CompuPro

CP/M® 2.2

Technical Manual
& Installation Procedures

CP/M 2.2 Technical Manual

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HARDWARE SECTION

INTRODUCTION & INSTALLATION

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.

This version of CP/M 2.2 requires the following hardware for proper operation:

HARDWARE REQUIREMENTS

(1) A working 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 or DISK 1A floppy controller addressed at 0C0H 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 to do 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.** Press the RETURN ([RET]) key. 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 other 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.

This 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. Call up the SYSGEN utility by selecting the "A" drive as the source and typing: **SYSGEN** [RET]. Select "B" as the destination drive. 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.

DISK 2 drive types:

M10	Fujitsu 10 megabyte drive
M20	Fujitsu 20 megabyte drive (default value)
M20BE	Fujitsu 20 megabyte drive with Pragmatic modification
M40BE	Fujitsu 40 megabyte drive with Pragmatic modification

DISK 3 drive types:

Q540	Quantum 40 megabyte drive
ST506	Seagate 5 megabyte drive

This test takes seventeen (17) 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.

INSTALLING YOUR CP/M 2.2 OPERATING SYSTEM

Your CompuPro CP/M 2.2 master disk is configured to "BOOT-UP" on a very simple system. This means that the system will not take advantage of many of the hardware features of your CompuPro system. If you have a non-CompuPro system, you will be on your own to look at the BIOS or system source and build a system for your hardware. For CompuPro systems, we have already configured systems that will take full advantage of your hardware. There are a number of pre-configured system files on your master disk of the form "CPM*.COM", where the "*" is replaced by letters denoting a particular hardware configuration.

The following list describes the notation used to describe the different systems:

CPMPLAIN.COM -- Same system that boots up off of master disk.

CPM210.COM -- Uses CPU 8085/88 with a CompuPro Disk 2 and
CPM220.COM 10 or 20 megabyte hard disk.

CPMQ540.COM -- Uses a CPU 8085/88 and the CompuPro H40 Hard Disk system.

CPMSYS.COM -- Uses a CPU 8085/88 and CompuPro floppy disk system.

CPMZ80.COM -- Uses A CPU-Z and a CompuPro floppy disk Subsystem.

CPMHMX2.COM -- Uses CPU 8085/88 and extended I/O system.

Once you have selected a system file that matches your hardware, you must create a "system" disk on a copy of your master for that configuration as follows (example is for a CPU 8085/88 and CompuPro Floppy Disks):

```
A>SYSGEN CPMSYS.COM

Destination drive (or hit RETURN to terminate): B
Function complete.

A>
```

Now you can use your newly created disk for a faster and quieter system.

RECONFIGURING YOUR SOFTWARE

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. If you are going to use ASM, 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" floppies on the DISK 1A or the special 5-1/4" DISK 1 addressed at 0CCh. WARNING: there are many different 5-1/4" floppy formats and types out there. The two-sided line (pin 10) on the 34 pin cable that goes to the floppies must be pulled to ground if your drives are two-sided and you are using a DISK 1. 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 two floppies, one hard disk and one memory drive will fit on the boot tracks. If you want 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 "soft" MDRIVE® 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 MDRIVE/H, called HMDRIVE in the bios. If only one of HMDRIVE or XMDRIVE is turned on, it will be set to letter "M". If both memory drives are turned on, HMDRIVE is drive "H" and XMDRIVE is drive "M".

GETTING READY TO REASSEMBLE THE COMPUPRO CP/M 2.2 SYSTEM

Your CompuPro CP/M 2.2 includes some already assembled system files for a few different system configurations. All of the system files are of the form "CPM*.COM", where the * stands for the particular configuration. The file "CPMSYS.COM", is a floppy only system designed for a CompuPro system with a CPU 8085/88 and 3ms step rate Qume floppy disk drives. "CPMPLAIN" will run on an 8080 type processor and uses an 8ms step for the floppy disk drives. Files named "CPM2??.COM", where the "?"s are 10, 20 or 40, are for the DISK 2 hard disk controller. "CPMQ540.COM" is for the CompuPro DISK 3 and 40 mbyte Quantum hard disk system. Use "CPM80.COM" for a Z-80 based system. Choose the configuration for your system and "sysgen" it on to a copy of the master as follows:

```
A>SYSGEN CPM?????.COM
```

Use your copy for the destination.

NOTE: If you have a DISK 3, be careful when changing from CP/M to MP/M™ 8-16™, CCP/M™ 8-16™, CP/M-86™ or CP/M® 8-16™ because the logical drive partitioning on the hard disk is different between CP/M and all the rest. However, the first and last logical drives are the same on all operating systems.

If you don't have a "standard" CompuPro system and need to change some parameters, use the following instructions before you reassemble your operating system.

Change the baud rate, step rate, software and hardware handshaking

To change the baud rate for the system console, use the HMXFBOOT.ASM file. Go to the Input/Output Device Initialization Sequence Table (see the following table). This table is arranged with the port number to initialize followed by its initialization byte.

```
;*****************************************************************
;*      INPUT/OUTPUT DEVICE INITIALIZATION SEQUENCE TABLE        *
;*****************************************************************
INISEQ: ;Port,  Value to transmit sequence until Port = OFFh.
;
; Interfacer 3,4 UART initialization.
   DB    IF3UX,  4        ;Select Uart 4
   DB    IF3UM,01011010b ;Async, 16x, 7 bits, odd parity, 1 stop
   DB    IF3UM,01111110b ; 9600 baud
   DB    IF3UC,00100111b ;Trans on, DTR low, rec. on, no break/
                         ;reset RTS low
;
   DB    IF3UX,  5        ;Select Uart 5
   DB    IF3UM,01011010b ;Async, 16x, 7 bits, odd parity, 1 stop
   DB    IF3UM,01111110b ; 9600 baud
   DB    IF3UC,00100111b ;Trans on, DTR low, rec. on, no break/
                         ;reset RTS low
;
   DB    IF3UX,  6        ;Select Uart 6
   DB    IF3UM,01011010b ;Async, 16x, 7 bits, odd parity, 1 stop
   DB    IF3UM,01111110b ; 9600 baud
   DB    IF3UC,00100111b ;Trans on, DTR low, rec. on, no break/
                         ;reset RTS low
;
   DB    IF3UX,  7        ;Select Uart 7
   DB    IF3UM,01011010b ;Async, 16x, 7 bits, odd parity, 1 stop
   DB    IF3UM,01111110b ; 9600 baud
   DB    IF3UC,00100111b ;Trans on, DTR low, rec. on, no break/
                         ;reset RTS low
;
; System Support I UART initialization.
   DB    SS1UM,01011010b ;Async, 16x, 7 bits, odd parity, 1 stop
   DB    SS1UM,01111111b ;19200 baud
   DB    SS1UC,00100111b ;Xmit on, DTR low, rec. on, no break, run,
                         ;RTS low

   DB    OFFh             ;End of I/O port initialization string
;
```

The lines of the table under the "System Support 1...", as well as the other headings are for mode register 1, mode register 2 and the command register (see the following tables). Refer to these tables and change the parameters as necessary.

MODE REGISTER 1 FORMAT

BIT NUMBERS

MR1-7	MR1-6	MR1-5	MR1-4	MR1-3	MR1-2	MR1-1	MR1-0
SYNC NO. OF SYN CHARACTERS 0 = DOUBLE SYN 1 = SINGLE SYN	SYNC TRANSPARENCY CONTROL 0 = NORMAL 1 = TRANSPARENT	PARITY TYPE 0 = ODD 1 = EVEN	PARITY CONTROL 0 = DISABLED 1 = ENABLED	CHARACTER LENGTH 00 = 5 BITS 01 = 6 BITS 10 = 7 BITS 11 = 8 BITS		MODE AND BAUD RATE FACTOR[1] 00 = SYNCHRONOUS 1x RATE 01 = ASYNCHRONOUS 1x RATE 10 = ASYNCHRONOUS 16x RATE 11 = ASYNCHRONOUS 64x RATE	

ASYNC:
STOP BIT LENGTH
00 = INVALID
01 = 1 STOP BIT
10 = 1½ STOP BITS
11 = 2 STOP BITS

MODE REGISTER 2 FORMAT

BIT NUMBERS

MR2-7	MR1-6	MR2-5	MR2-4	MR2-3	MR2-2	MR2-1	MR2-0
NOT USED		TRANSMITTER CLOCK 0 = EXTERNAL 1 = INTERNAL	RECEIVER CLOCK 0 = EXTERNAL 1 = INTERNAL	BAUD RATE SELECTION 0000 = 50 BAUD 0001 = 75 BAUD 0010 = 110 BAUD 0011 = 134.5 BAUD 0100 = 150 BAUD 0101 = 300 BAUD	0110 = 600 BAUD 0111 = 1200 BAUD 1000 = 1800 BAUD 1001 = 2000 BAUD 1010 = 2400 BAUD 1011 = 3600 BAUD	1100 = 4800 BAUD 1101 = 7200 BAUD 1110 = 9600 BAUD 1111 = 19200 BAUD	

Use the last four bits of mode register 2 in the table to make changes to the baud rate.

Locate:

```
; System Support I UART initialization.
   DB    SS1UM,01011010b ;Async, 16x, 7 bits, odd parity, 1 stop
   DB    SS1UM,01111111b ;19200 baud
   DB    SS1UC,00100111b ;Xmit on, DTR low, rec. on, no break, run, RTS low
```

Example: You need to change your system terminal's baud rate from the 19200 in the table to 9600.

Go into HMXFBOOT.ASM and find the line:

```
   DB    SS1UM,01111111b ;19200 baud
```

Change it to:

```
   DB    SS1UM,01111110b ;9600 baud
```

If you need to change the parameters for any of relative users 4-7, use the same format described above and change the bits based on the tables, only using the lines of the table under the "Interfacer 3,4 UART" heading of the INPUT/OUTPUT DEVICE INITIALIZATION SEQUENCE TABLE.

To change the software handshake, use HMXFBOOT.ASM. Find the Input/Output Device Initial Select Table.

```
;*****************************************************************
;*          INPUT/OUTPUT DEVICE INITIAL SELECT TABLE             *
;*****************************************************************
;
BIOTBL:          ;I/O byte (IOBYTE) value, Aux I/O control byte (IOCNTL) value
; Switch = 0
   DB    10$00$00$01b     ;LST:=LPT, PUN:=TTY;, RDR:=TTY:, CON:=CRT:
   DB    01$00$00$10b     ;LPT:=Interfacer I UART 1, CRT:=Interfacer I UART 0
; Switch = 1
   DB    10$00$00$01b     ;LST:=LPT, PUN:=TTY;, RDR:=TTY:, CON:=CRT:
   DB    01$00$00$10b     ;LPT:=Interfacer 3 USER 4 xon/xoff, CRT:=USER 0
; Switch = 2
   DB    10$00$00$01b     ;LST:=LPT, PUN:=TTY;, RDR:=TTY:, CON:=CRT:
   DB    01$00$00$10b     ;LPT:=Interfacer 3,4 USER 4, CRT:=System Support
; Switch = 3
   DB    10$00$00$01b     ;LST:=TTY, PUN:=TTY;, RDR:=TTY:, CON:=UC1:
   DB    01$00$00$10b     ;LPT:=Interfacer 3,4 USER 4, CRT:=System Support
;
; IOBYTE value is the first entry for each switch selection, and --
; IOCNTL =       ww$xx$yy$zzb     selects the following:
;(second byte    ww xx yy 00      CRT:=Interfacer 3 USER 0.
;of each entry   ww xx yy 01      CRT:=System Support I
;in BIOTBL).     ww xx yy 10      CRT:=Interfacer 1,2 UART 0.
;                   xx yy 11      CRT:=Interfacer 1,2 UART 1 (Custom Routine).
;                00 xx yy --      LPT:=Interfacer 3,4 USER 4.
;                01 xx yy --      LPT:=Interfacer 1,2 UART 1.
;                10 xx yy --      LPT:=Interfacer 1,2 UART 2 (Custom Routine).
;                11 xx yy --      LPT:=   "       "       "       "       "
;                -- xx -- --      Interfacer 3,4 USER 5 list routine select,
;                -- -- yy --      Interfacer 3,4 USER 4 list routine select,
;Where xx and/or yy = 00          Straight output, no software protocol
;                     01          XON/XOFF software protocol active.
;                     10          ETX/ACK software protocol active.
```

Change the yy bits for the required software protocol. If you are not sure of the switch value, you can set the yy bits of IOCNTL for all the switch values. The default software protocol is XON/XOFF for the system as shipped from CompuPro.

To change the hardware handshake to ON, if your peripherals are using an Interfacer 3 or 4, use the ACTIVE.LIB file.

Find the section that says:

```
; Interfacer 3,4 composit status masks and activity indicators:
;
INTERFACER3 EQU TRUE            ;Interfacer 3 board is present
INTERFACER4 EQU TRUE            ;Interfacer 4 board is present
;
IF3TMSK EQU  IF3TBE ;or IF3DSR  ;Xmit ready mask (for either board)
IF3FMSK EQU  IF3TBE ;or IF3DSR  ;Xmit buffer empty flip bit mask
;-----------------------------------
;
; System Support I setup characteristics:
SYSUP1  EQU     TRUE            ;System Support board is present
;
; System Support Uart Active Status Masks:
SS1TMSK EQU  SS1TBE ;or SS1DSR  ;Transmit Ready Mask
SS1FMSK EQU  SS1TBE ;or SS1DSR  ;Transmit Ready Bit Flip Mask
```

Remove the underlined semicolon in the above example. (The underline will not appear on the screen.)

To change the step rate, use the ACTIVE.LIB file. Change the underlined number in the table under the:

```
;     Floppy Disk (DISK 1) controller and drive constants:
;
; 8 inch drive characteristics:
FLOPPY8 EQU    TRUE             ;8 inch floppy disk system (Disk 1) present
FPY8X4  EQU    FALSE            ;4 drives present (2 is default)
STEPR8  EQU    3                ;8 inch drive step rate in milliseconds
ULOAD8  EQU    240              ;Head unload time delay in milliseconds
HDLT8   EQU    35               ;Head load settling time in milliseconds
```

The number will not appear underlined on the screen.

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 DD00H 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       (This is the hex number of 256 byte pages from
807 00 .        the top of memory to the start of the BIOS.)
-^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 [CLE800])
LINK 1.3

ABSOLUTE       0BAF (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  (CPMHMX2.COM for HMX2BIOS)
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 MDRIVE/H MEMORY DISK

The CompuPro CP/M BIOS includes drivers for an MDRIVE/H memory disk, containing up to **4 megabytes** of fast memory disk on drive "M", and a "soft" MDRIVE 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 MDRIVE/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 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 only the MDRIVE/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 MDRIVE/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 MDRIVE, but you must tell it which drive to format. (It will not automatically format the soft MDRIVE. 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 those of you 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 you understand how the software components work; thus making it possible for you to modify the software for your 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 if you have a DISK 1 board, you can change the density of your disk (data is destroyed). The FORMAT.com utility formats floppy disk in IBM compatible formats; not all disk controllers are IBM compatible.

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

FORMAT has simple and straightforward operating instructions. You are prompted for input to control the utilities flow. Start FORMAT by entering the following:

```
FORMAT    [RET]

or

FORMAT drive    [RET]
```

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

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

Enter the drive (A thru P) and FORMAT continues.

After you have specified the drive to be formatted, FORMAT attempts to determine the specified disk's format. The disk format or lack thereof is displayed for you 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     > _
```

Enter 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, FORMAT begins a verify operation. This verify operation shows you possible bad spots on the floppy disk. The screen will look like this:

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

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

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

After the verification, FORMAT asks if another disk is to be formatted. Your answer will result in one of three actions:

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

FORMAT can be used in many ways. You can see your options by entering the following command line:

```
FORMAT ?    [RET]
```

This will result in the following display:

> FORMAT will format a diskette to be compatible with the CompuPro disk subsystem. The FORMAT program will format a diskette as either 128, 256, 512 or 1024 byte sectors, depending on the user request.
>
> 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.

You 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 you 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 reminder
will be displayed.
```

You are then asked for the source and destination drive.

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 (or return to skip). A
Function complete
Destination drive name (or return to terminate): B
Function complete
```

Enter 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. 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. After running the "ALL" test, **DO NOT** reformat your drive. Reformatting will destroy the bad sector map! The different options that can be used are listed below.

Usage: DISK 3 {options}

At least one option must be specified. If a drive type is not specified, D3FMT will ask you 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.com - 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 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
- MFORM 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 references. 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
- Perform the Warm Boot function
- Transfer control to CCP
- Size both types of MDRIVE
- 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. Close all files and reset a disk.
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 you have 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:

- 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.

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 you to access the entire memory address range available on the IEEE 696 bus.

Set Number of Sectors

This routine allows you 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 transfered 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 transfered 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 you 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 MDrive 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 floppy 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 your specified destination disk.

COPY uses the 765A/8272 multi-sector commands 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 MDRIVE/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 0FFFF0).

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 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 Alteration section of the CP/M 2 Operating System manual by Digital Research. 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 Operating System manual 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 description in the Digital Research documentation 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:

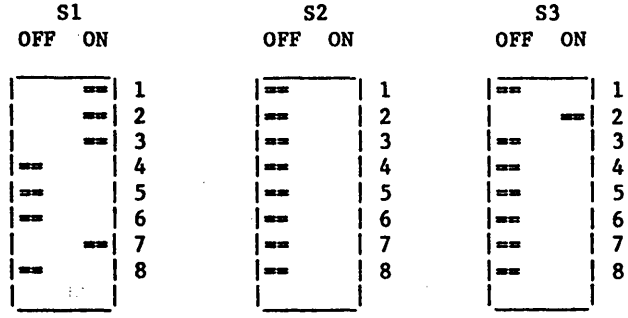
Problem	Probable Cause	Remedy
	FLOPPY DISK	
Fan off, power indicator not lit:	Power cord not plugged in.	Plug in cord.
	Power cord not plugged into rear panel of system.	Plug in cord.
	Wall outlet not live.	Check outlet. Check circuit breaker.
	Main circuit breaker has tripped.	Check system for shorts; 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 boot 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.

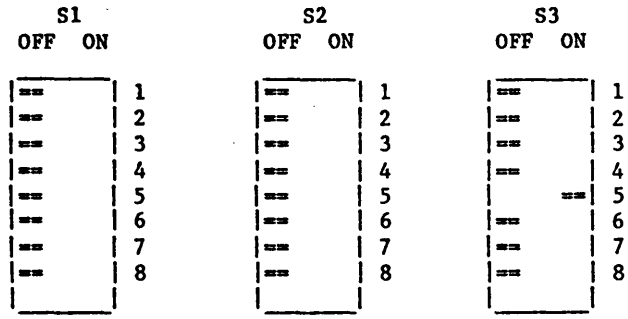
Problem	Probable Cause	Remedy
	TERMINAL I/O	
System sounds like it booted up but no message on the terminal:	Terminal cable incorrectly connected.	Check cable connections.
	Terminal incorrectly set.	Check baud rate and word size settings.
	Terminal not powered up.	Plug in terminal and turn on.
	I/O board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

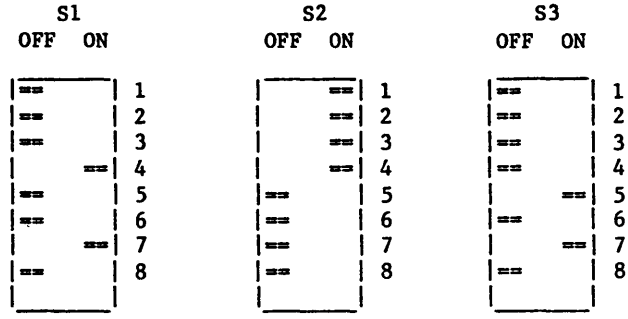
CPU 8085/88 - Switch Settings:



CPU Z - Switch Settings:



SYSTEM SUPPORT 1 - Switch Settings:



Jumpered Settings:

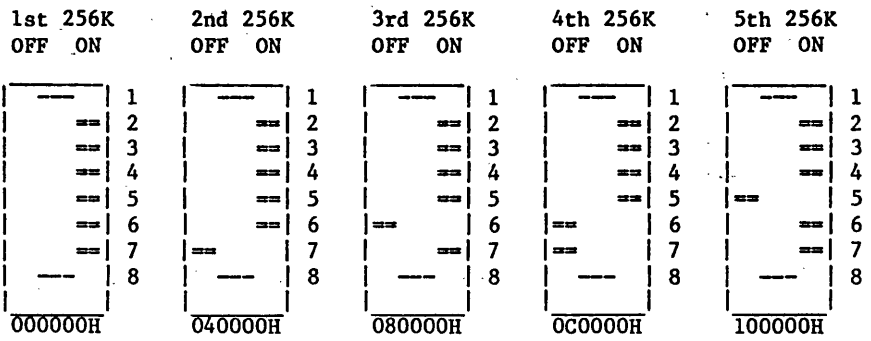
J1 — Serial port connection.
J2 — Insert a dip shunt, shunting all 8 lines.
J3 — Plug an auxiliary battery cable into this connector, red wire toward the left.
J13 — Insert shorting plug onto prongs 8 and C (if you have a CPU 8085/88).
Insert shorting plug onto prongs C and Z (if you have a CPU Z).

Remaining jumpers are left unconnected.

ROM Sockets:

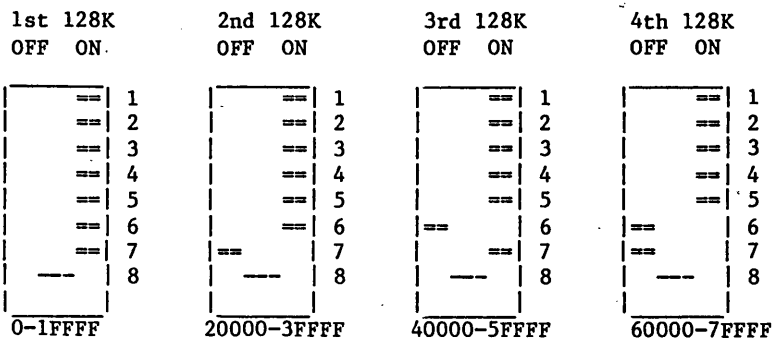
U16 — Install a 6116 RAM chip or "GO 86" EPROM (if you have a CPU 8085/88).

RAM 22 MEMORY BOARD - Switch settings

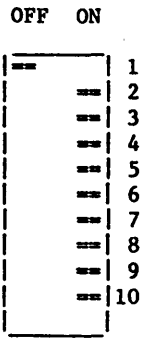


NOTE: This board does not allow any of the four 64K blocks on the board to be disabled.

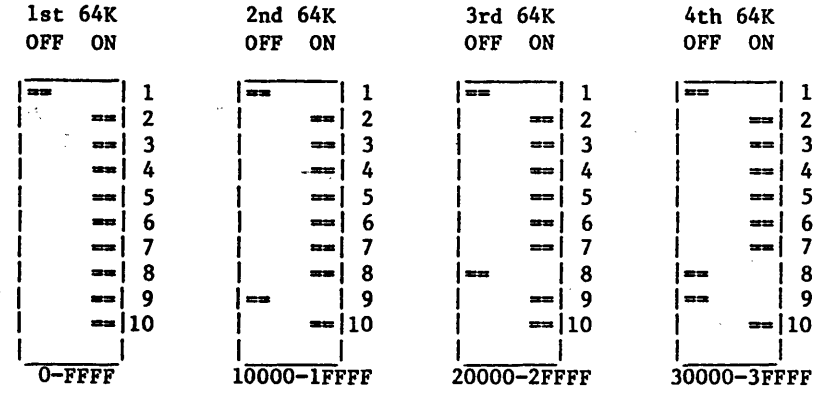
RAM 21 MEMORY BOARD - Switch Settings for S1:



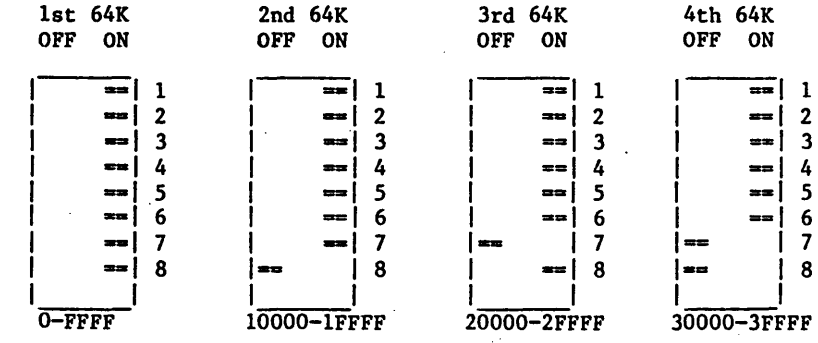
RAM 17 MEMORY BOARD - Switch settings for S1:



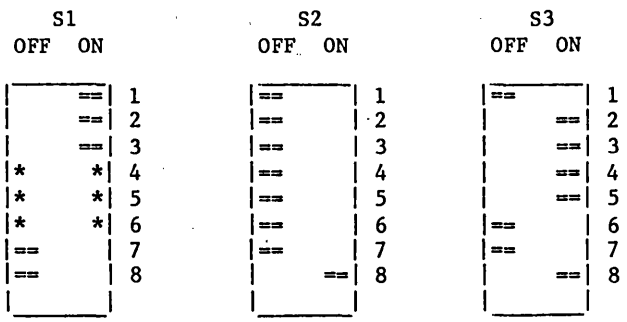
Switch Settings for S2:



RAM 16 MEMORY BOARD - Switch Setting for S1:



DISK 1A - 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.

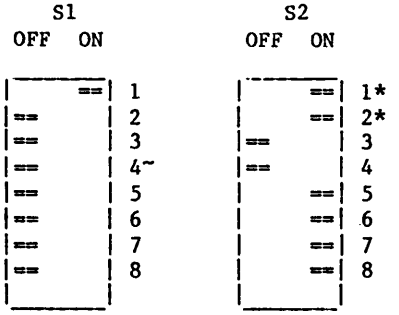
S1 POSITION 4	5	6	CPU TYPE	CONSOLE I/O DEVICE
ON	ON	ON	CPU 86/87	INTERFACER 1/2
ON	ON	OFF	CPU 68K	SYS. SUP./ INTERF. 3/4
ON	OFF	ON	CPU 86/87	SYSTEM SUPPORT
ON	OFF	OFF	CPU 86/87	INTERFACER 3/4
OFF	ON	ON	CPU 85/88 - Z	INTERFACER 1/2
OFF	ON	OFF	NOT SUPPORTED	
OFF	OFF	ON	CPU 85/88 - Z	SYSTEM SUPPORT
OFF	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 for 8" drives: (Disk 1-8)

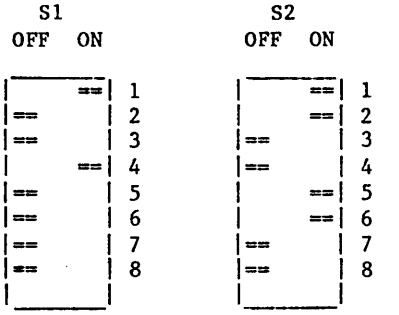


~ OFF to BOOT from a Floppy Disk, ON to BOOT from a Hard Disk.

* 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)



* Paddles 1 & 2 ON for INTERFACER 1 & 2

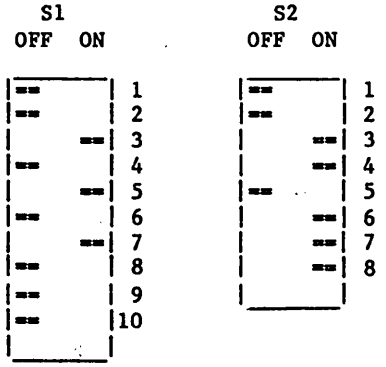
- Jumpered Settings:

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".

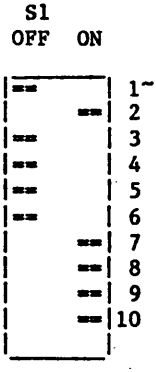
If you are using double-sided diskettes in your minifloppy, you must ground the "TWO-SIDED" line on the Disk 1-5 board.

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

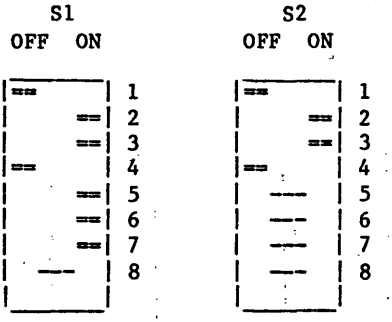
Jumper settings:

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:

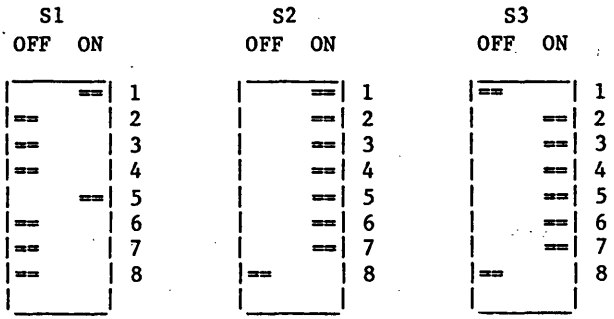


Jumper Settings:

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

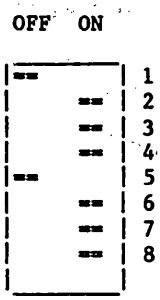
S1 -- Set paddles according to baud rate settings described in Technical Manual (example is for 9600 baud).



Jumpered Settings: J3 & J5 -- Pin 1 to 15
Pin 2 to 16

J4 & J6 -- Pin 6 to 7

INTERFACER 3 - Switch Settings for S1:



Jumpered Settings:

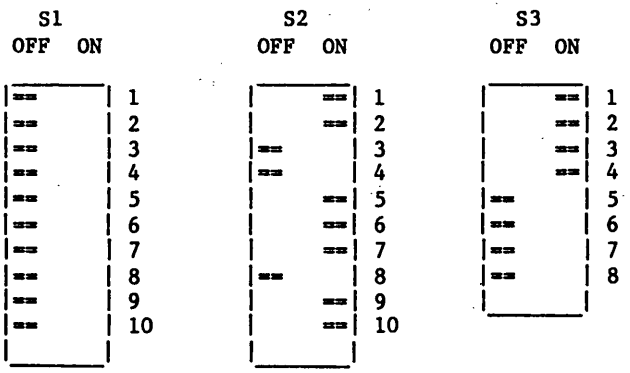
J1 — Insert a dip shunt, shunting all 8 lines.
Consult manual for hardware handshaking.

J2 — Insert a dip shunt, shunting all 8 lines.
Consult manual for hardware handshaking.

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 / 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

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

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

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