

**Desk Top Decision I**  
**Guide to Installation**  
**and Operation**  
**Revision 2**  
**February 1983**

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**WARNING:** This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. As temporarily permitted by regulation, it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference, in which case, the user at his own expense will be required to take whatever measures may be required to correct interference.

**Desk Top Decision I  
Guide to Installation  
and Operation**

Revision 2

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## 1. INTRODUCTION

Your Decision I Desk Top not only meets the requirements expected of a high performance, professional microcomputer system, it exceeds them. The Decision I is an IEEE/696 S-100 bus system, meaning the system is based on S-100 module boards. Each Decision I comes standard with an I/O controller, a 4 MHz Z80 CPU board and a RAM memory board. Morrow Designs' disk drive controller boards offer the latest advancements in disk control technology (and the widest range of disk storage options). These S-100 modules slip easily in and out of the 14-slot motherboard, making system integration and upgrading a snap. (The word "obsolete" is not in Morrow Designs' vocabulary.)

The Decision I runs on the CP/M operating system, which comes standard with each system. This popular O/S is compatible with the largest selection of business programs available on the market today.

This manual was written as a guide to help you set up your Decision I, test your disk drives, install the operating system and operate your new computer. We suggest that you read through this manual once before beginning the installation procedures. Instructions for installing and operating the software included with your Decision I are described in the accompanying manuals.

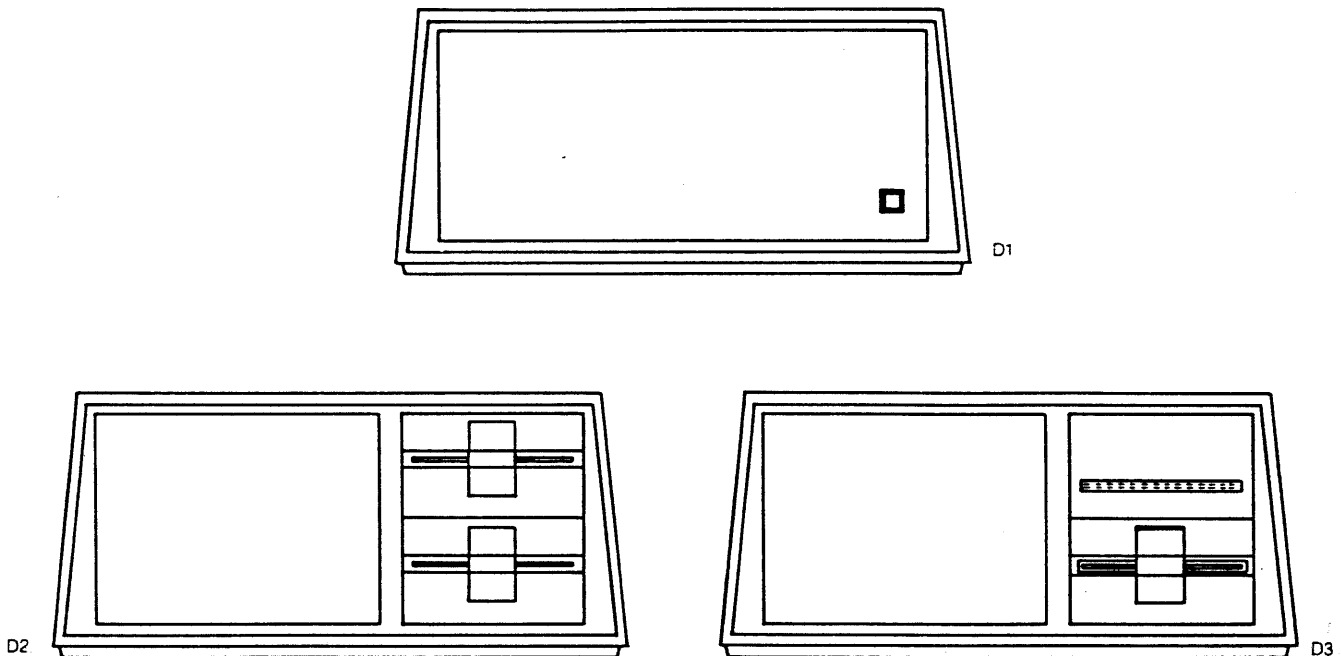


Fig. 1-1: Decision I Desk Top Computers

## 2. SYSTEM HARDWARE

Hardware for the standard Decision I Desk Top computer (model D1) includes:

- Wunderbuss I/O Controller - 14-slot motherboard with three RS-232 serial ports for connecting terminals or serial printers and one parallel printer port
- MPZ80 CPU - Z80 8-bit Central Processing Unit
- MM65KS RAM - 65k of static RAM (expandable to 1 megabyte of static or dynamic RAM)

Model D2 includes the hardware listed above, plus the Disk Jockey DMA (DJDMA) floppy disk controller and two double sided 5 1/4" floppy disk drives.

Models D2A, D3A and D3C include all this, plus the HDC/DMA hard disk controller and a 5 or 16 megabyte mini-Winchester hard disk.

The software supplied with these systems allows the addition of two eight inch floppy disk drives.

As a basic system, model D1 can be configured with any of Morrow Designs disk controller boards, enabling the user to "design" a custom system.

The DJDMA controls the activity of both 5 1/4 and 8 inch floppy disk drives; up to four of each type may be connected to the controller. The HDC/DMA board controls 5 1/4 inch mini-Winchester disk drives, again, up to four same type drives may be connected at one time.

The Disk Jockey 2D/B (DJ2D/B) floppy disk controller controls up to four eight inch floppy disk drives; the HDCA Winchester hard disk controller can control up to four 10, 20 or 26 megabyte hard disk drives.

Refer to the reference manuals included with your computer for more information on your system hardware.

## 3. SYSTEM SOFTWARE

Models D1, D2 and D2A of the Decision I are shipped with:

- CP/M 2.2                    Operating system by Digital Research
- BASIC-80                    Programming language by the Microsoft Corporation



Models D3A and D3C also include:

bAzic	NorthStar-compatible BASIC programming language by Micro Mike's Incorporated
WordStar	Word processing program by MicroPro International
Correct-It	Morrow Designs' spelling checker program
LogiCalc	Business management and "electronic spreadsheet" program by Software Products International
PERSONAL PEARL	A versatile information management package by Relational Systems International

Manuals for these programs are included with each system. Please refer to these manuals for instructions on installing the programs in your system.

#### **4. PRINTER AND TERMINAL REQUIREMENTS**

The standard communication rate for terminals connected to the Decision I is 9600 baud. Most terminals with an RS-232 type of interface that run in the 110 to 19.2K baud range can be connected to the Decision I, but this requires reconfiguring the system software. For ease in system installation and operation, we recommend you obtain terminals which run at 9600 baud.

The Decision I provides both parallel and RS-232 serial interface for printer connection. The standard baud rate for serial printers is 1200 baud.

Connection of a daisy-wheel (Diablo-style Hytype) printer also requires installation of printer driver, which is included with the Decision I system software. Instructions for connecting printers to the Decision I and installing the printer drivers are included in this manual.

For instructions on setting up your printer and terminal, refer to the manufacturers' installation guides.

#### **5. SYSTEM DISKETTES**

Your system software, and applications programs, if applicable, are supplied on floppy diskettes. The label on your system diskette describes the drive controller boards used in your system and the letters of the drives they address. This same list appears on your screen each time you boot the system. Become familiar with this information as it will help you learn how to address your disk drives.

## 5.1. Diskette Care

Handle your diskettes with care. Do not touch any of the exposed parts of the diskette, as this is sure to ruin the data that is magnetically encoded on the diskette surface. Keep your diskettes in the jackets when not in use and store them in a cool place away from dust and cigarette ashes, and magnetic fields (which can be created by color television screens, telephones and stereo speakers).

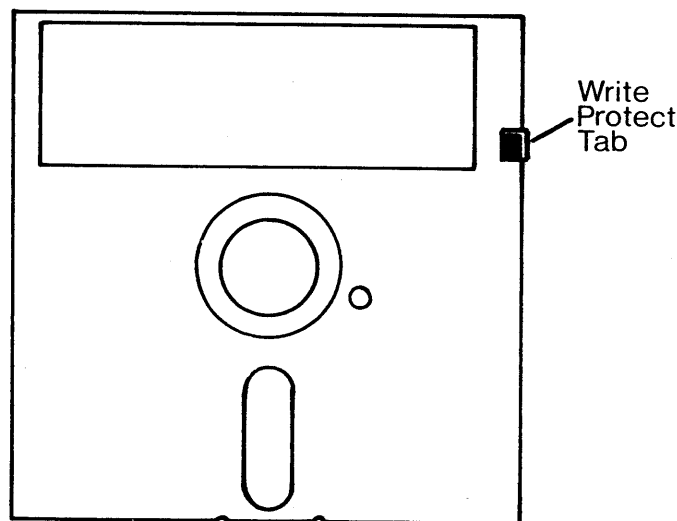
## 5.2. Protecting Information on the Diskette

One of the best ways to protect the information stored on your disks is to make periodic back ups of the files you have been working on. We recommend you make back ups at the end of each day.

We **strongly** recommend that you make a copy of the diskettes you have received with your system and keep the originals as back ups. Procedures for backing up diskettes are described in Section 14.2.

Another means of protecting information on the diskettes is by "write-protecting" them. This is done by special write-protect notches located on the diskette.

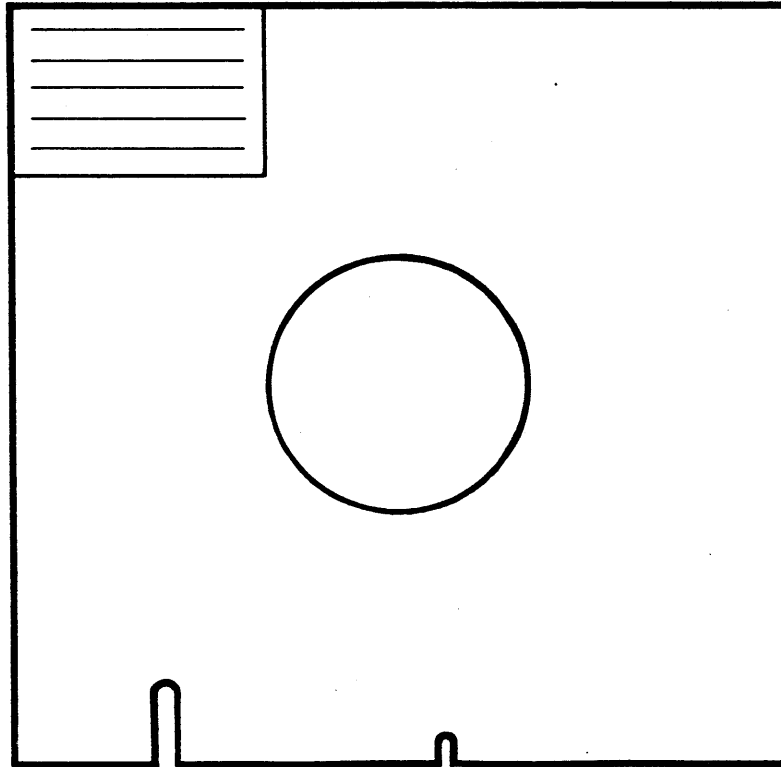
Most 5 1/4 inch diskettes have a write-protect notch on their right side. With the notch exposed, it is possible to write over, or erase the information on the diskette. Covering that notch with a write-protect tab (a gummed label or piece of tape) prevents you from accidentally erasing material on a diskette. It is a good idea to write-protect your back up copies of the diskettes that contain valuable data or programs. Write-protect tabs are usually included with the diskettes when purchased.



**Fig. 5-1: Write-Protected 5 1/4 Inch Floppy Diskette**

The eight inch floppy diskettes also have write-protect notches, but these are kept uncovered to write-protect the files on the diskette. Placing a tab over the write-protect notch enables the diskette to be written over or erased.

Diskettes must be write-enabled in order to be formatted, but it is good practice to always keep your diskettes, especially the system diskette, write-protected.



**Fig. 5-2: Write-Protected 8 Inch Floppy Diskette**

## 6. UNPACKING YOUR SYSTEM

**IMPORTANT NOTE: SAVE YOUR PACKING MATERIAL!** Your Decision I computer (and accompanying devices, if applicable) have been shipped from the factory in packing materials that help prevent damage due to rough handling.

If you need to return any of the units to Morrow Designs, they **must** be packaged in their original factory shipping container to qualify for service under warranty. Repacking the units in their original container provides the best protection during shipping.

- Enclosed in the Decision I box is a contents list for the system you have ordered. This list contains the serial numbers of all devices in your system. Please check the contents of the containers to verify all components have been received. File this list away with your records for future reference. Customer Service requires all parts numbers before authorizing warranty service.
- Remove the documentation and the AC power cords from the containers.
- Carefully lift all units from the shipping container and remove from foam packing material.
- Place units on a flat surface and inspect cabinets for shipping damage.

### 6.1. Inspecting Your System

The Decision I is shipped from the factory with all internal connections in place, but sometimes connectors are jarred loose during shipping. We recommend you remove the cover and check that the S-100 module boards are securely in place and that all connectors are plugged in before applying power to your system.

**WARNING:** The Decision I contains hazardous voltages inside. Extreme care should be taken when installing cables and components within this system. Never open the cover unless the AC power cord is disconnected to prevent electrical shock.

Two connectors on the Wunderbuss I/O motherboard should be checked especially carefully: the power connector and the RESET button.

Facing the computer from the front, note that there are numbers along the front end of the motherboard and letters along the right and left sides. These form a grid much like a map to help you locate components on the board.

The power connector is made of white plastic and has ten wires leading from it. It is located near the front of the computer and should be connected at board location 1C.

The connector for the RESET button is a small brown plastic connector with three wires leading from it. It is located near the back of the computer and should be connected at location 8E.

## **6.2. Unpacking the Floppy Disk Drives**

Instructions for unpacking your drives are illustrated on the drives and in the reference manuals included with your system documentation. Make sure you remove all cardboard shipping protectors and/or undo all latches and retaining screws before operating your floppy disk drive.

## **6.3. Unlocking the Hard Disk Drives**

Instructions for unlocking your drives are illustrated on the drives and in the reference manuals included with your system documentation. Make sure you unlock all heads and remove all retaining devices before operating your hard disk drive.

## **7. REPACKING INSTRUCTIONS**

If you must move or ship back your system, repack it as it was originally packed. Save all latches, screws, foam and cardboard shipping protectors for the disk drives in the original containers. BE SURE TO LOCK ALL DISK DRIVES.

Instructions for returning damaged or defective equipment are given in the Warranty Return Procedure sheet at the beginning of this manual.

Each ribbon is marked with a stripe (usually red) on one side indicating the connector for pin-1.

All connections to the Decision I back panel have been standardized so that 1) the stripe is always on the right, and 2) the cables lead down from the connection. In most cases, this is also true for device connections. These connections will always be correct as long as the pin-1 connector is matched to pin-1 on the socket.

Use the figures in this section to help you make your connections. Also, take care not to bend the pins or damage the connectors when plugging in the cables.

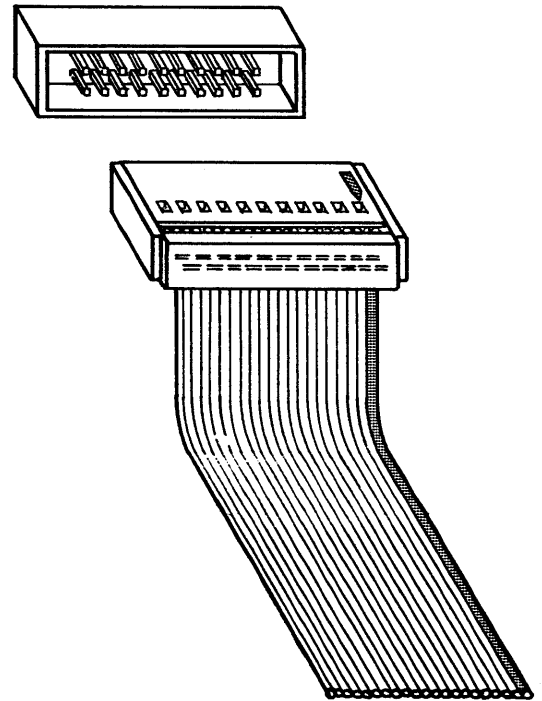


Fig. 8-2: Cable Connections

### 8.1. Terminal and Serial Printer Connections

These connections are simplified by the "D" style plug at each end of the cables. Simply match the plug to the connector.

The main console terminal and/or a single terminal is always connected to the far right (as viewed from the back of the unit) 25-pin "D" style connector labeled serial port 1 in the figure.

The connectors to the left of serial port 1 (serial port 2 and 3) are for second and third terminals, or for a second terminal and a serial printer in a multi-user operating system. In single user systems, a serial printer may be plugged into serial port 3.

### 8.2. Disk Drive Connections

If your system requires connection of an external floppy or hard disk drive, begin with one unit and make a complete connection: Plug one end of the cable into the back panel of the Decision I, then plug the other end of the cable into the corresponding pin connector on the back panel of the disk drive. If you are connecting a hard disk, make sure you connect a 20-pin data cable along with the 34 or 50-pin cable.

### **8.3. Daisy-Wheel Printer Connection**

Plug a 50-pin cable connector into the pin socket labeled daisy-wheel printer in the figure, making sure the pin-1 indicator stripe is to the right. Plug the other end of the cable into the printer with the indicator stripe corresponding to pin-1 on the printer pin socket. (This may take some "trial and error;" try the printer connection one way. If the printer does not respond correctly, turn the connector over and try again.) See Section 14.3 for instructions on installing the daisy-wheel printer driver software.

### **8.4. System Power**

The Decision I Desk Top computer requires 115 volts at 2.5 amps (maximum) for operation. An AC power receptacle mates with the supplied AC power cord on the rear panel. Externally connected devices also require connection of an AC power cord. Do **not** connect the power cords, however, until you are satisfied that all cables are properly installed.

### **8.5. AC Utility Outlets**

The Decision I also has provisions on the rear panel for plugging in terminals and/or disk drives. These AC utility outlets are switched by the main power button on the rear panel of the Decision I and have a maximum combined capacity of 5 amps.

### **8.6. Circuit Breaker Protection**

The main power button on the rear panel provides both power ON, OFF and circuit breaker protection. In the unlikely event of system or peripheral failure, the circuit breaker trips (switches to the middle position), preventing further damage to the components or peripheral devices. This circuit breaker is rated at 5 amps and trips when the AC power draw exceeds this limit. Upon tripping, power will not be supplied until the breaker switch is thrown to the full OFF position, then returned to the ON position. If the breaker does trip, investigate the conditions which caused the overload and correct them before reapplying power.

## 9. CONNECTION TEST

Once you are satisfied that all cables and power cords are properly connected, turn on power to your system and test your connections. The main power switches are located on the rear panels of the devices.

Check for the following on the front panel(s) of the system:

- The red RESET button on the Decision I front panel is lit. Press this button in once to reset all system functions.
- The red indicator light on floppy disk drive A should begin blinking. (In systems with both 5 1/4 and 8 inch floppy drives connected, the red indicator light will alternately blink, first on the 5 1/4, then on the 8 inch drive.)

If the red floppy disk indicator light is lit (not blinking), and pressing the RESET button on the Decision I front panel does not start it blinking, you have made an improper cable connection. Turn off all power to the system before going any further.

First try correcting the problem by unplugging only the back panel connection for the floppy disk drive. Turn the cable connector over and reconnect it.

Turn on power to the system and go over the above check again. If the system still does not power up correctly, make sure that you followed previous connection instructions correctly. A troubleshooting chart follows at the end of this manual; check this out, too.

If you are satisfied that all connections are made properly, but are still unable to get your system to operate correctly, contact your dealer.



## 10. SYSTEM START UP - FLOPPY DISK BOOT

Follow the instructions below to boot your system from the floppy disk drive:

1. Turn on power to the Decision I.
2. Turn on power to the terminal, printer and disk drives.
3. Press the red RESET button on the front panel of the Decision I. The red indicator light on floppy disk drive A begins blinking. It may be necessary to press the RESET button twice.

(In systems where both 5 1/4 and 8 inch floppy disks have been connected, the drive indicator light will alternately blink, first on the 5 1/4, then on the 8 inch drive; the system may be booted from either drive.)

4. Insert the CP/M system diskette, label facing up and away from the slot, and close the door.

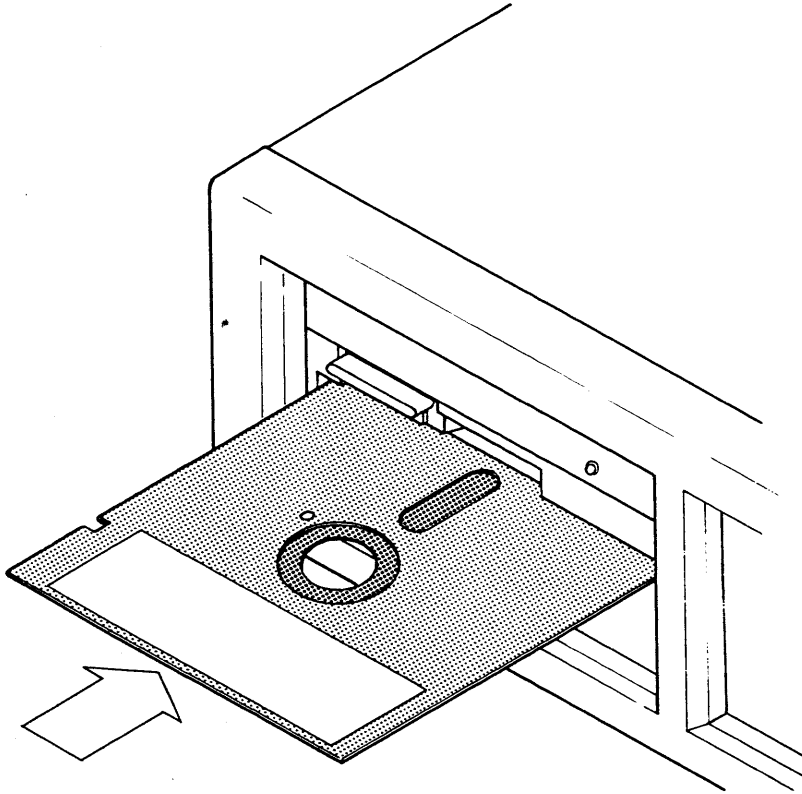


Fig. 10-1: Inserting the Diskette

5. Drive A lights up and there will be a slight "crunching" noise heard from the floppy drive, then the system header and configuration appears on the terminal screen. This is followed by the CP/M (A>) prompt, indicating you have successfully "booted" your floppy disk system.

As an example, the header for a system with two 5 1/4 inch floppy disk drives would appear as follows:

```
Morrow Designs 48K CP/M 2.2 E3  
ABCD: DJDMA 5 1/4", EFGH: DJDMA 8"
```

A>

The second line in this header describes the drive controllers and the addresses of the drives connected to them. In this example, the two floppy drives would be addressed as drives A and B. Notice that addresses are given for additional 5 1/4" floppy drives, as well as for 8 inch drives, that may later be connected to the controller.

If your system has floppy disk drives only, you will be finished with the installation process after completing the following system installation instructions. Next, read the operations section of this manual and the manuals for your applications programs to learn how to install the programs and operate your new system.

If you have a hard disk system, you must now test and format your hard disk. The procedures for this are described in Appendix A. Once this is done, turn to Section 12 and follow the procedures to install the operating system and boot the system from the hard disk. (Users installing the Micronix operating system will turn to the Micronix User's Manual after testing their hard disks for instructions on system installation.)

## 11. FLOPPY DISK SYSTEM INSTALLATION

Morrow Designs ships its versions of CP/M for a 48k system, but this can be expanded to a maximum of 64k for systems with standard Morrow Designs hardware. This procedure is accomplished with the CP/M MOVCPM and SYSGEN commands.

These commands are described in greater detail in the CP/M 2.2 Operating System Manual included with all systems, but briefly, MOVCPM reconfigures, or "tailors", the operating system for a specific operating environment. Parameters (numbers or characters that have specific meaning to a program) are entered with the MOVCPM command that tell it to make a new system size, then prompt the user to execute the SYSGEN command so the new system can be copied out permanently to a disk drive.

As an example, entering

```
A>movcpm 64
```

tells MOVCPM to make and execute a 64k CP/M system. The system is placed temporarily in the computer's memory (RAM), but "disappears" as soon as the system is shut off.

However, typing in the MOVCPM command as follows:

```
A>movcpm 64 *
```

tells the program to go ahead and make the 64k system, but the asterisk (\*) is a parameter that tells MOVCPM to wait before it executes the system so the user can enter SYSGEN and place the new system onto a disk drive. In this way, the system is permanently recorded on a diskette or disk drive and thus, recallable.

Note that you may also enter

```
A>movcpm * *
```

in which case the asterisks tell MOVCPM to examine your hardware and determine the largest system your computer is capable of supporting.

In this procedure, we will make a new CP/M system tailored for your computers' hardware. We recommend that you first make a copy of the system diskette included with your computer (procedure explained in section 14.2, then configure this copy as the system diskette you will use to start up your system. As added insurance, make a back up copy of this diskette when you've finished this procedure as well.

Follow the steps below to reconfigure your operating system:

1. Place the copy of the system diskette in drive A: and boot your system.

As an example, let's say the following header is displayed:

```
Morrow Designs 48K CP/M 2.2 E3  
ABCD: DJDMA 5 1/4", EFGH: DJDMA 8"
```

```
A>
```

2. Type in the MOVCPM command as follows:

```
A>movcpm * * [RET] ([RET] means press RETURN)
```

This command tells MOVCPM to make the largest system your hardware is capable of supporting. Users installing the daisy-wheel (Diablo-style HyType) printer drivers need to install a 62k system to leave room for the drivers. (See Sections N and N for further details.)

Once MOVCPM has constructed your new system, it prompts:

```
Ready for Sysgen or  
Save 48 CPMnn.COM
```

3. Enter

```
A>sysgen[RET]
```

to enter the SYSGEN program and copy the new system onto a diskette. SYSGEN responds with a series of prompts:

```
Morrow Designs Sysgen Version 4.n  
Source drive name (Or return if in memory)
```

4. Your new system size is in memory (RAM) at this point, so press the RETURN key. Next SYSGEN prompts:

```
Destination drive name (or return to warm boot)
```

5. The destination for this new system is the system diskette in drive A, enter a. No need to press RETURN.

6. SYSGEN responds with:

```
Destination on A, then type return
```

This prompt verifies that the new system is on the correct drive (A), (if not, enter a control C to exit SYSGEN); otherwise, press the RETURN key.

7. SYSGEN now displays

Function complete.

Destination drive name (or return to warm boot)

8. Press the RETURN key to "warm boot" your system and return it to CP/M.

9. Press the RESET button on the Decision I front panel. The system header now displays the new system size:

Morrow Designs 64K CP/M 2.2 E3

ABCD: DJDMA 5 1/4", EFGH: DJDMA 8"

A>

## 12. HARD DISK SYSTEM INSTALLATION

Installing the system on the hard disk involves five steps:

1. Boot the system from the floppy disk.
2. Format the hard disk.
3. Configure the operating system for your computer.
4. Copy the system files onto the hard disk.
5. Boot the system from the hard disk.

Booting the system from the floppy disk was covered in Section 10. If you have not done so already, return to this section and follow the instructions there.

Testing and formatting your hard disk is covered in Appendix A. Please turn to the appropriate section in this appendix and follow the instructions given before attempting to install the software on your hard disk.

Configuring the system is accomplished with the MOVCPM and SYSGEN commands. These commands were described briefly in Section 11 and are covered in detail in the CP/M 2.2 Operating System Manual included with your system. MOVCPM reconfigures the CP/M operating system for a particular hardware environment and SYSGEN copies this new system onto a disk drive in a permanent, recallable form.

As an added feature, Morrow Design's current version of the operating system includes several customized MOVCPM programs that will help you through the configuration process. These programs are listed on the label of your system diskette, along with other information describing your system configuration. This information is described in the following figures:

1. 48K CP/M version 2.2, CBIOS revision E.3
2. MOVCPM; AB: DJDMA 5, CD: DJDMA 8, E: HDDMA
3. MOVCPM5; A: HDDMA M5, BC: DJDMA 5, DE: DJDMA 8  
MOVCPM10 AB: HDDMA M10, CD: DJDMA 5, EF: DJDMA 8  
MOVCPM16; AB: HDDMA M16, CD: DJDMA 5, EF: DJDMA 8
4. Multio (9600) as console, Multio (1200) as list
5. (c) 1980 Digital Research, (c) 1982 Morrow Designs

Fig. 12-1: Sample Label For Systems with DMA Drive Controllers

1. Description of the operating system and the revision of the customized BIOS. A part number is also included and should be referred to during Customer Service calls.
2. MOVCPM program used to configure floppy based system, and the drive controllers and addresses of the drives connected to them during floppy disk boot.

3. Custom MOVCPM programs used to configure systems with a hard disk, and the drive controllers and addresses of the drives connected to them after the hard disk is booted.
4. I/O controller used in system and default baud rates.
5. Copyright notices.

The numbers following MOVCPM correlate to the size of the drive. Users with an M16 mini-Winchester hard disk drive, for example, would use the MOVCPM16 program to configure their system.

Users with an HDCA controller may also find several MOVCPM programs listed on the system diskette label. The numbers following MOVCPM correlate to the drive type ordered with their system:

```

48K CP/M version 2.2, CBIOS revision E.3
MOVCPM;   AB: DJDMA 8, CD: DJDMA 5, EFG: HDC3 M26
MOVCPM26; ABC: HDCA M26, DE: DJDMA 8, FG: DJDMA 5
Multio (9600) as console, Multio (1200) as list
(c) 1980 Digital Research, (c) 1982 Morrow Designs

```

**Fig. 12-2: Sample Label For System with HDCA Controller**

Follow the steps below to reconfigure your operating system:

1. Type in the the appropriate MOVCPM command for your system as follows ("movcpm5" is only an example):

```
A>movcpm5 * * [RET] ([RET] means press RETURN)
```

The asterisks (\* \*) are parameters that tell MOVCPM to configure the largest system your hardware is capable of supporting. (Note: users installing the daisy-wheel printer driver need to install a 62k system to leave room for the drivers. See Sections 14.3 - 14.4 for further details.)

Once MOVCPM has constructed your new system, it prompts:

```

Ready for Sysgen or
Save 48 CPMnn.COM

```

2. Enter

```
A>sysgen[RET]
```

to enter the SYSGEN program and copy the new system onto your hard disk. SYSGEN responds with a series of prompts:

```

Morrow Designs Sysgen Version 4.n
Source drive name (Or return if in memory)

```

3. The new system is in memory (RAM) at this point, so press the RETURN key. Next SYSGEN prompts:

Destination drive name (Or return to warm boot)

4. Enter the disk drive address where the system is to be copied. Use the first hard disk drive address listed on the line describing the floppy boot addresses on your system diskette label. (NOTE: These same addresses appear on your screen when the floppy disk is booted.)

Using the label in Figure 12-1 as an example, we'd enter drive E as the destination.

5. SYSGEN responds with:

Destination on E, then type return

This prompt verifies that the new system is on the correct drive (E); (if not, enter a control C to exit SYSGEN).

If so, press the RETURN key. SYSGEN responds with:

Function complete.

Destination drive name (or return to warm boot)

6. Press the RETURN key to "boot" the system (return it to CP/M) and get on with your installation process.

### 12.1. Copying the System Files

Once your hard disk has been tested, formatted and installed with an operating system, you are ready to copy the system files onto to it. This is done with the CP/M PIP command.

To copy the system files from the floppy to the hard disk, enter the PIP command with the address of the drive to receive the file copies first, followed by an equal sign and the address of the drive containing the system diskette. The format for the command line looks like:

PIP destination drive:=source drive:filename.ext[v]

It may be easier to enter this command with the system header and drive configuration in view. Press the red RESET button on the Decision I front panel to get this display.

As an example,

```
Morrow Designs 64K CP/M 2.2 E3
AB: DJDMA 5 1/4", CD: DJDMA 8", E: HDDMA M5
```

```
A>
```



The system diskette is in the floppy drive addressed as A by the system software. Copies of the system files will be placed on hard disk drive E.

Determine the drive in which your system diskette is placed and on which hard disk drive you want the system files copied, then enter the addresses accordingly. Use the following command line as an example only:

```
A>pip e:=a:*. *[v] [RET]
```

PIP is explained further in the CP/M 2.2 Operating System Manual and in Section 14.2 of this manual, but the asterisks used in the command act as "wildcards," telling PIP to copy all files on the floppy diskette to the hard disk; the [v] portion of the command line directed PIP to verify that the files were copied over correctly.

If this command was entered correctly, the red indicator light on the floppy drive lights up. Shortly thereafter some "crunching" noises are heard from the floppy drive. PIP also displays the names of the files it is copying on the terminal screen. Since there are a lot of files included with the system, this process takes a few minutes.

Once this process is finished, you are ready to boot the hard disk.

## 12.2. Hard Disk System Boot

To boot your system from a "cold start" (from a system that is currently off), follow the instructions given in Section 10 to boot your system from the floppy disk, then enter one of the commands listed below to boot your system from the hard disk.

If your system is already on and booted from the floppy, just enter one of the following commands.

1. For Winchester hard disks controlled by the HDCA hard disk controller, enter "boothd" after the prompt to boot your hard disk:

```
A>boothd[RET]
```

2. For mini-Winchester hard disks controlled by the HDC/DMA, enter "bootmw" after the prompt to boot your hard disk:

```
A>bootmw[RET]
```

This time a system header and the drive addresses for your hard disk system appears, followed by the CP/M prompt, indicating you have successfully "booted" your system.

The example header used above would now be displayed as

```
Morrow Designs 64K CP/M 2.2 E3  
A:HDDMA M5, BC: DJDMA 5 1/4", DE: DJDMA 8"
```

```
A>
```

Enter the CP/M directory (DIR) command now for an on-screen display of your system files.

```
A>dir[RET]
```

Appendix C contains a description of all files sold with Morrow Designs' CP/M systems. Check this list for a description of the files included on your system diskette.

This is a good time to read through the manuals for your applications programs for the procedures on how to install them on your system.

### 12.3. Warm Boot - Control C

Sometimes it is necessary to reboot the system after it is already running. This is called a "warm boot" and is done by entering a control C command. A warm boot causes the system to stop whatever it was doing and reload the operating system. This is usually done to exit a program and should always be done after changing the logged drive to reset the disks. Entering a control C is like entering a capital C at the keyboard, only instead of pressing the SHIFT key, press the control (CTRL) key and the C key. Refer to the CP/M manual for more information on this command.

### 12.4. Optional Automatic Hard Disk Boot

In systems that have been set up to boot from the hard disk, all that you need do is turn on power to your system and press the RESET button on the Decision I front panel. This requires resetting switches on the MPZ80 CPU board to allow it to read firmware contained in the monitor PROM. These settings are described in Appendix D of this manual. The PROM and switch settings are also described in the MPZ80 CPU Technical Manual.

### 12.5. Booting From the Monitor Prompt

Systems set up to boot from the hard disk (refer to above section) may occasionally come up in the monitor, indicated by a ":" prompt. Enter a b (for boot) after this prompt. The system should automatically come up. If not, check the settings for switch 16D on the MPZ80 CPU board against those given in Appendix D of this manual and, if appropriate, reset this switch.

### 13. SYSTEM MAINTENANCE

The Decision I requires no special maintenance under normal operation. The cabinet is constructed of a highly durable plastic impervious to stains and dirt. If required, the cabinet may be cleaned with a damp, nonabrasive cloth. Internal components need no special maintenance.

Failure of any Decision I system component during the warranty period not due to abuse is covered under the standard Morrow Designs warranty and the customer is referred to his supplier for service. (See also Morrow Designs' warranty and return policy.)

Enjoy your new system. If you encounter any problems, a troubleshooting chart and some helpful appendices follow at the end of the manual.

## 14. SYSTEM OPERATION

The CP/M 2.2 Operating System Manual offers a good description of the program, its features and utility routines. This section will describe some of these features and give examples on how to perform them, but is limited in detail, focusing mainly on the programs supplied by Morrow Designs for use with the Decision I microcomputer. Thus, we recommend you carefully read through both the CP/M manual and this section to learn how to operate your new system.

CP/M (Control Program/Monitor) is written and distributed by Digital Research. This program helps you operate your computer and perform system functions such as running other software programs and creating, printing and maintaining files. CP/M also includes programs that allow you to write, test and debug software programs, check available disk space and transfer file data from one device to another.

The CP/M operating system is made up of four distinct parts which operate together to perform these functions. The Basic Disk Operating System (BDOS) handles all the disk-oriented system tasks. The Transient Program Area (TPA) stores and executes user programs. The Command Console Processor (CCP) oversees the creation, execution, deletion, etc. of programs loaded into the TPA, and finally, the Basic I/O System (BIOS) contains the programming instructions that coordinate all these functions.

As distributed by Digital Research, the BIOS is fairly primitive and must be "customized" for the particular hardware on which the operating system will be run. Morrow Designs has customized the BIOS for the Decision I hardware and also added some features that make system operation even easier. These changes appear in the CBIOS.ASM file, included on your system diskette. Morrow Designs is currently shipping revision E of the CBIOS. This customized file allows your system to

- Read/write 8 inch IBM 3740 and System 34 single and double sided floppy diskettes, as well as NorthStar-compatible 5 1/4 inch hard sectored, single and double sided diskettes.
- Automatically determine diskette size and density and configure itself for the format. This relieves the user of having to inform the system ahead of time about the type of diskette being inserted.
- Automatically set the step and settle rate (disk access time) for both double and single sided floppy disk drives. Double sided drives are faster, but users with these drives must use double sided diskettes to take advantage of the faster (3 ms.) step rate. Using single sided diskettes in a double sided drive causes the CBIOS to default to the single sided (6 ms.) step rate. This default remains in effect, even if the next diskette inserted is double sided, until after the disk is reset by performing a warm boot.

Many parameters of the CBIOS can be modified by changing the values of certain variables, thus simplifying system reconfiguration. Users familiar with earlier versions of our CBIOS will find some new utility programs in this version, but, will also find that many of the older, more useful programs have been retained. These programs are explained in the sections that follow.

#### 14.1. Formatting Diskettes

Data is stored on floppy diskettes in predetermined "blocks" that are laid out in circular tracks on the enclosed, plastic media within the diskette cover. Each block is referred to as a sector, and each sector has an "address" that is used by the operating system to store and retrieve data. Morrow Designs' version of the CP/M operating system expects a certain pattern for reading these sector addresses. Diskettes are given this pattern when they are formatted.

Morrow Designs currently has two programs for formatting diskettes. If your floppy disks are driven by a Disk Jockey 2D/B (DJ2D/B) floppy disk controller, you will call the FORMT#.COM program; users with the Disk Jockey DMA (DJ/DMA) floppy disk controller will call the FORMATDJ.COM program. Both programs are menu-driven to simplify the process, but before you insert a diskette into the drive for formatting, remember that **formatting erases any information on the diskette.**

##### 14.1.1. FORMT#.COM

This program formats standard single or double density 8 inch IBM diskettes for systems with the DJ2D/B controller and Morrow Designs' version of CP/M.

This program is menu-driven and asks you to enter the number or letter that corresponds to the action you want taken on your diskette. Eight inch diskettes may be formatted for 128, 256, 512 or 1024 byte sectors, depending on their density.

Single density diskettes must be formatted for 128 sectors.

Double density diskettes may be formatted at any of the three remaining choices, but 1024 sectors is recommended since it offers the most storage space and is read more quickly by the DJ2D/B controller.

Hard disks connected to the system are not addressed by this program. Keep this in mind when entering the address of the disk drive containing the diskette to be formatted. Only your floppy disk drives are addressed; the first one connected to the controller is addressed as drive A.

Diskettes must be write-enabled to be formatted. Also be sure your floppy diskette is in the drive you selected from the menu. This program displays a "Drive Not Ready" error message if it appears that the diskette is not in the drive when it begins formatting, or if the diskette is write-protected. You may remove the diskette and write-enable it or place it in the correct drive. If you need to select another drive, enter an "N" and press the RETURN key. This returns you to the beginning of the program.

Enter the program by typing

```
A>formt#[RET]
```

Read the prompts carefully. If you need to start again, enter an "N" and press the RETURN key. To stop the process, enter a control C.

#### 14.1.2. FORMATDJ.COM

This program formats both 8 inch IBM and 5 1/4 inch NorthStar CP/M-compatible single and double sided diskettes for systems with the DJ/DMA controller and Morrow Designs' version of CP/M.

Eight inch diskettes may be formatted for 128, 256, 512 or 1024 byte sectors, depending on the density of the diskette.

Single density diskettes are automatically formatted for 128 sectors.

Double density diskettes may be formatted at any of the three remaining choices, but 1024 sectors is recommended since it offers the most storage space and is read more quickly by the DJ/DMA controller.

FORMATDJ.COM formats 5 1/4 inch single or double sided 35 track diskettes for use with the CP/M operating system, (and 40 track diskettes for use with the Micronix operating system.) Single density diskettes offer ten 256 byte sectors; double density diskettes offer twice this storage space.

This program is menu-driven and asks you to enter the number or letter that corresponds to the action you want taken on your diskette. Initially, it asks you to select whether you'll be formatting an IBM 8 inch or NorthStar-compatible 5 1/4 inch diskette. Once that is determined, you will be asked to select options describing the type of format you want.

Default selections are built into the menu program and are the recommended format for diskettes used with the Decision I and CP/M operating system. They are selected by pressing the

RETURN key, thus simplifying the selection process. These default selections are listed below:

**Table 14-1: Default Selections - FORMATDJ.COM**

5 1/4" Defaults:

Drive: Drive 0  
Tracks: 35 tracks  
Density: Double density  
Media: Single sided media  
Format: CP/M data format

8" Defaults:

Drive: Drive 0  
Density: Double density  
Sectors: 1024 byte sectors

Hard disks connected to the system are not addressed by the program. Keep this in mind when entering the address of the disk drive containing the diskette to be formatted. Only your floppy disk drives will be addressed; the first one connected to the controller is addressed as drive 0.

Enter this program by typing in

A>formatdj[RET]

Read the prompts carefully. FORMATDJ.COM formats all tracks on the diskette then verifies them, displaying the number of any tracks found with bad sectors. If a bad sector is found, we recommend you run the diskette through the FORMATDJ.COM program again. If it still fails during the verification portion of the formatting process, throw the diskette away.

Diskettes must be write-enabled in order to be formatted. Also be sure the floppy diskette is in the drive you selected from the menu. This program will display a "Drive Not Ready" error message if it appears that the diskette is not in the drive when it begins formatting, or that the diskette is write-protected. At this point you have two choices: Restart the program (takes you back to beginning of menu so you may start over again) or Cycle the program (program continues, giving you a chance to reinsert the diskette if you need to change drives or write-enable the diskette).

If at any point you need to exit the program, press the ESCape or DElete key. This returns you to the first menu choice, which offers you an option to exit the program and return to CP/M.

## 14.2. File Back Up Procedures

Two CP/M programs are used to make back up copies of your files: 1) PIP, which copies nonsystem files from one drive to another, and 2) SYSGEN, which copies the operating system tracks from one drive to another. We can't stress enough the importance of backing up your files. Read through the following sections

carefully and refer also to the CP/M manual included with your system to become familiar with this important procedure.

#### 14.2.1. Backing Up Files

The PIP command has many functions within CP/M, but is used mainly to copy files from one drive to another for back up and transferring purposes. This section will give some examples on how to use PIP so that you can become familiar with it and begin making back up copies of your important files as soon as possible.

The PIP command is generally entered in the following way:

```
PIP destination drive:=source drive:filename.ext[v]
```

"Destination" drive indicates the drive that the file will be copied to. The "source" drive is the address of the drive containing the file to be copied. "Filename" is the name of the file and its extension - such as CBIOS.ASM. The "[v]" portion of the command line directs PIP to verify the copy it is making. This ensures that all data is transferred intact.

A simple PIP command line would look like this:

```
PIP b:=a:cbios.asm[v]
```

This line tells PIP to copy the CBIOS.ASM file on drive A to drive B and verify the copy it makes.

If you have a lot of files to copy from one drive to another, it might be easier to enter into the PIP mode. This is done by typing:

```
A>pip [RET]  
*
```

The asterisk is the PIP command line prompt. It allows you to enter a series of command lines. To exit this mode, enter a control C or a carriage return ([RET]).

PIP also features some file matching symbols, or "wildcards" that can help make the copying process much simpler.

The asterisk (\*) is used to match any amount of letters or numbers that make up the file name. (CP/M file names are limited to eight characters for the name and three for a file extension.)

If, for example, you wanted to copy all the files on one diskette to another, you could enter the file name portion of the PIP command line as

```
*.*
```

which would tell PIP to match all file names on the source



diskette. You can also use the asterisk to match just one portion of the file names.

As an example

\*.doc

would tell PIP to match only those files on the source diskette ending with a ".doc" extension.

A question mark (?) acts as a wildcard for single characters in a file name. Up to eight question marks may be entered for the name; up to three question marks may be entered for the extension.

In the following example,

????.txt

PIP would seek out all four letter names ending with a ".txt" extension.

Suppose now that you have been working on several files on drive A of your hard disk named ACCT1.FIL, ACCT2.FIL, ACCT3.FIL and ACCT83.FIN. Copying these files onto a back up diskette can be easily done by performing the following steps:

1. Place a formatted diskette into a floppy disk drive (drive D for this example) and enter PIP by typing:

A>pip[RET]

The PIP prompt is returned:

\*

2. Enter

\*d:=a:?????.fil[v] [RET]

3. PIP lists all the five letter names it finds with the ".FIL" extension, then copies over all these files onto the floppy diskette for you. Since you entered the "[v]" portion of this command, it will also verify all the copies it makes for you.

4. Next type in

\*d:=a:acct83.fin[v]

to "PIP over" the last of the files to be copied.

5. Once PIP is finished, enter a control C or a carriage return ([RET] to exit PIP.

### 14.2.2. Backing Up the System Diskette

The SYSGEN program copies the system tracks onto another drive. It does not transfer system files to another drive, however. In order to make a back up copy of the system diskette, both SYSGEN and PIP must be called.

In the example below, we will make a back up copy of the system diskette on a system with two 5 1/4 inch floppy disk drives:

1. Place the system diskette into floppy drive A and a blank, formatted diskette in drive B. At your keyboard enter

```
A>sysgen[RET]
```

The following appears:

```
Morrow Designs Sysgen Version 4.n  
Source drive name (Or return if in memory)
```

2. Enter the drive address containing the system diskette (A) and press the RETURN key. SYSGEN then prompts:

```
Source on A, then type return
```

press the RETURN key. Now SYSGEN prompts:

```
Destination drive name (Or return to warm boot)
```

3. Enter the drive address containing the blank diskette upon which the system will be copied (B) and press the RETURN key. Once the copy has been made, SYSGEN returns:

```
Destination on B, then type return.
```

SYSGEN is giving you a chance to be sure your copy of the system is going to the right place (if not, enter a control C).

If so, press the RETURN key for the last prompt:

```
Function complete.  
Destination drive name (or return to warm boot)
```

4. Press the RETURN key to warm boot your system and return control to CP/M. Once the CP/M (A>) prompt reappears, you are ready to copy over the system files onto the back up diskette. This time you need to call the PIP program.

Enter:

```
A>pip b:=a:*. *[v] [RET]
```

In this command line, the file name specified by "\*. \*" makes use of PIP's "wildcard" feature. In this case, all

files on the source diskette are matched, telling PIP to copy over all files on the diskette in drive A to the diskette in drive B.

The "[v]" portion of the command line told PIP to verify the files being copied. PIP will also display the names of the files it is copying on the terminal screen.

### 14.3. Installing the HyType II Parallel Printer Driver

Included on your system diskette is the HYTYPE.PRL file. This is a HyType II parallel printer driver designed to run on both the Mult/IO and Wunderbuss I/O controller boards where the console device is connected to port 1. (Note: If either of these controller boards are used as a parallel printer board, and the console device is not connected to port 1, then the driver must be installed with a flag option, described below.)

This printer driver is an additional file that is integrated into the operating system via the INSTALL.COM program. This is a temporary "patch," meaning that the HYTYPE.PRL file must be installed on top of the operating system (in RAM) each time the computer is booted. In order to do this, however, there must be room for it.

The HYTYPE.PRL driver takes up approximately 2 kbytes of space in memory. Thus, in order to install this file into a 64k system, the size of the system must be reduced by 2 kbytes.

To reconfigure a 64k CP/M system for the HYTYPE.PRL driver, follow these steps:

1. Subtract the size of the HYTYPE driver file (2k) from your current system size (64k).
2. Create a new CP/M system using the size obtained from step 1.
3. Boot the new system.
4. Determine the first available memory location above your new system (given in Table 14-2).
5. Install the driver using the memory location obtained in step 4 and the INSTALL.COM program.

Table 14-2, at the end of this section, lists common CP/M system sizes and the address of the memory location where the HYTYPE.PRL file (or any .PRL file) is installed.

Let's go through a reconfiguration and installation procedure as an example:

1. Subtract the size of the .PRL file from the current system size:

$$64 - 2 = 62$$

2. This number is the size of the new system you must make in order to provide room for the driver. New system sizes are made with the MOVCPM program. Enter:

```
A>movcpm 62 * [RET]
```

The following is displayed:

```
Constructing 62K CP/M
Ready for "sysgen" or
"save 48 cpm62.com"
```

3. To make a "stable" copy of the new system size, use the SYSGEN program.

Enter:

```
A>sysgen[RET]
```

which returns the following prompts:

```
Morrow Designs Sysgen version 4.n
Source drive name (Or return if in memory)
```

4. The source drive is in memory, press the RETURN key. Next it prompts:

```
Destination drive name (Or return to warm boot)
```

5. Enter the address of the drive where you want the new system size (drive A, as an example) and press the RETURN key.

SYSGEN then prompts:

```
Destination on A, then type return
```

Press the RETURN key; SYSGEN prompts:

```
Function complete
Destination drive name (Or return to warm boot)
```

7. This last prompt gives you the option of copying the new system size to another drive. To return to CP/M, press the RETURN key. Boot your system now (press RESET). It should greet you with a header designating your new system size. As an example:

Morrow Designs 62K CP/M 2.2 E3  
A:HDDMA M5, BC: DJDMA 5 1/4", DE: DJDMA 8"

A>

8. For a 62K system size, the first available memory location above the system is f800. This number was determined by checking Table 14-2 at entry 62. This address is entered as part of the command line when using the INSTALL.COM program to integrate the HYTYPE.PRL driver into the operating system (usually done right after the system is booted).

#### 14.4. Using INSTALL.COM

INSTALL.COM expects the following command format:

```
INSTALL [flag] FILENAME.PRL ADDRESS
```

To install the Hytype II driver for a 62k CP/M system, enter the following:

```
A>install hytype.prl f800[RET]
```

INSTALL returns the next available memory location, indicating that the driver is now temporarily a part of the operating system.

In systems where the Mult/IO or Wunderbuss I/O controller is not used as a console board, the INSTALL command must be entered with a "-" flag option. Using the above example:

```
A>install - hytype.prl f800[RET]
```

**Table 14-2: System Size Reconfiguration Table**

The following table lists some common CP/M system sizes (in kbytes) and the end addresses of the first available RAM memory locations (in hexadecimal).

KBytes	End	KBytes	End	KBytes	End	KBytes	End
24	6000	35	8c00	57	e400	56	e000
25	6400	36	9000	46	b800	58	e800
26	6800	37	9400	47	bc00	59	ec00
27	6c00	38	9800	48	c000	60	f000
28	7000	39	9c00	49	c400	61	f400
29	7400	40	a000	50	c800	62	f800
30	7800	41	a400	51	cc00	63	fc00
31	7c00	42	a800	52	d000		
32	8000	43	ac00	53	d400		
33	8400	44	b000	54	d800		
34	8800	45	b400	55	dc00		

## 14.5. Useful System Programs

This section describes the programs developed by Morrow Designs to help you in the operation and maintenance of your system.

### 14.5.1. BAD.COM

The BAD.COM program is used in conjunction with the FORMATHD.COM program. Both programs were designed for users with an HDCA hard disk controller and the M10, M20 or M26 hard disk drives. This program is called to map out bad sectors on the hard disk, thus preventing their use by the operating system. The BAD.COM program is menu-driven and performs three main functions:

1. read and display the bad sector list
2. add sectors to the bad sector list
3. read the map and allocate new bad sectors to a special CP/M file

This program uses four subroutines to perform these functions:

Getbad - reads and displays the existing bad sector list

Putbad - adds new bad sectors to the bad sector list

Fixbad - creates special CP/M files to map out bad sectors

Clearbad - erases old bad map

These functions are performed within the CP/M logical drives (A, B, C, etc.) as opposed to the physical drive itself. Information about each logical drive is contained in a VITALS.BAD file. This information includes the drive type, location of the bad map and specific drive details (disk size, sectors per track, number of cylinders, etc.) which is read and used by BAD.COM when reading or creating bad sector maps.

BAD.COM is described in further detail in Appendix A.

### 14.5.2. BAUD.COM

Serial baud rates on the Wunderbuss I/O controller mother board may be changed through software via the BAUD.DOC program.

Baud rates changed with the BAUD.COM program are in effect only as long as the system is running and must be reset each time the system is booted. This program comes in handy if

you want to temporarily connect a serial device, such as a modem, and do not want to change switch settings.

The format for entering this program is as follows:

```
BAUD BAUDRATE [PORT NUMBER]
```

Baud rate is the new rate desired for the port. Port number is the number of the serial port (1 thru 3) to be changed; default is serial port 1.

To change serial port 3 on the Wunderbuss I/O to 1200 baud, as an example, you would enter:

```
A>baud 1200 3[RET]
```

**Table 14-3: Baud Rates Supported by Decision I Software**

110	1200	4800	19,200
300	2400	9600	

#### 14.5.3. REGEN.COM

The REGEN.COM command regenerates CP/M single density diskettes which have been formatted in such a way that they are incompatible with the normal operation of the 1791 controller chip (IMSAI diskettes in particular have this problem). This program is of interest to those users with the Morrow Designs Disk Jockey 2D/B controller only. It is not intended for use with the Disk Jockey DMA controller.

The REGEN program is designed to be used with diskettes which have been formatted incorrectly - not with diskettes that have been partially destroyed. An example of a diskette that could be used with the REGEN program is one that the Disk Jockey 1D board can read, but the Disk Jockey 2D/B cannot (the DJ1D does not utilize the 1791 controller chip).

Essentially, the REGEN program reads a complete track of data and format information into memory, filters out the formatting, reformats the track and then rewrites the data. This process is repeated until the whole diskette has been regenerated. The original diskette is both the source and destination diskette, and must therefore be write-enabled.

The final result should be a single density diskette that is readable both on the machine that originally produced it as well as on the Disk Jockey 2D/B controller.

Type REGEN [RET] to invoke this program. It has enough prompts to explain its use.

#### 14.5.4. SINGLE.COM

The program SINGLE.COM is of interest only to those users who have a single drive floppy disk subsystem and a DJ2D/B controller. Its purpose is to allow these users to copy CP/M files between diskettes. Users with dual drive systems can perform such copies faster and more conveniently by using PIP to transfer files from one drive to another.

SINGLE.COM turns drive A into a logical dual drive system by intercepting CP/M calls to disk drive select routines. Since no additional disk drives really exists, SINGLE.COM asks the user to designate floppy diskettes as drives A and B and prompts the user to "swap" diskettes at the appropriate time during data transfers. The user, however, must keep track of which diskette has been designated the "A" diskette and which the "B" diskette. Perhaps an example will make this process clearer:

To begin operation in single mode, enter the single command followed by an "S" (for Start):

```
A>single s[RET]
```

The program tells you that SINGLE has been installed, then returns to CP/M.

To back up all the files on the floppy diskette in drive B, the following would be entered:

```
A>pip[RET]
*a:=b:*.*[RET]
```

As PIP begins copying files from drive B to drive A, SINGLE prompts the user to insert or remove (swap) diskettes. This process takes many many swaps but does the job. The number of diskette swaps depends on the amount of memory which PIP has to use, and on the amount of data to be transferred.

In general, any CP/M command which can be used in regular mode can be used while in single mode. There are two exceptions, however: The FORMAT#.COM program, because it makes direct calls to Disk Jockey 2D/B firmware, does not function properly in single mode, and MOVCPM.COM because of memory relocation problems.

To exit single mode, type:

```
A>single e[RET]
```

This returns the user to the standard CP/M system (the "E" argument is for End). Typing SINGLE E when not in single mode generates an error messages and returns the user without any change being made, as does typing SINGLE S if already in single mode.



## **A. Preparing Hard Disks for System Installation**

All drives shipped from Morrow Designs' are pretested at the factory. Only a minimal amount of bad sectors (less than 5%) are allowed on our disk drives, and these are mapped (blocked) out by a special program (BAD.COM) to prevent their use by the operating system. However, it is possible that new bad sectors may have developed on the hard disk during shipping. We recommend that all hard disks be tested and formatted (using FORMATMW.COM for 5 1/4 inch mini-Winchesters, and FORMATHD.COM for 8 and 14 inch Winchesters) before installing the operating system.

### **A.1. Disk Data Organization**

Before we begin explaining the procedures for formatting and testing the hard disk, a brief (and basic) background on how the disk drives operate and a description of some of the terms used to describe this operation is in order.

Inside the drives are rotating platters which store magnetically encoded data, data being programs, text, numbers, etc. which are contained in files. This data is stored within circular tracks on the disk platter, with the number of tracks varying, depending on the type of drive you have ordered (M5, M26, etc.). Magnetic heads (much like the ones used in tape recorders) float over each platter surface. These heads seek for areas upon which to write new data or read data already on the disk platter. These heads would be totally lost, however, if the platters did not provide some clue as to what was written on them.

To solve this problem, remember that platters are made up of circular tracks. Within these tracks, data is stored in distinct regions called sectors. Each sector can hold 512 bytes (or characters) of data. Additionally, each of these sectors has a header field that gives the read/write heads information on the track and sector number (much like an address). Following the header field is a data field that holds information on the type of data written into the sector.

Suppose you had a large program stored on your hard disk. It would be stored on many sectors within the circular tracks on the disk platter. Each time you accessed this program, the magnetic head would scan the platter and read the header and data fields searching for information (the address) that tells them where your program is stored.

This information must be on the disk platter in a certain pattern in order for the heads to find data, or to write new data into free sectors. The format for this pattern is placed on the disks by running them through a format program, such as FORMATMW.COM or FORMATHD.COM, which are included on your system diskette.

## A.2. FORMATHD.COM Program Options

This section describes the FORMATHD.COM program, which is used to test and format 8 and 14 inch hard disks (M10, M20 or M26) connected to the HDCA controller. (Section A.3. describes the FORMATMW.COM program used to test and format mini-Winchester hard disks (M5, M10 or M16) connected to the HDC/DMA controller.)

The FORMATHD.COM program initially comes up with a menu offering four options:

- L - Format a logical drive only. Only a single designated drive will be formatted. Drives are entered as 1, 2 or 3 and correspond to drives A, B and C, respectively.
- F - Format the physical drive, in which case the whole drive is formatted.
- C - Continue an interrupted test - NOT IMPLEMENTED
- D - Perform a diagnostic test. Options include testing of the sector header and data fields and a seek mechanism test.

Depending upon the selection made, additional menus are displayed to help the user define the type of testing or formatting to be done on the drive. Options listed in these menus are described in the following sections.

### A.2.1. Diagnostic Options

If option D is selected from the initial menu, FORMATHD.COM displays another menu that describes options for the type of diagnostic test to be performed on the drive. These options are preceded by a number. The numbers may be added together for a combined diagnostic test, or entered individually to begin a specific diagnostic. All even numbered tests require the drive to be preformatted. Formatting is done automatically in all odd numbered tests.

#### 1 = Sector header field test

This test places read and write test patterns on the sector headers. Upon finishing the full cycle of patterns, it writes out header information on the sector header areas. The disk does not need to be formatted before beginning this test. It takes 30 minutes to complete. No data is erased during the test.

#### 2 = Sector data field test

This test places read and write test patterns on the sector data fields. This test leaves "garbage" test patterns on the data fields, thereby destroying data previously on the disk. Disks run through this test must be run through a full formatting

procedure to erase the test patterns left in the data fields before being used again. The disk must be formatted before beginning this test. It takes 5-12 hours to complete, depending upon the size of the drive. All data previously on the disk is destroyed during the test.

#### **4 = Seek mechanism test**

This test runs a check on the disk platter, seeking and reporting any malfunctions it may encounter. This is a good (and safe) test to run initially on a new disk drive, and periodically on a drive in use. The disk must be formatted before beginning this test. It takes 15 minutes to complete. This is a read-only test. All sector and data fields are left intact.

### **A.2.2. Formatting Options**

Two options are available for formatting the disk drive:

#### **H = Format headers**

Sector header information is checked, and if needed, new header information is placed into the appropriate area. Formatting takes about 4 minutes to complete. Data is not affected.

#### **D = Erase data field also**

If this option is entered, the sector headers will be checked, and fixed if necessary, and all data fields are erased. This option must be entered on all drives that have undergone a full diagnostic test to erase the test data patterns left on the data sector fields. Formatting takes about 4 minutes.

### **A.3. Testing 8 and 14 Inch Hard Disks - FORMATHD.COM**

We highly recommend that all Winchester hard disks be put through an initial diagnostic check to determine if any problems developed during shipping. If any problems are reported, it will be necessary to run a full diagnostic test, reformat the disk and run BAD.COM, a bad sector fix program, before placing the operating system on it.

If no problems are encountered during the initial diagnostic, you need only format the sector headers before installing the operating system.

Use the following tables to help you run the diagnostic and formatting procedures. Read and follow all instructions carefully. Be sure to press the RETURN key after entering your choices from the menus.

**Table A-1: Initial Diagnostic Check**

**Purpose:** Check out the sector header fields and the seek mechanism.

**Time required:** Approximately 45 minutes.

**Effect:** All data previously on the hard disk remains intact.

Enter FORMATHD.COM by typing

A>FORMATHD[RET]

The following menus are displayed:

Discus M26 and M10 Hard Disk Format Program, Rev. 2.n.  
Choose the desired function:

- L = format a Logical drive.
- F = Format an entire physical drive.
- C = Continue an interrupted test.
- D = run a Diagnostic test.

Function (RETURN to exit):

Option D begins the diagnostic test.

How much of a diagnostic do you want to run:

- 1 = Sector header field test only.
- 2 = Sector data field test only.
- 4 = Seek mechanism test only.

Choose the diagnostic by adding together the desired options.  
Options (RETURN to exit):

Enter 5 to test the sector header fields and the seek mechanism.

Enter physical number to be tested or formatted (1-4, RETURN to exit):

Enter the number of same type hard disk drives connected to the controller.

Select the drive type:

A = Discus M26, 26 megabyte drive.  
B = Discus M10, 10 megabyte drive.  
C = Discus M20, 20 megabyte drive.

Drive type (RETURN to exit):

Enter the letter corresponding to the drive(s) being tested. If a Morrow Designs' M10 disk system is being tested, the following menu appears:

Select drive type:

F = Fujitsu  
M = Memorex

Enter option F; these hard disk systems are currently manufactured by the Fujitsu Corporation.

Don't be alarmed by the noises coming from the hard disk; these are normal.

FORMATHD.COM displays the test it is performing and tells you approximately how long it will take. A dot appears on the screen for each part of the test. At the end of the test it will ask you to press the RETURN key to return to CP/M.

If no sector errors are detected, proceed to Table A-4 to format the sector headers, then turn to Section 12 (or the Micronix User's Manual) to install the operating system on your hard disk.

If sector errors are detected, it will be necessary to run the full diagnostic described in Table A-2.

ERROR MESSAGE:

Waiting for the drive to become ready, could take as long as 2 minutes

If after two minutes the drive is not ready, or if the program "locks up", check your cable connections to be sure they are correct.

## Table A-2: Full Diagnostic Test

Purpose: Test all functions of the hard disk.

Time required: Approximately 5 - 12 hours, depending on the size of the drive

Effect: All data previously on the disk is destroyed. It is recommended that the BAD.COM program be run first to record the placement of all existing bad sectors so they may be remapped out after the test has finished.

Enter FORMATHD.COM by typing

A>FORMATHD[RET]

The following menus are displayed:

Discus M26 and M10 Hard Disk Format Program, Rev. 2.n.  
Choose the desired function:

- L = format a Logical drive.
- F = Format an entire physical drive.
- C = Continue an interrupted test.
- D = run a Diagnostic test.

Function (RETURN to exit):

Option D begins the diagnostic test.

How much of a diagnostic do you want to run:

- 1 = Sector header field test only.
- 2 = Sector data field test only.
- 4 = Seek mechanism test only.

Choose the diagnostic by adding together the desired options.  
Options (RETURN to exit):

Total = 7. All diagnostics are run.

Enter physical number to be tested or formatted (1-4, RETURN to exit):

Enter the number of same type hard disk drives connected to the controller.

Select the drive type:

A = Discus M26, 26 megabyte drive.  
B = Discus M10, 10 megabyte drive.  
C = Discus M20, 20 megabyte drive.

Drive type (RETURN to exit):

Enter the letter corresponding to the drive(s) being tested. If a Morrow Designs' M10 disk system is being tested, the following menu appears:

Select drive type:

F = Fujitsu  
M = Memorex

Enter option F; these hard disk systems are currently manufactured by the Fujitsu Corporation.

Don't be alarmed by the noises coming from the hard disk; these are normal.

FORMATHD.COM displays the test it is performing and tells you approximately how long it will take. A dot appears on the screen for each part of the test. At the end of the test it will ask you to press the RETURN key to return to CP/M.

If no sector errors are detected, proceed to Table A-3 to format the disk, then turn to Section 12 (or to the Micronix User's Manual) to install the operating system.

If sector errors are detected, turn to Section A.4. and run the BAD.COM program to map out (block) all bad sectors from system use, then follow the above instructions.

ERROR MESSAGE:

Waiting for the drive to become ready, could take as long as 2 minutes

If after two minutes the drive is not ready, or if the program "locks up", check your cable connections to be sure they are correct.

**Table A-3: Disk Formatting Procedure - Entire Physical Drive**

**Purpose:** Format the disk for system use after a full diagnostic has been run.

**Time required:** Approximately 4 minutes

**Effect:** Erases all test patterns placed on data fields; all data destroyed.

Enter FORMATHD.COM by typing

A>FORMATHD[RET]

The following menus are displayed:

Discus M26 and M10 Hard Disk Format Program, Rev. 2.n.  
Choose the desired function:

L = format a Logical drive.  
F = Format an entire physical drive.  
C = Continue an interrupted test.  
D = run a Diagnostic test.

Function (RETURN to exit):

Option F begins formatting.

Enter physical number to be tested or formatted (1-4, RETURN to exit):

Enter the number of same type hard disk drives connected to the controller.

Select the drive type:

A = Discus M26, 26 megabyte drive.  
B = Discus M10, 10 megabyte drive.  
C = Discus M20, 20 megabyte drive.

Drive type (RETURN to exit):

Enter the letter corresponding to the drive(s) being tested. If a Morrow Designs' M10 disk system is being tested, the following menu appears:



Select drive type:

F = Fujitsu  
M = Memorex

Enter option F; these hard disk systems are currently manufactured by the Fujitsu Corporation.

Enter amount of formatting desired:

H = Format Headers only (data remains intact)  
D = Erase Data field also

Enter option D to format the headers and erase all data.

Don't be alarmed by the noises coming from the hard disk; these are normal.

FORMATHD.COM displays the test it is performing and tells you approximately how long it will take. A dot appears on the screen for each part of the test. At the end of the test it will ask you to press the RETURN key to return to CP/M.

Once this procedure is finished, turn to Section 12 (or the Micronix User's Manual) and install the operating system on your hard disk.

**Table A-4: Disk Formatting Procedure - Sector Headers Only**

Purpose: Format the hard disk for system use.

Time required: Approximately 4 minutes

Effect: Ensures disk is ready for the operating system. Data remains intact.

Enter FORMATHD.COM by typing

A>FORMATHD[RET]

The following menus are displayed:

Discus M26 and M10 Hard Disk Format Program, Rev. 2.n.  
Choose the desired function:

- L = format a Logical drive.
- F = Format an entire physical drive.
- C = Continue an interrupted test.
- D = run a Diagnostic test.

Function (RETURN to exit):

Option F begins formatting.

Enter physical number to be tested or formatted (1-4, RETURN to exit):

Enter the number of same type hard disk drives connected to the controller.

Select the drive type:

- A = Discus M26, 26 megabyte drive.
- B = Discus M10, 10 megabyte drive.
- C = Discus M20, 20 megabyte drive.

Drive type (RETURN to exit):

Enter the letter corresponding to the drive(s) being tested. If a Morrow Designs' M10 disk system is being tested, the following menu appears:

Select drive type:

F = Fujitsu

M = Memorex

Enter option F; these hard disk systems are currently manufactured by the Fujitsu Corporation.

Enter amount of formatting desired:

H = Format Headers only (data remains intact)

D = Erase Data field also

Enter option H to format the sector headers.

Don't be alarmed by the noises coming from the hard disk; these are normal.

FORMATHD.COM displays the test it is performing and tells you approximately how long it will take. A dot appears on the screen for each part of the test. At the end of the test it will ask you to press the RETURN key to return to CP/M.

Once this procedure is finished, turn to Section 12 (or the Micronix User's Manual) and install the operating system on your hard disk.

#### A.4. Mapping Out the Bad Sectors - BAD.COM

If, after running the FORMATHD.COM program, you find there are new bad sectors on your hard disk:

1. Call the BAD.COM program by entering

```
A>bad[RET]
```

2. This program displays five choices:

- 1) Getbad  
To read the existing bad map on a drive
- 2) Putbad  
To manually add to the bad map
- 3) Fixbad  
To create special CP/M files to take bad sectors out of circulation
- 4) Clearbad  
To clear out the old bad map
- 5) Quit  
All done

3. Select choice 3), Fixbad, which automatically creates the special CP/M file that effectively blocks use of the bad sector by the operating system.

4. Install the operating system and system files.

**NOTE:** If you plan to run a full diagnostic on the hard disk, it is recommended that you check the manufacturer's bad sector list, found on the disk drive itself, or run the Getbad option and make a list of these sector errors before testing the hard disk, then manually map out these sectors using Putbad.

If you suspect that a bad sector has developed after system installation, try to back up as many files as possible, run the FORMATHD.COM program to determine where the bad sector is located, then follow the procedure described above.

## A.5. Testing 5 1/4 Inch Hard Disks - FORMATMW.COM

It is recommended that you test and format your hard disk before installing the operating system to ensure that no damage occurred to it during shipping and that it is properly formatted.

The FORMATMW program is included on the CP/M system diskette and is called by entering the following command line:

```
formatmw drive-type [arguments]
```

A drive-type must be specified. The arguments are optional but tell the program how to format your hard disk. By default, FORMATMW formats all heads and sets the sector size to 1024 bytes using a skewing factor of 3 (standard CP/M format). Other options are described in Section A.3.1.

For a normal CP/M installation, use one of the following examples of this command to format and test your mini-Winchester hard disk:

```
A>formatmw m5 test      - formats and tests an M5
A>formatmw m10 test     - formats and tests an M10
A>formatmw m16 test     - formats and tests an M16
```

Once the program has been executed, the program displays:

```
Formatting.
```

When it has finished the format test, it verifies it by

```
Checking format.
```

then begins a series of checks on the disk. This part of the test takes about 30 minutes to complete. The program makes 19 passes through the hard disk, alternately reading and writing test patterns. At the end of the test it should return:

```
Bad sector report:
No bad sectors detected.
```

A small number of bad sectors will be "mapped" (effectively blocked) out of the hard disk. If this program reported an abundance of bad sector errors, however, contact your dealer.

When the CP/M prompt reappears, you are ready to install the operating system onto your hard disk.

### A.5.1. Program Options

The FORMATMW program offers several options that may be entered to format, or format and test, a mini-Winchester for a particular application. These options are described below.

<u>DRIVE-TYPES</u>	<u>COMPANY</u>	<u>1K SECTORS</u>
seagate, st506, m5	Seagate Technology.	5,508 (M5)
st412, m10	Seagate Technology	11,016 (M10)
cmi, cm5619, m16	Computer Memories Inc.	16,524 (M16)

#### OPTIONAL ARGUMENTS:

drive #	Specify a physical drive (0-3) to be formatted. Default is drive 0.
head #	Specify a physical head to be formatted. By default, all the heads are formatted and tested. If you want to check out one head only, include this argument. Consult the manufacturer's manual for the allowable head numbers.
nosoft	When this flag is specified, soft errors that occur during formatting or testing will be reported but not added to the bad spot map being built. This flag is used primarily during drive evaluation and allows the CP/M test programs to get a shot at marginal sectors. This flag may also be used when the drives' bad spot map overflows, i.e., entries will not be "wasted" on soft errors.
size #	Specify the sector size. Legal values are 128, 256, 512, 1024, and 2048 bytes. Default is 1024 bytes. Note: Users of the Morrow Designs' multi-user operating system, Micronix, are required to format their disks with 512 byte sectors.
skew #	Specify the skewing factor to be used. Default is 3. A skew factor of 6 is suggested for Micronix.
test	Invoke a disk test routine. This routine writes various patterns on the disk and then verifies them.

track #                   Specify a particular cylinder to be formatted and tested. Consult with the manufacturer's specifications for legal cylinder values.

Any combination of optional arguments can be combined for various effects. Common command usage includes:

A>formatmw cmi test

formats and tests an M16 hard disk to prepare it for the CP/M operating system.

A>formatmw seagate

formats an M5 for CP/M; no diagnostic is run.

A>formatmw cm5619 drive 2 size 512 skew 6

formats drive 2 of an M16 for a Micronix environment.

A>formatmw ml0 test size 512 skew 6

formats and tests an M10 in preparation for the Micronix operating system.

## B. Troubleshooting the Decision I

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

PROBLEM	PROBABLE CAUSE	REMEDY
<b>FLOPPY DISK</b>		
<b>FAN OFF, POWER INDICATOR NOT LIT:</b>	Power cord not plugged in wall.	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.	See Section 8; turn breaker OFF, then ON.
<b>FAN ON, POWER INDICATOR NOT LIT</b>	Indicator light bad.	Replace indicator light.
	Internal connection loose.	Contact service center.
	Power supply connection loose.	Contact service center.
<b>POWER ON, BUT DISK DRIVE INDICATOR LIGHT DOES NOT BLINK:</b>	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; turn breaker OFF then back ON.



PROBLEM	PROBABLE CAUSE	REMEDY
DISK DRIVE INDICATOR LIGHT DOES NOT BLINK	Cable improperly connected.	Reconnect it.
	System not initialized.	Push RESET on Decision I front panel.
DRIVE HEAD LOADS, SEEKS, BUT SYSTEM DOES NOT POWER UP:	Floppy diskette inserted incor- rectly.	Insert diskette with label facing up and away from slot.
	Wrong dis- kette inserted.	Insert CP/M boot diskette.
	Bad system dis- kette.	Make new dis- kette from back up copy.
	Cables and plugs incorrectly connected.	Refer to Sec- tion 8.
<b>HARD DISK</b>		
DRIVE DOES NOT PERFORM CORRECTLY	Data or control cable connected incorrectly.	Methodically change cable connections.
	Power supply con- nection loose.	Contact service center.
	Drive head not unlocked.	Unlock head.
	CPU switch set- tings incorrect.	Check switch settings.
	External drive cable unplugged.	Check cable connections.
	Internal drive cable unplugged.	POWER OFF. Undo drive cabinet cover and re- connect.
	Sector errors in tracks 0 and 1.	Contact service center.
	Headers not for- matted correctly.	Format headers only.

### C. Program Descriptions

ABOOT&.ASM	Source code for cold boot section of CP/M configured for Morrow Design hardware.
ASM.COM	CP/M command; assembles 8080 assembler source.
BAD.COM	Maps out bad sectors found on the hard disk by the FORMATHD program to an "invisible" file.
*BAD.DOC	Describes the BAD.COM program. (HDCA controller only.)
BAUD.COM	Commands to change the baud rate on the Decision I Wunderbuss or Mult/IO boards.
*BAUD.DOC	Instructions for BAUD.COM
BIOS.ASM	Digital Research supplied CBIOS configured for an Intel MDS-800.
BOOT.ASM	Digital Research supplied boot loader configured for an Intel MDS-800.
BOOTH.DASM	Source code for BOOTH.D.COM.
BOOTH.D.COM	Command to boot hard disks with HDCA controller.
BOOTMW.ASM	Source code for BOOTMW.COM
BOOTMW.COM	Command to boot hard disks with HDC/DMA controller.
CBIOS.ASM	Skeletal BIOS (basic I/O system) supplied by Digital Research.
CBIOS&.ASM	Source for CBIOS configured for Morrow Designs hardware.
DDT.COM	CP/M command; Dynamic Debugging Tool which allows interactive testing of programs generated in CP/M environment.
DEBLOCK.ASM	CP/M command; source for sector deblocking subroutines.
DISKDEF.LIB	CP/M source for macro expansions of disk definitions.
DUMP.ASM	Source code for DUMP.COM.
DUMP.COM	CP/M command; types contents of disk files at the console in hexadecimal form.
ED.COM	CP/M command; calls context editor to create and alter source files.

FORMATDJ.ASM Source code for FORMATDJ.COM.  
 FORMATDJ.COM Format program for DJDMA controller.  
 FORMATHD.ASM Source code for FORMATHD.COM  
 FORMATHD.COM Commands to format and test Discus hard disk systems - HDCA controller.  
 FORMATMW.COM Format program for HDDMA controller.  
 \*FORMATMW.DOC Documentation for FORMATMW.COM  
 FORMT#.ASM Source for FORMT#.COM.  
 FORMT#.COM Command to format diskettes on DJ2D/B.  
 HYTYPE.ASM Source file for HYTYPE.PRL.  
 HYTYPE.DOC Documentation for the Hytype printer driver.  
 HYTYPE.PRL Hytype printer driver installation package.  
 INSTALL.COM Command to temporarily add devices onto CP/M system.  
 \*INSTALL.DOC Documentation for INSTALL.COM.  
 LOAD.COM CP/M command; converts Intel hexadecimal format files to command format files.  
 MAKEPRL.COM Relocatable module generator.  
 \*MAKEPRL.DOC Documentation file for MAKEPRL.COM.  
 MBASIC.COM Microsoft's BASIC-80, Rev 5.21  
 MOVCPM.COM CP/M command; moves and/or changes CP/M system size.  
 \*NOTESHD.DOC Descriptions and examples of commonly used system files.  
 PIP.COM CP/M command; Peripheral Interchange Program used to transfer files between selected I/O devices.  
 PRL.DOC Documentation about PRL files.  
 REGEN.ASM Source file for REGEN.COM.  
 REGEN.COM Converts non-1791 format diskettes to that format. Used with the DJ 2D/B controller.

SINGLE.ASM      Source code for SINGLE.COM.

SINGLE.COM      Turns single drive system into "logical" dual drive system for copying diskettes. Used with DJ 2D/B controller.

STAT.COM      CP/M command; provides statistical information about files and disks.

SUBMIT.COM     CP/M command; runs commands in batch mode.

SYSGEN.COM    CP/M command; reads or writes reserved CP/M system tracks.

VITALS.BAD    Used by BAD.COM. Contains specific information about hard disk drives for reading and mapping out bad sectors.

XSUB.COM      CP/M command; allows submitted commands to receive input from submit file.

CP/M commands are described in more detail in the CP/M manual.

\*Denotes files that may be printed out in either the CP/M or WordStar program, or viewed on-screen with the CP/M TYPE command.

## D. Factory Settings for the Decision I Hardware

The following tables depict the switch and jumpered settings made at the factory for proper system operation.

If you find it necessary to change the settings on your hardware, make sure all power is turned off to the Decision 1 before removing any boards. Boards are removed by firmly, but gently pulling them out of the motherboard. Once proper settings have been made, return the board to a slot and press down firmly (but gently) until board is securely reinstalled. Be sure to double check all settings and connections before reapplying power to your system.

**Table D-1: Wunderbuss I/O Controller**

Switch 7C			Switch 10A		
OFF	ON		OFF	ON	
	==	1		==	1
	==	2		==	2
	==	3		==	3
	==	4		==	4
	==	5		==	5
	==	6		==	6
	==	7		==	7
	==	8		==	8

### Jumpered Settings:

- J1 - not installed
- J2 - A to B
- J3 - installed
- J4 - no jumpers
- J5 - battery (user supplied)
- J6 - to front panel RESET switch

**Table D-2: Decision I MPZ80 CPU**

Switch 16D

Floppy Disk			Hard Disk*		
OFF	ON		OFF	ON	
==		1		==	1
==		2		==	2
==		3		==	3
==		4		==	4
==		5		==	5
==		6	==		6
==		7		==	7
	==	8		==	8

\*Optional: These settings allow the system to be booted from the hard disk. Requires a PROM, revision 4.44 or later, with the bootstrap software is burned in. See Section 12.4. in this manual and the Decision CPU Technical Manual for further details.

**Table D-3: MM65KS Memory Board**

Switch 1C			Switch 5D		
OFF	ON		OFF	ON	
	==	1	==		1
	==	2	==		2
	==	3		==	3
	==	4	==		4
	==	5	==		5
	==	6		==	6
	==	7		==	7
	==	8		==	8

Switches set to enable extended addressing. Chip 2D not installed; chip 1D installed.

**Jumpered Settings:**

- J1 - installed
- J2 - installed
- J3 - not installed
- J4 - installed
- J5 - not installed
- J6 - installed
- J7 - not installed

**Table D-4: Disk Jockey 2D/B Floppy Disk Controller**

Switch 5D			Switch 13C		
OFF	ON		OFF	ON	
==		8	==		8
	==	7	==		7
==		6	==		6
==		5	==		5
==		4	==		4
==		3	==		3
==		2	==		2
==		1	==		1

Note that in some systems these switches were installed such that the top paddles are labeled "1" and the last paddles "8." In the event that your DJ2D/B has been constructed this way, all paddles are OFF except paddle 2 on Switch 5D, which is ON.

**Jumpered Settings:**

- J2 - installed
- J4 - jumpered A to B

**Table D-5: HDCA Winchester Hard Disk Controller  
(8 and 14 inch hard disks only)**

**Switch 8C**

OFF ON

	==	1
==		2
	==	3
==		4
	==	5
	==	6
	==	7
	==	8

**Table D-5, Cont.**

**Interrupt Jumper Settings:**

A to VIØ

B to VII

**Seek Complete Plugs:**

P3 - jumpered 7 to 8

P4 - jumpered 7 to 8

P5 - jumpered 7 to 8

**Table D-6: Disk Jockey DMA Floppy Disk Controller**

J1 - B to C = 2732 EPROM  
(A to B = 2716 EPROM)

J2 - B to C = conditional bootstrap mode  
(A to B = non-bootstrap mode)

P3 - jumpered 2 to 3 for bootstrap mode.

**Table D-7: HDC/DMA Hard Disk Controller  
(mini-Winchester hard disks only)**

J4 - not installed

J5 - to PINT\*



## **E. Decision I Desk Top System Specifications**

### **Dimensions:**

48.2 X 53.4 X 22.8 cm.  
(19 X 21 X 9 inches)

### **Net Weight:**

10.3 Kg. (23 lbs.) - without drives

### **External Power Requirements:**

115 VAC nominal - 60 Hz (domestic)  
(90V to 130V min/max)

115/220 VAC nominal - 50/60 Hz (import)  
(198V to 242V min/max)

### **AC Power:**

2.50 amps @115 VAC (max.)  
1.25 amps @220 VAC (max.)

### **Internal Power Requirements:**

+8 volts @12.0 amps (filtered)  
+16 volts @ 1.5 amps (filtered)  
-16 volts @ 1.5 amps (filtered)

### **Supply Type:**

Switching

### **Efficiency:**

80% typical

### **CPU Specifications:**

Type: Z80A (NEC 780A)  
Speed: 4 Mhz (6 Mhz optional)  
Math Processor: AMD 9512 (optional)

### **Memory:**

65K bytes of 200 ns low power static  
standard (expandable to 1M byte);  
2K bytes of EPROM

### **Standard I/O:**

3 Serial channels (50 baud to 56K baud)  
1 daisy-wheel printer channel  
1 multi-purpose eight-bit parallel port  
(bi-directional)

### **Real-Time Clock:**

NEC 1990C

I/O Controller:

8259A PIC

Environmental Considerations:

Temperature: 10 to 40 degrees C (operating)  
-40 to 52 degrees C (nonoperating)

Humidity: 10 to 90%

Elevation: Sea Level to 3658 meters (12,000 ft)

## WARRANTY RETURN PROCEDURE

Should a customer experience a defect in either workmanship or materials during the warranty period, Morrow Designs, Incorporated will replace or repair the product at its expense only if the product is promptly returned to Morrow Designs, Incorporated for repair or replacement, and the following procedure for returning the product is followed:

1. Phone Morrow Design's Customer Service Department at (415) 430-1970. Inform the customer service staff of the nature of your problem and obtain a RETURN AUTHORIZATION NUMBER. No return shipment will be accepted without this number.
2. Repack the equipment and ship it to Morrow Designs, Incorporated, care of the Customer Service Department, 600 McCormick St., San Leandro, California, 94577. All freight charges must be prepaid by the customer, as well as all related charges, such as customs clearance and documentation. CODs WILL BE REFUSED. Indicate the RETURN AUTHORIZATION NUMBER on the waybill and shipping label. Include with the equipment a copy of proof of purchase showing the date the equipment was purchased. Any shipment received without proof of purchase will be billed as non-warranty repairs. Please also include a brief written description of the problem experienced with the equipment.
3. Morrow Designs, Incorporated, will repair or replace defective items and return the product to the customer via UPS surface, prepaid rates. Any other form of delivery or shipment required or requested by the customer is at the sole expense of the customer.
4. SHIPPING DAMAGE: (a) Morrow Designs, Incorporated, is not responsible for damage to goods in transit. (b) If you return a product because of shipping damage, have the product inspected by the carrier before returning it to us. Failure to do so may result in denial of your claim by the carrier. (c) Always ship the product in its original packing material. If the original packing material has been damaged or lost, new packing material can be purchased from Morrow Designs. Many shippers will not honor damage claims if the product is not adequately packaged.
5. Morrow Designs, Incorporated, is not responsible for the integrity of any data recorded on any media returned for service or repair. It is the responsibility of the user to back-up all necessary information.

## IMPORTANT WARRANTY INFORMATION

### LIMITED WARRANTY

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