Digital Microsystems

DMS-86

STATION MANUAL

Digital Microsystems DMS-86 HiNet Station Manual

Contents

1.0 INTRODUCTION

This manual describes the Digital Microsystems' DMS-86. This is a single-board system, based on the Intel 8086 microprocessor chip. The DMS-86 can only be used as a work station on the Digital Microsystems HiNet (TM) Local Area Network. Additional information on HiNet can be found in the HiNet Users Manual.

The DMS-86 is packaged in a wafer shaped cabinet suitable as a base for a VDT screen or keyboard/screen. For a complete user station, the user will need to select a CRT for use with the DMS-86; the user may also connect a parallel or serial printer to the station.

1.1 Feature Summary

Intel 8086 at 5 MHz
Intel 8087 Numeric Data Processor (optional)
256K to 1016K dynamic RAM (above 512K requires daughter board)
8K PROM monitor
2 RS-232 ports, 1 RS-422 port, 1 RS-232 or RS-422 port
2 8-bit bidirectional parallel ports
CP/M-86 and HiNet operating systems

1.2 Unpacking Instructions/Component Summary

Your shipping box should contain the following components:

1. DMS-86
2. Power Cord (DMS Stock #27-5000)
3. RS-232 CRT Cable (DMS Stock #83-0048)

When you receive your DMS-86 it is suggested that you perform a careful visual inspection of the exterior of the DMS-86 and associated hardware. The computer undergoes extensive tests at the factory and is carefully packaged for shipment; however, it still may be upset in transit. If any part appears damaged or sounds loose, do not connect your DMS-86 to a power supply until you have consulted with your dealer or DMS.

1.3 Warranty Information

1. LIMITED WARRANTY. Equipment manufactured and sold by Seller is warranted to be free from defects in material or workmanship for a period of ninety (90) days from the date of shipment by Seller. The warranty as to Equipment manufactured and sold by Seller is conditioned upon proper use of such Equipment by Buyer and will not cover Equipment which has been modified without the written approval of Seller or which has been subjected to unusual physical or electrical stress. Equipment sold to Buyer by Seller which is not manufactured by Seller is sold subject to the warranty and/or disclaimer of warranty of its manufacturer, a copy of which is attached hereto and receipt of which Buyer acknowledges. THE FOREGOING WARRANTIES ARE IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR PARTICULAR PURPOSE, USAGE FOR TRADE. SELLER MAKES NO OTHER WARRANTY TO ANY PERSON WITH REGARD TO EQUIPMENT AND FORBIDS BUYER TO REPRESENT OTHERWISE TO ANYONE WITH WHICH IT DEALS.

2. REMEDIES. If Buyer notifies Seller during the warranty period of any alleged defect in material or workmanship in Equipment manufactured by Seller and returns such Equipment to Seller freight prepaid fo inspection, Seller will repair or replace such Equipment found to be so defective and return the same to Buyer freight prepaid. If repair or replacement of defective Equipment manufactured by Seller is not practicable, Seller may, at its option, in lieu of repair or replacement, refund the purchase price paid by Buyer for such Equipment. If no defect is found by Seller in Equipment returned to it, such Equipment will be shipped back to Buyer freight collect. If Buyer notifies Seller during the applicable warranty period, if any, of any failure of Equipment not manufactued by Seller (but sold by Seller to Buyer) to conform to the applicable warranty, if any, by the Manufacturer of such Equipment, Seller will make reasonable efforts to assist Buyer in obtaining remedies specified under such warranty. THE FOREGOING REMEDIES ARE THE SOLE AND EXCLUSIVE REMEDIES OF PURCHASER FOR DEFECTIVE EQUIPMENT.

3. Limitation of Liability; Exclusion of Consequential Damages. SELLER'S TOTAL LIABILITY FOR ALL CLAIMS OF ANY KIND, INCLUDING WITHOUT LIMITATION BREACH OF WARRANTY OR OTHER BREACH OF CONTRACT, NEGLIGENCE AND STRICT LIABILIY IN TORT, FOR LOSS OR DAMAGE ARISING OUT OF, CONNECTED WITH OR RESULTING FROM EQUIPMENT MANUFACTURED OR SOLD BY SELLER, OR THE PURCHASE, USE OF PERFORMANCE THEREOF, SHALL IN NO EVENT EXCEED THE PURCHASE PRICE PAID FOR SUCH EQUIPMENT. IN ADDITION, IN NO EVENT SHALL SELLER BE LIABLE TO BUYER OR THIRD PARTIES FOR ANY INCIDENTAL, CONTINGENT, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION LOSS OF PROFITS OR REVENUE, LOSS OF USE OF THE EQUIPMENT, COST OF CAPITAL OR CLAIMS BY BUYER, BUYER'S CUSTOMERS OR OTHER THIRD PARTIES FOR DAMAGES RESULTING FROM PROPERTY DAMAGES OR PERSONAL INJURY.

1.4 System Registration and Update Information

Enclosed with your system diskette is a CP/M license agreement and registration card. Please return these directly to Digital Research to receive their update information.

In order to receive DMS hardware and software information, and to establish warranty, please fill out and return this page to:

DIGITAL MICROSYSTEMS, INC
1755 Embarcadero
Oakland, CA 94606

ATTN: CUSTOMER SERVICE

You can get the model and serial numbers from the back of the cabinet. The CP/M serial number is written on the diskette.

NAME _____ MODEL NUMBER _____

COMPANY _____ SERIAL NUMBER _____

ADDRESS _____ CP/M SERIAL# _____

_____

PURCHASED FROM _____

DATE PURCHASED _____

1.5 Service Information

The DMS-86 contains no user serviceable parts and must be serviced only by your dealer or the factory.

Any DMS-86, whether purchased from a Dealer or from the factory, may be serviced at the factory by following this procedure.

1. Call DMS customer service department (415) 532-3686 to ask for a Material Return Authorization (MRA) number.

2. Fill out a copy of the service form included in the following pages of the manual. Be sure to fill in all of the blanks.

3. Carefully package the DMS-86 in either its original or other suitable container.

4. Label the carton as follows:

MRA # _____
ATTN: REPAIR DEPARTMENT
DIGITAL MICROSYSTEMS, INC.
1755 EMBARCADERO
OAKLAND, CA 94606

DMS will accept no machine returned to it freight collect.

If your machine is in warranty, and you have returned your registration form, that fact should be established at the time you receive your MRA number. Warranty machines will be returned freight prepaid via UPS. If you want a different method of shipment, specify on the service form, and the machine will be returned freight collect via that method. There is no charge for warranty service.

The standard charge for out-of-warranty service is $250. Your repaired DMS-86 will be returned collect for the repair charge and freight charge via your specified method. You may pre-pay the service charge to avoid carrier surcharge on collect shipments.

ANY MACHINE, WHETHER IN OR OUT OF WARRANTY, THAT HAS BEEN DROPPED, PLUGGED IN TO THE WRONG VOLTAGE, OR OTHERWISE ABUSED WILL BE FIXED AT TIME AND MATERIALS RATE. BE SURE THAT YOU HAVE INCLUDED YOUR TELEPHONE NUMBER, SINCE NO WORK WILL BE DONE WITHOUT FIRST ADVISING YOU OF THE PROBABLE CHARGE.

A charge of $100 will be made "for no trouble found" systems to cover test time and handling.

All repair work carries a 60 day warranty; prices and procedures are subject to change without notice and should be verified when you receive your MRA.

SERVICE REQUEST FORM

MRA# _____

NAME _____ Date Returned _____

COMPANY _____ System Serial # _____

ADDRESS _____

_____

CITY _____ STATE _____ ZIP _____

TELEPHONE _____

SHIPPING INSTRUCTIONS:

UPS GROUND ____ PO# _____

UPS BLUE ____ Check Enclosed? ___

EMERY ____ OVERNIGHT SERVICE ____

FEDERAL EXPRESS ____ OVERNIGHT SERVICE ____

OTHER ____

==========

BRIEF DESCRIPTION OF PROBLEM:

DIGITAL MICROSYSTEMS, INC. 1755 EMBARCADERO OAKLAND, CA 94606
415-532-3686

2.0 INSTALLATION

2.1 Voltage Installation

Check that the 115/230 line voltage selector switch, which is located adjacent to the power cord at the rear of the cabinet, is set to the correct voltage. The visible voltage indication on the switch should be the voltage you are running. The DMS-86 operates on either 50Hz or 60Hz without switch selection. Check that the ON/OFF switch is in the OFF (down) position and attach the power cord to the back side of the cabinet.

2.2 CRT Installation

Use the RS-232 cable to connect your CRT to serial port 0 on the station. Looking at the rear of the unit, this is the lowermost and rightmost RS-232 (DB-25) socket. Check that your CRT is set for 9600 baud, 2 stop bits, "space" parity.

2.3 Printer Installation

If a parallel printer is to be connected to the DMS-86 it should be connected to the centronics connector on the rear panel. A serial printer can be connected to any serial port. Looking at the rear, port2, the default serial printer port, is the uppermost and rightmost RS-232 socket.

2.4 Power On

Turn the power on. The red light on the front of the unit should show. You should be able to get into the PROM monitor by pressing in the "INT" button, then pressing and releasing the "RST" button, then finally releasing the "INT" button. The DMS-86 should respond with

```
DMS-86 Hardware Monitor
8086 - Version x.xx -  (C) 198x

:
```

on the screen. If this doesn't happen check all the connections and cables as this indicates a hardware problem of some sort.

2.5 HiNet Installation

Before proceding with this section, verify that the PROM monitor is working properly by following the procedure in section 2. If this is your first DMS-86 station read section 3.3 and if necessary install the bootstrap program and CP/M-86 on your Master Computer hard disk.

Use an RS-422 cable to connect the station to the main HiNet cable. Plug the cable into the rightmost socket on the back of the unit.

Verify that the network master computer is operational.

Turn the power on. The red light on the front panel should slow and the network sign-on message should appear:

Network User Name =>

If this message does not appear check your cables and HiNet node with a known working station, if possible. Next refer to chapter 5 and use the PROM monitor to help determine what part of the hardware is not functioning.

If this message does appear then type in your user name and optional password. If a correct name and password are entered, the CP/M-86 environment is now available to you and the CP/M-86 prompt

A>

should appear. The ASSIGN command may be used to change the A, B, C, and D disk assignments from their default partitions to those desired.

3. CP/M-86 OPERATING SYSTEM

3.1 Overview

CP/M stands for "Control Program for Microcomputers." The "86" refers to the Intel 8086, the microprocessor chip on which the DMS-86 is based. CP/M-86 is an operating system that manages the resources of an 8086-based microcomputer to make them convenient to use. This operating system is described in detail in a set of reference manuals provided with the purchase of CP/M-86.

The primary purpose of CP/M-86 is to handle disk files, and it can handle all of the types of disk systems that are connectible to your DMS-86 locally or via HiNet.

CP/M-86 file names consist of two parts--a "primary name" of up to 8 characters, and a "secondary name" or "file type" of up to 3 letters. The two parts are separated by a period. The following file types are used for special purposes by parts of the CP/M-86 system:

A86	source file for ASM86 (the CP/M-86 assembler)
H86	object file produced by ASM86
LST	listing file produced by ASM86
SYM	symbol file produced by ASM86
CMD	command file produced by GENCMD or LMCMD file
SUB	source file for SUBMIT command

Most programming language or applications packages use some set of file types for their own purposes. To avoid conflicts in setting up their own conventions for file typing, users need to be aware of the conventions in effect for the software they use.

CP/M-86 is divided into three major components:

(1) CCP - Console Command Processor

This component handles communication with the user at the system console. The CCP prompts the user with:

x> (where "x" is the currently active drive)

The user may then type a command, terminated by a carriage return. The CCP has the following built-in commands:

DIR [filemask]	Display directory entries
ERA filemask	Erase file(s)
REN newname=oldname	Rename file
TYPE filename	Display an ASCII file
USER n	Login to user area n

If the user types a name that is not a built-in command, the disk directory is searched for a CMD file by that name. If found, the file is loaded into memory and the command is executed. This file may be an application program from any software system. The commands supplied by DMS are described in section 3.2.

(2) BDOS - Basic Disk Operating System

The BDOS controls disk allocation and the reading and writing of sequential or random records on a disk. It also provides the interface between user applications and I/O devices and manages the allocation of files and directories.

(3) BIOS - Basic I/O System

The BIOS controls the actual reading and writing of particular tracks and sectors on a disk. Each computer manufacturer who supplies CP/M-86 normally rewrites the BIOS so that CP/M-86 will operate on its particular hardware. Digital Microsystems' version of the BIOS enables communication with HiNet as well as establishing a link between the hardware and CP/M-86.

3.2 CP/M-86 commands

Standard CP/M-86 commands

These commands are described in the CP/M-86 manuals.

ASM86 filename	CP/M-86 assembler
DDT86 [filename]	CP/M-86 dynamic debugger
DUMP filename	Display a binary file
ED filename	CP/M-86 editor
GENCMD FN parameters	Convert H86 to CMD file
LMCMD FN parameters	Convert L-module file to CMD file
PIP [command]	File copy utility
STAT	File status utility
SUBMIT filename	Submit utility
XSUB	Used in conjuction with SUBMIT
GENDEF FN parameters	Disk parameter table generation

Digital Microsystems CP/M-86 commands

These files are supplied with all DMS-86 systems, and are available only on DMS equipment. ASSIGN is described below, while the other 3 commands are HiNet commands and are described in section 4.2.

Command	Description
ASSIGN [disk device]	Assign disk device to A,B,C,D,E,F,G, or H
WHO	Find out who is logged onto the network
DIRNET	List names of partitions on the shared disk
LOGIN	Login under another users name

Assign a CP/M disk to a storage device

Command: ASSIGN [disk device]

ASSIGN is used to assign a CP/M disk (A,B,C,D,E,F,G,H) to a storage device, or the printer (P) to an output port.

Arguments:

disk = A, B, C, D, E, F, G, H (A CP/M-86 disk name) or P (printer)
device = HiNet Partition name
PORT0, PORT2
PORTP (parallel printer port)
SPOOL (HiNet spooler)

CP/M-86 drives A,B,C, and D normally default on login to specific HiNet partitions, and the CP/M-86 LST: device will normally default to the HiNet spooler. ASSIGN is used to change these defaults when necessary and to connect drives E through H, if needed.

If no arguments are specified in the "ASSIGN" command, then the current disk and printer assignments will be displayed.

Any drive can be "unassigned" by assigning it to "U:". For example, the command "ASSIGN D U:" makes the D drive inaccessible. A "*** CALL error" will result if a user attempts to access an "unassigned" drive.

If your DMS-86 has more than 256K bytes of RAM, you can use the top 256K bytes as a "disk." The solid state "disk" partition name is ULTRA0. This name is built in and cannot be changed. For example, the command "ASSIGN H ULTRA0" makes the last 256K bytes of memory look to CP/M-86 like the H drive. Assigning a drive to memory and copying program overlay files onto that drive makes program chaining operations run at solid-state memory speeds instead of rotating-memory speeds.

The ASSIGN command can also be used to assign the CP/M-86 LST: device to different output ports. For example, the command "ASSIGN P PORTP" will assign the printer to the parallel port.

The 4 different printer drivers which are supported by the ASSIGN command are as follows:

PORT0 : serial port 0 - This is the standard default console port.

PORT2 : serial port 2 - This is the standard default serial printer port.

PORTP : parallel port - This printer driver should be used if you have a printer which uses a parallel port interface.

SPOOL : spooler — To use the HiNet spooler, the LST: device should be assigned to SPOOL (see section 4.8).

Some examples of the ASSIGN command are shown below:

```
A>ASSIGN A TOOLS86                          Assign A to HiNet
Assignment accepted.                        partition TOOLS86.

A>ASSIGN                                    Display current
                                            assignments.
                Disk Assignments
                ----------------

    A     TOOLS86        HiNet      512K bytes
    B     APP1           HiNet      256K bytes
    C     ACCTG          HiNet        1M bytes
    D     Unassigned
    E     Unassigned
    F     MT86           HiNet      256K bytes
    G     Unassigned
    H     UltraO         Memory     256K bytes


Printer assigned to PORT2 (serial port 2)

A>ASSIGN C USER1A                           Assign C to HiNet
Assignment accepted.                         partition USER1A

A>ASSIGN D PRIVATE                          Assign D to password
                                            protected HiNet
Enter Password: HIDE (psw not echoed)       partition PRIVATE.
Assignment accepted.

A>ASSIGN P PORTP                            Assign the printer
Assignment accepted.                        to the parallel port

A>ASSIGN                                    Display current
                                            assignments.
                Disk Assignments
                ----------------

    A     TOOLS86        HiNet      512K bytes
    B     APP1           HiNet      256K bytes
    C     USER1A         HiNet        1M bytes
    D     PRIVATE        HiNet      512K bytes
    E     Unassigned
    F     MT86           HiNet      256K bytes
    G     Unassigned
    H     UltraO         Memory     256K bytes


Printer assigned to PORTP (parallel port 2)
```

3.3 System Initialization

This section describes the steps required to install the bootstrap program and CP/M-86 on your master hard disk. If you already own one or more DMS-86 stations you have probably allready done this and may skip this section. Depending on what previous equipment you own, you will fall into one of the following three catagories:

1. You have no CP/M-80. You will need to install CP/M-80, and the bootstrap program and CP/M-86 for the DMS-86. See section 3.3 of the DSC-3/DSC-4/HiNet System Manual for instructions on how to install CP/M-80. Next, follow the instruction given below to install the bootstrap program and CP/M-86 for the DMS-86.

2. You have a master running CP/M-80, but not the bootstrap program and CP/M-86 for the DMS-86. You will need to install the bootstrap program and CP/M-86 for the DMS-86.

3. You have a master running CP/M-80, and the bootstrap program and CP/M-86 for the DMS-86. All you need do is plug in your DMS-86 and turn it on. (This is probably the case if you allready own one or more DMS-86 units.) You can skip the rest of this section.

How to install CP/M-86 on your HiNet master

1. From the master, run alloc to create a partition where you will store all the CP/M-86 utility programs. It should be 512k (i.e. size 2). You might want to call it "cpm86". Alternately, you may want to store all the CP/M-86 utility programs on your system partition. In this case make sure that you have about 400K free in your system partition.

2. From the master, use the utility "users" to create new HiNet user name(s) which include the above partition as one of the default partitions (probably on logical drive "A"). I/o ezit =

3. Reboot the master to activate the new partition allocation.

4. Make a copy of the original CP/M-86 diskette. You should only use the copy to work with; use the master only to make more copies. If you will be making many copies you may want to make 1 copy of the original, and then use that copy ("working master") to make the working copies. This way the original master won't get used as much. Write-protect all the copies once they are made by removing the foil sticker.

5. Copy everything from the copy of the CP/M-86 diskette into the new CP/M-86 partition.

6. ~~Bring down HiNet by~~ booting the master off of a floppy diskette. This can be any diskette as long as a) it can be booted from; b) it can be written to; and c) it has the "assign" utility on it.

7. Make sure the diskette is assigned ot logical drive "A", then assign logical drive "D" to the CP/M-86 partition on the hard disk (e.g.

A> assign d: h:cpm86

).

8. Install the CP/M-86 bios in the proper place on the master hard disk by submiting the file "makdms86.sub" (e.g.

A> d:submit d:makdms86

The "d:" before the "submit" command is not necessary if you have the submit utility on the floppy that you booted from.)

9. Finally, re-boot the master ("bring HiNet back up"), plug in your DMS-86 station, and login. (See section 2 of the DMS-86 HiNet Station Manual.)

3.4 Error Messages

Errors can be caused by hardware malfunction, software malfunction, or improper use of commands. This section suggests some courses of action to determine the nature of the problem and an approach to a solution.

BDOS Err on x:Select
A drive "x" other than A,B,... or H has been selected. Press return or CTRL-C to return to the command processor.

BDOS Err on x:R/O
The directory on drive "x" has changed since the directory was last accessed. A warmboot (CTRL-C) will reload all the directories.

CALL error
A non-available BIOS feature has been requested, or an attempt has been made to access non-existent hardware. Use a warmboot (CTRL-C) to return to the command processor.

HALT error
An attempt was made to execute a HALT instruction at the address printed. Use a warmboot (CTRL-C) to return to the command processor.

INT error
Bad interrupt. An interrupt has occured, but the wrong vector was used. This usually indicates a software error. Use a warmboot (CTRL-C) to return to the command processor.

3.5 Contents of HiNet 86 distribution diskette

Standard CP/M-86 commands:

File name	Description
ASM86.CMD	CP/M-86 assembler
DDT86.CMD	CP/M-86 dynamic debugger
DUMP.CMD	Display a binary file
ED.CMD	CP/M-86 editor
GENCMD.CMD	Convert H86 to CMD file
PIP.CMD	File copy utility
STAT.CMD	File status utility
SUBMIT.CMD	Submit utility
GENDEF.CMD	Disk parameter table generation
LMCMD.CMD	Convert L-module file to CMD file

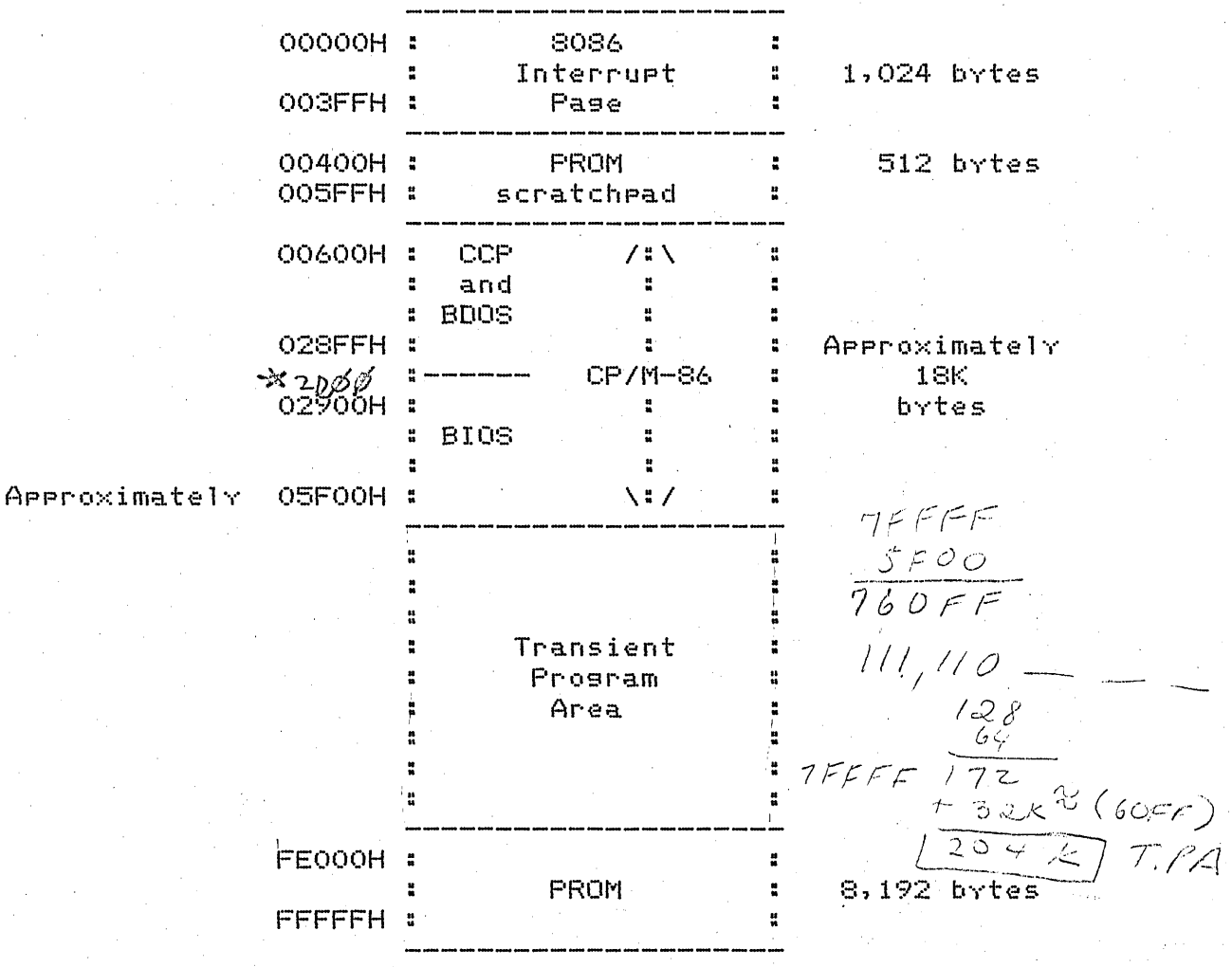
Digital Microsystems' CP/M-86 commands:

File name	Description
ASSIGN.CMD	Assign disk device to A,B,C,D,E,F,G, or H
DIRNET.CMD	List names of partitions on the shared disk
WHO.CMD	Find out who is logged in to the network
LOGIN.CMD	Login under another user name

Other Files:

File name	Description
makdms86.sub	Submit file that installs CP/M-86 on the Master Computer hard disk.
wrun0.com	Write to hard disk partition 0 from a file. Used by "makdms86.sub" to write CP/M-86 on the Master Computer hard disk.
submit.com	Submit utility. Used to submit "makdms86.sub".
zeroboot.cmd	Bootstrap code for DMS-86 stations.
cpm.sys	CP/M-86 for DMS-86 stations.

3.6 CP/M-86 Memory Allocation



The memory of the DMS-86 is divided into five different blocks. The first 1024 bytes (addresses 00000 through 003FFh) are used as the 8086 "interrupt page". The next 512 bytes are used as a scratchpad area for the PROM. The next section of memory (approximately 18K bytes) is occupied by CP/M-86. All memory from the end of CP/M-86 to the end of RAM (or to address FF000, whichever comes first) is available for user programs and data. The last 8,192 bytes of the 1,048,576-byte address space (FE000 through FFFFF) is occupied by the PROM.

The CCP and BDOS portions of CP/M-86 occupy memory

locations 00600h through 028FFh. The BIOS occupies the space from 02900h through approximately 05F00h. (The end of BIOS depends on which specific version of the software you have.)

Under normal circumstances, the only matter of concern is whether or not you have enough memory available to run the application you wish to. If you don't, you will see the error message "INSUFFICIENT MEMORY" when you try to run your program.

4. HiNet operating system

4.1 Overview

The DMS HiNet system is a high speed local computer network. The network uses a shared disk system for data storage, and a single cable for communication. A HiNet system consists of a master computer and one or more stations. The master provides control of the network communication lines and interfaces the user stations (and optionally a user connected directly to the master computer) to the shared disk resources. A DMS-86 user station is a complete computer system in itself, with its Intel 8086 central processor, 128K to 1016K bytes of memory, and several I/O interfaces. It runs under its own local copy of CP/M-86 and uses HiNet to share the Master station's disk and printer. A DMS-86 station may, at the user's option, have it's own printer or other devices.

The Master's shared hard disk is partitioned into 1 to 64 logical units. Each partition is assigned an 8 character name and a 6 character password. Each partition has a separate directory, which can be assigned for the exclusive use of one user, or for shared use by several users.

The environment seen by a typical DMS-86 HiNet user station is that of standard CP/M-86, plus four available HiNet commands:

ASSIGN [x partition]	Associate drives with disk partitions
DIRNET	List names of partitions on the shared disk
WHO	Find out who is logged in to the network
LOGIN	Login under another user name

4.2 HiNet commands

The ASSIGN command is described in section 3.2. DIRNET, WHO, and LOGIN are described below.

command form: DIRNET

This command displays the name of all HiNet disk partitions.

Example:

```
A>DIRNET
                        HiNet Partitions
                        ----------------

TOOLS80  256K   ADMIN    256K   ACCTG    1Meg   WP       1Meg
TOOLS86  256K   APP1     512K   MT86     256K   MT80     256K
DATABASE 2Meg   8087     256K   FORTRAN  256K
```

command form: WHO

This command displays the names of all users who are currently logged into HiNet. It also displays a list of all spool jobs. The users' names are printed along with their login times and their last I/O requests.

Example:

```
A>WHO
                        HiNet users
User      Login Time    Last Access    Last Request   Status
-------   ----------    -----------    ------------   ------
MASTER      10:12:03      10:12:06         read         HiNet
8087        15:55:23      17:30:16          Who         HiNet
ADMIN       15:56:55      15:57:23         Read         HiNet
```

command form: LOGIN

This command is used to log into HiNet under a different user name. The normal login procedure is to boot directly from HiNet by powering on or by hitting RESET. The LOGIN program makes it possible to re-login under a different user name, usually for the purpose of assigning drives A, B, C, and D to new defaults.

Example:

```
A>LOGIN
Network User Name => David
Password =>       [password not echoed]

     Digital Microsystems CP/M-86 BIOS Version x.x
     Digital Research CP/M-86 Version x.x
     System Generated xx/xx/xx

A>
```

4.3 Error messages

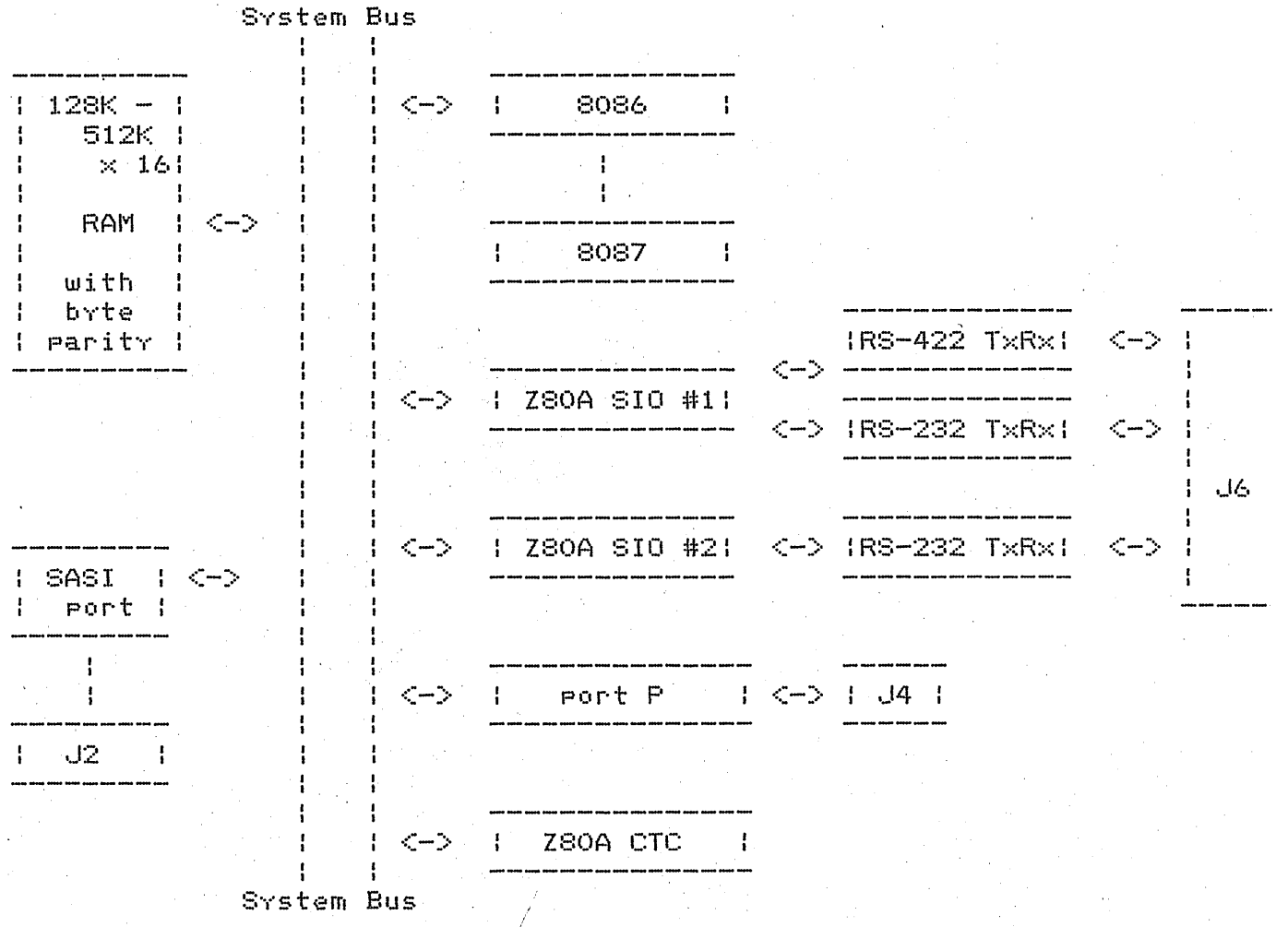
In addition to the CP/M-86 error messages described in Section 3.3, the message "*** Waiting" may occur. This means that the network station has not received a poll from the master station for several seconds. It usually means that the master has failed. The master console may be consulted to determine the cause of the failure.

5. DMS-86 CPU Board Operations

5.1 Overview

The block diagram on the next page shows the major components of the DMS-86. The primary support chips are the Zilog Z80A SIO/O and CTC chips. Each SIO chip controls two I/O ports. SIO #1 controls two RS-422 ports (port 3 on channel A, port 4 on channel B) or one RS-232 (port 1 on channel B) and one RS-422 (port 3 on channel A); SIO #2 controls two RS-232 ports (port 0 on channel A and port 2 on channel B).

The CTC chip generates the baud rates for the I/O ports and generates real-time interrupts at line frequency.



5.2 PROM moniter

When the power is turned on the DMS-86 or when the RESET switch is pressed, the DMS-86 will begin executing an 8K PROM monitor program, and it will attempt to boot from the network.

Under normal circumstances, the Monitor is invisible to the user (even though it is invoked automatically each time power is turned on or the RESET button is depressed). However, when problems arise in either hardware or software, the Monitor can be a great help in solving them.

Using the Hardware Monitor

There are two different ways to interact directly with the Hardware Monitor. One method depends partially on software loaded into the DMS-86's memory from an external storage medium--the other method relies entirely on the DMS-86 hardware.

Both require that the power to the DMS-86 be on and that a terminal of some sort be connected to RS-232 Port 0 on the DMS-86.

The first method is to depress the INTERRUPT button on the front of the DMS-86. This issues a 8086 Non-Maskable Interrupt (NMI) to the 8086 and displays the following messages on the screen:

```
NMI Interrupt

86: >
```

These messages are printed by the Hardware Monitor, which is accessed by jumping to an address contained in the Interrupt Page of RAM memory (Specifically, the jump address is contained in the type 2 interrupt pointer area, the four byte region in RAM beginning with location 00008. All DMS software preserves this jump address.) This method of entering the Hardware Monitor can be invaluable in debugging software, and an example is given below. [Note: It is possible for a malfunctioning program to overwrite the NMI jump address, causing the INTERRUPT button to generate unpredictable results. This in itself can provide clues in debugging software, of course.]

The second method of entering the Hardware Monitor is to hold the INTERRUPT button in, and while it is depressed, push the RESET button. This method relies entirely on hardware [i.e., it should work no matter what, and if it doesn't, indicates some sort of hardware malfunction, from no power to a faulty terminal connection to worse...]. When

this entry method is used, the Hardware Monitor puts the messages

```
DMS-86 Hardware Monitor
8086 - Version x.xx -  (C) 198x

86:
```

on the screen.

No matter which method you've used to enter the Hardware Monitor, once you see the ":" prompt, you're ready to use the Monitor. Begin by typing a question mark (?) followed by a RETURN. A list of the Hardware Monitor commands and their meanings should appear on the screen. The ? command can be used anytime to refresh your memory. A more complete description of each command follows. When you are entering commands to the Hardware Monitor, you may use the <BACKSPACE> key to correct typing errors, and you may use either upper or lower case letters.

Hardware Monitor Commands

A — ASCII value mode

This command puts the DMS-86 into a mode where the (hexadecimal) ASCII value of each incoming character from the terminal is displayed (followed by a space) rather than the normal mode in which each character typed is echoed to the screen. It is useful in determining exactly what character (or sequence of characters) is emitted by a terminal when particular keys are depressed. (For instance, many current terminals have special function keys which produce sequences of characters when pressed.) Once the DMS-86 is in this mode, the only way to return to the normal mode is to hit RESET, INTERRUPT, or switch the power on and off.

B — Boot

This command causes the Hardware Monitor to attempt to "boot" from the rightmost (facing the rear) RS422 serial port. Using this command is equivalent to pressing RESET or turning the power on and is provided as a convenient way to escape from the Hardware Monitor and resume normal activity.

C start, end, seg off — Copy

This command copies the information contained in the current segment (see the segment Prefix command P) from offset "start" to offset "end" into the specfied new segment "seg," beginning at offset "off." PARMeters can be sep by space or comma

C source offset, ByteCNT, destination seg, destination offset

D address — Display contents of memory

Typing D followed by a hexadecimal value for address displays the contents of the 256 bytes of memory beginning with the 8086 "paragraph" (16 byte region) containing the address. For example, typing D 9C45 <RETURN> causes the 256 bytes whose offset values are 9C40 through 9D3F to be displayed in hexadecimal form. In addition, each byte is displayed as a printing ASCII character. The format of the display is sixteen bytes per line with the hex interpretations printed on the left and the ASCII characters on the right. To produce the ASCII display, high order bits are ignored, and periods are displayed for non-printing ASCII values. Full addresses for each displayed paragraph are denoted in the form "segment prefix:offset" (see the segment Prefix command P).

F start addr, end addr, value — Fill memory

This command causes the memory locations with offsets ranging from start addr through end addr to be filled with the (one byte) hexadecimal value. The offsets are relative to The current segment (see P).

G address[,breakpoint] — Go to address

This command causes the Hardware Monitor to execute an 8086 JUMP FAR instruction to the place in memory whose Segment is the current segment prefix value (see P), and whose offset is address. If the optional breakpoint is specified, the Hardware Monitor will save the byte at that address and replace it by a breakpoint (INT 3) instruction. When a breakpoint instruction is encountered in the instruction stream, control returns to the Hardware Monitor, which replaces the breakpoint instruction with the saved byte, prints a message indicating that a breakpoint trap has been encountered, and displays the Hardware Monitor prompt. See the discussion on "Using Breakpoints" for examples of using the G command.

I port — Input from port

This command causes a byte to be input (and displayed) from the port whose address is port. This is particularly useful during debugging of complex communication protocols, as it (in conjunction with the O command) allows status bytes to be read from the various I/O devices on the DMS-86.

M start addr, end addr — Memory test

This command causes a simple memory test to be carried out. The test writes all memory locations in the current segment (see the P command) with offsets from start addr through end addr with a byte value. Next the test waits a short time, then reads all of the locations under test to see if the value has changed. The value being written begins with 00, then proceeds with 01, 02, ... FF before repeating. The test repeats endlessly until you strike the RETURN key. When you do so, the Hardware Monitor completes the test with the last value, then displays the number of memory errors. (Any errors detected will cause a display during the test as well.) This test is not sensitive to all memory errors, however, and is intended to be used as a quick "first cut" when you suspect memory problems.

O value,port — Output to port

The one byte value is sent to the output port with the given port address.

P segment — set segment Prefix

The 8086 addresses its memory in segments, and a complete address of a given location consists of a 16-bit segment prefix P and a 16-bit offset O. The 8086 forms a 20-bit address from these values by the formula 16P+O. When the Hardware Monitor issues a memory address to carry out a Copy, Display, Fill, Go, Memory test, or Set command, it normally assumes that the segment prefix is 0000. However, you can this force the Monitor to use another segment prefix via the P command. For example, if you wanted to examine the contents of location 1FFFF, you could use the commands:

```
P 1000  <RETURN>
D FFFF  <RETURN>
```

The first 64K of memory can be accessed with Segment value ("prefix") 0000, the second 64K of memory begins with prefix 1000, the third with 2000, and so on. However, different prefix/offset combinations can refer to the same memory location. For example, the Hardware Monitor uses the RAM scratchpad in memory locations 00400 through 005FF. This scratchpad region of memory can be displayed in a variety of ways. For example,

```
P 40  <RETURN>
D 0   <RETURN>
```

will display the first 256 bytes of the scratchpad, as will

```
P 0   <RETURN>
D 400 <RETURN>
```

as will

```
P 20  <RETURN>
D 200 <RETURN>
```

S address — Set memory

Striking S <RETURN> puts the Hardware Monitor into the Set Memory mode. In this mode, you may enter hexadecimal values directly into memory in the current segment (see the P command) beginning at the location whose offset is address, one byte (that is, two hex digits) at a time. While you're in Set memory mode, striking the <SPACE> bar will display the current contents of the next byte in memory and let you enter a new value for it. Striking <RETURN> causes the Hardware Monitor to leave the Set Memory mode and return to the ":" prompt to await your next command. (See also the "Type" command T.)

For instance,

```
: S 4000
```

displays the contents of location 4000 (relative to the current segment prefix) in the form

```
50:
```

(assuming the byte happens to have the value "50 hex") and leaves the cursor to the right of the ":". You may now type a pair of hex digits to specify a new value for this byte.

```
50:4F
```

If you want to go on to the next byte, strike the <SPACE> bar after entering the new value and the contents of the next byte (offset 4001 in this example) will appear. You can then enter a new value for it (or type a <SPACE> to leave it as is), and so on as far as you want to go.

```
50:4F 0D:FF 29:34     ... etc ...
```

Striking <RETURN> stops the process and returns to the ":" prompt.

T — Type into memory

The T command provides a convenient way to enter a string of printing characters into memory. After you type T <RETURN> in response to a ":" prompt, all characters you enter from the keyboard (up to the next <RETURN>) will be entered directly into consecutive bytes in memory. The first character will go into the location which was the target of the last Display or Set operation. To see how this works, try the following sequence of events.

```
: P 60 <RETURN>

: D 7000 <RETURN>
  7000
: T^<RETURN>

abcdefghijklmnopqrstuvwxyz<RETURN>

: D 7000 <RETURN>
```

and look at the ASCII part of the displayed region. You will see the alphabet stored in the twenty-six bytes at locations 0060:7000 through 0060:7019 (that is, addresses 07600 through 07619).

W — Write initial values into memory

The Write command sets all memory bytes beyond the RAM scratchpad (see "Memory Allocation") to the hex value E5. This will avoid parity errors if a program accesses memory that hasn't been initialized. (The value E5 hex was chosen to make unused memory look like a formatted diskette.)

X — eXamine registers

The X command shows the contents of all of the 8086's registers at the time of the last Non Maskable Interrupt (i.e., the last time you pressed the INTERRUPT button on the front of the DMS-86). This is an exceptionally valuable feature for debugging system software. For instance, suppose you're working on a program, and it appears to go into an infinite loop. Hit the INTERRUPT button, then type X <RETURN> in response to the ":" prompt. You'll see something like

```
Flags.AX. .BX.  ...  .CS. .DS. .SS. .ES. .IP.
0214 0002 2500  ...  343E 3736 37F0 3736 1C0B
```

showing the values of the 8086 registers at the time you interrupted your malfunctioning program. The Code Segment register CS had the value 343E, and the Instruction Pointer

had the value 1C0B. This tells you the region of your program which was being executed. You can instantly get a look at the stack your program was using by Displaying the region at segment prefix value 37F0 (the Stack Segment register's contents) and at the offset shown for the Stack Pointer.

The X command also lets you change the contents of the 8086's registers. You'll notice that no ":" prompt appears after you've done an X command. Instead, the Hardware Monitor has entered the Set Registers Mode. You may terminate this mode by hitting the <RETURN> key, you may scan (from left to right) by striking the <SPACE> bar, and you may enter new values into the registers by simply typing the hexadecimal value you desire. Follow each new value with a <SPACE> if you want to continue in the Set Registers mode, follow the last value you want to change with a <RETURN>.

Note: If your program has overwritten the type 2 interrupt pointer area in low memory, hitting the INTERRUPT button will not have the desired effect.

? — Help

Use the ? command to see a summary of the Hardware Monitor commands.

: — Load Intel format Hex file line

As an aid to system development, the Hardware Monitor will load programs from the RS232 port which is normally connected to a video display terminal. Each response to the ":" prompt that begins with a colon is interpreted as a string of 8086 instructions and/or data written in the Intel 8086 Hex file format. Such a Hex file contains both instructions/data and address designations. The Hardware Monitor loads these strings of instructions/data into the designated portions of memory. To be more specific, when the Hardware monitor receives the sequence of characters <RETURN>, <LINE FEED>, <:>, it interprets the rest if the line as a line from an Intel 8086 Hex file.

Using Breakpoints

The Hardware Monitor has a Breakpoint facility for use in software debugging. To use it, use the second argument of the Go command to designate the place where you want the interrupt to occur. The Hardware Monitor will insert a Single Byte Interrupt instruction (CC hex) at that point in your program and save the byte that was there. The first argument of the Go command designates the point where you want execution to begin. When the Single Byte Interrupt instruction is encountered by the 8086, control will be transferred to

the Hardware Monitor, the saved byte will be replaced, and the message:

Breakpoint Trap

:

will be displayed. Now you can use the X command to see the state of the 8086's registers at the time of the breakpoint.

Resuming execution after hitting the INTERRUPT button

As described above, when you hit the INTERRUPT button (assuming that low memory has not been overwritten), the Hardware Monitor takes control, allowing you to inspect and change the 8086's registers and memory. To resume execution after a Non Maskable Interrupt, you must use the X command to see the values of the Code Segment register (let's call this "CS-value") and the Instruction Pointer (IP-value). Use the P command to set the segment prefix to CS-value, then type G IP-value to jump to the instruction that was to be carried out next.

Additional Notes

During the execution of the Hardware Monitor, hardware interrupts are disabled. If you are using a version of HiNet that throws a station off line if polls are not acknowledged, you will probably be thrown off the network. (Note: This will not happen if you are using version 37 or later HiNet.)

The Hardware Monitor occupies the top 8K bytes of the 8086 address space at all times. This means that in a DMS-86 with a full Megabyte of RAM, the top 8K of RAM is not accessible, leaving only 1,040,384 addressable bytes of RAM. The method of interfacing the 8086 sections of the hardware to the Z80 I/O chips is proprietary and utilizes a "write" into PROM address space to trigger a reset condition in the I/O chips. Peculiar results may ensue after a malfunctioning program runs wild and writes garbage into the entire address space.

5.3 Memory management

Your DMS-86 will have between 256K and 1024K bytes of dynamic RAM, all of which is addressable via the Intel 8086 segmented addressing scheme. However, if your DMS-86 has the full 1024K, the last 8K will be lost to the PROM monitor because address in that range fall in the part of the address space occupied by the PROM monitor.

5.4 System clock and timer

All timing on the DMS-86 is derived from a 14.7456 MHz crystal driving an Intel 8284 clock. The output is divided into integral parts to derive all the neccessary frequencies. For example, it is divided by 3 for the 5 MHz 8086 and by 4 to provide 4 MHz for the Z80A SIO chips. A Zilog CTC chip is used to generate the baud rates for the I/O ports.

5.5 SIO#1 and SIO#2 - Serial I/O ports

The DMS-86 has two RS-232 ports, one RS-422 port, and a fourth port that can be jumper-selected to be either RS-232 or RS-422 (see Section 6.2 for jumper connections). There are two SIO chips connected to the internal bus and to edge connectors. One controls two RS-232 ports via EIA RS-232 and RS-422 signal receivers and drivers. The other controls two RS-422 ports or one RS-232 and one RS-422.

Each port can be accessed separately by using the following Z-80 port numbers:

Serial I/O	8086 data port	8086 command port	Standard Use
SIO 1A	80h	82h	network RS422 or RS232 port 1
SIO 1B	84h	86h	console RS232 port 0 or aux net RS422
SIO 2A	90h	92h	aux RS232 port 3
SIO 2B	94h	96h	printer RS232 port 2

Warning: the method used to emulate Z80A signals for the SIO chips is proprietary and fundamental to the correct operation of the system. The user should view the ports strictly as 8086 I/O ports and not try to reprogram the SIO chips themselves.

5.6 Parallel I/O ports

Two 8-bit parallel ports are provided on the DMS-86. Both are bidirectional. One, referred to as port P, is typically used to connect a parallel printer. The other, referred to as the SASI port, is designed for connection to a local disk unit.

These ports are addressable as follows:

8086 Port Address	INput function	OUTput function
98h	SASI data read	SASI SEL strobe
9Ah	Parallel Ports Status Byte*	SASI ACK strobe SASI data write
9Ch	Port P data read	Port P data write
9Eh	SASI software reset	Port P AUX strobe

* The Parallel Ports Status Byte contains information on the status of both port P and the SASI port. It is layed out as shown below.

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Port P Aux Stat	Port P Stat 1B	Port P Stat 1A	SASI +I/-O	SASI -REQ	SASI -C/+D	SASI -MSG	SASI -BUSY

5.7 CTC - Baud rates

In normal operation, the serial I/O ports are intialized as follows:

Port 0 - RS-232, 9600 baud

Port 1 - RS-422, 500 Khz

Port 2 - RS-232, 9600 baud

Port 3 - RS-232, 9600 baud

Port 4 - RS-422, 500 KHz (not available if Port 1 is jumper selected)

To change the baud rate of a serial I/O port, it is necessary to reprogram the appropriate channel of the CTC chip. This is done by sending out two bytes on an 8086 port corresponding to the CTC baud-rate generator for the serial I/O port.

[WARNING: THERE MAY BE ERRORS HERE.]

Serial I/O port	8086 port	Baud rate	Command bytes
0 [SIO2A,CTC1]	8Ah	9600	55h,04h
1 [SIO1B,CTC2]	8Ch	4800	55h,08h
2 [SIO2B,CTC0]	88h	2400	55h,10h
		1828	55h,15h
		1200	55h,20h
		600	55h,40h
		300	55h,80h
		110*	55h,174

* To set 110 baud, you must also send the two bytes 04h,C4h to the appropriate SIO channel's command-port (see Section 5.5 for SIO port addresses).

For example to set port 0 [SIO 2A, CTC 1] to 300 baud, execute the following 8086 instructions:

```
mov AL,55h  ;CTC ctrl:disabl ints,counter mode,rising edge,tc follows
out 8Ah,AL  ;send ctrl byte to CTC, channel 1
mov AL,80h  ;time constant for CTC
out 8Ah,AL  ;send time constant to CTC, channel 1
```

To set port 2 [SIO 2B, CTC 0] to 110 baud, execute the following 8086 instructions:

```
mov AL,04h  ; send 2 bytes
out 96h,AL  ;  to SIO 2B's
mov AL,0C4h ;   command
out 96h,AL  ;    port
mov AL,55h  ;CTC ctrl:disabl ints,counter mode,rising edge,tc follows
out 88h,AL  ;send ctrl byte to CTC, channel 0
```

```
mov AL,80h  ;time constant for CTC
out 88h,AL  ;send time constant to CTC, channel 0
```

5.8 Interrupts

Interrupts on the DMS-86 can be generated by the following chips.

SIO 1	Channel A (HiNet)
SIO 1	Channel B (auxilliary HiNet or auxilliary RS232)
SIO 2	Channel A (Standard console RS232 port)
SIO 2	Channel B (Standard printer RS232 port)
CTC	Channel 0 (interrupt not used)
CTC	Channel 1 (interrupt not used)
CTC	Channel 2 (interrupt not used)
CTC	Channel 3 (8087 interrupt)

Should more than one hardware interrupt occur at once, they will be serviced in the order shown (SIO 1 Channel A has highest priority).

5.9 Memory daughter board

The CPU board in the DMS-86 is designed to carry a maximum of 512K dynamic RAM with parity, using 64K-bit RAM chips. However, a connector on the board allows for an additional 512K RAM on mounted on a daughter board configured identically to the memory array on the CPU board.

6. DMS-86 hardware connectionsn

6.1 CPU board jumper connections

The DMS-86 may be configured for various options by making connections between jumper pins with removable shorting blocks (jumpers). Each such jumper is designated by name: JPa, JPb, etc. The physical location of each jumper and its function is described in this section.

Auto Bootup Jumper Options

There are four start-up options: boot from HiNet, boot from floppy disk A, boot from hard disk, and enter Hardware Monitor (no boot). These options are selected by jumpers JPf and JPg (located on the PC board between chip 12A and connector J6), and by the position of the interrupt switch on the front panel when the reset button is pressed (or when the power is turned on).

JPf	JPg	INT	Start-up Option
open	open	open	boot from HiNet
open	installed	open	boot from SASI Unit 0
installed	open	open	boot from SASI Unit 1
installed	installed	open	enter Hardware Monitor (no boot)
either	either	pressed	enter Hardware Monitor (no boot)

Port 1 (RS-232) or Port 4 (RS-422)

Channel B on SIO #1 may be used to support Port 1, an RS-232 asynchronous port, or to support Port 4, an RS-422 synchronous port. The supported port is determined by jumpers JPa and JPb (located between chips 9A and 11A), jumper JPc (between chips 9A and 11B), and jumpers JPd and JPe (between chips 9C and 11B).

JPa	JPb	JPc	JPd	JPe	Supported Port
installed	open	installed	open	installed	Port 1 -- RS-232
open	installed	open	installed	open	Port 4 -- RS-422

The BIOS supplied with your system supports Port 1 (RS-232 asynchronous communication) automatically. To "jumper" the BIOS to support Port 4 (RS-422 synchronous communication), instead, follow the installation directions supplied with your system diskette.

Port 0 (RS-232) Asynchronous or Synchronous

Port 0 is normally used for asynchronous communication with the system console (CRT), but may be altered for synchronous operation. Jumpers JPh and JPi (between chips 9C and 9E) are

used to determine which mode Port 0 operates in. Note that to select synchronous operation, you must cut the trace on the PC board that connects the pins of jumper JPh.

JPh	JPi	RS-232 Mode
installed (or trace not cut)	open	asynchronous
open and trace cut	installed	synchronous

Port P Data Out Enabled or Set Externally

Port P may be set to keep data-out enabled (pin 11, connector J4) and to hold STAT1A low, or it may be jumpered to vary with the state of an external device connected to J4. In the variable case, the external device must bring pin 11 on connector J4 low to enable data-out on Port P. The choice of which option is determined by jumper JPJ (between chips 11R and 11S). If it is installed, then data-out is always enabled and pin 11 is held low; if installed, they vary with the state of the external device connected to J4.

7. Printer, CRT, and HiNet connections

7.1 Serial Port Connections

The following chart shows the correspondence between pins on connector J6 on the PC board and and pins on the external RS-232 and RS-422 connectors.

RS-232 (Ports 0, 1, and 2)

RS-232 Pin	J6 Pin Port 0	Signal Port 0	J6 Pin Port 1	Signal Port 1	J6 Pin Port 2	Signal Port 2
1	13	grd	13	grd	13	grd
2	21	RxD	3	RxD	17	RxD
3	25	TxD	5	RxD	24	TxD
4	20	CTS	none	none	12	CTS
5	26	RTS	6	pullup	18	RTS
6	23	DTR	6	pullup	15	DTR
7	31	grd	31	grd	31	grd
8	10	pullup	6	pullup	10	pullup
17	14	TxC	none	none	none	none
20	22	DSR(DCD)	none	none	11	DSR(DCD)
24	16	RxC	none	none	none	none

RS-422 (Ports 3 and 4)

RS-422 Pin	J6 Pin Port 3	Signal Port 3	J6 Pin Port 4	Signal Port 4
1	13	grd	13	grd
2(req)	29	+clk	8	+clk
3(req)	13	grd	13	grd
4(req)	33	+data	27	+data
5	13	grd	13	grd
6	13	grd	13	grd
7(req)	30	-clk	9	-clk
8(req)	13	grd	13	grd
9(req)	34	-data	28	-data

??? DMS may want to add to this section, a la pp 7-3 - 7-7, 7-11 in the DSC-3/DSC-4/HiNet manual.

7.2 Parallel Port Connections

Connectors J4 and J5 on the PC board carry signals from the parallel ports:
Port P and the SASI port.

Port P data, bits 0 through 7 are on J4, pins 2 through 9. Port P -ENAB, STAT1A, STAT1B, and AUX Strobe are on J4 pins 11, 15, 17, and 21, respectively.

SASI data, bits 0 through 7, appears on J5, even numbered pins 2, 4, 6, ..., 16. SASI -BUSY, ACK, RESET, -MSG, SEL, -C/+D, -REQ, and I/-O are on even numbered pins 36, 38, ...50, respectively.