turned on.

CHANGING INTIALIZATION PARAMETERS

To change the step rate of the floppy disk drives(s), for example, go to the file called "ACTIVE.EQU" and find the portion labeled 'FLOPPY DISK'. There, directly below the logical switch that enables the 8-inch disk drives, you will find a variable called STEPR8 (this is the head positioning stepper motor latency, in milliseconds), which you can set to the value appropriate for your drive(s) using a text editor. Once you have made the desired change, save the updated file back to the disk (again using your text editor) and run the MAKLDR submit file.

To change the startup parameters for the USART's (e.g., if your terminal defaults to 19,200 baud and you would like CP/M to boot at this speed), go into the file named 'TMXDEVIO.INI' (or 'TMXINTIO.INI' for an interrupt driven system) where you will find a list of all the USART ports and the values that are sent to the USARTS. See the INS 2651 Programmable Communications Interface Note for the appropriate values. Again, once you have made the changes, reassemble the Loader (see above for directions).

CHANGING PARAMETERS WITH DDT86

This section is for relatively experienced programmers who wish to make on-the-fly changes to the CPM.SYS file with a program utility such as DDT86. Due to the structure of the BIOS, the system parameters of interest to the programmer (i.e., disk step rates, USART parameters, etc.) are not located in a particular place or absolute adddress. The exact placement of this data depends on the configuration settings when the BIOS is assembled (e.g., hard disk code enabled, or I/O 3 interface code enabled). Once again, most of the data is to be found in the file named LDR88.CMD or LDR86.CMD.

Using DDT86 will load the file and tell you where it was loaded. Type L1500 and you will see the jump table (a list of JMP xxxx statements). After the last jump there will be two addresses (you can't list the addresses using the L command since they are just numbers and not jump statements). Use the D(isplay) command to read these two addresses, as shown in the example below.

```
B>DDT86
DDT86 1.1
-RLDR88.CMD
  START       END
1231:0000 1231:1E7F
-L1500
1231:1500 JMP    1B9B
1231:1503 JMP    1543
1231:1506 JMP    1565
1231:1509 JMP    15AD
```

```
1231:150C JMP     160B
1231:150F JMP     160B
1231:1512 JMP     160B
1231:1515 JMP     15AD
1231:1518 JMP     1695
1231:151B JMP     1667
1231:151E JMP     169E
1231:1521 JMP     16B0
-L
1231:1524 JMP     16B5
1231:1527 JMP     16D7
1231:152A JMP     16FD
1231:152D JMP     160A
1231:1530 JMP     16A3
1231:1533 JMP     16BA
1231:1536 JMP     1549
1231:1539 JMP     1561
1231:153C JMP     155C
1231:153F INT     3
1231:1540 SBB     E819[BX],CH
1231:1544 DEC     DI
-D153F,154E
1231:153F CC 18 AF 19 E8 4F 01 E9 BD ED BB 50 18 C3 53 E8
```

The first of these addresses points to the USART initialization bytes, and the second points to the location of the disk head step rate and head unload bytes. Add 300h to these addresses to find the physical location as below:

```
-H19AF,300
1CAF 16AF
-S1CAF
1231:1CAF DF  - step rate*
1231:1cb0 46  - head load
```

*The step rate is the high nibble of this byte, (D0h); the low nibble should be set to 0Fh for all drives curently supported.

The step rate nibble is arrived at by this formula: step nibble=16-srate (in milliseconds). Hence, for a Qume 842 drive, this byte should be set to hex DF (16-3=0Dh, for 3 ms.). For a Shugart 800, set it to hex 8F (16-8=8 ms.).

The location of the USART initialization bytes is derived as follows:

```
-H18CC,300
1BCC 15CC
-D1BCC
1231:1BCC 17 00 12 5A 12 7E 13 27 17 01 12 5A 12 7E 13 27
1231:1BDC 17 02 12 5A 12 7E 13 27 17 03 12 5A 12 7E 13 27
1231:1BEC 15 00 14 00 17 04 12 EE 12 7E 13 27 17 05 12 EE
1231:1BFC 12 7E 13 27 17 06 12 6E 12 77 13 27 17 07 12 5A
1231:1C0C 12 7E 13 27 17 08 12 5A 12 7E 13 27 17 09 12 7F
1231:1C1C 12 75 13 27 17 0A 12 5E 12 7E 13 27 17 0B 12 5E
1231:1C2C 12 7E 13 27 15 00 14 00 5E EE 5E 7F 5F 27 57 36
```

Legend for the initialization code:

```
1BCC 17   Interfacer port select
1BCD 00   Relative user number
1BCE 12   Select mode register 1
1BCF 5A   Value sent to mode register 1
1BD0 12   Select mode register 2
1BD0 7E   Value sent to mode register 2; 19.2K baud=7F, 9600=7E
1BD2 13   Select command register
1BD3 27   Value sent to command register
```

This sequence repeats itself for each relative user number up to 0Bh. Also, please note that the initialization code for the System Support UART resides at addresses 1C34 through 1C39.

Relative user number device assignments:

```
  User #0:  auxiliary I/O
  User #1:      "       "
  User #2:      "       "
  User #3:      "       "
  User #4:  list device (LST:)
  User #5:  UL1: device
  User #6:  TTY device (modem port) (RDR:, PUN:)
  User #7:  console terminal (UC1:)
  User #8:  auxiliary I/O
  User #9:      "       "
  User #10:     "       "
  User #11:     "       "
```

Once you have made the changes you want, save the amended file to the disk with DDT86's W(rite) command: WLDR88.CMD(cr). If you have not changed the length of the file, which you normally won't, DDT86 remembers the start and end address of the file loaded earlier. Now your amended file is on the disk as LDR88.CMD, but it is not yet on the system tracks where it has to be for loading CP/M-86. Again, to put the Loader on the system tracks, we use a program called SYSGEN. Type SYSGEN LDR88.CMD(cr). Now your changes are implemented, and all you have to do is hit RESET to get a cold boot, which loads in the program you just modified.

NOTE: CompuPro strongly recommends any changes be made in the source code, reassembling the BIOS and/or Loader as needed. The data in this last section is presented for experienced programmers... please be cautious when making immediate changes to your BIOS through DDT86; for if you make any modifications, you are on your own, there will be no support.

SOFTWARE UTILITIES

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

FORMAT.cmd — Floppy Disk Format Utility

The FORMAT.cmd utility program is supplied so that purchasers of the DISK 1 board can change the density of his disk (data is destroyed). The FORMAT.cmd 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 straightforward 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: - D:) :
```

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

NOTE: 'A:-D:' refers to **physical** drives 0 - 3, **not** logical drive designations. Therefore, the FORMAT utility will always see the floppy drives as A and B (etc.) even though you have configured your CPM.SYS to see a hard disk as your system drive.

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:

```
Disk is Formatted as 1024 byte sectors.

Select Disk format mode (0,1,2,3):
   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 follows:

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

          1         2                    6         7
01234567890123456789      . . .      01234567890123456
FFFFFFFFFFFFFFFFFFFF      . . .      FFFFFFFFFFFFFFFFF
 VVVVVVSSSVVVVEEEVVVV     . . .      VVVVVVVVVSVVSVVEEE
```

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 program is initiated by:

        FORMAT <dr:><cr>

Where <cr> is the Carriage Return.
If the drive <dr:> is not specified,
it will be prompted for.
```

COPY.cmd — Disk Copy Utilities

The COPY.cmd 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.

Do you want to copy:

      SYSTEM tracks only?     (type S)
      DATA tracks only?       (type D)
      ALL of the disk?        (type A)
      Exit back to system?    (type X) _

Source drive?  (A, B, C, or D) _
Destination drive?  (A, B, C, or D) _
```

NOTE: COPY uses **logical** drives A-P.

```
Put source disk on X
Put destination disk on Y
Then type <return>
```

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

The source and destination drive prompts display.
```

A similar message will be displayed by the CONVERT program.

SYSGEN.cmd — System Tracks Copy Utility

The SYSGEN program is used to put the BOOT and LOADER routines on the system tracks (0 and 1) of a disk drive formatted in any of the MFM modes. SYSGEN using LDR88.CMD will put a BOOT program on track 0 that is written in 8080 code. The BOOT 8080 routine switches over to the 8088 processor of the CPU 8085/88 board before beginning execution of the LOADER. SYSGEN using LDR86.CMD will put a BOOT program on track 0 that is written in 8086 code for the CPU 86/87 or CPU 286 processors.

The SYSGEN program must be given a source LOADER file as part of the command line as shown below:

```
SYSGEN LDR88.CMD
CompuPro 16 bit Sysgen Vers. 1.2d
Destination drive name (or return to terminate). B
```

The user now enters a drive name. The program will put the BOOT 8080 routine and the LOADER file on the system tracks (0 and 1) of the "B" drive. The SYSGEN utilities will continue to ask for a destination drive until only a return is pressed. If no source file is given you will be prompted for a source drive.

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

The "CPM.SYS" file should now be "PIP"ed over to the "B" drive. "PIP"ing the "CPM.SYS" file first will minimize the time required to boot the system.

DISK2.cmd — Hard Disk Format/Test Utility.

Before using your hard disk, you must format it with the "DISK 2" utility provided with your CP/M 80 and CP/M-86 system disks. The "DISK 2" program will format, verify and test your hard disk drive. 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
m20be	Set drive type to Fujitsu 20 Mbyte BE
m26	Set drive type to Shugart 26 Mbyte*
m10m	Set drive type to Memorex 10 Mbyte*
m40be	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.

* Although the DISK 2 program will format these drives, The CompuPro CP/M 80 and CP/M-86 systems are not configured for them.

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.cmd - 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:

st412	Set drive to Segate ST 412 10Mbyte
cmi5619	Set drive to CMI 5619 20 Mbyte
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
dummy	Do nothing except put out an unused bad map (pristine) - useful for retrieving data from damaged file system

The defaults for this program are:

```
q540
step rate in 0 increments of 100 us
head settle time is 0 ms
sector size of 1024
sectors per track is 9
# of heads is 8
# of cylinders is 512
precom will start on cylinder 256
reduce current will start on sylinder 512
interleave of 1
retry count is 8
reserved track count is 21
drive 0
no tests or formatting
```

MFORM.cmd - Memory Disk Format Utility

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

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

- DISK 1 ROM / BOOT
- DISK 1 LOADER - TMXLOAD
- DISK 1 CBIOS - TMXBIOS

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. Keep in mind the following disk layout:

Cylinder 0, Head 0 — FM recording; 128 byte sectors 0-3 reserved for CompuPro DISK 1 BOOT. Sectors 5-23 reserved for CompuPro DISK 1 CBIOS. Sector 24 reserved for Group header of LDR.CMD.

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

Cylinder 1, Head 0 — MFM; 256 byte sectors. Sectors 0-3 reserved for LDCPM. Sectors 4-17 reserved for LDBDOS. Sectors 18-25 reserved.

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

Cylinder 1, Head 0 — MFM; 1024 byte sectors. Sectors 0-1 reserved for LDCPM. Sectors 2-5,7 reserved for LDBDOS. Sector 6 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 ROM/BOOT

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

- Put a jump at the 8086 reset location to the ROM code.
- Reads the first four sectors (BOOT program).
- Disables the ROM.
- Begin executing the BOOT program.

The ROM provided on CompuPro DISK 1 revision "E" and later, contain two "jumper selectable" versions of the DISK 1 ROM boot. The "A" half of the ROM contains 8080 code for bringing up CP/M 2.2 or CP/M-86 with the CPU 8085/88 dual processor. The "B" half of the ROM contains 8086 code for use with the CPU 86/87 coprocessor or with the CPU 286. The "B" half of the ROM will first swap processors so that it can be used with the CPU 8085/88.

Another feature of the "B" half of the ROM is that it can "capture" the 8086 on a reset. When the 8086 is issued a reset signal, it begins to execute code at location OFFFF0h. This means that there must be some code up at the top of the memory map, either in RAM or ROM, for the processor to execute and jump back to the bottom of memory, where the system usually resides. The CompuPro DISK 1 will disable all system memory, so that the processor sees the ROM BOOT in every 256 byte block. By putting a jump to location 0 at 0F0h of the ROM code, the processor will see the jump to 0 at location OFFFF0h, jump to location 0 and begin executing the ROM code. The ROM on the SELECTOR CHANNEL - hard disk controller set works the same way.

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-86 LOADER.
- Swaps processors if using a CPU 8085/88.
- Jumps to the Cold Start entry of the LOADER.

The LOADER resides in the 5th 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 DISK 1 LOADER

The CompuPro DISK 1 LOADER's basic function is to initialize any hardware that requires it, to load in CP/M and the CBIOS (contained in the file CPM.SYS), and transfer execution to the CCP.

The LOADER.CMD is composed of three parts, LDCPM, LDBDOS, and TMXLOAD. LDCPM and LDBDOS are part of CP/M and should never have

to be changed. They are included on your system disk as hex files (LDCPM.H86,LDBDOS.H86).

The third part is TMXLOAD. This part is very hardware dependent and unique to CompuPro. TMXLOAD.H86 is assembled from the file TMXLOAD.A86 through equates and conditional assemblies. TMXLOAD uses the same routines for I/O and disk transfers as the TMXBIOS, and in addition has its own USART initialization routines.

CompuPro DISK 1 CBIOS

The CompuPro DISK 1 CP/M CBIOS implements all of the jump vectors described in the CP/M-86 Operating System System Guide.

Since the CompuPro CBIOS uses Blocker / Deblocker code to handle the MFM recorded disks; assumptions are required because CP/M 86 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.

Cold Start

The Cold Start code performs the following functions:

- Initialize, System Segment Location 3 — IOBYTE
- System Segment Location 4 — Current Flexible disk
- Initialize the Memory Region Table (MRT)
- Performs the Warm Boot function.
- Transfers control to CCP

Warm Boot

The Warm Boot code does a HOME call to flush any unwritten buffers to the disk.

Unit Record

The Standard Unit Record Input / Output routines are:

Console Status.	List Output.	Set IOByte
Console Input.	List Status.	Get IOByte
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 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

The "Set IOByte" and "Get IOByte" functions work exactly as described in the CP/M-86 System Systems Guide with an additional feature. The high byte of CX is used as an I/O control byte, which can be used to change printer and console drivers. See the TMXBIOS source for a complete explanation of how the I/O Byte and I/O Control Byte work.

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 modification 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:

- Checks for valid drive selection.
- Computes the specified drive's DPH address.
- If this is a "first time call" then
  the disk type is determined and the DIRECTORY
  is read in to memory if the selected disk is
  a floppy disk or drive A: of a hard disk.

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 Segment Address

Sets the 8086 "segment" buffer address for the next disk transfer.

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. EXTREME caution must be taken if this function is used.

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 by the caller.

Get Segment Table Address

Returns the address of the system MRT table.

CompuPro CBIOS - OVERVIEW

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 pointers to the CP/M Disk Parameter Header (DPH) for each logical disk drive. The DPH is described in the CP/M-86 Operating System System Guide, but a few comments here are appropriate. The DPH is used mostly by CP/M , but four entries are of interest to the CompuPro DISK 1 CBIOS -- 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 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-86 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
ACTGAP	—	GAP 2 of floppy disk
ACTEOT	—	Number of sectors on 1 track (for floppy disk buffering)
RCDADR	—	Offset of actual address of desired data
RCDSEG	—	Segment of actual address of desired data

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 CL register contains a value which indicates on of the following:

0	—	Write to a 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-86 Operating System System Guide, 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 DX. If register DX is zero, then no sector translation is performed. Otherwise, DX 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 of DX 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.

Additionally SELDSK will read in the Directory track into a special buffer if the selected disk is a floppy disk. If the selected disk is the A: drive of a hard disk, the 1st 32 1K sectors are read into a buffer. Individual buffers are kept for each floppy and 1 hard disk.

Both the READ and WRITE routines look simple due to modularization of the code. Both routines call FILL to get the desired data into memory. READ and WRITE differ in that WRITE checks CL after the call to FILL. If the write type was non-deferred (type 1), FLUSH is called to write the sector immediatly. Since the floppy disk uses track buffering, all sectors are preread.

The purpose of the FILL routine is to get the desired sector off of either a hard disk or floppy disk and puts the address of the desired sector in the RCD variables. FILL first checks current ACTive sector (or track for floppies) to see if the desired sector is current. If the ACTive sector is dirty (needs writing) and is not the desired sector (SEK), the ACTive sector is written to the disk and the desired sector becomes the active sector. FILL then checks to see if the desired sector is part of the directory and thus already in memory. If the desired sector is not already in memory, FILL drops into the FINAL routine, which vectors to either the hard disk or floppy disk hardware drivers.

This concludes the overview of the CompuPro CBIOS. If the reader wishes more detailed information, he should 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:

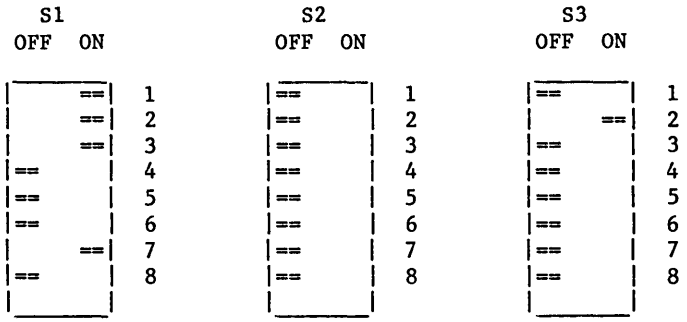
Problem	Probable Cause	Remedy
	FLOPPY DISK	
Fan off, power indicator not lit:	Power cord not plugged in.	Plug in cord.
	Power cord not plugged into rear panel of system.	Plug in cord.
	Wall outlet not live.	Check outlet. Check circuit breaker.
	Main circuit breaker has tripped.	Check system for shorts; turn breaker OFF, then back ON.
Fan on, power Indicator not lit	Indicator light bad.	Replace indicator light.
	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 MP/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 and re-connect.
	Error in tracks tracks 0 and 1.	Contact dealer.

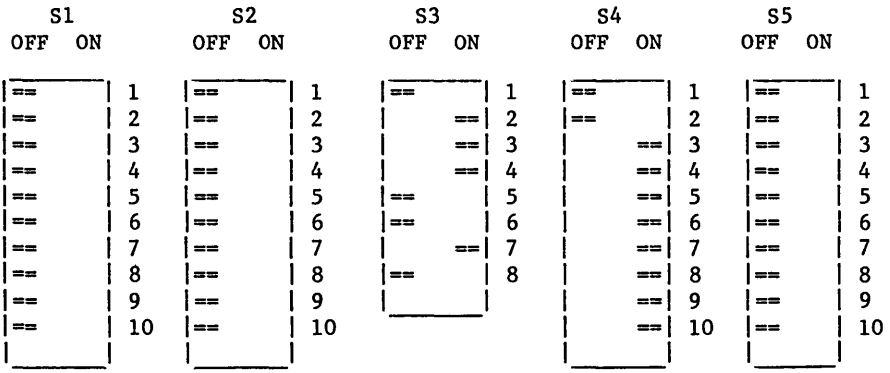
Problem	Probable Cause	Remedy
	TERMINAL I/O	
System sounds like it booted up but no message on the terminal	Cable incorrectly connected.	Check cable connections.
	Terminal incorrectly set.	Check baud rate and word size settings.
	Terminal not powered up.	Plug in terminal and turn on.
	I/O board switches 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-86

CPU 8085/88 - Switch Settings:



CPU 86/87 - Switch Settings:



Jumpered Settings: J8 -- No shunt installed if using an 8087 coprocessor, otherwise install shunt.

CPU 286 - Switch settings

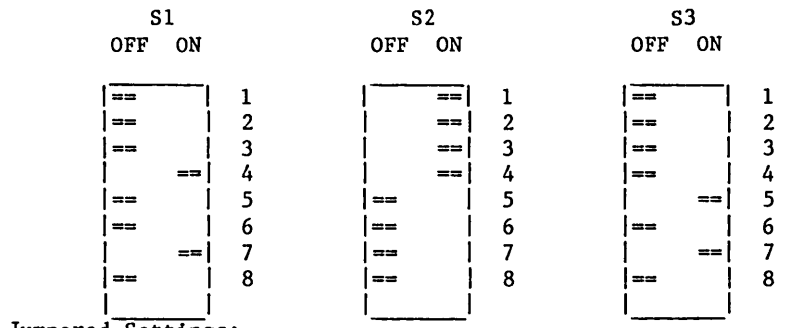
DIP SWITCH S1

Turn paddle 4 ON, all others OFF.

JUMPERS

Jumper J1 and J2 should both be installed across A-C (the top two pins and bottom two pins of the six located next to U13 should have shunts). Jumper J3 should have shunts in position A and B (the top two locations). Jumper J4 (single pair of pins immediately below J3) should not have a shunt.

SYSTEM SUPPORT 1 - Switch Settings:



Jumpered Settings:

J1 -- Serial port connection.

J2 -- Insert an eight pin dip shunt, shunting s11 8 lines.

J3 -- Plug an auxiliary battery cable into this connector, red wire toward the left.

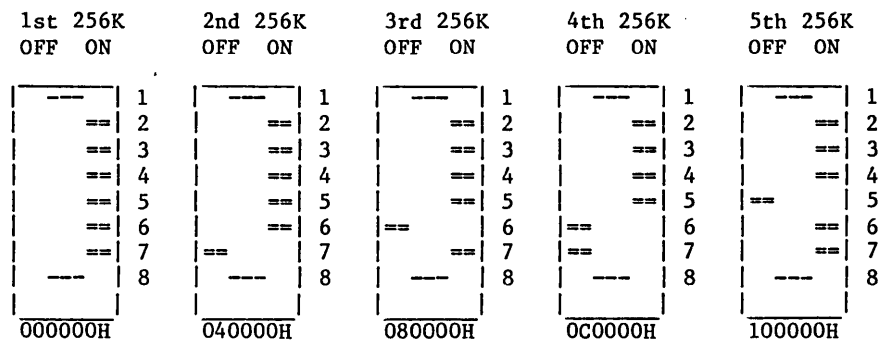
J13 -- Insert a shorting plug onto prongs 8 and C.

Remaining jumpers are left unconnected.

Rom Sockets:

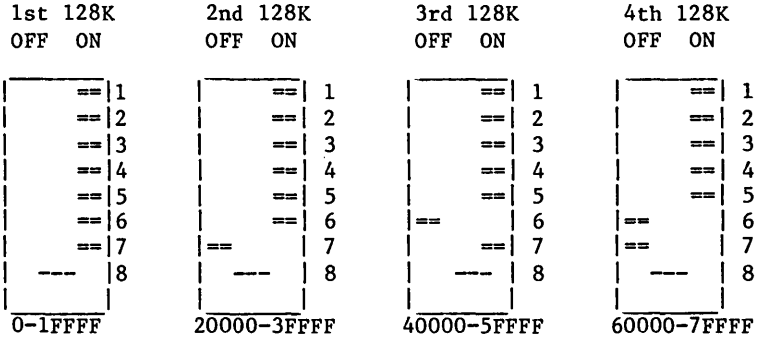
U16 -- Install a 6116 RAM chip or a "GO 86" EPROM (if you have a CPU 8085/88)

RAM 22 MEMORY BOARD - Switch settings

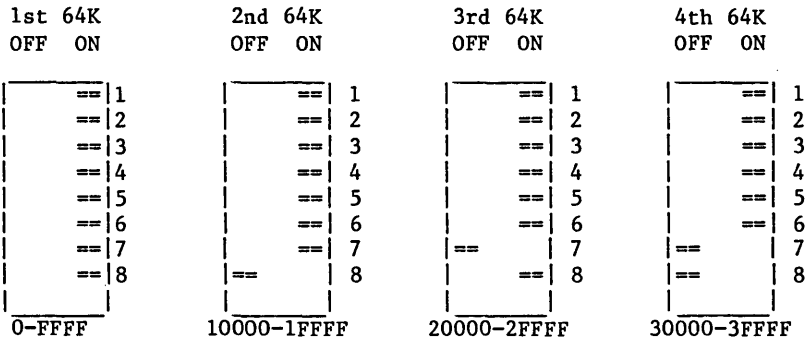


NOTE: This board does not allow any of the four 64K blocks on the board to be disabled.

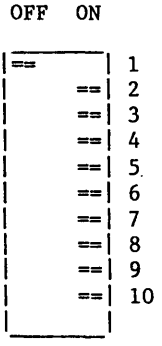
RAM 21 MEMORY BOARD - Switch Settings for S1:



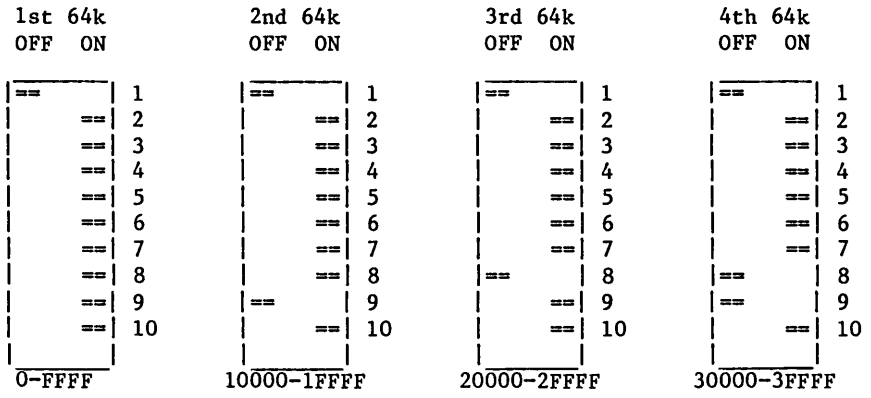
RAM 16 MEMORY BOARD - Switch Setting for S1:



RAM 17 MEMORY BOARD - Switch Settings for S1:

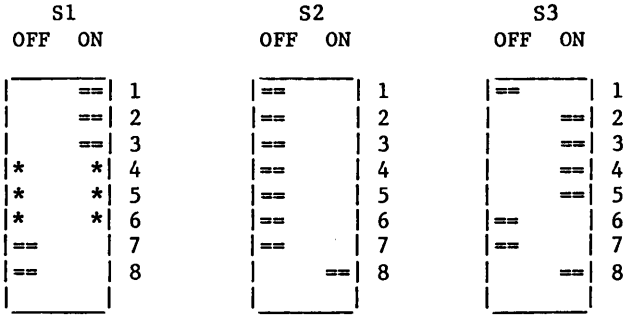


Switch Settings for S2:



DISK 1A - Switch settings

The standard switch settings for running 8" floppies as drives "A" and "B", and 5.25" floppies as drives "C" and "D" are as follows:



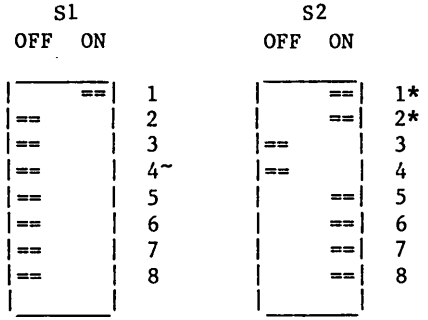
*S1 positions 4-6 must be set as shown below depending on the type of CPU being used and the I/O device being used as the console.

S1 POSITION 4	5	6	CPU TYPE	CONSOLE I/O DEVICE
ON	ON	ON	CPU 86/87	INTERFACER 1/2
ON	ON	OFF	CPU 68K	SYS. SUP./ INTERF. 3/4
ON	OFF	ON	CPU 86/87	SYSTEM SUPPORT
ON	OFF	OFF	CPU 86/87	INTERFACER 3/4
OFF	ON	ON	CPU 85/88 - Z	INTERFACER 1/2
OFF	ON	OFF	NOT SUPPORTED	
OFF	OFF	ON	CPU 85/88 - Z	SYSTEM SUPPORT
OFF	OFF	OFF	CPU 85/88 - Z	INTERFACER 3/4

J1 - POSITION "5"
J2 - POSITION "5"
J3 - POSITION "8"
J4 - POSITION "8"
J5 - REMOVED
J6 - A-C FOR MINIFLOPPIES GENERATING READY, OTHERWISE B-C.
J7 - B-C (TWO WAIT STATES)
J8 - LEAVE AS SHIPPED
J9 - LEAVE AS SHIPPED
J10- SHUNT ON "4"
J11- SHUNT INSTALLED

These settings select DMA arbiter priority 15, port C0H-C3H, wait states enabled, and the BOOT routine as selected.

DISK 1 FLOPPY DISK CONTROLLER - Switch Settings:



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

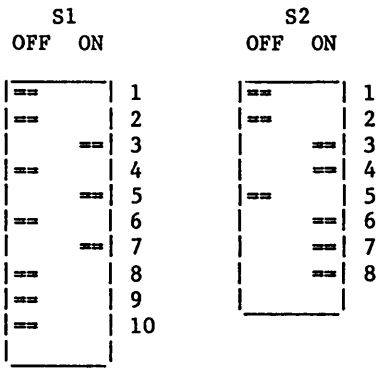
* Paddles 1 & 2 ON for INTERFACER 1 & 2; Paddle 1 OFF, Paddle 2 ON for SYSTEM SUPPORT 1; Paddle 1 & 2 OFF for INTERFACER 3 & 4

- Jumpered Settings: J16 -- Install a jumper on B-C

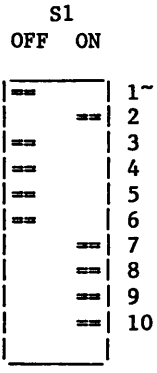
J17 -- Jumper A-C if using a CPU 8085/88
Jumper B-C if using a CPU 86/87

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

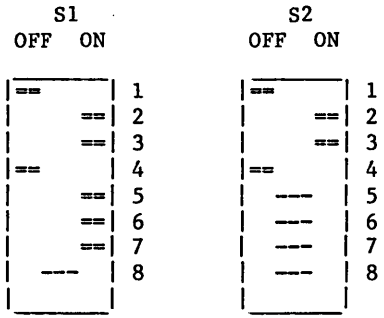
Jumper settings:

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" if CPU 8085/88
Jumper installed on "+" if CPU 86/87

DISK 3 Switch Settings:

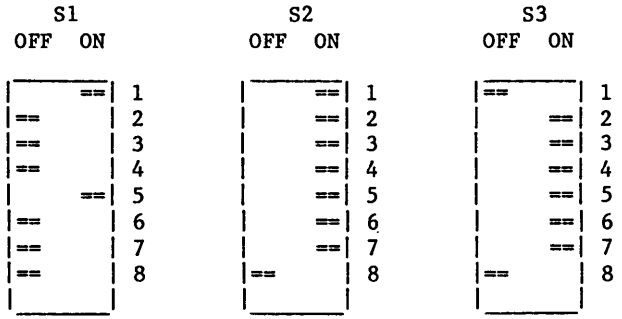


Jumper Settings:

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:

Jumpered Settings:

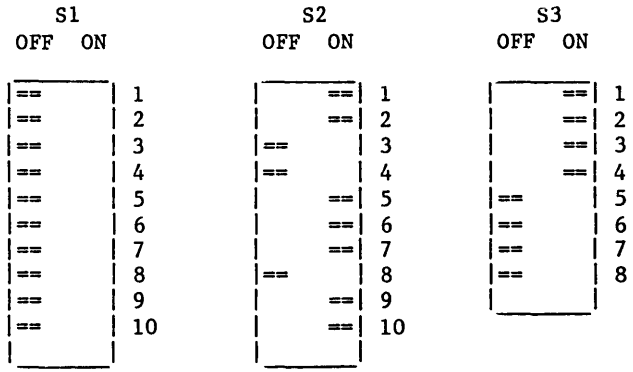
J1 -- Insert an 8 pin dip shunt, shunting all 8 lines.

J2 -- Insert an 8 pin dip shunt, shunting all 8 lines.

J17 -- Jumper top two pins.

Remaining jumpers unconnected.

INTERFACER 4: - Switch Settings:



- Jumpered Settings

J1 -- No Shunt need be installed

J2 -- Bottom installed with Epson printer /
No shunt otherwise

J3 -- Top installed with Epson printer /
No shunt otherwise

J4 -- Bottom installed with both Epson and Centronics

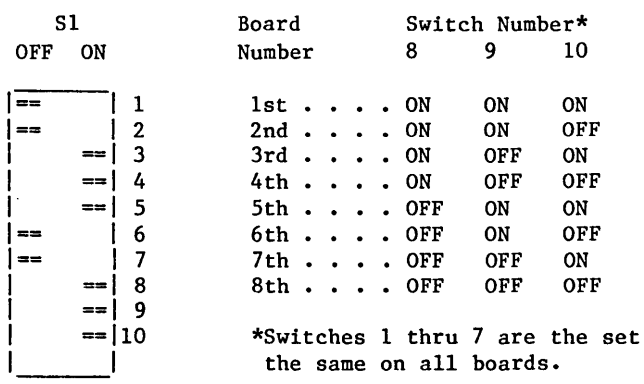
J5-J25 -- Removed

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.

MDRIVE/H - Switch settings



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

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

CP/M-86

A *GODBOUT* COMPANY
3506 Breakwater Court, Hayward, CA 94545