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1. INTRODUCTION

1.1 Purpose of This Manual

This document is intended as an installation guide and introduction to the the Decision computer system. Installing your Decision does not take any technical expertise, and the simple procedures outlined in this manual should make it a short and simple process. This manual is also intended to help you get acquainted with the CP/M operating system and the applications software packages provided with your Decision.

For more specific information on CP/M and the applications software packages, consult the manuals which accompany these programs. For technical information not contained in this manual, consult the Decision technical binder.

NOTE:

This manual discusses single user applications; that is one person operating the Decision at any given time. The Decision does support multi-user environments through the Micronix operating system, but this manual does not cover multi-user operation. If you have purchased the Micronix operating system and wish to use this operating system with the Decision, refer to the Micronix User's Manual, not this one. This manual discusses use of the CP/M operating system only.

1.2 How to Use This Manual

We have attempted to present the material contained in this manual in a way that will enable you to learn about your new system as you install it. The sections are sequentially ordered, so that if you proceed section by section, you will first have a general understanding of the Decision; you can then properly unpack the system and other items enclosed in the shipping carton, easily install the hardware, start-up the system, and begin using your new computer with the software provided by Morrow.

In some of the sections, we have incorporated details or information which may not directly affect the installation of a "standard" Decision (specifically Sections 8, 10 and 11). Basic procedures and instructions have been expanded somewhat to include special features or tips that may be helpful in day-to-day operation of the Decision, or allow you to reconfigure your system for a "non-standard" installation. We strongly recommend that you read the entire manual thoroughly before even taking the computer out of the box. You can then follow the procedures specific to installation and system start-up. The detailed Subject Index at the end of this manual will enable you to later locate those details you may have skipped over when you first read this manual.

1.3 Conventions

Throughout this manual, technical jargon and "computerese" have been minimized (if not eliminated), with the intent of providing a straight-forward, non-technical approach to installation and operation. A few conventions or guidelines, however, have been established to help you understand what is meant by some of the instructions in this manual.

<CR> When you see this code, it simply means that you should press the RETURN key on your keyboard. The letters represent Carriage Return, which is the computer's signal to process the information you entered.

Control X This is a control code, where X may be any specified character. Generally, reference is made in this manual to "Control C". To enter this code, press the key marked CTL or CTRL on your keyboard. Continue holding this key down while typing the character C (or other specified character). This is similar to typing an upper case character; the SHIFT key is held down while typing the letter to be capitalized.

2. SYSTEM DESCRIPTION

The Decision is a high performance computer system, designed to suit the needs of both single and multi-user environments. It can accommodate a variety of video terminals, three types of printers (serial, parallel and daisy-wheel) and up to a total of eight disk drives.

All Decision computer systems are shipped with CP/M, a single-user operating system. This operating system enables you to use the software packages provided by Morrow and many other commercially available programs. Several models of the Decision include some of the most popular business-related software packages.

This general information is all you really need to get started with the unpacking and installation of your Decision. If you would like a more complete discussion of your system, please refer to Appendix A. The technical and software manuals included with your Decision will also provide more detailed information.

3. INSPECTION AND UNPACKING PROCEDURES

3.1 Introduction

This section contains simple instructions for inspecting and unpacking your new Decision computer. The following steps will be covered:

1. Checking the shipping carton for obvious damage.
2. Selecting a work space that has ample room and stability to support the Decision, and provides the proper power source.
3. Verifying the contents of the shipping carton.
4. Unpacking your system and all items included with your system.
5. Checking the Decision for shipping damage.

If, for any reason, your new system must be returned to Morrow, please refer to Section 3.6 and the Warranty Return Procedure at the front of this manual.

3.2 Receiving Inspection

When the Decision is delivered by a transfer company, the shipping carton should be carefully inspected for damage. Prior to accepting delivery, carefully inspect the carton for obvious damage. If damage is evident, note it on the waybill and require that the delivery agent sign the waybill. Notify the transfer company immediately, and submit a damage report to the carrier.

NOTE:

If the computer must be reshipped for any reason, it must be repacked in the original shipping carton and in a manner that will prevent damage while in transit.

If exterior damage is not apparent, proceed to Section 3.3. Before you take the Decision out of the box, you should know the amount of space it takes up and its power requirements.

3.3 Site Preparation

There are very few constraints to selecting the desired work space in which to install your system. Extreme temperature and/or humidity, however, should be avoided.

3.3.1 Physical Requirements

The Decision requires an area 8.5 inches high x 19 inches wide x 20.5 inches deep. An additional four inches should be provided for cable clearance. Space for ventilation clearance is not required. The weight of this system is 36 pounds.

3.3.2 Power Requirements

NOTE:

DO NOT PLUG IN YOUR DECISION until you read Section 4.0 and are sure the proper voltage setting has been selected.

The installation site should have a 115 Vac 60 Hz at two (2) amps power source in the immediate vicinity; in the United States, this is a NEMA standard 5-15R, 3-prong receptacle.

To ensure adequate protection from electrical shock and provide immunity from EMI (electro-magnetic interference), RFI (radio frequency interference) and electrical power surges, a proper ground must be provided on the power source.

3.4 Unpacking Instructions

1. Examine the contents of the Decision shipping carton. The following items should be enclosed:
 - 1 Decision Computer
 - 2 Cables:
AC Power Cord and Terminal Data Cable
 - 7 Diskettes: CP/M and applications software
 - 6 Software Manuals: CP/M, MBASIC, NewWord, Correct-It, LogiCalc, Personal Pearl
 - 1 Set of Technical Hardware Manuals
2. Remove the documentation and the cables.
3. Remove all packing material. **Save all packing materials for possible use in reshipping the computer.**
4. Carefully lift the Decision from the shipping container and remove the remaining foam packing material. **Save the box!**

5. Place your system on a flat surface (See Physical Requirements, Section 3.3.1) and inspect the cabinet for damage.

3.5 Shipping Damage Inspection

If damage to the system is apparent, notify the transfer company immediately. Save all packing materials for the transfer company's inspection, and file a damage report with the carrier.

NOTE:

Damage to equipment in transit is not covered under warranty.

Promptly notifying the transfer company of damage will ensure claim validity and will help expedite payment for necessary repairs by the transfer company or its insurance agent.

3.6 Repacking Instructions

Your Decision has been shipped from the factory in packing materials that help prevent damage due to rough handling. If, however, you need to return any of the units to Morrow, 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.

A complete Warranty Return Procedure is provided at the front of this manual.

4. INSTALLING YOUR SYSTEM

4.1 Overview

Your video terminal and printer must be connected to the Decision, and all of the devices plugged into the AC power source, before your new system can be used. This process is called "installation". Connecting a video terminal, a printer and optional, externally connected drives is accomplished by plugging in the appropriate cables to the proper connectors on the Decision rear panel. Power cords are also connected to the Decision using the AC power receptacle and utility outlets located on the rear panel. Figure 4-1 illustrates the location and labels of each rear panel connector.

The standard Decision installation procedure is **very easy**. You don't have to understand what affect the installation process has on the computer; you need only follow the steps outlined below and you will be ready to start using your new computer.

If the assumptions listed below do not reflect your particular installation, or if you would like to understand more about the installation process, refer to the section that discusses your specific area(s) of interest.

1. Your AC power source matches the voltage indicated on the serial number sticker. If it does not match, see Section 11.3, Changing the Voltage.
2. Your video terminal is set up to operate at 9600 baud. If it is not, refer to Section 4.4.1, Printer and Terminal Requirements, and Section 11.4, Changing Serial Port Baud Rates.
3. Your printer is configured to operate at 1200 baud. If it is not, refer to Section 4.4.1, Printer and Terminal Requirements, and Section 11.4, Changing Serial Port Baud Rates.
4. You will be using a printer equipped with an RS-232C serial interface (check the specifications listed in your printer manual if you have any doubts). If you plan to use a Diablo-standard parallel interface daisy wheel printer, you will require a special type of cable to connect the printer to the Decision, and must also install a driver for this printer (see Section 11.5). Those of you wishing to use a parallel printer with a Centronics interface should refer to Section 11.6.
5. You have purchased a Morrow data cable to connect the Decision and your printer. If you did not purchase this cable from Morrow, refer to Section 11 and Appendix C.

4.2 Installation Procedure

1. You should have full access to and a clear view of the Decision rear panel when installing your system. This is necessary because you will be connecting power cords and data cables to the "ports" (sockets) located on the back of the Decision.
2. Connect one end of the video terminal cable to the Decision rear panel port labeled Serial Port 1 (see Figure 4-1). Connect the other end of the cable to a port on the back of the terminal (see Figure 4-2).

NOTE:

The way that rear panel connectors are labeled vary among terminals. Typically, two data plugs (connectors) are available. In most cases, you will plug the cable into the connector labeled HOST, EIA, RS-232 or MODEM. Do not connect the cable to the connector marked "AUX" or "PRINTER"; this will not allow communication between your terminal and the Decision.

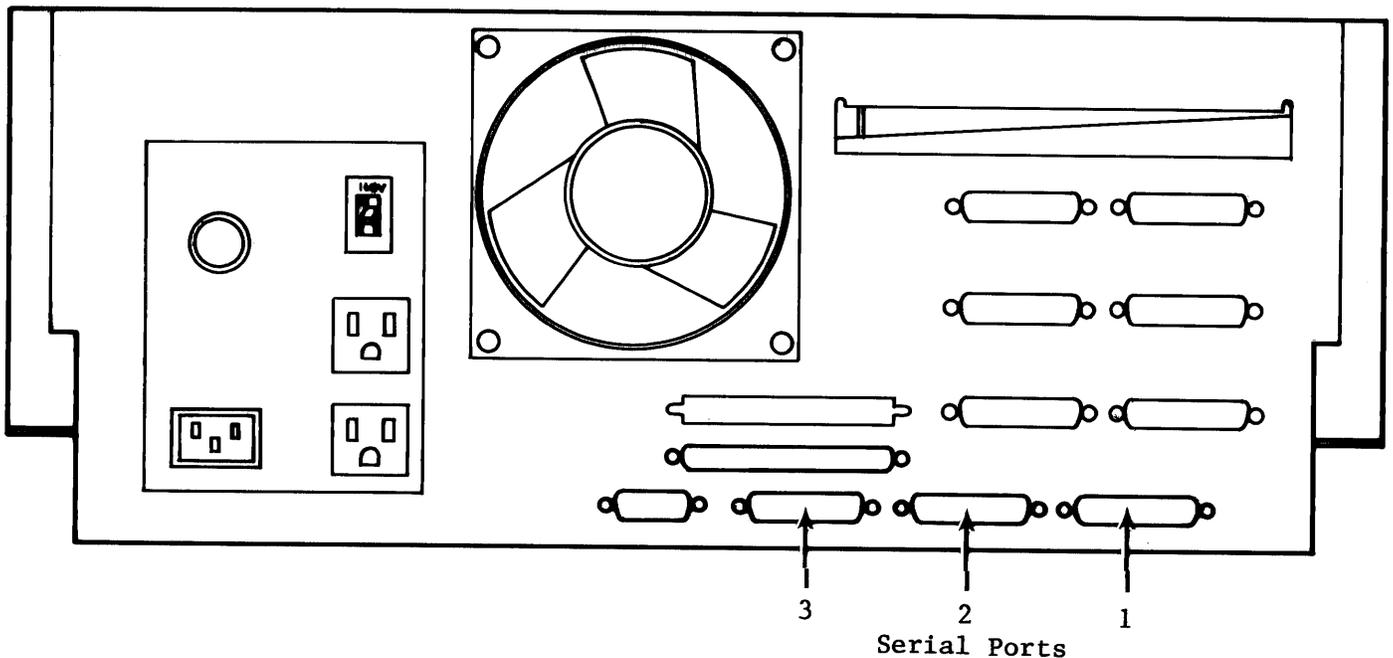


Figure 4-1: Decision Rear Panel

3. Connect one end of your printer cable to the connector provided on your serial printer. Connect the other end of the cable to Serial Port 3.

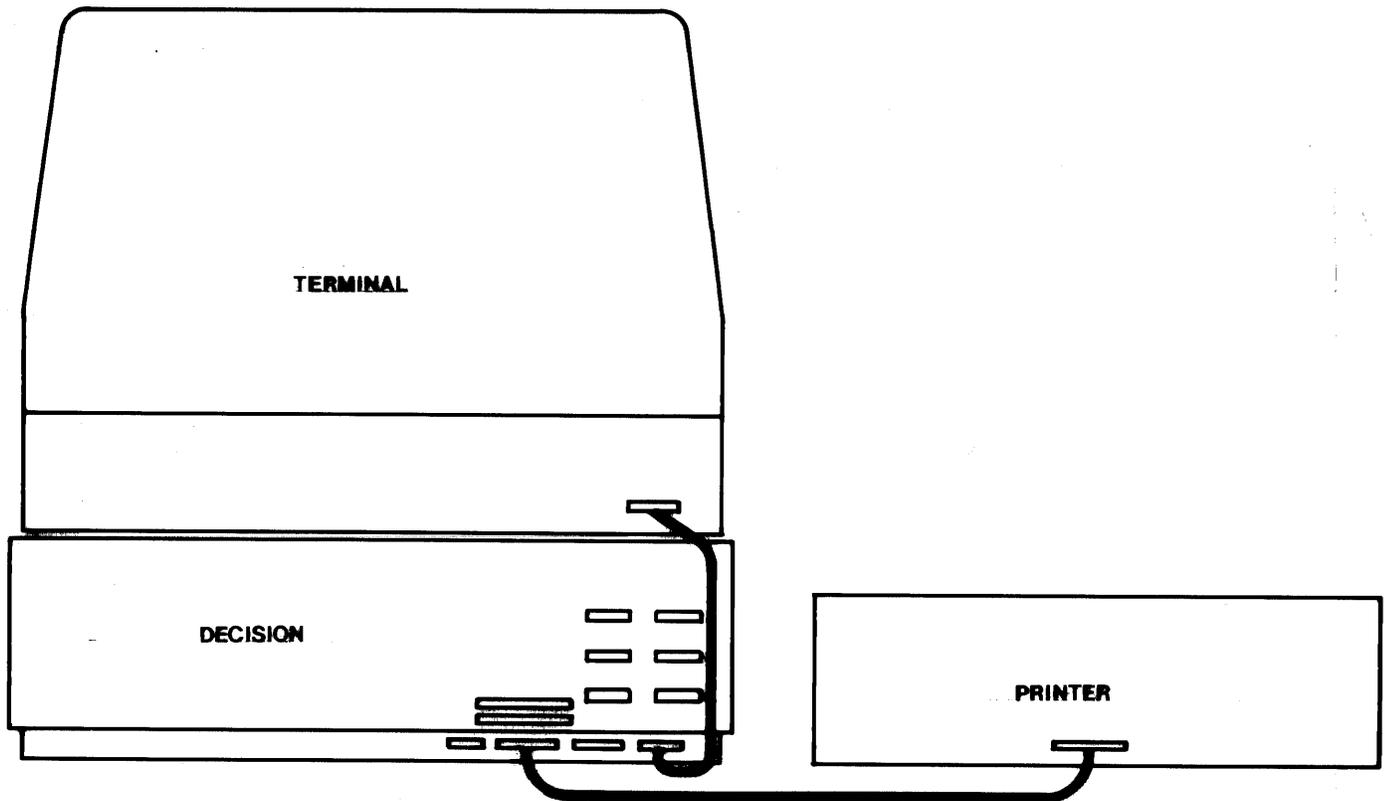


Figure 4-2: Connecting a Printer and Terminal

4. Plug the video terminal and printer power cords into the AC utility outlets provided on the rear panel of the Decision. Be sure that the computer and peripheral power switches are off. Turn the keyswitch on the Decision fully counter-clockwise.
5. Insert the Decision AC power cord in the AC power receptacle on the rear panel. Plug the other end into a grounded AC wall outlet.
6. Your installation is now complete, and you are ready to proceed to Section 4.3, Installation Checks.

4.3 Installation Checks

Once you are satisfied that all cables and power cords are properly connected, turn on power to your system by turning the keyswitch one click clockwise. If you plugged the terminal and printer into the AC utility outlets on the Decision rear panel, turning Decision power on will cause these devices to power on at the same time. If you did not connect the power cords of your terminal and printer to the Decision, these devices must be powered on separately.

1. Once power has been turned on, verify that the panel around the keyswitch is lit up.
2. Turn the key momentarily to the right. This switch is spring loaded, like a car's ignition switch, so after you turn it to the right allow it to return to the ON position. In the right-most position, the key causes the system to RESET all of its functions and memory.
3. The red indicator light on floppy disk Drive A should begin to blink, and continue to blink for several seconds.

If the light on the floppy disk drive (Drive A) begins blinking, your installation has been successful and you should proceed with Section 5, System Start-Up.

If the red floppy disk indicator is lit but is not blinking, reset the system again (turn the key momentarily to the right). If the light still does not blink, chances are that the floppy disk cable has a loose connection, or one/some of the boards inside the Decision are not seated (pushed down securely in the card cage). Follow the instructions in Section 11.7 and 11.8 to remove the Decision cover and inspect the internal connections.

4.4 Specific Installation Details

4.4.1 Printer and Terminal Requirements

The standard communication rate for video terminals connected to the Decision is 9600 baud. This means that information transferred to and from the Decision will be at the rate of 960 characters per second. The Decision is configured at the factory to expect connection to video terminals that are set at 9600 baud. For ease in system installation and operation, we recommend that you obtain a terminal which runs at this baud rate.

The terminal that you will connect to the Decision must have an RS-232 type of interface. Most of these RS-232 type terminals operate at baud rates ranging from 110 to 19,200. Any of these terminals can be connected to the Decision, but if they are not set to run at 9600 baud, you will have to reconfigure either the system software or the switch settings on a printed circuit board located inside the Decision. You can usually tell if your terminal is set to the wrong baud rate if you get "garbage" characters on the screen, rather than the normal messages (see Section 5.3.2). Refer to the Operator's Guide that accompanied your video terminal to determine the available baud rate settings for your terminal. If, for some reason, you do not have or wish to connect a video terminal that operates at 9600 baud, refer to Section 11.4 for a discussion of the program "BAUD.COM".

While video terminals must have an RS-232 type of interface, the Decision provides both a parallel and RS-232 serial interface for printer connection. The Operator's Guide that accompanied your printer will tell you what type of interface the printer has, and at what baud rates the printer will operate. The standard baud rate for serial printers connected to the Decision is 1200 baud. For ease in installation, set your printer baud rate to 1200; if this is not possible or desirable, refer to Section 11.4 to modify the Decision software.

Connection of a 50 pin parallel daisy-wheel (Diablo-style Hytype) printer also requires installation of a printer driver, which is included with the Decision system software. This process is discussed in Section 11.5.

Connection of a 36 pin parallel Centronics printer differs from the process mentioned above. Section 11.6 covers this type of driver installation.

For general information to help clarify the requirements explained here, or for specific instructions on setting up your printer and video terminal(s), refer to the manufacturers' installation guides and/or operator's manuals.

4.4.2 Cables and Power Cords

The power cord provided is for the Decision; separate power cords (not included with your system) will be used for the devices you connect to the Decision.

Morrow supplies one (1) data cable. It is intended for use in connecting a video terminal to the Decision. The data cables required to connect additional devices (such as a printer or modem) may not be included with your system but can be purchased from Morrow (see Appendix C).

A special 50 pin parallel interface type cable is required for connecting some parallel interface daisy wheel types of printers (Diablo, NEC, Qume, etc.), and is detailed in Section 11.5 of this manual. Information concerning the interface cable required for use with a Centronics printer is provided in Section 11.6.

4.4.3 Power Configuration

The Decision will operate at 115 Vac or 230 Vac, depending upon the rating of the user site power line. Throughout the continental United States, installation sites require 115 Vac; this does not involve any special procedures, as **all** Decision computers are shipped from the factory configured to operate at 115 Vac. If, however, you are using the Decision in a country where 230 Vac is the rating of the power line, you must reconfigure the Decision to operate in this environment. Details for 230 Vac power configuration are provided in Section 11.3, Changing the Voltage.

A gummed label (sticker) will cover the AC power receptacle on the rear panel of the Decision (see Figure 4-1). This label will verify the power configuration of your unit. Make sure that this setting matches the installation site before removing the label and plugging in the Decision power cord!!

NOTE:

Failure to operate this unit at the proper voltage setting may result in damage to the Decision.

4.4.4 Circuit Breaker Protection

The circuit breaker is located above the AC power receptacle and below the AC utility outlets on the rear panel of the Decision. In the unlikely event of system or peripheral failure, the circuit breaker trips (pops out like those on the back of stereo speakers), preventing further damage to the components or peripheral devices. This circuit breaker is rated at 6 amps and trips when the AC power draw exceeds this limit. If the breaker does trip, investigate the conditions which caused the overload (refer to Section 4.4.5, AC Utility Outlets) and correct them before reapplying power:

1. Turn the key switch to the "Off" position (counter-clockwise).
2. Push the back panel CIRCUIT BREAKER **IN**. Release it with a snap.
3. Return the key switch to the "On" position (clockwise).

4.4.5 AC Utility Outlets

Your printer and terminal can be connected to the AC utility outlets provided on the rear of the Decision computer. These AC utility outlets are switched by the key switch located on the front of the Decision. When the Decision is powered on, any device(s) connected to the utility outlets will automatically be powered on at the same time. The AC utility outlets have a maximum combined capacity of 6 amps.

4.4.6 Daisy-Wheel Printer Connection

A special type of cable is required to connect a parallel interface, daisy wheel printer to your Decision. This cable may be purchased from Morrow and is discussed in Section 11.5. Proceed with the instructions below, but be aware that you must install a driver for this printer before it can be used with the Decision. Section 11.5.3 will provide the information necessary to modify the Decision software so that it can output your information to the daisy wheel printer.

1. Plug the 50 pin printer cable connector into the pin socket labeled DAISY PRINTER (see Figure 4-1).
2. Make sure that the pin-1 indicator stripe is to the right. This stripe is generally red (see Figure 4-3).
3. Plug the other end of the cable into the printer with the indicator stripe corresponding to pin-1 on the printer pin socket.

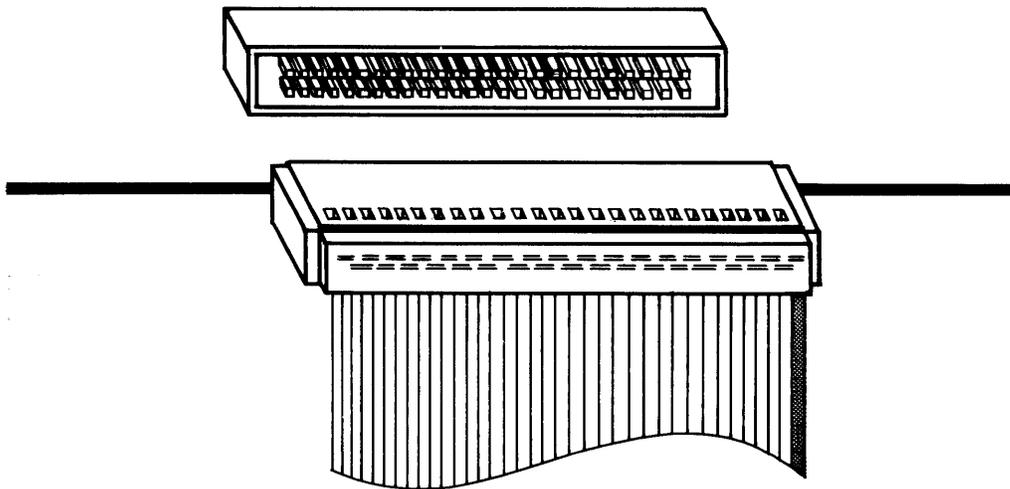


Figure 4-3: Parallel Printer Cable Connection

4.4.7 Centronics Printer Cable

The 50 pin connector for Daisy-Wheel printers may also be used for connecting Centronic's interface printers. A special cable is needed to convert the 50 pin output to the 36 pin Centronics. Morrow makes an adapter kit (part number 500-DTC) which converts the Daisy-wheel interface to the Centronics.

The Centronics driver is called the PUN: device by CP/M, (the third serial port is called the LST: device). If you'd like to swap the assignments of these two ports, you can use the SWAP.COM program.

4.4.8 Eight Inch Floppy Drive Connection

Your Decision is shipped with two disk drives installed, a hard disk and a 5 1/4" floppy; they are connected to separate drive controller boards located inside the computer. If you wish to add on an additional 8" inch floppy disk drive, it must be connected externally, through the port labeled 8" FLOPPY" (see Figure 4-1). Instructions for cabling, port addressing and general information about externally connected 8" floppy drives is provided in Section 11.11 of this manual. If you are connecting any other type of disk drive, refer to the supplemental "Disk Drive Add-On" documentation supplied with your Morrow disk drive.

5. SYSTEM START-UP (FROM FLOPPY DISK)

5.1 Overview

This section will provide general information about the floppy disk drive installed in your Decision, and the floppy diskettes you will use to operate the system. We will describe how to get your system "up and running" and provide some simple check-out procedures to ensure that your system is operating properly. System start-up from the floppy disk involves:

1. Inserting the CP/M boot diskette
2. Turning the keyswitch to perform a system RESET.

Both of these steps are discussed in detail in the following sections.

5.2 Floppy Disks

5.2.1 General Information

Your system software and applications programs are supplied on floppy diskettes. System software refers to the CP/M operating system, which is a set of programs that the Decision relies on to perform basic functions. Applications programs are packages like "NewWord", which have a specialized function (i.e. word processing). These diskettes will be inserted in the floppy disk drive and will enable you to perform a variety of activities. You will create files and store information on data diskettes. Data diskettes start out as blank diskettes purchased from a computer or office supply dealer or store; they are formatted (initialized), and then written on through use of your system and application software.

To simplify the relationship of floppy disks and disk drives, we can use the analogy of a record album (a disk of sorts) and turntable. The music is "encoded" on the record. When the record album is carefully placed on the turntable, and the proper switches, levers and/or buttons are pushed, the stereo equipment produces the sound you want to hear from the record. Similarly, an encoded floppy disk is placed in the disk drive, and the Decision is able to perform the function you've requested.

It is a given fact that a record album retains its quality if handled with care. They should be kept free from dust and scratches, away from heat and direct sunlight, and stored in its cover in a cool, dry place. Handle your diskettes with the same amount of 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).

Floppy disks are available in two sizes: 8 inch and 5-1/4 inch. The type of floppy disk drive installed will determine the size of disk you will use. Decision computers have a 5-1/4 inch floppy disk drive installed, and will therefore require use of 5-1/4 inch floppy disks. The hard disk installed in your Decision is also a 5-1/4 inch size, but the disk surfaces are permanently enclosed in a sealed housing. This hard disk is discussed further in Section 6.

5.2.2 Protecting Information on the Diskette

One of the best ways to protect the information stored on your disks is to make periodic back-ups (copies) of the files you have been working on (see Section 8). 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. Section 8 explains the procedure for backing-up diskettes.

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 (see Figure 5-1). 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, sticker or piece of tape) prevents you from accidentally erasing material on a diskette. It is a good idea to write-protect the back up copies of diskettes that contain valuable data or programs. When you purchase diskettes, these write-protect tabs are usually included in the box.

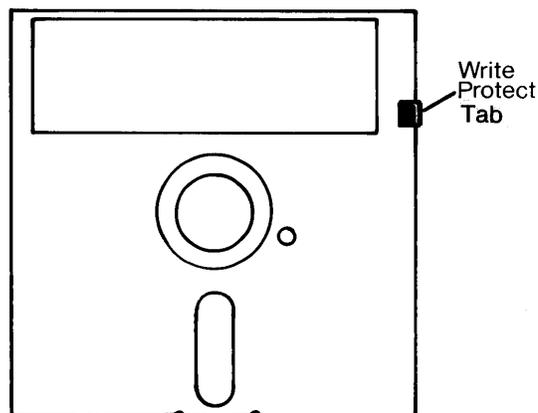


Figure 5-1: Write-Protected 5 1/4 Inch Floppy Diskette

The eight inch floppy diskettes also have write-protect notches, but to confuse the issue, these are kept uncovered to write-protect the files on the diskette. Unlike the 5-1/4 inch diskettes, 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 CP/M system diskette, write-protected.

5.2.3 Inserting Floppy Diskettes

Diskettes must be inserted in the floppy disk drive so that the computer can "read" the instructions or the data written on them. Refer to Figure 5-2 and follow the procedure outlined below to insert a disk properly:

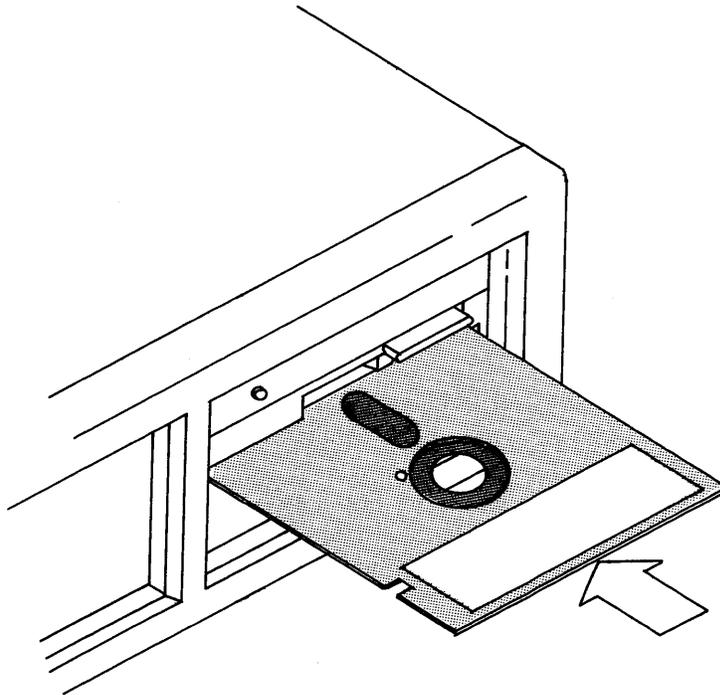


Figure 5-2: Inserting a Floppy Diskette

1. Open the disk drive door. This is accomplished by gently lifting the drive door latch.
2. Remove the cardboard retainer. **Keep this item and reinsert it only when the system is transported.**
3. Turn the system power ON.

4. Hold the diskette by its label. Do not touch any of the exposed areas.
5. The diskette label should be the closest area of the disk to you. The elongated, exposed area of the diskette should be closest to the disk drive.
6. The write-protect notch should be on the left as you face the drive, and the label should be at the top right corner.
7. Gently slide the diskette in the drive.
8. Close the disk drive door by gently pulling the latch downward until it locks into place.

NOTE:

NEVER turn the power off or remove a disk when the floppy disk drive indicator light is ON.

5.2.4 Removing the Diskette

To remove a diskette, open the disk drive door. Slide the floppy diskette out of the drive, taking care not to touch any of the exposed areas. Return the diskette to its jacket.

5.3 Booting the System

5.3.1 The CP/M Boot Diskette

Several diskettes were shipped with your Decision. The CP/M boot diskette, however, is the first diskette we will discuss. It contains the operating system, which is a group of programs (instructions) the computer needs in order to perform its tasks. The CP/M diskette contains all of the necessary software utilities to prepare (format) blank disks for use with the Decision, copy files, list the names of files stored on disk, print file contents, erase files, etc. Section 7 and Appendix A of this manual, and the CP/M documentation provided with your system, provide more detailed information on this operating system.

NOTE:

This CP/M diskette should always remain write-protected; do not remove the sticker over the write-protect notch.

Initially, you will start up or "boot" the system from this diskette. Locate the CP/M boot diskette; the top line of its label will display:

48K CP/M version 2.2, CBIOS revision E.4 #948

The second line of the label identifies the drive controller boards used in your system and the letters of the drives they address (communicate with).

Example:

MOVCPM; AB:DJDMA 5, CD:HDDMA M10, EF:DJDMA 8

This example is for a Decision with a 5 1/4" diskette drive (A:), controlled by the DJDMA. A 10 megabyte drive is partitioned into two logical drives (C: and D:) and controlled by the HDC/DMA.

Drive B is reserved for an external 5-1/4 inch drive, and drives E: and F: are reserved for external 8" drives, if you decide to add any at some point.

The drive configuration line from the CP/M diskette label (above) will also appear on your screen each time you boot the system from the floppy CP/M diskette. You need to become familiar with this way of designating drives. The drive designations are established by the software (in particular, the CP/M system you are using), so they are changeable.

The drive designations for the floppy drives and hard disk **will change** after you boot from the hard disk. All you need to do is use the drive designations in the second line of the sign-on message. Once your Decision is installed, you will be using the hard disk most of the time, and your drive designations won't be changing any more.

5.3.2 Bringing Up CP/M

NOTE:

Be sure you have read the previous sections (5.2.1 through 5.3.1) before proceeding with this section.

1. Insert the 48K CP/M boot diskette in the floppy disk drive (Drive A). Make sure that the system power is ON! (Panel next to keyswitch is lighted).
2. Close the disk drive door.
3. Turn the keyswitch to the RESET (full clockwise) position; allow the key to return to the center position.

4. Note the red light on the front of the floppy disk drive. It should turn on. If it does **not** turn on, turn the key to the RESET position again.
5. As soon as the red light turns on, you will hear a slight mechanical noise, and then the following message will be displayed on your video terminal:

**MORROW DESIGNS 48K CP/M 2.2 E4
AB:DJDMA 5 1/4", CD:HDCDMA M10, EF:DJDMA 8"**

A>

This message means that you are now in CP/M. The top line of this message is called the "System Header". The second line describes the system configuration (Drive A is the 5 1/4 inch floppy disk drive, addressed by the DJDMA controller; Drives C and D are the hard disk drive, addressed by the HDC/DMA controller). The last line of this sign-on message is the CP/M (A>) prompt, indicating you have successfully booted your floppy disk system.

If the red light came on, your drive made noises, but nothing appeared on your screen, check your terminal hook-up (Section 4.2). If some letters appeared, but they were jumbled garbage, your terminal is set to the wrong baud rate. Change it to 9600 baud.

6. Type:

DIR <CR>

This command instructs the Decision to display a disk directory, listing all of the files stored on your CP/M boot diskette. Once the directory is displayed, the CP/M prompt is once again displayed. This feature of CP/M is discussed further in Section 7.2.

Now that you have successfully booted your Decision, you are "up and running". You are ready for Section 6, which discusses the hard disk drive installed in your system.

6. HARD DISK CHECK-OUT AND BOOT PROCEDURES

6.1 Overview

The hard disk drive installed in your system is either a 10 megabyte or 16 megabyte drive. A 10 megabyte drive allows you to store ten million characters; 16 megabyte drives have a storage capacity of 16 million characters. This is quite a bit more than the 300,000 character storage capacity of a 5-1/4 inch floppy disk drive!

While CP/M views the floppy disk drive as one drive, it sees the hard disk drive as two logical drives. If you followed the steps outlined in Section 5.3, Booting the System, you would have noticed that the floppy drive is labeled by CP/M as the "A" drive; the hard disk drive is seen as Drives C and D. This is because CP/M **can't handle** drives larger than 8 megabytes!

If your Decision was configured with a 16 megabyte hard disk drive, you have 8 megabytes of available storage on each logical drive. Systems with a 10 megabyte hard drive, however, do not divide the hard drive storage capacity equally; the first logical drive (in this case, Drive C) has 8 megabytes of storage capacity, and the second (Drive D) has 2 megabytes. This is because some software applications expect to have 8 megabytes of storage on a drive.

We previously discussed booting your system from the floppy disk. In Section 6.3, we will supply the procedure to boot from the hard disk. This will verify that the hard disk is indeed operational, and that you can begin copying the applications software provided onto your hard disk.

Unlike floppy disks which are inserted and removed from the floppy disk drive, the hard disk is "fixed". It cannot be easily removed, and should never be disconnected unless it is necessary to send it to an authorized service organization for maintenance. Data stored on the hard disk may be copied onto floppy disks so that you always have a back-up of the important files on your hard disk. This process is discussed in Section 8.

When the Decision is shipped from the factory, the hard disk drive is pre-formatted (ready for use). Morrow has also copied the CP/M operating system on this disk so that it can be used for both booting the system and for storing your data files. Before using the hard disk drive though, you should perform a simple check-out procedure to make sure that the disk drive was not damaged in transit. This check will also verify that all of the system files are resident on the hard disk, and that all files have been transferred accurately. This process is discussed in the following section.

6.2 Hard Disk Check-Out

Once you have read the previous sections on system start-up from floppy disk, you are ready to check the hard disk for proper operation. The program "CHECK.COM" is stored on your CP/M boot diskette (see Section 5.3.1), and will be used to perform this check-out task.

1. Boot the Decision from the floppy boot diskette as described in Section 5.3.2.
2. Type:

CHECK <CR>

A menu will appear on the screen, prompting you to enter the drive number, drive type and format.

3. Select Drive 0, M10 and CP/M when prompted from the menu, unless you don't have a 10 megabyte hard disk. If your hard disk is different, select the appropriate drive name.
4. The hard disk will now be subjected to a verification process. It will be checked for formatting errors, bad sectors (see Appendix D), and overall disk drive performance.
5. After a couple of minutes, the check-out program will complete its verification. If errors were not encountered, the following message will be displayed:

NO UNREADABLE SECTORS FOUND

followed by the CP/M prompt (A>). The return of this message and prompt indicates that the hard disk is now up and running. You should now proceed to Section 6.3 for instructions on booting from the hard disk.

5. If the terminal displays error messages on the screen, there is a problem with your hard disk. If the CHECK program discovers as many as 15 **soft errors**, your hard disk is probably okay, so you can proceed with section 6.3. If it has any **hard errors**, it cannot be used until you have reformatted it and recopied the CP/M operating system from the floppy disk. Details on this procedure are included in Appendix D.

6.3 Booting CP/M from the Hard Disk

Booting the system from the floppy disk was covered in Section 5.3.2. If you have not done so already, return to this section and follow the instructions there. You must boot from the floppy disk before proceeding to this section.

1. From the CP/M prompt (A>), type:

BOOTMW <CR>

2. If the system has just been powered on, there will be a slight delay. The hard disk performs a 5-30 second warm up/diagnostic when power is first applied. Subsequent BOOTMW commands should not result in any further delays.
3. The system header and the drive addresses for your hard disk drive will appear, followed by the CP/M prompt:

Morrow Designs 64K CP/M 2.2 E4
AB:HDCDMA M10, CD: DJ/DMA 5 1/4", EF: DJ/DMA 8"

A>

Note that the drive addresses are different from those displayed during the boot from floppy diskette. The hard disk drive is now Drives A and B; the floppy disk drive is Drive C.

3. When the new system header appears on your terminal, you have successfully booted your system from the hard disk. You are ready to proceed to Section 8, which will tell you how to copy the applications software programs from the floppy diskettes onto your hard disk. Section 8 will also provide instructions for making back-up copies of your files.

NOTE:

Although you are ready to begin work with programs such as NewWord, we suggest that you continue reading this section and Sections 7 and 8 before installing your applications software. The information following in this section covers performing a system "soft" reset ("warm boot") and the instructions for performing an automatic hard disk boot. A general understanding of CP/M and the PIP utility are also very important; these topics are covered in Sections 7 and 8 respectively.

The DOWN command has been provided for parking the heads of the hard disk. Before powering down your Decision, type DOWN to prepare the hard disk. Then you can safely turn the Decision off. There is more information on DOWN at the end of Chapter 6.

6.4 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 get out of a program gone awry and should always be done after changing diskettes. 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.

6.5 Automatic Hard Disk Boot

An automatic boot from the hard disk means that the Decision will automatically read the operating system from the hard disk rather than the floppy whenever the system is RESET. Drives A and B will become the hard disk drive, and Drive C will be the floppy disk drive. An automatic boot from the hard disk is not required, but is advantageous. If, when you turn on the Decision, you are automatically "logged on" or communicating with the hard disk, you have considerably better performance regarding storage and speed than you do with the floppy disk drive. As mentioned in Section 6.1, the hard disk drive provides far more data storage capability than the floppy disk. It also accesses your files and system programs much faster than the floppy disk is able to. Once you have used your hard disk, chances are you will only use your floppy disk drive as a tool to make back-up copies of the files you have created or modified on the hard disk.

To configure your Decision for an automatic hard disk boot, you need to change the switch settings on the MPZ80 CPU board and alter two jumpers on the DJDMA board (see Section 11.10). These switches and jumpers are set at the factory to automatically boot the operating system from the floppy disk drive at power-on. After you change the switch and jumper settings, your Decision will (at power on) read the firmware contained in the monitor PROM. This means that at power-on, the Decision will "read" the instructions programmed in a chip on the CPU board, and "know" that it is supposed to bring up CP/M from the hard disk. For more technical details and instructions refer to Section 11.10 and/or the MPZ80 CPU Technical Manual contained in the Decision technical binder.

6.6 Booting From the Monitor Prompt

The Decision has a built-in monitor program for system testing. Systems may start up in the monitor program, indicated by a ":FFFF" prompt instead of the "A>" prompt. The Decision is shipped to boot up CP/M without going through the monitor; if, however, Paddle 6 of Switch 16D on the MPZ80 board has been inadvertently switched "On", the computer will come up in a monitor program. If this occurs, enter a B (for boot) after this prompt. The system should automatically come up. 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.

If the computer displays any message other than ":FFFF", refer to the Troubleshooting Guide in Section 12.

6.7 Turning Off the Decision

There is a program that prepares the Decision for power down. This program, named DOWN, moves the heads of the hard disk to a safe position. If you have more than one hard disk, the heads of any hard disk that have been accessed will also be moved to a safe position.

A "safe" position is the last cylinder that will be used on your hard disk. If your hard disk is jarred while being moved, or glitches during power-down, the errors will be on the cylinder considered the least important. Without DOWN, the heads would most likely be positioned over the directory cylinder, the most important place on the disk. **Always use DOWN before turning off your Decision.**

A>DOWN

The DOWN command uses no arguments. It simply parks the heads, and halts CP/M. When DOWN has finished, you will be told that it is now safe to turn off your system.

7. AN INTRODUCTION TO CP/M

7.1 General Information

CP/M is the link between the Decision hardware and the application software (NewWord, LogiCalc, etc.). It 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 data from one device to another. A general understanding of this operating system will simplify operation of your Decision, and the CP/M utilities will enable you to create and maintain copies of the valuable data you will store on disk.

This section of your manual will introduce you to CP/M, the programs stored on the CP/M diskette, and explain some of the rules or conventions established by Digital Research (the creators and distributors of CP/M). It is very limited in detail, however; you are encouraged to read the CP/M 2.2 Operating System User Reference Manual provided with your Decision for a more complete introduction. The CP/M manual offers a good, thorough, but highly technical description of CP/M. For a more fundamental or tutorial guide to CP/M, check your local bookstore. Several good beginner's guides to CP/M are available, some of which are listed in Appendix A.4, Recommended Reading.

7.2 The CP/M Disk Directory

Several files that are stored on the system diskette will be used frequently; others may not be used at all, or their function may not be apparent to the user. To display the names of the files stored on the CP/M diskette, boot the system and type (after the CP/M prompt):

DIR <CR>

A typical CP/M system directory might look like this:

```
A:  MOVCPM   COM :  ASM      COM :  DDT      COM :  DUMP   COM
A:  ED      COM :  LOAD     COM :  PIP      COM :  STAT   COM
A:  SUBMIT  COM :  SYSGEN  DOC :  XSUB   DOC :  MBASIC COM
A:  MOVCPM10 COM :  BOOTMW  DOC :  FORMATMW COM :  DOWN   COM
A:  CHECK   COM :  BAUD     COM :  SWAP   COM :  FDJ    COM
A:  E4      DOC :  FORMATMW DOC :  PILOT  COM :  RAMCHK1 COM
A:  BAUD    DOC
```

The "A:" displayed as the first characters of each line in the preceding example indicates that the files are stored on Drive A. Each name listed represents a "file" or data that is stored on your diskette.

7.3 CP/M File Naming Conventions

Files have two parts: one part is the actual filename and the other part is the filename extension. The filename is always the first few characters of the entire name. CP/M limits this part of the file name to eight characters. Following the filename is a period (.) and then a three character extension. The extension describes the type of file that the filename represents. Note that the DIR command does not display the period (.) as a part of the file. In the directory listing shown on the previous page, "PIP COM" represents the file PIP.COM. The filename is PIP, the period is replaced with spaces, and COM is the extension.

You can do yourself a real favor by carefully choosing filenames so that they can be grouped together. For example, using the same three letters as the beginning of a group of files allows you to copy all these files with a single PIP command (Section 8.4). In the same way, using the same extension for a type of file, for example, .DOC for text files, .ASM for assembly language source files, allows PIP to copy these files with a single command.

7.4 CP/M File Types

All entries with the "COM" extension are programs which may be executed by simply typing their name (the part of the file preceding the period). The entries with the "DOC" extension are documentation files. They contain an explanation of the command that shares the same file name. Look at the directory displayed for Drive A. Notice the files BAUD.COM and BAUD.DOC. BAUD.DOC contains information about the program BAUD.COM. If you want to examine the text of this or any other "DOC" file, you can use the CP/M utility "TYPE" (see the CP/M User Reference Manual for specific instructions and details on this utility). For example, type:

```
TYPE BAUD.DOC <CR>
```

The contents of the file BAUD.DOC will be displayed on your video terminal. It will appear at the rate of 960 characters per second; to stop the text from scrolling off the screen faster than you can read it, press the CTRL key on your keyboard while typing the letter S. The CTRL and S keys must be held down simultaneously. To cause the scrolling to begin again, type the CTRL S sequence again.

The entries with the "ASM" extension are ASSEMBLY files. They contain listings of some of the programs on the diskette. These files are used by Assembly language programmers only.

Appendix A lists and summarizes all of the commands/programs/files stored on your system diskette.

8. COPYING FILES

8.1 General Information

In this section we will discuss how to transfer files from one disk to another, so that you have what are called "back-ups". It is extremely important to back-up (copy) any file or program that is valuable to you. If you only have one copy of a file, and something happens to the disk it is stored on, you may be unable to edit, print, read or copy that particular file. Taking a few minutes at the end of each day to back-up your work is far less time consuming than typing it in all over again!

Two CP/M programs are used to make back up copies of your diskettes:

1. PIP Copies nonsystem files from one drive to another.
2. SYSGEN 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 Section 1.6.4 of the CP/M User Reference Manual included with your system to become familiar with this important procedure. Appendix A of this manual summarizes the information provided in the CP/M documentation.

8.2 Copying Individual 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 to be copied 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 C:=A:CBIOS.ASM[V]
```

This line tells PIP to copy the CBIOS.ASM file on Drive A to Drive C and verify the copy it makes. In this way, you can back up an individual file on the hard disk to a floppy disk.

8.3 Copying Several Different Files

If you want to copy several files from one drive to another, it is often more convenient to enter the PIP mode. To enter this mode, make sure the CP/M prompt (A>) is displayed on your screen. Type:

```
PIP <CR>
```

PIP will respond by displaying an asterisk (*) on the screen. The asterisk is the PIP command line prompt. It allows you to enter a series of PIP commands (see Section 1.6.4 of the CP/M User Reference Manual). To exit this mode, enter a Control C or a carriage return (<CR>).

8.4 Copying Several "Common" Files

File matching symbols, or "wildcards" are incorporated in the PIP program to help make the copying process much simpler. It is through use of these wildcards that you can copy all ".COM" files, for example, from one disk to another, without entering each of their file names. This feature is also detailed in Section 1.6.4 of the CP/M User Reference Manual.

Remember how we suggested that you choose your names carefully? Well, this is where naming comes in. If you are working on a large project and you were clever enough to begin the names of all the files with the letters "PRO", for example, you can copy all these files with one command by typing

```
PIP C:=A:PRO*.*
```

This allows you copy any file whose name begins with "PRO" with a single instruction. If you had been editing several files in this group, this command would copy them to your backup diskette simply and easily.

In the same way, you can copy all your ".COM" files with a single command with the line

```
PIP C:=A:*.COM
```

Since CP/M does not provide an easy way of selecting files for backup, choosing names as a method of grouping will make backups easier.

A Note on Backups

If you don't back up your hard disk, no one else will. We can't force you to make backup copies of everything worth anything; and we can't bring back lost files either. If you lose a file, please be aware that we warned you about the importance of backups. If you lose a file, whether by accident or hardware malfunction, there's nothing the folks at Morrow can do to restore it. Keep at least one backup on a diskette of every file you don't want to retype (or repurchase).

8.5 Copying the Applications Software Diskettes

Now that you are familiar with PIP and how it works, you are ready to copy some of the software distribution diskettes onto your hard disk.

1. Boot the system from the hard disk.
2. Insert the NewWord (or other application package) diskette in floppy disk Drive C. It should be WRITE-PROTECTED (notch covered).

NOTE:

DO NOT COPY THE PERSONAL PEARL DISKETTES (Distribution Diskettes #4-#6). The programs on these diskettes will be copied as a part of the Personal Pearl installation process.

3. At the CP/M prompt (A>), type:

PIP A:=C:*. *[V] <CR>

4. This command will cause PIP to copy onto Drive A (the hard disk drive) all of the files contained on Drive C and verify each copy it makes. The filename and extension of each file being copied will be displayed on the screen. When all files have been transferred to the hard disk, the CP/M prompt will be displayed.
5. Remove the diskette presently in Drive C, and replace it with the next software distribution diskette you wish to copy.
6. Type a Control C.
7. Repeat Steps 3-6 for each diskette you want to copy onto your hard drive.

8.6 Minimum Hard Disk System Requirements

As mentioned in Section 6.1, the 10 megabyte hard disk drive is divided by CP/M into two logical drives. Drive A has eight megabytes of disk storage, Drive B has two megabytes. You will notice that programs stored on many of the Distribution Diskettes will occupy a large amount of space on your disk (use the STAT command explained in Section 1.6.1 of the CP/M User Reference Manual to determine the amount of space left on your hard disk drive). If you are inclined to erase some of the CP/M programs to ensure that you have ample room on your hard disk, you can do so, but make sure that the following files **are not** erased!

MOVCPM10.COM	MOVCPM.COM
FDJ.COM	SYSGEN.COM
STAT.COM	PIP.COM
BAUD.COM	CHECK.COM
BAUD.DOC	DDT.COM
SWAP.COM	

These files are essential for a minimum hard disk system.

8.7 Using SYSGEN to Back Up the System Diskette

The SYSGEN program copies the CP/M operating system onto another drive. It does not transfer CP/M programs like STAT.COM to another drive, however. In order to make a back up copy of the system diskette, both SYSGEN and PIP must be used.

1. Boot the system from the hard disk (see Section 6.3).
2. Put the CP/M boot diskette in Drive C (floppy drive).
3. Type:

SYSGEN <CR>

The following appears:

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

4. Enter the drive address containing the operating system (C) and press the RETURN key. SYSGEN then prompts:

Source on C, then type return

5. Press the RETURN key. The floppy disk drive light will turn on and then SYSGEN prompts:

Destination drive name (Or return to warm boot)

6. Place a blank, formatted, write-enabled diskette in floppy disk Drive C (see Section 10 for details on formatting floppy diskettes).

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

Destination on C, 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. The floppy disk drive light will go on and the final SYSGEN prompt will be displayed:

Function complete.

Destination drive name (or return to warm boot)

8. 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.
9. Enter:

PIP C:=A:*.COM[V] <CR>

In this command line, the file name specified by "*.COM" makes use of PIP's "wildcard" feature (see Appendix A and Section 1.6.4 of the CP/M User Reference Manual). In this case, all COM type files on the source diskette are matched, telling PIP to copy over all COM files on the hard disk to the diskette in Drive C.

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.

9. APPLICATION SOFTWARE

9.1 Overview

The application software supplied with your Decision allows you to perform more specialized types of tasks, like BASIC programming, word processing, text file "proofreading", data base management and spread sheet analysis. Morrow supplies the following packages with each Decision:

- MBASIC A Basic language interpreter developed by Microsoft. This has become the industry standard for CP/M-based Basic languages.
- OBASIC An extended precision version of the MBASIC interpreter program.
- NEWWORD Advanced-capability word processing software. This program allows users to create, edit, print and/or store documents, letters, etc.
- CORRECT-IT Compares the text you have created (using NewWord or another editor) to a 36,000 word dictionary for correct spelling.
- LOGICALC An "electronic spread sheet" program to help you answer the "what if" questions common in business management and planning.
- PEARL The Personal Pearl Database Management System. This program will help you keep track of records, accounts and other types of information. It can help you generate forms to handle your information, and will also generate a variety of reports.

9.2 Copying Application Software to the Hard Disk

This procedure was discussed in Section 8.5, but we will provide the command format here, once again, for easy reference: After booting from the hard disk, type:

```
PIP A:=C:*. * <CR>
```

Be sure you have run the CHECK.COM program discussed in Section 6.2 before copying any data on your hard disk!! Also note that the Personal Pearl diskettes should **not** be copied prior to installing this package (see Section 9.4.3).

9.3 Verifying the New Directory Entries

Each application package is made up of several individual files. Once you have copied the application software diskettes to the hard disk, you should verify that all of the files making up the packages appear in the hard disk directory. Table 9-1 provides a listing of these individual files, which are necessary for the proper operation of each application software package. Files that make up Personal Pearl have been intentionally omitted. You will verify the transfer of these files as a part of the Personal Pearl installation process (see Section 9.4.3).

Table 9-1: Files Comprising Application Software Packages

MBASIC	NEWWORD	CORRECT-IT	LOGICALC
MBASIC.COM	NWU.COM	AUXDICT.TXT	BALSHEET.LCF
OBASIC.COM	NWINSTAL.COM	CORRECT.COM	LC.COM
RANTEST.BAS	NWMSG.S.OVR	CORRECT.DOC	LC.OVL
	NWPRINT.OVR	DICT.BIN	LCDUMP.COM
	SAMPLE1.DOC	DICTEDIT.COM	LCDUMP.OVL
	SAMPLE2.DOC	DINDEX.BIN	LCMASK.MSK
	PRACTICE.DOC	EMPTYDIC.BIN	LCSET.COM
		FIXUP.COM	LCSET.DAT
		LOOKUP.COM	LCSET.OVL

9.4 Installing the Application Software

Some of the application software packages must be "installed" for your particular hardware environment, once they have been copied onto your hard disk. This process prepares your applications software for operation on the Decision and the video terminal you will be using. Installation of NewWord, Personal Pearl and LogiCalc is discussed in the subsections following. MBASIC, OBASIC, and CORRECT-IT do not require special installation procedures.

9.4.1 NewWord

The program NWINSTAL.COM is provided to enable you to install NewWord.

1. From the CP/M prompt, type:

NWINSTAL <CR>

2. The installation process will begin; prompts requiring response from the keyboard and a menu of options available to you will be displayed on your screen. When making your selections, enter the letter or number that corresponds to the desired option.
3. The first prompt asks for the name of the file to install. If this is the first installation, as opposed to a modification of an already installed file, respond:

NWU <CR>

If you are modifying an installed version, give its name instead (see step 4 below).

4. Then you are asked to name a file to hold the installed NewWord. This will be the command you type later when you want to run NewWord. The typical response would be NW. However, you can install NWU.COM several times to create various versions of NewWord that work with different terminals, printers, and other features. In this case, each version must have a distinct name. In the normal situation of a single installed version, respond:

NW <CR>

5. You are then presented a list of installation options, like terminals, printers, and so on. Start with terminals. Type:

A

6. The list you pick from has many popular terminals, including those marketed by Morrow. Your terminal should be in this list, or should be able to emulate one that is. If so, type its letter. If not, select **K Minimum**. You may not get optimum performance with this selection, and it may not work right at all, but this is the way to start. Later, you can use the "Special Patches" section of NWINSTAL to enhance NewWord's use of your terminal's capabilities. Refer to Appendix B in the NewWord Encyclopedia for instructions.

When you have typed your selection and verified that you made no mistake, enter:

N

7. NWINSTAL's Main Menu returns. You can really quit at this point, since the rest of the options have default settings that will handle most situations. You may, however, wish to select a non-default printer before leaving the program.

The default ("draft") printer driver will not perform certain special functions, like bidirectional print or sub/super-scripting. If you have a printer capable of these (especially a letter-quality printer), select **B Printers** and see if the printer menu lists your printer or an equivalent.

If so, select its letter. If not, select **X** to return to the Main Menu.

8. Unless you have studied the NewWord manual for installation details and you have other modifications to make, you can now quit by selecting **X End of Installation** at the Main Menu.

The pertinent areas of the NewWord manual are the Appendices to the Encyclopedia, Chapter 2 of Do-It-Yourself, and Nuts and Bolts.

From this point forward, NewWord will be configured for your present terminal and printer environment. Whenever you want to enter the NewWord program, simply type:

NW <CR>

from the CP/M prompt, (or another name if you didn't use "NW") and the program will begin execution. Note that the following programs must be reside on the disk for NewWord to function properly:

NW.COM NWMSG.S.OVR NWPRINT.OVR SAMPLE1.DOC SAMPLE2.DOC
PRACTICE.DOC NWU.COM NWINSTAL.COM

9.4.2 LogiCalc

The program LCSET.COM is used to install LogiCalc for use with your hardware environment. The procedure for executing this program is explained below:

1. From the CP/M prompt, enter:

LCSET <CR>

2. The program will ask if this is a first-time installation. Since it is, enter:

Y

3. The program will then ask for type of terminal you will be using with Logicalc. If you are using a Morrow MD20 or MD50 terminal, enter:

B

and then select the terminal model. If you are not using an MD20 or MD50 terminal, select the option that matches your terminal. If your terminal is not listed in the menu, select the option that closely resembles your terminal, and then refer to Appendix B of the LogiCalc manual.

4. The CP/M prompt will appear, once you have responded to the prompt for terminal type. Now enter:

DIR <CR>

Verify that the files TERMCAP.SYS and LC.COM are on your working drive; they must be resident there for LogiCalc to operate properly.

5. Now type:

LC <CR>

LogiCalc will begin executing.

9.4.3 Personal Pearl

Personal Pearl is a powerful data base management system. The entire package is distributed on three diskettes (Volumes 4-6) which were supplied with your Decision. It is extremely important that you read Chapters 1 and 2 of the Personal Pearl manual before continuing with the installation procedure outlined below.

Installation of Personal Pearl is a little more involved than that for NewWord and LogiCalc, mainly because of the size and complexity of the package.

Personal Pearl requires approximately 700K of storage. It is configured to reside on Drive A, so you must boot from the hard disk before proceeding. (See Section 6.3)

1. Insert Distribution Diskette #4 in the floppy disk drive.
2. Type:

C: <CR>

followed by:

WELCOME <CR>

A terminal selection menu will then be displayed on the screen.

3. Select the name of the terminal which is to be used with Personal Pearl. If you are using a Morrow Model MD20 terminal, select option 31. If you are using an MD50, select option 30.
4. Once you have made your terminal selection, type:

<CR>

There will be a brief delay, and then the Personal Pearl "Welcome Logo" will be displayed on your screen. After another brief pause, the program will print the Welcome Services Menu.

5. You have two options at this point: you can request a demonstration of the Personal Pearl program which will highlight some of Pearl's numerous features, or you can personalize the package; this option will allow you to copy your master floppy diskettes onto your hard disk. Enter:

P <CR>

6. The Personal Pearl "Getting Underway" menu will be displayed on your screen. From this menu you are able to:

Step 1	Make working copies
Step 2	Personalize working copies
Step 3	Verify program files (optional)
Step 4	Change terminal or system configuration (optional)

You will be making working copies, so type:

1 <CR>

7. A working copy menu will then be displayed. The options presented are: 1 for floppy disk and 2 for hard disk configurations. Select the hard disk by typing:

2 <CR>

8. Following this menu, two more explanatory screens will be displayed. They will prompt you to enter a carriage return <CR> after you are finished reading them.
9. Once that process is complete, all of the Personal Pearl files from Distribution Diskette #4 will be copied onto the hard disk. The name of each file will be printed as it is copied. When the contents of Distribution Diskette #4 has been transferred onto the hard disk, the Welcome program will prompt you to insert Distribution Diskette #5, and then #6. All of the following files will now be resident on your hard disk (which at this point must be Drive A).

Table 9-2: Distribution Diskette #4, Personal Pearl, Disk 1 of 3

CALENDR.D00	CALENDR.DIR	CALENDR.E00	CALENDR.100
CALENDR.S00	CASH.DOC	CASH.DIR	CASH.E00
CASH.100	CASH.200	DAILY.M00	DAILY.R00
DEDUCT.M00	DEDUCT.R00	DIARY.M00	DIARY.R00
EXPENSE.M00	EXPENSE.R00	HISTORY.M00	HISTORY.R00
INSTALL.DAT	JOURNAL.M00	JOURNAL.R00	LABELS.M00
LABELS.R00	LEDGER.M00	LEDGER.R00	PEARL.DIR
PEARLFM.COM	PEOPLE.D00	PEOPLE.DIR	PEOPLE.E00
PEOPLE.100	PEOPLE.S00	PHONE.M00	PHONE.R00
PROFILE.M00	PROFILE.R00	PSORT.COM	PSORT.LIB

Table 9-3: Distribution Diskette #5, Personal Pearl, Disk 2 of 3

PEARL.A00	PEARLDF.COM	PEARLDR.COM	PEARLED.LIB
PEARLFM.LIB	PEARLPR.COM	PRLHELP.TXT	

Table 9-4: Distribution Diskette #6, Personal Pearl, Disk 3 of 3

PEARLDF.LIB	PEARLDR.LIB	PEARLED.COM	PEARLI.COM
PEARLI.LIB	PEARLPR.LIB	MAKELCF.COM	

10. Once the copying process is complete, the Welcome program will instruct you to reboot your system and log onto the drive which will be your working Pearl drive. This will be Drive A, the hard disk drive.
11. Locate the CP/M Boot diskette. Insert it in the floppy disk drive and close the disk drive door (latch).
12. Turn the keyswitch to the right (RESET). The following prompt will appear:

**Morrow Designs 48K CP/M 2.2
AB:DJ/DMA 5 1/4", CD:HDC/DMA M10, EF:DJ/DMA 8"**

A>

13. After the CP/M sign on message (system header) appears, type:

BOOTMW <CR>

14. Once the CP/M sign on message and prompt appear, type:

WELCOME <CR>

15. The Pearl Welcome program will begin execution again. As explained in the previous steps, select the terminal that you will be using with the software. Enter your selection and press <CR>.
16. After a short delay, the "Welcome Logo" will again appear on the screen, followed by the options presented in Step 6 of this procedure. Enter:

P <CR>

17. From the "Getting Underway" menu displayed on your screen, select Option 2. From this point forward, respond to the screen prompts. When prompted, type the name you wish to appear in your personalized copies of Pearl (either your name or business name) and press <CR>. Your files will then be personalized by the program, and you will be returned to the "Getting Underway" menu when this process is complete.

18. At this point you should have the program verify that all of the Pearl files are resident on the working disk and that they were copied correctly. Type:

3

to select this option from the "Getting Underway" screen. The program will then prompt you for the files you want to verify. Enter:

W

to indicate the working disk. Then select the drive. Type:

A

19. Once the verification process is complete, Personal Pearl is installed and ready to be used. Continue pressing the key marked ESC (the Escape key) on your keyboard until the Welcome program returns you to the CP/M prompt (approximately four screens will be displayed in the process).

NOTE:

Pressing the ESC key (while in the Personal Pearl program) will always return you to the previously displayed menu.

To become familiar with all of Personal Pearl's features, and begin using this powerful package, you should now complete the tutorial in Chapter 3 of the Personal Pearl User Reference Manual.

10. FORMATTING FLOPPY DISKS

10.1 General Information

All valuable information stored on disk should have a duplicate or back-up copy on a different disk. New diskettes, however, must be prepared before using them with your Decision. This preparation is called formatting, and ensures that CP/M will be able to read your new diskettes.

Data is stored on floppy diskettes in predetermined "blocks". These blocks 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's 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. Diskettes must be write-enabled before the formatting process can occur. If a write-protected diskette is placed in the drive to be formatted, an error message will be displayed.

You can "recycle" old disks by formatting them. Formatting erases EVERYTHING on a diskette though, so you should be absolutely sure that you no longer need ANY of the data stored on a diskette before reformatting it.

NOTE:

NEVER REFORMAT the CP/M or SOFTWARE DISTRIBUTION DISKETTES provided with your Decision.

A more technical explanation of the formatting process (for those of you who are interested) is provided below:

Formatting writes a sector identification at the beginning of each sector. It initializes every sector with the byte E5 (in hexadecimal notation). FDJ.COM (the Morrow floppy disk formatting program) also writes a configuration byte in the first sector of a 5-1/4 inch hard sectored diskette that labels the diskette with the type of format used.

10.2 FDJ.COM

The name of this program is derived from the fact that it formats disks in drives connected to the DJ/DMA floppy disk controller board (both 8 inch IBM and 5-1/4 inch CP/M-compatible). FDJ.COM comes on your CP/M system diskette, and formats single and double sided diskettes for the Decision and Morrow's version of CP/M.

We will provide general information here about 8 inch diskettes, but since this is not the typical size of drive installed in the standard Decision systems, we will only provide the procedure for formatting the 5-1/4 inch floppy disk. Refer to Section 11.11 if you have an externally connected 8 inch drive.

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

Eight inch diskettes may be formatted for 128, 256, 512 or 1024 byte sectors, depending on the density of the diskette. Single density 8 inch diskettes (IBM 3740 standard) are automatically formatted for 128 byte sectors.

Double density diskettes may be formatted at any of the three remaining choices, but 1024 byte sectors is recommended since it offers the most storage space and is read more quickly by the DJDMA controller. This format also allows the CP/M operating system to boot from the eight inch floppy.

FDJ.COM 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 which of seven standard formats you are interested in. Once that is determined, you will be asked to select a drive number.

FDJ.COM enables you to format your 5-1/4 inch floppy disks so that they are compatible with the Morrow Micro Decision computer. Refer to Table 10-1 for the appropriate responses to the FDJ.COM prompts.

10.3 Formatting Procedure

During the formatting process, the address of the floppy disk drive is different than in operations discussed previously. FDJ.COM addresses floppy disks as 0, 1, 2 and 3, **NOT** A, B, C, D, etc. Keep this in mind when entering the address of the disk drive containing the diskette to be formatted. Only floppy disk drives will be addressed; the first one connected to the controller is addressed as Drive 0. If you only have one drive, it will always be drive 0. An additional 5 1/4" floppy disk drive connected externally to the Decision will be addressed as Drive 1.

If you add one or two 8" drives, they will be numbered drive 0 and drive 1, respectively. The FDJ.COM program does not use the drive number to distinguish between drive types, but uses your format selection to select 5 1/4" or 8" drives. Drives are selected based on whether you chose an 5 inch or 8 inch format, and the way the drive select header is set on any additional drives.

Hard disks connected to the system are not addressed by the program; for instructions on formatting the hard disk drive, refer to Appendix D.

To use the FDJ.COM program, follow these instructions:

1. Insert a write-enabled floppy disk in Drive C (for most systems, this is the only floppy drive), assuming you have booted from the hard disk.
2. At the CP/M prompt, type:

FDJ <CR>

3. CP/M will respond by displaying the format menu on your screen. You will first be prompted to enter the one of the letters to select a format. For the Decision, you would normally enter D for double-sided 5 inch hard sector.

D

4. The next prompt will request the address of the drive containing the disk to be formatted (Drive 0-3). Enter:

0

8. At the prompt to insert a WRITE-ENABLED diskette in Drive 0, press RETURN.
9. 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.
10. If you got a "Drive Not Ready" message, 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.
11. FDJ.COM formats all tracks on the diskette and then goes back and reads the diskette to verify that there are no errors or defects in the media. Track numbers will print on the screen as each track is formatted and verified. The number of the track(s) containing a bad sector, if applicable, will also be displayed.

10.4 FDJ's Menu

FDJ's menu currently provides eight standard format selections. A ninth selection, Do It Yourself, is provided for the daring and technically expert, format-wise. A table of translations of the format selections is provided below:

Table 10-1: FDJ Menu Selections

A) Morrow single sided	MicroDecision soft-sectored, 1024 byte sectors, single sided 40 tracks.
B) Morrow double sided	Same as A), but double sided.
C) Single sided	NorthStar compatible, 35 tracks hard sectored.
D) Double sided	Same as C), but double sided.
E) Morrow Micronix	Same as D), but 40 tracks.
F) CP/M standard single density	26 128 byte sectors, IBM 3740 format.
G) Morrow CP/M double density	8 1024 byte sectors.
H) Morrow Micronix	15 512 byte sectors.
I) Other	Do it yourself.

When formatting 8" diskettes, the drive is capable of distinguishing double-sided from single sided diskettes (or drives). Double-sided 8" diskettes have the index hole (the small hole just outside of the large hole in the center of the disk) in a slightly different position than single sided diskettes. The hole is almost in line with the oblong read-write slot for single sided, and offset a half inch for double sided.

The Other selection lets you pick ALL the formatting parameters. In fact, you must know everything about your desired format for this to work correctly. If you make a mistake in selecting a parameter, FDJ will try to format the diskette anyway, and may not even tell you that your parameters don't work. Use this selection with caution!

10.5 Formatting Errors

If a bad sector/track is found during the FDJ process, the program will return an error to the screen, and indicate the number of the track where the error was found. If a bad sector is found, we recommend you run the diskette through the FDJ.COM program again. If it still fails during the verification portion of the formatting process, throw the diskette away or return it to the store, and format another.

11. RECONFIGURING YOUR DECISION

11.1 Standard Configuration

This section is intended to give you a brief overview of the Decision hardware components. If you are interested in learning more about the Decision hardware, please refer to the technical reference manuals included with your computer.

The Decision architecture conforms to the IEEE 696 standards for S-100 bus board connection. This means that Morrow has adopted an industry standard hardware design, built in hardware memory management, incorporated the latest advancements in disk control technology and designed several user protection features to provide a flexible, powerful and reliable computer system.

The Decision hardware, for the sake of explanation, can be compared to a car body and engine. You needn't know all of the mechanical details to operate a car, but some basics are, obviously, helpful! The basic mechanics of your Decision include:

Wunderbuss I/O Controller	14-slot motherboard with three RS-232 serial ports for connecting terminals or serial printers and one parallel printer port. Serial Port 1 is configured for 9600 baud, Serial Port 2 is not used in a standard CP/M system, and Serial Port 3 is configured for 1200 baud.
DJDMA Floppy Disk Controller Board	Controls the activity of the 5-1/4 floppy disk drive and any additional floppy disk drives connected to the Decision. Up to four 5-1/4" and four 8" drives may be connected to this controller.
HDCDMA Hard Disk Controller Board	Controls the hard disk drive, and any additional hard disk drive connected to the Decision. Up to four drives may be connected.
MPZ80 CPU	Z80A Central Processing Unit.
MM65KS RAM	65k of static RAM (expandable to 1 megabyte of static or dynamic RAM).
5-1/4" Floppy Disk Drive	All Decision systems have a double-sided drive installed.
5-1/4" Winchester-Style Hard Disk Drive	Decision computers are supplied with a 10 megabyte or 16 megabyte drive.

With the exception of the disk drives installed in your system, all Decision hardware components are S-100 modules. This means that they are easily inserted in and removed from any slot on the 14-slot motherboard. This makes system integration, upgrading and maintenance very quick and easy.

11.2 Reconfiguring Your System: General Information

The Decision may be reconfigured to accommodate additional disk drives, terminals and printers that do not operate at the baud rates established for the serial ports, connection of a daisy wheel printer, and an automatic boot from the hard disk. Some of these system modifications will require that you change some switch setting(s) on boards located inside the Decision. If this is the case, please refer to Section 11.7 which explains how to remove the Decision cover, and Section 11.9 for information on removing the S-100 module boards.

NOTE:

If you find it necessary to change the settings on your hardware, make sure you unplug the Decision, and all power is turned off to the Decision before removing any boards.

11.3 Changing the Voltage

A voltage selection switch is located on the Decision rear panel, next to the AC utility outlets. The numbers displayed correspond to the voltage selection.

WARNING:

If it is necessary to change the voltage, make sure the power cord is removed first!

Once you have removed the power cord, flip the voltage selection switch. Verify that voltage selection matches the power requirements of the installation site.

The fuse, installed beneath a black knob near the power cord socket, **must** also be changed. Use

4 amp 250 volt fuse for 230 volt operation

8 amp 250 volt fuse for 115 volt operation

11.4 Changing Serial Port Baud Rates

Serial baud rates on the Wunderbuss I/O controller mother board may be changed through software via the BAUD.COM 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 cold booted (RESET). 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 or change CP/M permanently.

The format for entering this program is as follows:

BAUD [BAUDRATE] [PORT NUMBER]

BAUDRATE 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 <CR>

The Decision can produce any baud rate between 75 and 19200 baud. A clock rate is established by the BAUD program capable of all the standard baud rates, and any strange ones you may desire.

11.5 Installing a Parallel Hytype Printer

11.5.1 Interface Cable Requirements

Installing serial interface printers is discussed in Section 4. This section only covers installation of a Diablo-standard daisy wheel printer that has a parallel interface. A special 50-pin cable is required for connecting this type of printer, and can be purchased from Morrow. Specify part number 060-50722P when ordering.

NOTE:

This section does not apply to Centronics-type printers. If you are installing a Centronics or Centronics-like printer, refer to Section 11.6 for cable requirements.

11.5.2 Cable Connection

1. Connect one end of the special 50-pin cable to the connector located on your printer.
2. Connect the other end of the cable to the Decision rear panel socket labeled DAISY PRINTER. Pin 1 should match up with the leftmost connection of the Decision socket (see Figures 4-1 and 4-3).

11.5.3 Software Modifications and Installation

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 Expansion I/O board and Wunderbuss I/O motherboard, where the console device is connected to Serial Port 1.

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.

The procedure for adding the HYTYPE.PRL driver is explained, step by step, on the next page.

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

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>MOVCPM10 62 * <CR>
```

The following is displayed:

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

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

Enter:

```
A>SYSGEN <CR>
```

which returns the following prompts:

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

4. The source is in memory (from the MOVCPM10), so 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
```

6. 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. Now RESET the computer. It should greet you with a header designating your new system size. As an example:

```
Morrow Designs 62K CP/M 2.2 E4  
AB:HDCDMA M10, CD: DJDMA 5 1/4", EF: DJDMA 8"
```

```
A>
```

8. For a 62K system size, the first available memory location above the system is F800. 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 (always done right after the system is booted).

Type

```
A>INSTALL HYTYPE.PRL F800
```

and the HyType printer driver is part of your CP/M system until you re-boot.

11.5.4 Using INSTALL.COM

INSTALL.COM expects the following command format:

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

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

```
A>INSTALL HYTYPE.PRL F800 <CR>
```

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

11.6 Installing a Centronics Parallel Printer

The Decision is shipped with a 50 pin parallel Diablo printer interface. Morrow offers a conversion kit to convert this port to a 36 pin standard Centronics interface. The kit includes complete installation instructions for converting from Diablo daisy-wheel interface to Centronics, and is available from Morrow (see Appendix C). The part number is 060-500-DTC.

If you want to make your cable, you will need a fifty pin flat cable female connector for one end and a male Centronics connector for the other end. You will need 17 conductors in your cable. The interconnections between the two connectors go like this:

Table 11-1: Daisy-Wheel to Centronics

50 pin flat cable female connector																
2	3	12	13	21	24	26	27	28	33	36	37	39	40	42	43	45
16	12	32	31	1	36	10	11	13	5	3	2	4	6	7	8	9
36 pin male Centronics connector																

Once you have built your cable, (or installed the adapter kit from Morrow), you need to use the SWAP.COM program to exchange your LST: and PUN: devices. Every time you cold boot (RESET) your system, the LST: device is the third serial port and the PUN: device is the Centronics port (after cable conversion). The SWAP program exchanges the two ports, so that programs that send output to the LST: device can work with Centronics printers.

To make the exchange, type

SWAP L

which makes the third serial port the PUN: devices, and the Centronics port the LST: device. Executing the SWAP L command a second time restores things to normal.

After connecting your printer and using SWAP L, you can test your changes by typing Control-P (which toggles on the printer, so all console output is printed), and typing

DIR

Pressing Control-P a second time turns off the "copy console to printer" toggle.

11.7 Removing the Decision Cover

1. DISCONNECT the Decision power cord from the AC power receptacle on the back panel.
2. Locate the four (6 x 32) screws on the base of the computer. Figure 11-1 shows the underside of the computer and the location of these screws.

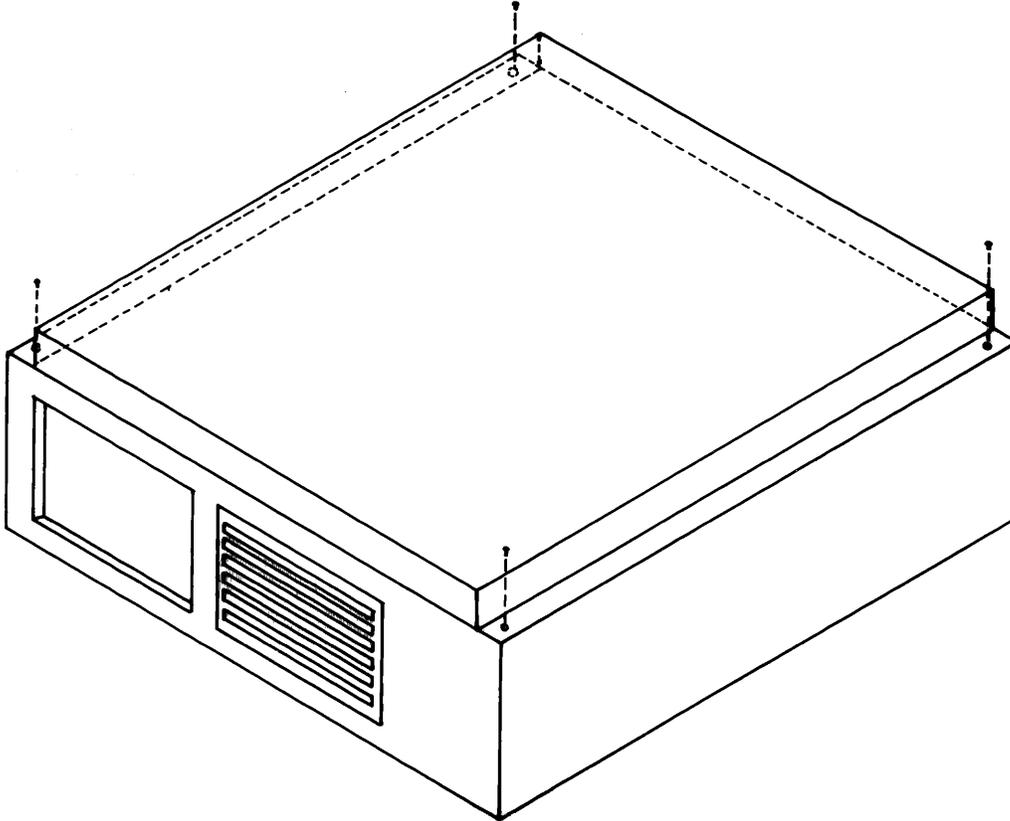


Figure 11-1: Decision Cover Screws

3. Remove the screws and put them in a place where they are not likely to drop into the Decision.
4. Slide the cover toward the front of the computer, and then lift the cover off.

WARNING:

The Decision 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.

11.8 Checking Internal Connections

The Decision is shipped from the factory with all internal connections in place, but sometimes connectors are jarred loose during shipping. If you are unable to successfully power on the Decision after installation, we recommend that you remove the cover (see Section 11.7), check the disk drive connectors, and make sure that the S-100 module boards are securely seated in the motherboard.

The disk drive connectors should be securely connected to the connectors provided on the drive controller boards. Figure 11-2 illustrates proper disk drive cabling.

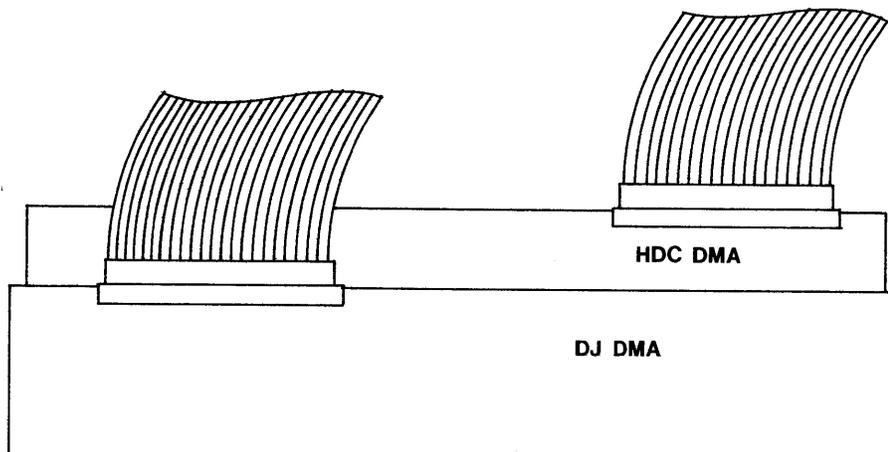


Figure 11-2: Disk Drive Cable Connections

If the cable connection(s) does not appear as in Figure 11-2, remove the cable CAREFULLY. Turn it over and reconnect it. Be careful not to bend any of the pins in the process.

If you continually run into problems with this portion of the installation, refer to the more detailed troubleshooting chart that follows in Section 12 of this manual. If you are satisfied that all connections are made properly, but are still unable to get your system to operate correctly, contact your dealer.

11.9 Removing the S-100 Module Boards

The S-100 module boards (the printed circuit boards you see when you lift off the cover) are secured by a retaining bracket and four screws (see Figure 11-3). To ensure that these boards are properly seated in the 14-slot motherboard, or if you find it necessary to remove one or some of the boards (to enable an automatic hard disk boot, for example), you should follow the procedure outlined below:

1. Make sure all power to the computer is OFF, and that the Decision is unplugged.
2. Remove the Decision cover (see Section 11.7).
3. Remove the four screws holding the retaining brackets and lift the brackets off.

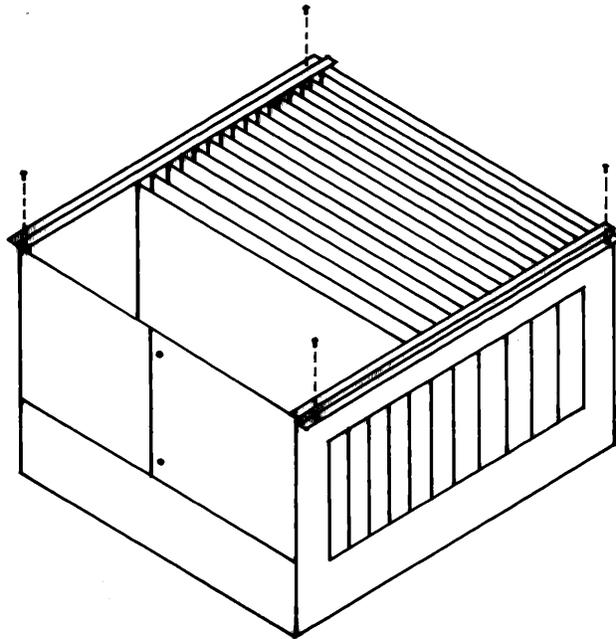


Figure 11-3: Retaining Brackets for S-100 Module Boards

4. Grasp the top corners of the board and carefully pull the desired board out of the motherboard (gently but firmly).
5. When you have finished the hardware reconfiguration, make sure that any disconnected cables have been properly reconnected (see Section 11.8) and the boards are well seated in the appropriate slot of the motherboard.
6. To return the board to the card cage, slide the S-100 module board into any available slot. It need not be the slot from which you removed the board.

7. Reseat the board by gently rocking the board from side to side while firmly pressing down.
8. Return the retaining brackets to their original location (see Figure 11-3).
9. Return the Decision top cover.

11.10 Modifications for Automatic Hard Disk Boot

The automatic hard disk boot was discussed in Section 6.5. If you wish to enable this feature of the Decision, you must change the settings of Switch 16D on the Decision MPZ80 CPU board. This board is illustrated in Figure 11-4; the required switch settings are provided in Figure 11-5. Note that switches are protected by plastic covers; these covers must be removed to change the switch settings, but should be put back on the switch after the changes have been made.

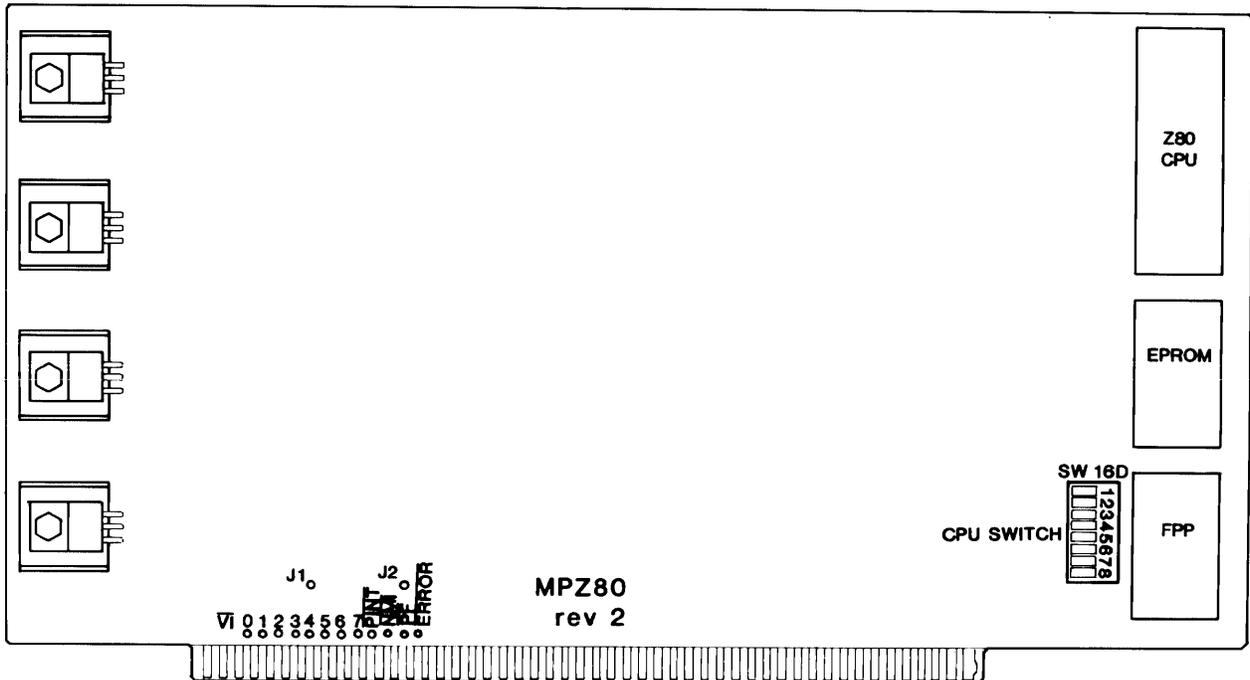
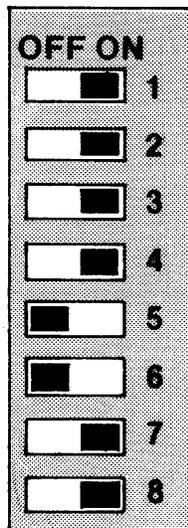


Figure 11-4: Decision MPZ80 CPU Board

NOTE:

When first applying power to the computer, the hard disk performs a 4 second warm up/diagnostic. There will be a slight delay between resetting the system, and the sign-on message that appears. Subsequent resets will immediately display the sign-on message.



To enable an automatic hard disk boot, Paddle 4 must be ON and Paddle 5 must be OFF on the MPZ80 (see Figure 11-5).

The DJDMA board must also be modified to enable an automatic hard disk boot. A shunt must be installed between jumpers A and B at J2 (near bottom of board).

Figure 11-5: Automatic Hard Disk Boot

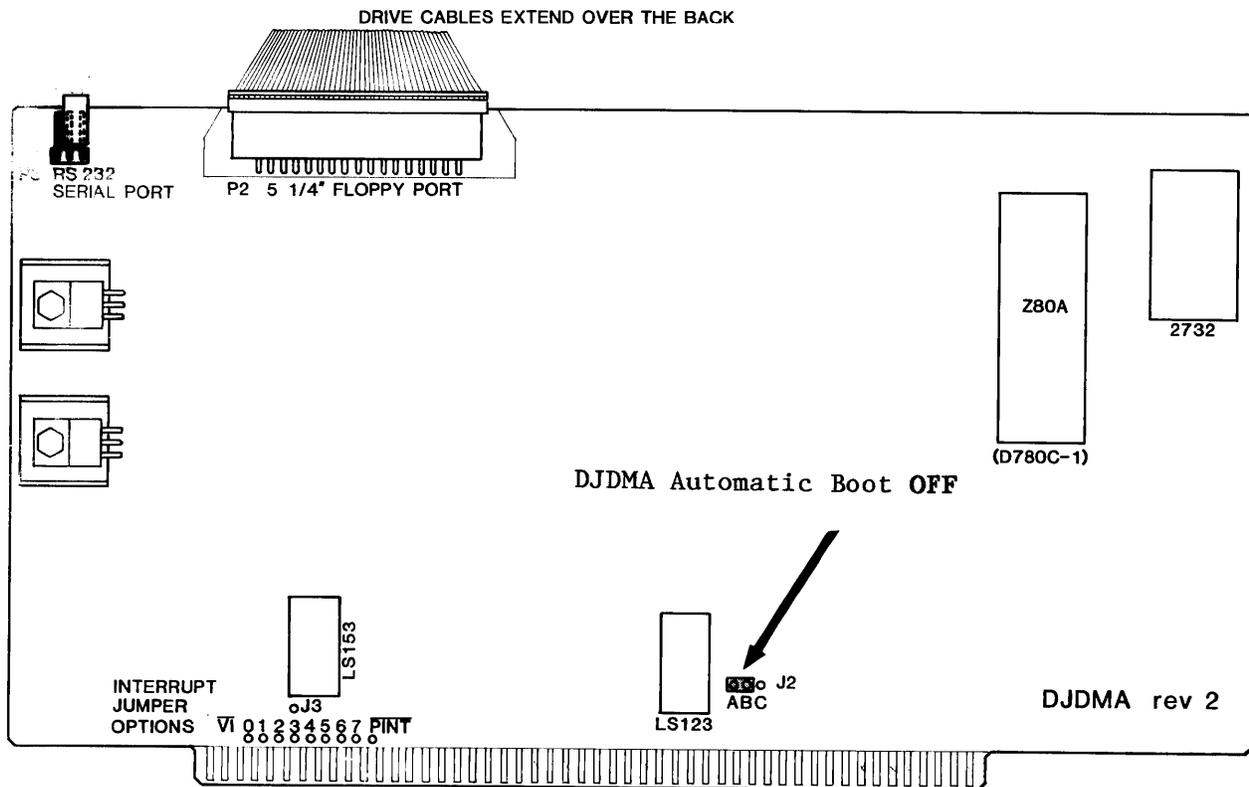


Figure 11-6: DJDMA Board Configured for Automatic Hard Disk Boot

If you decide to return to an automatic floppy disk boot, the board configuration process is reversed. Switch 16D of the MPZ80 CPU board should be set as illustrated in Figure 11-7. Paddle 4 must be OFF and Paddle 5 must be ON.

The DJDMA controller board must also be modified; a shunt must be in place to jumper B to C. The shunt on P3, connecting pins 2 and 3 must be in place.

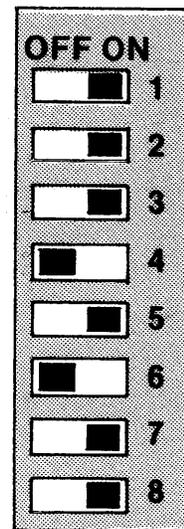


Figure 11-7: Automatic Floppy Disk Boot

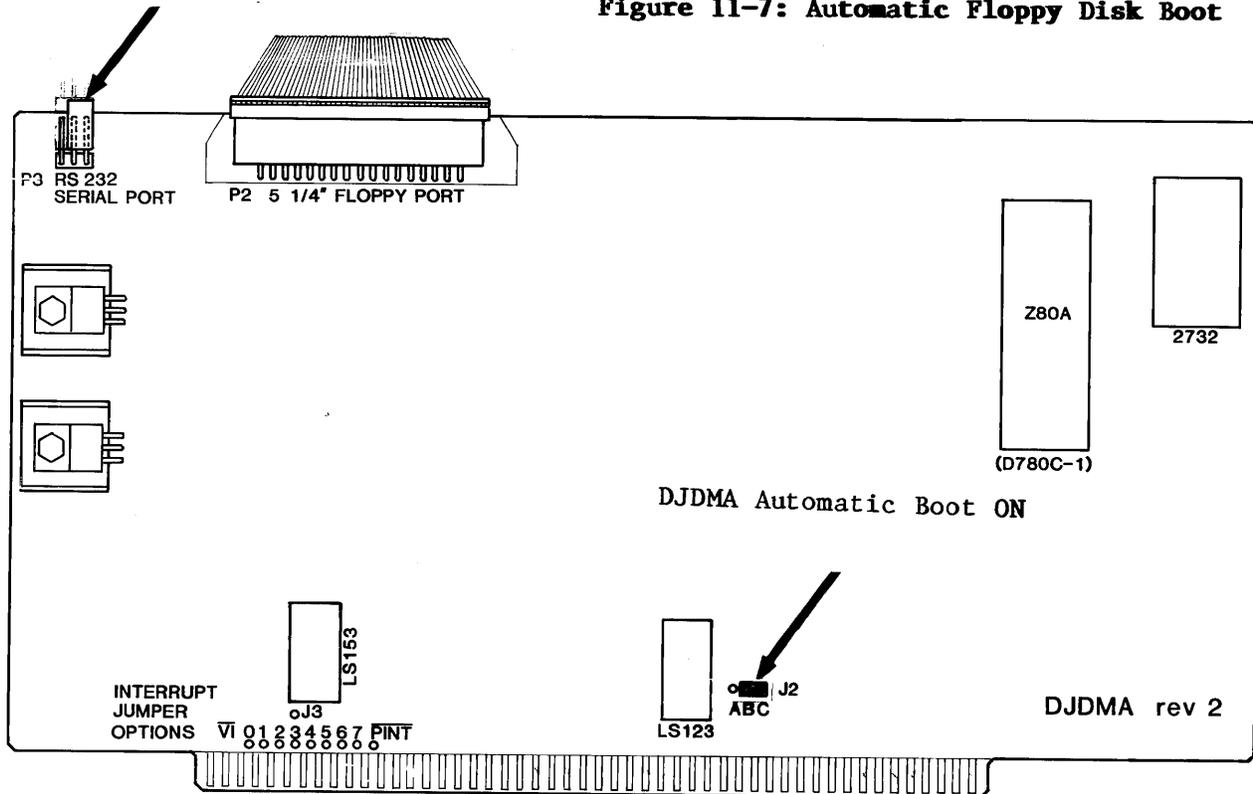


Figure 11-8: DJDMA Board Configured for Automatic Floppy Disk Boot

Refer to the MPZ80 section of the Decision CPU Technical Manual for further details.

11.11 Installing Additional Disk Drives

11.11.1 General Information

Up to four drives of the same type (i.e. four floppy disk drives or four hard disk drives) may be connected to each of the drive controller boards installed in your Decision. This manual, however, will only discuss the addition of one 8 inch floppy disk drive. If you wish to install any other type of drive, refer to the "Add-On" documentation supplied by Morrow with your drive.

11.11.2 Connecting an 8 Inch Floppy Disk Drive

Eight inch floppy disk drives are connected externally, through the 50 pin connector just above the daisy printer connector on the rear panel of the computer. The cable required for this connection is available from Morrow. Specify Morrow part number 060-50782P when ordering.

1. Plug one end of the cable into the Decision rear panel 50 pin connector, just above a similar 50 pin connector for the daisy printer port. The ribbon cable should come out of the bottom of the connector, and the stripe on the cable should be on the left (looked at from the back of the Decision).
2. Plug the other end of the cable into the corresponding pin connector on the back panel of the disk drive. The ribbon cable should come out of the bottom of the connector, and the stripe on the cable will be on the left (looked at from behind the drive).

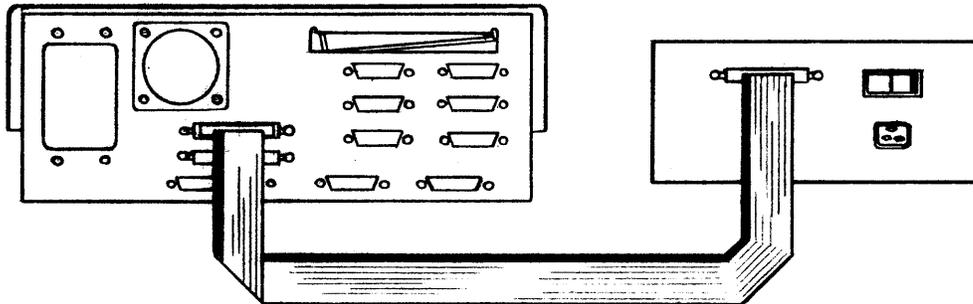


Figure 11-9: Connecting an 8" Floppy Disk Drive

3. The 8" drive can now be accessed as Drive E when using CP/M.
4. If you have added a dual 8" floppy disk drive unit to your system, the left drive will be accessed as Drive E; the right drive will be referred to as Drive F when using CP/M.
5. The last drive connected to the cable must be terminated. All drives purchased from Morrow will have termination on the last (or only) drive. If, after you add an 8" drive, you start getting write errors, there is a problem with termination on the last drive. The pins on the termination resistor for WRITE GATE and WRITE DATA must be lifted. If you are unable to locate these pins, call Customer Service for assistance.

12. SYSTEM MAINTENANCE

12.1 Overview

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

The fan filter should be cleaned every six months (more often in dusty environments). Remove the fan filter by pinching it in the middle and pulling it out. Wash it in warm, mildly soapy water and rinse until clean. After it is thoroughly dry, fit it back into its enclosure.

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

Enjoy your new system. If you encounter any problems, a troubleshooting chart and some helpful appendices follow.

12.2 Troubleshooting

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

PROBLEM	PROBABLE CAUSE	REMEDY
	FLOPPY DISK	
FAN OFF, POWER INDICATOR NOT LIT	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; press in the button labeled 6.

PROBLEM	PROBABLE CAUSE	REMEDY
FAN ON, POWER INDICATOR NOT LIT	Indicator light bad.	Replace indicator light. System can be used in the meantime.
	Internal connection (power supply) loose.	Contact service center.
POWER ON, BUT DISK DRIVE INDICATOR LIGHT DOES NOT BLINK	Drive power cable not plugged in.	Remove the top cover; plug in drive cable.
	Drive signal cable improperly connected.	Remove the top cover; reconnect cable.
	System not initialized.	Activate RESET on Decision front panel.
DRIVE HEAD LOADS, SEEKS, BUT SYSTEM DOES NOT BOOT UP (No sign-on message)	Floppy diskette inserted incorrectly.	Insert diskette with label facing up and away from slot.
	Wrong diskette inserted.	Insert CP/M boot diskette.
	Bad system diskette.	Make new diskette from back up copy.
	Cables and plugs incorrectly connected.	Refer to Section 8.
STRANGE CHARACTERS APPEAR ON CRT AFTER RESET	Terminal not configured correctly.	See Section 4.4.1.
DRIVE HEADS LOAD AND MOVE BUT NO SIGN-ON MESSAGE APPEARS	Terminal not on.	Turn it on.
	Terminal data cable not connected to Decision.	Connect cable.
	Terminal not set up correctly.	See Section 4.4.1.

Diskette is not
a boot diskette.

Insert the CP/M
boot diskette.

Bad diskette.

Use back-up boot
diskette.

HARD DISK

PROBLEM	PROBABLE CAUSE	REMEDY
DRIVE DOES NOT PERFORM CORRECTLY or GETS BDOS ERROR MESSAGES	Data or control cable connected incorrectly.	Remove cover; methodically change cable connections.
	Power supply or ground connection loose.	Reconnect it.
	CPU switch set- tings incorrect.	Remove cover; check switch settings.
	Internal drive cable unplugged.	POWER OFF. Remove cover and recon- nect drive cable.
	Sector errors in tracks 0 and 1.	Contact service center.
	Drive not formatted correctly.	Contact service center.
	No operating system on the hard disk.	See Section 8 of this manual.
CHECK.COM REPORTS HARD DISK ERRORS	Disk format problem.	See Appendix D.
	Shipping damage.	Contact service center.

12.3 Error Handling

The following information discusses the possible errors which may be encountered when booting from either the floppy or hard disk. Tables are also provided, listing error codes that will be displayed and their meaning. Since this section is very technical in nature, we realize that many users will want to call for assistance, rather than try to interpret these error messages. When calling for assistance, however, please be sure you have written down the error message received, and give this information to the technician who can interpret it for you.

12.3.1 HDCDMA Controller Errors

If an error is encountered when you attempt to boot your system from the hard drive, the following message will be displayed on your terminal:

Hxxyy

H indicates that the error was caused by the HDCDMA controller. The xx represents the command issued to the HDCDMA that caused the error. The characters yy represent the status returned by the controller. Commands and status are defined in Table 12-1.

Table 12-1: HDCDMA Error Code Summary

Command Code	Definition	Status Code	Definition
00	Read	00	Busy
01	Write	01	Not Ready
02	Read header	02	Wrong cylinder
03	Format	03	Wrong head
04	Load constants	04	Header not found
05	Return status	05	Data not found
06	Seek	06	Data overrun
		07	Data CRC error
		08	Write fault
		09	Header CRC error
		FF	O.K.

12.3.2 DJDMA Controller Errors

If an error is encountered when you attempt to boot your system from the floppy disk drive, or if the controller does not sense that a diskette is in the floppy disk drive, a time-out will occur and the following message will be displayed on your terminal:

Fxxyy

F indicates that the error was caused by the DJDMA controller. The xx represents the low byte of the address the MPZ80 was instructed to jump to by the DJDMA. The characters yy represent the byte of status returned by the controller. Status is interpreted as shown in Table 12-2.

Table 12-2: DJDMA Error Code Summary

Error Code	Description
00	Controller not responding
40	O.K.
80	Improper command
82	Illegal disk drive
83	Illegal track
84	Media not readable
85	Improper sector header/missing sync byte
86	Header CRC error
87	Seek error
88-8D	Compare error in sector header scan
8E	Data CRC error
8F	Illegal sector value for current media
90	Media is write protected
91	Lost data - DMA channel did not respond
92	Lost command - channel did not respond

The `xx` byte of the status (low byte of the jump address listed above) will, in most cases, be an 80h, since the first sector normally loads in at 80 h (128 bytes long). Do not be concerned about the meaning of this technical information; it is provided so that you are able to assist the Customer Service Department in diagnosing your system's problem.

12.3.3 UART (Serial port) Errors

The following message will be displayed on your terminal if a UART error is encountered during the computer's initialization sequence:

Uxxyy

This message will be displayed before the monitor program is invoked. The U indicates that the UART caused the error, `xx` indicates which one, (1, 2 or 3) and the `yy` represents the data byte returned by the UART.

The character sent to the UART is a byte of 00. The UARTs should return this value. In the case of an error, you should compare the faulty bits returned as `yy` above. Also note that the monitor performs its I/O through Serial Port 1; if this port is not functioning, nothing will appear at the terminal.

12.3.4 Memory Errors

The monitor only checks for the presence of memory in the system. If it detects that there is no addressable memory in the first 64K of memory address, the following error message will be displayed on your terminal:

MOBAD

As in all instances where error messages are displayed on your terminal, contact your dealer or Morrow's Customer Service Department, and report the error reported.

A. CP/M OVERVIEW

A.1 Program Descriptions

ABOOT.A	Source code for cold boot section of CP/M configured for Morrow hardware. The .A file contains equates, and the .B file the assembly code. These files need to be joined before assembly as in
ABOOT.B	
	PIP ABOOT.ASM=ABOOT.A,ABOOT.B
ASM.COM	CP/M command; assembles 8080 assembler source.
BAUD.COM	Commands to change the baud rate on the Decision Wunderbuss or Mult/IO boards (see Section 11).
*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.
BOOTMW.ASM	Source code for BOOTMW.COM
BOOTMW.COM	Command to boot hard disks with HDC/DMA controller. See Section 6).
CBIOS.A	Like ABOOT.ASM, these two files form the basis for CBIOS.ASM. They must be edited and combined before you can use them. See E4.DOC.
CBIOS.B	
CHECK.COM	Morrow hard disk check out program.
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 sub-routines.
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.
E4.DOC	Document explaining the E4 revision of Morrow CP/M.
ED.COM	CP/M command; calls the CP/M line editor to create and alter source files.

FDJ.COM Format program for DJDMA controller (see Section 10).

FORMATMW.COM Format program for HDCDMA controller (see Appendix D).

*FORMATMW.DOC Documentation for FORMATMW.COM.

HYTYPE.ASM Source file for HYTYPE.PRL.

HYTYPE.DOC Documentation for the Hytype printer driver.

HYTYPE.PRL Hytype printer driver installation package (see Section 11.5).

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 (see Section 9).

MOVCPM.COM CP/M command; moves and/or changes CP/M system size (see Section 11 and/or Appendix D).

MOVCPM10.COM

PIP.COM CP/M command; Peripheral Interchange Program used to transfer files between selected I/O devices (see Section 8).

PRL.DOC Documentation about PRL files.

RAMCHK1 Checks any memory in the first megabyte of address space; a G is printed for each 4 k of Good memory.

STAT.COM CP/M command; provides statistical information about files and disks (commonly used program).

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

SW9xx.000 Assembly source file for making MOVCPM.COM.

SW9xx.010 Assembly source file for creating MOVCPM10.COM.

SWAP.COM CP/M command; exchanges pairs of device assignments.

SYSGEN.COM CP/M command; reads or writes reserved CP/M system tracks (see Section 8.7).

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

- * Files that may be printed out in either the CP/M or NewWord program, or viewed on-screen with the CP/M TYPE command.

Detailed information on each of these programs is provided in the CP/M documentation. Those referenced with section numbers are discussed in this manual as well.

A.2 Using "Wildcards" with PIP

The following information is a supplement to Section 8.4, Copying Several "Common" Files. This information is not intended as a replacement for the information provided in Section 1.6.4 of the CP/M User Reference Manual and should be used for reference only. Consult your CP/M manual for a more detailed explanation.

A.2.1 The Asterisk (*) Wildcard

The asterisk (*) is used to match any amount of letters or numbers that make up the file name. It should not be confused with the PIP command line prompt (*) described in Section 8.

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.2.2 The Question Mark (?) Wildcard

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 A for this example) and enter PIP by typing:

PIP <CR>

The PIP prompt is returned:

*

2. Enter:

C:=A:?????.FIL[V] <CR>

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:

*C:=A:ACCT83.FIL[V] <CR>

to "PIP over" the last of the files to be copied. This particular file was not covered by the command listed in Step 3 because it had too many characters in the filename.

To accomplish the results obtained in Steps 3 and 4, you could have entered the following command:

C:=A:ACCT*.FIL[V] <CR>

5. Once PIP is finished, enter a Control C or a carriage return (<CR>) to exit PIP.

A.3 Operating System Details

The CP/M operating system is made up of four distinct parts which operate together to perform system 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. E4.DOC, on the system distribution diskette, is full of useful information for system hackers.

The Customized BIOS (CBIOS)

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 has customized the BIOS for the Decision hardware and also added some features that make system operation even easier. These changes appear in the CBIOS.B file, included on your second diskette. Morrow is currently shipping revision E4 of the CBIOS. This customized file allows your system to:

1. Read/write the following types of diskettes:
 - a. 8 inch IBM 3740 and System 34 single and double sided floppy diskettes
 - b. NorthStar-compatible 5-1/4 inch hard sectored, single and double sided diskettes
 - c. Morrow Micro Decision diskettes
2. 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.
3. 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. To reassemble the CBIOS.A and CBIOS.B file with changes, you must use the MAC assembler from Digital Research.

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.

A.4 Recommended Reading

CP/M Primer, by Stephen M. Murtha and Mitchell Waite, (San Francisco: Howard W. Sams & Co., Inc., 1980)

Using CP/M - A Self-Teaching Guide, by Judi N. Fernandez and Ruth Ashley (New York: John Wiley & Sons, Inc., 1980)

The CP/M Handbook with MP/M, by Rodney Zaks (Berkeley: Sybex, 1980)

Osborne CP/M User Guide, Second Edition, by Tom Hogan (Berkeley: Osborne/McGraw-Hill, 1982)

Mastering CP/M, by Alan R. Miller (Berkeley: Sybex, 1982)

Wordstar Made Easy, by Walter A. Ettlín (Berkeley: Osborne/McGraw-Hill, 1981) NewWord is very similar to WordStar.

Introduction to WordStar, by Arthur Naiman (Berkeley: Sybex, 1981) NewWord is very similar to WordStar.

Introduction to Word Processing, by Hal Glatzer (Berkeley: Sybex, 1981)

DON'T (Or How to Care For Your Computer), by Rodney Zaks (Berkeley: Sybex, 1981)

Your First Computer, A Guide to Business and Personal Computing, by Rodney Zaks (Berkeley: Sybex, 1981)

BASIC for Business, by Douglas Hergert (Berkeley: Sybex, 1982)

An Introduction to Microcomputers, Vols. 0-3, (Berkeley: Osborne/McGraw-Hill, 1980)

B. DECISION FACTORY--SET SWITCH SETTINGS

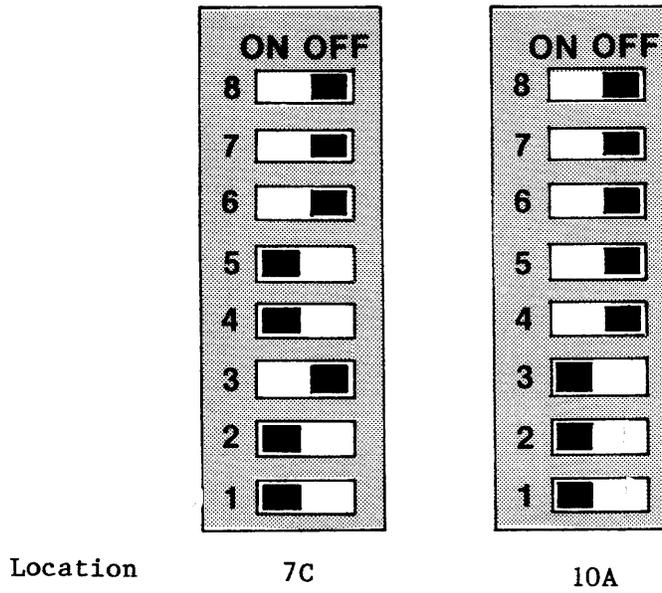


Figure B-1: Wunderbuss I/O Controller Switch Settings

Table B-1: Wunderbuss I/O Controller Jumpered Settings:

Jumper	Setting
J1	Not installed
J2	A to B
J3	Installed
J4	No jumpers
J5	Battery (user supplied)
J6	To front panel keyswitch

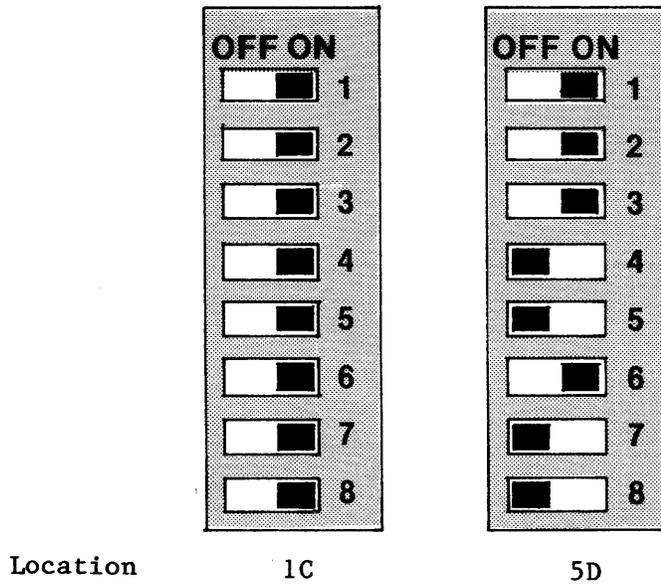


Figure B-2: MM65KS Memory Board Switch Settings

Table B-2: MM65KS Memory Board Jumpered Settings

Jumper	Setting
J1	Installed
J2	Installed
J3	Not installed
J4	Installed
J5	Not installed
J6	Installed
J7	Not installed

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

Table B-3: DJDMA Floppy Disk Controller Jumpered Settings

Jumper	Setting
J1	B to C
J2	B to C
J3	To VI 1
P3	2 to 3

Table B-4: HDCDMA Hard Disk Controller Jumpered Settings

Jumper	Setting
J5	To VI0

C. DECISION CABLE CONNECTOR TYPES

Table C-1: Types and Functions of Cable Connectors

TYPE	FUNCTION	LABEL
25-pin "D" style	Connecting terminals and a serial printer	Serial Ports 1-3
34-pin	Connecting 5 1/4 inch hard or 5 1/4 inch floppy disks	No Label
50-pin	Connecting 8 inch floppy or 8 and 14 inch hard disks	8" FLOPPY
20-pin	Hard disk cable connection	No Label

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

All connections to the Decision back panel have been standardized so that:

- 1) the stripe (conductor) is always on the left, when viewed from behind the cabinet, 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.

If you should need a cable to interface some device to your Decision, contact Morrow. Part numbers are provided below:

Cable Type	Part Number
Conversion Kit-Daisy to Centronics Interface	060-500DTC
Parallel (Hytype) Interface Cable	060-50722P
8" Floppy Disk Drive Cable	060-50782P

D. HARD DISK FORMATTING AND SYSTEM RECONFIGURATION

As shipped from the factory, all hard disks will be formatted for your particular configuration (CP/M as explained in this manual, or MICRONIX, described in supplemental documentation). Since shipping can sometimes cause damage to the hard disk media surface, the hard disk check-out procedure explained in Section 6, should be performed. If the program CHECK revealed errors or defects on your hard disk, you must reformat it, configure the system to accommodate the hard disk, and then recopy the operating system onto the hard drive. The procedure for these tasks is explained below.

D.1 Formatting the Hard Drive

To format a 10 megabyte drive, boot the system from the floppy disk drive A. At the CP/M prompt, enter:

```
FORMATM10 M10 <CR>
```

To format a 16 megabyte drive, type:

```
FORMATM16 CMI <CR>
```

The CP/M prompt will be displayed at the end of the formatting process. For details on this program, and the formatting process in general, use the CP/M utility TYPE to look at the file FORMATM10.DOC. This file will provide detailed information on the FORMATM10 program.

D.2 Configuring the System

To configure a system for the 10 megabyte drive, type:

```
MOVCPM10 * *
```

This command will create a hard disk version of CP/M in memory. After using SYSGEN, you will be able to boot from the hard drive.

If a 16 megabyte hard drive is installed in your Decision, type:

```
MOVCPM16 * *
```

This command works the same way as MOVCPM10, but is used for 16 megabyte hard disks. A system image in memory is now ready and you must use the SYSGEN program to immediately write the system out to the desired drive.

D.3 Generating the Operating System on the Hard Drive

The SYSGEN program writes the system tracks of hard disks or floppies. To start SYSGEN, type

SYSGEN

SYSGEN will prompt you for the location of the data to be written. If you have followed the instructions provided above, the data will be in memory, so enter <CR>.

The program will then prompt for the destination drive. At this point, type:

C <CR>

The system will then be written onto the hard disk.

D.4 Testing the Format and System Generation

BOOTMW.COM will test the above procedures by attempting to boot the operating system from the hard disk. If you have followed the steps outlined previously, the CP/M prompt will appear and the current "A" and "B" drive will be the hard disk drive. The 5-1/4" floppy drive is Drive C.

E. DECISION SYSTEM SPECIFICATIONS

Dimensions:

19 X 20.5 X 8.5 inches

Net Weight:

36 pounds

External Power Requirements:

Switchable

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

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

AC Power:

Switchable

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

Internal Power Requirements:

	Average		Peak	
+ 8 volts	@7.0	-	12.0	amps (filtered)
+16 volts	@0.06	-	3.0	amps (filtered)
-16 volts	@0.04	-	3.0	amps (filtered)
+12 volts	@2.6	-	5.2	amps (regulated) average
+ 5 volts	@1.5	-	1.75	amps (regulated) average

Supply Type:

Switching

CPU Specifications:

Type: Z80A (NEC 780A)
Speed: 4 Mhz (6 Mhz optional)
Power: 1.6 amps @ +8 volts; .010 amps @ +16 volts

Memory:

65K bytes of 200 ns low power static
standard (expandable to 1M byte);
2K bytes of EPROM
Power: .4 amps @ +8 volts

Standard I/O:

3 Serial channels (75 baud to 19.2K baud)
1 daisy-wheel printer channel
1 multi-purpose eight-bit parallel port
(bi-directional)
Power: .9 amps @ +8 volts; .036 amps @ +16 volts;
.022 amps @ -16 volts

Real-Time Clock:

NEC 1990C

Interrupt Controller:

8259A PIC

Environmental Considerations:

Temperature: 50 to 85 degrees F (operating)
15 to 30 degrees C (operating)
-40 to 125 degrees F (nonoperating)
-40 to 52 degrees C (nonoperating)
Humidity: 10 to 90% (non-condensing)

DJDMA Floppy Controller:

Z80A CPU (NEC 780)
4K EPROM
24 Bit Address
SA-800/850 Interface (Four 8" floppy disk drives)
SA-400/450 Interface (Four 5" floppy disk drives)
Power: 1.4 amps @ +8 volts; .022 amps @ +16 volts;
.006 amps @ -16 volts

HDCDMA Hard Disk Controller:

8x300 microprocessor
512 Bytes ROM
24 Bit Address
ST-506 Interface (Supports 4 drives)
Power: 2.8 amps @ +8 volts; .020 amps @ -16 volts

All power ratings are TYPICAL requirements, and do not reflect peak usage.

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