CP/M-80 SYSTEM
User's Guide

II

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SECTION DIVIDERS

INTRODUCTION

This guide explains how to run the CP/M-80 operating system using the CP/M-80 interface card. For a more detailed description of CP/M-80, refer to the CP/M version 2.2 User's Manual supplied by Digital Research.

This guide is written for a reader with experience in the areas described below. You are expected to be able to:

▶ Install the CP/M-80 card in the computer.

▶ Select port addresses using switches on the CP/M-80 card.

▶ Be familiar with CP/M and Z80 assembly language.

▶ Select I/O device codes.

▶ Install a Corvus hard disk.

▶ Configure the hard disk.

THE CP/M-80 CARD   1.1

The CP/M-80 card gives you access to 64K CP/M-80 version 2.2 running on a Z80 processor at 6MHz (with no wait states). This allows you to run virtually any CP/M-80 software. By typing a command you can switch between CP/M-86 and CP/M-80, and both operating systems can read or write files on the same diskette.

The CP/M-80 card also has a built-in hard disk port which allows you to connect a 5, 10, or 20 megabyte high-speed hard disk drive. Up to 64 computers can share a single hard disk by using a multiplexing unit.

1.2   CP/M-80

CP/M-80 is a disk operating system (DOS). The DOS manages your program and data files on floppy or hard disks. CP/M-80 provides a standard environment for developing and running application programs.

Many software packages are available for CP/M-80. Languages include CIS-COBOL, FORTRAN, C, APL, PL/1, FORTH, and Pascal. Also available are Microsoft's extended BASIC compiler and interpreter, Cross assemblers, and Macro assemblers. Business packages include WordStar™, dBASE II™, and Magic Wand™.

Most applications written for CP/M-80 run on any computer system supporting CP/M-80, provided that sufficient memory is available. The maximum is typically 60K bytes of RAM on an 8080 or Z80 based system. A library of software is available to the CP/M-80 user from a wide variety of suppliers.

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INSTALLING CP/M-80
ON YOUR SYSTEM

INPUT/OUTPUT ADDRESSING 2.1

The CP/M-80 card occupies one of the 65,536 available I/O port addresses. It is normally strapped to work with I/O port 0. This can be changed if it conflicts with other I/O cards plugged into your computer's expansion slots.

You can change the switches on the CP/M-80 card (shown below) to change the port address. You must also change the port address in the CP/M-80 software (using the NEWSYS program). Consult your dealer if you require more information on input/output addressing.

Switch 1 (nearest center of card)

1	I/O address bit 0
2	I/O address bit 1
3	I/O address bit 2
4	I/O address bit 3
5	I/O address bit 4
6	I/O address bit 5
7	I/O address bit 6
8	I/O address bit 7
9	I/O address bit 8
10	I/O address bit 9

Switch 2 (furthest from center of card)

1	I/O address bit 10
2	I/O address bit 11
3	I/O address bit 12
4	I/O address bit 13
5	I/O address bit 14
6	I/O address bit 15
7	Reserved for future use
8	Reserved for future use
9	Reserved for future use
10	Reserved for future use

2.2 INSTALLING THE CARD

The CP/M-80 card can reside in any of the four expansion slots inside the computer.

WARNING: Do not attempt to install the card with power applied to the computer, or serious damage might occur to the computer or card.

Be sure to plug the card in correctly: *the component side of the card should be facing outward, away from the floppy disk drives.* Ensure also that the edge connector tracks on the card line up properly with the pins of the expansion socket.

When you have inserted the card correctly, replace the cover of the computer and turn on the power.

2.3 MAKING A WORKING COPY OF THE CP/M-80 DISKETTE

You should next make a working copy of the CP/M-80 master diskette. Do not use the original copy as a work diskette, because it contains serialized software that cannot be replaced.

Use DCOPY or PIP to copy the diskette or its files. Your dealer can provide you with manuals that describe these programs. When this is done, remove the CP/M-80 master diskette and put it in a safe place.

RUNNING CP/M-80   2.4

To try out your CP/M-80 card, type the command:

   80 <cr>

The sign-on message:

64K CP/M-80 Version 2.2
©1982 Victor Technologies Inc.
Revision xx-month-198x
A>

indicates that the CP/M-80 card and the CP/M-80 operating system have
been invoked. List the directory by typing DIR. Files are stored identically
under CP/M-86 and CP/M-80. This is important because files created or
edited under CP/M-86 can be accessed under CP/M-80 and vice versa.

DIFFERENCES BETWEEN CP/M-80 AND CP/M-86

While CP/M-86 is designed to be similar to CP/M-80, there are some
important differences between the two systems. The main differences are:

1. CP/M-80 commands have file type COM, and CP/M-86 commands
    have file type CMD. Command files created for one operating system
    will NOT work on the other. Many source files, such as Microsoft
    BASIC programs, are interchangeable between CP/M-80 and CP/M-86.

2. The amount of RAM addressable under CP/M-80 is limited to 64K
    because, like most 8-bit CPU's, the Z80 is designed to address 65536
    bytes of memory.

3. While the two operating systems are very similar from the user's point
    of view, there are major differences in internal organization. This re-
    flects the different architecture of the 8080 and the 8086 CPU families.
    For example, BDOS calls are made by calling location 5 under

CP/M-80; CP/M-86 uses an interrupt 224 instruction. More details of CP/M-80 internal operation are given in Chapter 4.

4. Assembly language programming is different under CP/M-80. There is no memory segmentation on the Z80 and programs always start at location 100 hex. The programs ASM, LOAD, and DDT are used to assemble an 8080 source program, generate a command file, and debug 8080 programs, respectively. Command (.COM) files under CP/M-80 are binary code images loaded in at location 100 hex and executed. There are no headers as in CP/M-86 CMD files.

RETURNING TO CP/M-86

To get back to CP/M-86, type:

86 <**cr**>

You can switch between CP/M-80 and CP/M-86 by using the "80" and "86" commands. I/O device assignments and the current disk drive are unaltered when you switch operating systems. If the computer fails to recognize a CP/M-80 or a CP/M-86 command, you are probably in the wrong operating system.

AUTOLOAD COMMANDS

The NEWSYS program, described in Appendix B, allows you to insert an autoload command into a CP/M-80 operating system. An autoload command is performed automatically when that copy of CP/M-80 is run.

For example, you can enter:

dir <**cr**>

to print out a directory listing each time the CP/M-80 system is loaded. You can also make CP/M-80 directly load a BASIC interpreter, or your own turnkey application program.

The A (autoload) option in NEWSYS displays the current autoload command. A NEWSYS prompt asks if you want to change or remove the autoload command. If you do not want to make changes, type Return to return to the main menu. If you want to insert an autoload command, type Y and a Return. Another prompt asks you to enter the new autoload command, just as it would be typed, in reply to the CP/M prompt. To remove the existing autoload command, type Return at this prompt.

PIP COMMAND   2.5

When you use PIP to copy CMD files under CP/M-80, or to copy COM files under CP/M-86, always use the [O] option. This option tells PIP that the files being copied are object files rather than ASCII text files, and files will not be truncated if an ALT-Z (1A hex) character is found.

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CP/M-80 UTILITIES

MEMTEST 3.1

MEMTEST is a memory test program for the CP/M-80 card memory. It is supplied on your CP/M-80 master disk.

To invoke the memory test, type:

memtest <cr>

MEMTEST performs a complete cycle of tests on the 64K bytes of RAM on the CP/M-80 card. Ten different tests are performed (passes 1 to 10). After each test, a cumulative error count is printed. After the tenth pass, the cycle is repeated (passes 11 to 20) and so on until you press a key or perform a hardware reset.

If errors occur, the cumulative address range of the faulty locations is displayed. A data byte is also displayed, indicating the faulty bit positions with 1's. The display is used by your dealer or service engineer.

DUMP 3.2

The DUMP utility is a file dump that displays the contents of a file on the console screen. The dump is sixteen bytes per line, and the absolute address is displayed on the left in hex. The syntax is:

DUMP drive designation:filename.ext <cr>

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CP/M-80 PROGRAMMING

The following information may be helpful to users writing application programs in machine code for the CP/M-80 card.

Z80 MEMORY MAP   4.1

Page zero is reserved by CP/M:

0000 to 0002	Jump to warm boot routine at FA03
0003	IOBYTE
0004	Current drive #
0005 to 0007	Jump to BDOS entry point
0008 to 003F	Reserved by CP/M for the 8080 interrupt vectors. CP/M-80 card does not use any interrupts but some CP/M application programs may use the restart vectors for code efficiency. The CP/M debuggers use restart vector 7 for their breakpoints.
0040 to 005B	Used internally by the CP/M-80 BIOS
005C to 007F	CP/M's 36-byte default file control block (FCB)
0080 to 00FF	128 byte default buffer for disk transfers. Also used as a console buffer for passing command parameters.
0100 to E3FF	Transient Program Area (TPA). This is a general purpose RAM area. CP/M application programs (transients) load in here, and execution starts at 100 hex.
E400 to EBFF	CP/M's Console Command Processor (CCP) gets loaded here after a cold or warm boot. This is the program that processes CP/M command lines typed at the console, and executes them. The CCP may be overwritten during execution of a user program.
EC00 to F9FF	CP/M's Basic Disk Operating System (BDOS) gets loaded here after a cold or warm boot. This is a collection of routines to perform disk or I/O related functions

required by the CCP. The BDOS can also be called by
user programs, or overwritten if it is not needed.

FA00 to FFFF   The CP/M-80 Basic Input/Output System (BIOS) gets
loaded here on cold boot only. It should not be over-
written by user programs. This is the hardware-depend-
ent part of CP/M-80 and comprises a collection of low-
level I/O routines such as console, printer and disk I/O.
These routines are used by the BDOS and can also be
called directly from user programs.

4.2 THE IOBYTE

The IOBYTE (CP/M memory location 3) is a byte that determines which
physical I/O device is linked to each of the four CP/M logical devices. The
I/O Byte setting can be examined and set by using the STAT command.
Physical devices in brackets are not used:

    bits 0-1 (least significant) are the console device:
        00 = TTY: 01 = CRT: [10 = BAT: 11 = UC1:]

    bits 2-3 are the reader device:
        00 = TTY: 01 = PTR: [10 = UR1:   11 = UR2:]

    bits 4-5 are the punch device:
        00 = TTY: 01 = PTP: [10 = UP1:   11 = UP2:]

    bits 6-7 are the list device:
        00 = TTY: 01 = CRT: [10 = LPT: 11 = UL1:]

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ACCESSING RAM AND I/O

When running under CP/M-80 you may need to access the 8088's memory and I/O space:

► To write directly to the screen or character RAM.

► To write to an I/O card.

► To make use of the RAM for extra storage.

WRITING TO RAM   5.1

The specified number of bytes are written to the specified memory address.

```
MVI   A, 0DH
CALL FA33H
MVI   A, low address
CALL FA36H
MVI   A, high address
CALL FA36H
MVI   A, low byte count
CALL FA36H
MVI   A, high byte count
CALL FA36H
MVI   A, byte1
CALL FA36H
MVI   A, byte2
CALL FA36H
        .
        .
        .
```

5.2 READING FROM RAM

The specified number of bytes are read from the specified memory address.

```
MVI   A, 0CH
CALL  FA33H
MVI   A, low address
CALL  FA36H
MVI   A, high address
CALL  FA36H
MVI   A, low byte count
CALL  FA36H
MVI   A, high byte count
CALL  FA36H
CALL  FA39H
STA   byte1
CALL  FA39H
STA   byte2
      .
      .
      .
```

5.3   EXECUTE AN 8088
SUBROUTINE IN RAM

Control is temporarily transferred to the 8088 processor of the computer, at the specified memory address. Control can be returned to the Z80 by executing a "RETF" instruction.

```
MVI   A, 0EH
CALL  FA33H
MVI   A, low address
CALL  FA36H
MVI   A, high address
CALL  FA36H
```

FIND THE MAXIMUM RAM ADDRESS 5.4

This function returns a 16-bit segment value representing the top of memory available to the user. Memory is available from address 02C00 hex up to this address during CP/M-80 operation. To calculate the number of bytes available, subtract 02C00H from the number returned by this function.

```
MVI   A, 16H
CALL FA33H
CALL FA39H
STA    low max address
CALL FA39H
STA    high max address
```

SET THE SEGMENT VALUE 5.5

This function sets up the 16-bit base segment value for read, write, and execute operations in memory. It defaults initially to F000 hex (the start of the screen RAM).

```
MVI   A, 12H
CALL FA33H
MVI   A, low segment value
CALL FA36H
MVI   A, high segment value
CALL FA36H
```

5.6 WRITE TO AN I/O PORT

An 8-bit value is output to the 16-bit 8088 I/O port address.

```
MVI   A, 15H
CALL FA33H
MVI   A, low port address
CALL FA36H
MVI   A, high port address
CALL FA36H
MVI   A, data value
CALL FA36H
```

5.7 READ FROM AN I/O PORT

An 8-bit data value is input from the specified 16-bit 8088 I/O port address.

```
MVI   A, 14H
CALL FA33H
MVI   A, low port address
CALL FA36H
MVI   A, high port address
CALL FA36H
CALL FA39H
[data value is in A]
```

5.8 ACCESSING THE CORVUS DRIVE DIRECTLY

The Corvus ports are:

Data   - Z80 port #1
Status in   - Z80 port #0 (bit 0 = drive ready, bit 1 = drive active)

Examples of Corvus commands are provided by the SEMA4, MIRROR, PUTGET, and CDIAGNOS utility programs whose source code is provided on the CP/M-80 disk.

NOTES ON CP/M-80 PACKAGES

INTRODUCTION   A.1

The main application for your CP/M-80 card is to run the commercially available CP/M software packages. When you receive this manual and diskette, you should first make a back-up copy of the master diskette for the package.

To format a diskette you use the FORMAT utility running under CP/M-86. Your dealer can provide you with a manual that describes this utility.

Running your application package on the CP/M-80 card is just like running it on any 8080/Z80 CP/M 2.2 system.

WORDSTAR   A.2

Use the "X" terminal option (Heath H89/H19) when configuring. Also alter the delay bytes at hex memory locations 2AE and 2AF to zero for maximum operating speed.

CORVUS HARD DISK INTERFACE

INTRODUCTION   B.1

The hard disk interface on the CP/M-80 card can drive a Corvus 5, 10, or 20 megabyte hard disk. CP/M-80 operation using a Corvus drive is similar to operation using floppy disks, but is much faster and offers more on-line storage capacity.

DRIVE ACCESS TIME:	10 or 20 Mbyte drive:	80ms maximum 40ms average
	5 Mbyte drive:	240ms maximum 125ms average

5Mb Winchester	file space (2 × 2788 Kbytes): block size: directory entries (2 × 256):	5576 Kbytes 8 Kbytes 512
10Mb Winchester	file space (2 × 4704 Kbytes): block size: directory entries (2 × 256):	9408 Kbytes 8 Kbytes 512
20Mb Winchester	file space (4 × 4704 Kbytes): block size: directory entries (4 × 256):	18816 Kbytes 8 Kbytes 1024

During normal operation you generally want drive A: to be on the Corvus drive, because it is used most. Because CP/M-80 version 2.2 only supports drives up to 8 Mbytes, the Corvus drive is divided into logical CP/M-80 drives of about 5 Megabytes each. These are typically:

5 Mbyte drive	CP/M-80 drives A: and B:
10 Mbyte drive	CP/M-80 drives A: and B:
20 Mbyte drive	CP/M-80 drives A:, B:, C: and D:

B.2 SETUP PROCEDURE FOR A NEW DRIVE

With the power turned off, connect the Corvus drive to the CP/M-80 card using the 34-pin ribbon connector. *Be sure that the cable orientation is correct, or it may damage the card or the drive.* The CP/M-80 card should be positioned so the red stripe of the ribbon cable is in the top left corner of the card. The red stripe on the Corvus drive is nearest the right side of the socket marked "processor" when the drive is viewed from the rear.

> **WARNING:** On the revision B Corvus drives, inspect the row of four switches located under the front panel of the drive, below the Busy, Ready and Fault lights. Reading from left to right, these switches are the LSI-11, Constellation, Format, and Reset switches.
>
> If a Constellation unit is not part of the configuration, all four switches should be in the left position during normal operation. If a Constellation unit is attached, the CONSTELLATION SWITCH ONLY (second switch from the left) should be switched to the right.
>
> The Format switch must remain in the left position during normal use or the drive controller firmware may be overwritten. The drive reset switch should never be used when a disk operation is in progress, or data may be destroyed.

Power up the computer and the Corvus disk drive. The Busy and Fault lights on the drive should go out after a few seconds, leaving the Ready light on. This indicates that the drive is up to speed. You need to reconfigure a copy of your CP/M-80 operating system to work with the hard disk (use the NEWSYS program). *Never reconfigure your master of the CP/M-80 disk.* Place the disk to be reconfigured in drive A and load CP/M-80. Type:

    NEWSYS <cr>

The NEWSYS program displays the prompt:

    Reconfigure "80.CMD" on which drive (A-P) ?

Reply with:

A `<cr>`

When the system to be reconfigured is loaded into memory, NEWSYS displays a menu of options:

A - autoload command
D - disk drive assignments
I - change I/O port number
M - drive M setup
S - save reconfigured system
E - execute reconfigured system
Q - quit to CP/M-80

Type D and a Return. CP/M-80 displays several choices of disk drive assignments:

1. A, B = floppy
2. A, B = floppy, C, D = 5 Mbyte Corvus
3. A, B = floppy, C, D = 10 Mbyte Corvus
4. A, B = floppy, C, D, E, F = 20 Mbyte Corvus
5. C, D = floppy, A, B = 5 Mbyte Corvus
6. C, D = floppy, A, B = 10 Mbyte Corvus
7. E, F = floppy, A, B, C, D = 20 Mbyte Corvus
8. Special drive assignment (not recommended)

Select option 2, 3, or 4 (depending on drive size) and a Return. Then type:

E `<cr>`

to execute the reconfigured system with drives C, D (E, F) as the hard disk.

Next, clear the directory on the hard disk by typing:

CLEAR `<cr>`

The directory clearing program asks for a disk drive name. Type:

C <cr>

The program asks if you are sure, and then clears the directory on drive C. Next, the program prompts you for another drive name. At this point, type:

D <cr>

to clear the drive D directory. If you have a 20-Mbyte drive, clear the directories on drives E and F in the same way. After all the directories have been cleared, type a Return to exit from the directory clearing program.

Now you should be able to read and write CP/M-80 files on the hard disk as if it were a floppy disk. Copy all the files from your master CP/M-80 disk with the command:

PIP C: =*.*[o]

When the copying has finished, you can run programs from the hard disk instead of the floppy disk. To run a program from the hard disk, indicate the drive name of the hard disk before typing the program name. For example,

C:STAT

runs STAT.COM from drive C.

When you are satisfied that the hard disk is functioning properly, the final step is to reconfigure the system with the Corvus as the main system drive—namely, drive A:. Use NEWSYS to reconfigure your system again, but this time specify drive configuration 5, 6 or 7 (depending on drive size), and use the S command to save the reconfigured system on the floppy disk.

DRIVE M OPERATION

Drive M is a feature that allows you to treat expansion RAM cards as disk drives. You can transfer frequently used programs and files into RAM (drive M) at the start of a session. The RAM card behaves as a high-speed, volatile, CP/M disk drive. All of the normal CP/M commands can be used with drive M (STAT, PIP, ERA, DIR, etc.).

CAUTION: When all of available RAM is used, the system may hang up. Use this feature with caution.

CARE OF THE DISK DRIVE

The Corvus drive is considerably more durable than a floppy disk unit, but observe the following points to avoid damaging your drive or data:

1. Always power the drive up last and switch it off first.

2. Do not obstruct the air holes on the drive or keep it in an enclosed space without adequate ventilation.

3. Keep the drive away from strong magnetic fields.

4. Ensure that the front panel switches are always kept in their correct positions, as described in Section B.2.

5. Avoid excessive mechanical shocks, such as dropping the drive.

CAUTION: Run a format check on any newly shipped drive before any valuable data is stored on it (see Section B.3, "Diagnostic Utility").

CORVUS UTILITY PROGRAMS   B.3

The CP/M-80 master disk contains Corvus documentation files, which can be displayed using the TYPE command. It also contains support programs for the hard disk. These programs are designed to run under CP/M-80, and include:

▶ Diagnostic utility.
▶ Mirror utility.

B

DIAGNOSTIC UTILITY

The Corvus diagnostic program includes a format check function. A format check should be run on new hard disk drives to determine whether the hard disk was damaged in shipping.

To use FORMAT CHECK, run the CDIAGNOS program from the utility disk and answer the menu prompt with the command "2" (FORMAT

CHECK). Specify drive number 1 to start the format check. While FORMAT CHECK is in operation, pressing any key produces the display:

FORMAT CHECK IN PROGRESS . . .

When the check is finished, the program displays the number of bad sectors found. If there are no bad sectors, press ALT-C to return to CP/M-80.

If bad sectors are found, attempts are made to correct them without destroying the data. Repeat the format check until no bad sectors are found.

MIRROR UTILITY

The Corvus Mirror option supported by the CP/M-80 card provides a fast and inexpensive way to back up the contents of Corvus hard disks on a commercially available video cassette recorder. Two speeds, Normal or Fast, record the data with quadruple or dual redundancy.

The Normal backup speed is about 7.5 Kbytes per second (recording with quadruple redundancy). A 10 Mbyte drive can be copied in about 20 minutes. The data capacity of a video cassette is about 100 Mbytes.

There are four commands in the Mirror utility: BACKUP, VERIFY, RESTORE, and IDENTIFY.

B.4 HARD DISK ERRORS

The message "Hard disk error" is displayed during CP/M-80 operation when a disk read/write failure occurs. If this occurs while a file is being read/written with the hard disk, the transferred file is bad. A format check should be run (see the section on the diagnostic utility), and the file operation which caused the error should be re-run if possible. Hard disk errors are rare and are usually caused during shipping or by a power supply failure.