

## ***USER'S GUIDE***

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***WD 1003-RAH***  
***WD 1003S-RAH***  
***WD 1003-RA2***  
***WD 1003A-RA2***  
***Winchester***  
***Disk Controllers***

***Important Information***  
***Do not Discard***

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***WESTERN DIGITAL***

## Document Scope

This document describes the hardware and software installation of the following Western Digital controllers:

WD 1003-RAH      WD 1003-RA2  
WD1003S-RAH    WD 1003A-RA2

Two versions of the WD1003-RA2 are available:

Feature 000 (F000). Non-translation operation only

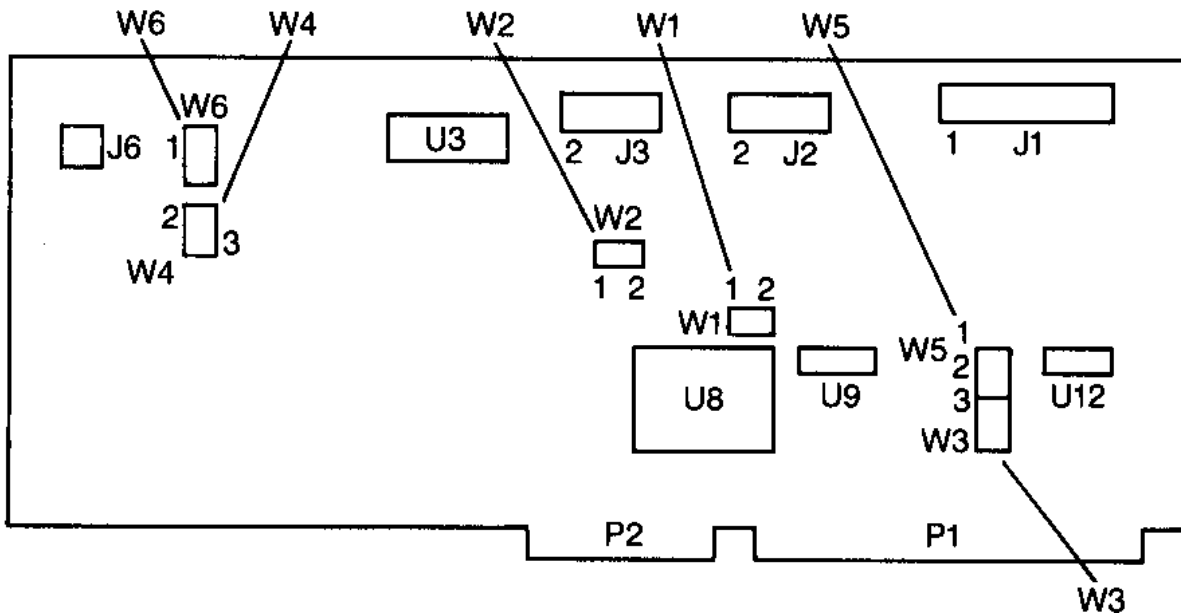
Feature 001 (F001). Translation operation only.

The other controllers described in this document have one standard version.

These controllers are designed for use in IBM Personal Computer ATs or other AT-compatible computers with a 16-bit data bus.

The use of the term controller refers to all boards described within this document. When a reference is made to a particular board, the appropriate WD part number is used.

## WD1003-RAH JUMPER LOCATIONS



### WDI003-RAH JUMPER SETTINGS

JUMPER	PIN CONNECTS	DESCRIPTION
W1	1-2	Standard factory setting. Status read is latched. Used for IBM Personal Computer AT if Winchester activity LED is connected to J6.
	OPEN	Status read is not latched. Activity LED turns on during drive access. W5 must be jumpered 2 to 3. Used for Compaq hosts.
W2	OPEN	Standard factory setting. Selects primary addresses, 1F0 through 1F7 and 3F0 through 3F7 hex. Do not modify the primary address jumper unless your BIOS operating system is configured to accept more than two hard disk drives.
	1-2	Selects secondary addresses, 170 through 177 and 370 through 377 hex.
W3	OPEN 1-2	This configuration used with WD11C00C-22 at board location US or if W5 is jumpered 1 to 2. Required only on early units with WD11C00-22 at board location U8 and W5 is jumpered 1 to 2. DO NOT JUMPER WITH THE WD11C00C-22 INSTALLED.
W4	2-3	Standard factory setting. No translation for drive 0.
	1-2	Enables translation for drive 0. Translation is only available for 615 cylinders and four headed drives. In translation mode, the controller translates the 26 physical sectors per track into 17 sectors. The extra sectors are "translated" into logical heads. To use the translation mode, select through the Setup program a 615 cylinder and six head drive type. (This is drive type three for IBM Personal Computer AT users. Not all AT-compatible systems use the same drive tables as IBM.) This configuration must be used when running an operating system or application program which requires a 17 sector per track disk drive.
W5	2-3	Standard factory setting. WG and drive select lines only enabled when drive is accessed. This configuration also provides power up and down protection.
	1-2	WG and drive select lines are disabled during power up reset and when +5V power supply drops below approximately +4.15V.
W6	2-3	Standard factory setting. No translation for drive 1.
	1-2	Enables translation for drive 1. Translation is only available for 615 cylinders and four headed drives. In translation mode, the controller translates the 26 physical sectors per track into 17 sectors. The extra sectors are "translated" into logical heads. To use the translation mode, select through the Setup program a 615 cylinder and six head drive type. (This is drive type three for IBM Personal Computer AT users. Not all AT-compatible systems use the same drive tables as IBM.) This configuration must be used when running an operating system or application program which requires a 17 sector per track disk drive.

## **Hardware Installation**

This section describes installation of your hardware. If the disk drive(s) is (are) installed internally, it is best to locate the controller in the closest available expansion slot relative to the drive.

### **CAUTION**

**Handle the controller board by the ends of the board. Some of the chips are static sensitive and damage may occur if the board is incorrectly handled.**

**Furthermore, do NOT under any circumstances connect an RLL controller to an MFH drive. Refer to “If You Have a Problem” section for further information.**

## WD10035-RAH JUMPER SETTINGS

JUMPER	PIN CONNECTS	DESCRIPTION
W1	1-2	Standard factory setting. Status read is latched. Used for IBM Personal Computer AT if Winchester activity LED is connected to J6.
	OPEN	Status read is not latched. Activity LED turns on during drive access. W5 must be jumpered 2 to 3. Used for Compaq hosts.
W2	OPEN	Standard factory setting. Selects primary addresses, 1F0 through 1F7 and 3F0 through 3F7 hex. Do not modify the primary address jumper unless your BIOS operating system is configured to accept more than two hard disk drives.
	1-2	Selects secondary addresses, 170 through 177 and 370 through 377 hex.
W3		Applicable to the WD1003-RAH. Eliminated by design and artwork changes to the WD1003S-RAH.
W4	1-2	Standard factory setting. No translation for drive 0.
	2-3	Enables translation for drive 0. Translation is only available for 615 cylinders and four headed drives. In translation mode, the controller translates the 26 physical sectors per track into 17 sectors. The extra sectors are "translated" into logical heads. To use the translation mode, select through the Setup program a 615 cylinder and six head drive type. (This is drive type three for IBM Personal Computer AT users. Not all AT-compatible systems use the same drive tables as IBM.) This configuration must be used when running an operating system or application program which requires a 17 sector per track disk drive.
W5	2-3	Standard factory setting. WG and drive select lines only enabled when drive is accessed. This configuration also provides power up and down protection.
	1-2	WG and drive select lines are disabled during power up reset and when +5V power supply drops below approximately +4.1 5V.
W6	1-2	Standard factory setting. No translation for drive 1.
	2-3	Enables translation for drive 1. Translation is only available for 615 cylinders and four headed drives. In translation mode, the controller translates the 26 physical sectors per track into 17 sectors. The extra sectors are "translated" into logical heads. To use the translation mode, select through the Setup program a 615 cylinder and six head drive type. (This is drive type three for IBM Personal Computer AT users. Not all AT-compatible systems use the same drive tables as IBM.) This configuration must be used when running an operating system or application program which requires a 17 sector per track disk drive.
W7	1-2	Standard factory setting. Controller operates with daisy-chained drive(s). Both can be daisy-chained from J1 or drive 0 can be connected to J1 and drive 1 can be connected to J5. For daisy-chained operation, set the drive select jumpers on the first drive for drive 0 and on the second drive for drive 1.
	3-4	
	1-3	Controller operates with parallel connected drives. Attach drive 1 control connector to J1.
	2-4	Attach drive 0 control connector to J5. For parallel operation, set the drive select jumpers on both drives for drive 0.
W8	1-2	Standard factory configuration. Ties input high.
	2-3	Enables seek to landing zone (cylinder 663) on any seek to a cylinder greater than 615. Used only for 615 cylinder drives. This jumper also changes step rate 0 (24 µsec) to step rate 15 (11 µsec).

Only verify the jumper settings in step 1. Modification of the standard factory jumper settings on the controller is rarely necessary. Modify jumpers only under the direction of a qualified individual, i.e. your dealer.

1. Verify controller jumper settings. Refer to pages 1 through 9 for jumper setting information.
2. Verify termination on last drive. Verify proper setting of drive select switches on drive, i.e. set the drive select switches for drive select 1 or 2. Refer to your drive owner's manual for information about proper drive termination and select switches.
3. Remove the blank expansion slot bracket. Put the bracket away and save it for possible future use. The screw will be used to hold the new controller board in place.

#### NOTE

**Verify that the cable connectors mate properly with the board connectors. This is easily done by checking that pin 1 on the cable mates with pin 1 on the connector. Pin 1 is clearly marked on the board's connectors. Pin 1 on the cables is usually on the color coded side.**

4. WDI003-RAH: Attach 34-pin control connector to J1  
WDI0035-RAH: Attach 34-pin control connector to J 1 if W7 is set for daisy-chained operation.

#### NOTE

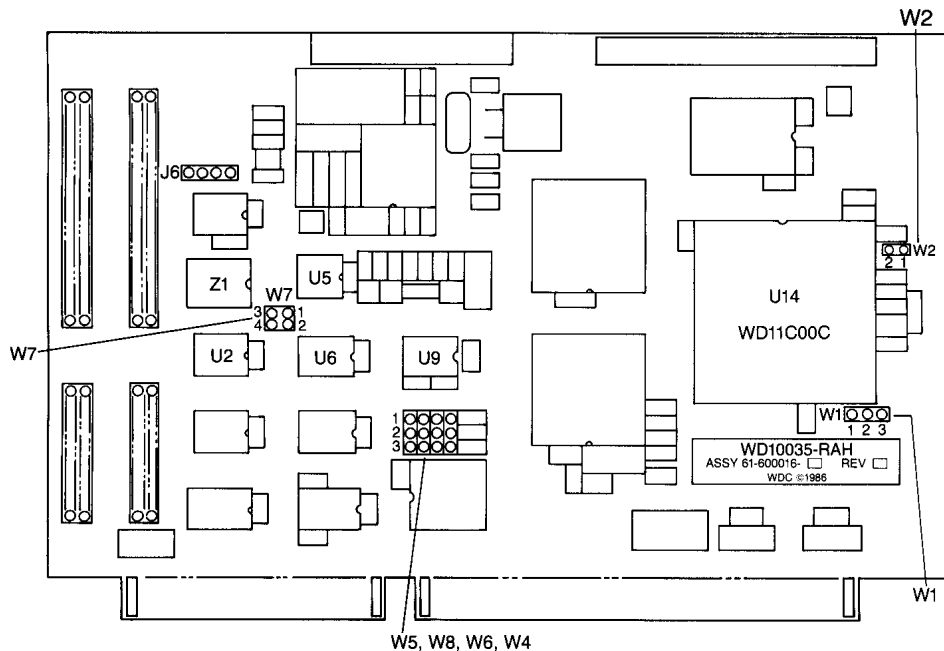
**Normally, daisy-chaining implies that two drives connect to the same connector. That is still true with the WDI0035-RAH. However, it is possible to connect the second drive to J5. Regardless of the connection, one drive must be configured as drive 0 and the other drive must be configured as drive 1.**

Attach drive 1 's 34-pin connector to J 1 and drive 0's 34-pin connector to J5 if W7 is set for parallel connection. (Refer to Table 2 for further information.) Set the drive select jumpers on both drives to drive 0 if W7 configures the controller for parallel connection.

- WDI003-RA2: Attach 34-pin control connector J5.  
WDI003A-RA2: Attach 34-pin control connector to J4.

5. Connect control cable(s) to drive(s).
6. WDI003-RAH WDI003S-RAH: Attach drive 0's 20-pin data connector to J2.

## WD1003S-RAH JUMPER LOCATIONS



WD1003-RA2: Attach drive 0's 20-pin data connector to J4.

WD1003A-RA2: Attach drive 0's 20-pin data connector to J3.

7. WD1003-RAH  
WD1003S-RAH

WD1003-RA2: Attach drive 1's data connector to J3.

WD1003A-RA2: Attach drive 1's data connector to J2.

8. Connect data cables to drives.

9. WD1003-RA2: Attach 34-pin floppy cable connector to J1.

WD1003A-RA2: Attach 34-pin floppy cable connector to J5.

10. WD1003-RAH  
WD1003S-RAH

WD1003-RA2: Attach Winchester activity LED connector to J6.

WD1003A-RA2: Attach Winchester activity LED to J1.

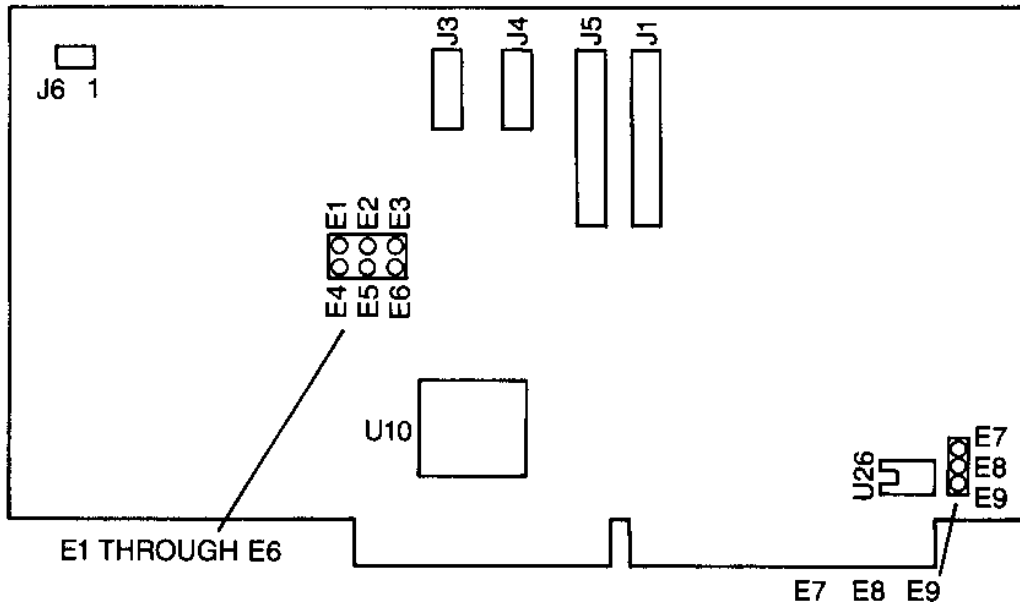
11. Install the controller board into the expansion slot. Make sure that the board is seated properly by pressing down on both ends of the board. Secure the board with the bracket screw.

12. Remove or disable any other floppy controller in your system if you are installing a WD1003RA2 or WD1003A-RA2. It is NOT possible to disable the floppy controller on the WD1003-RA2 or WD 1003A-RA2.

**NOTE (For WD1003-RA2 only)**

Translation is only available with F001 controllers. F000 controllers operate in non-translation mode only. F001's translation program converts the drive's 26 physical sectors per track to 17 sectors per track. The extra sectors are "translated" into logical heads. To use the translation mode, select through the Setup program a 615 cylinder and six head drive type. (This is drive type three for IBM Personal Computer AT users. Not all AT-compatible systems use the same drive tables as IBM.) This configuration must be used when running an operating system, application program, or system BIOS that requires a 17 sector per track disk drive.

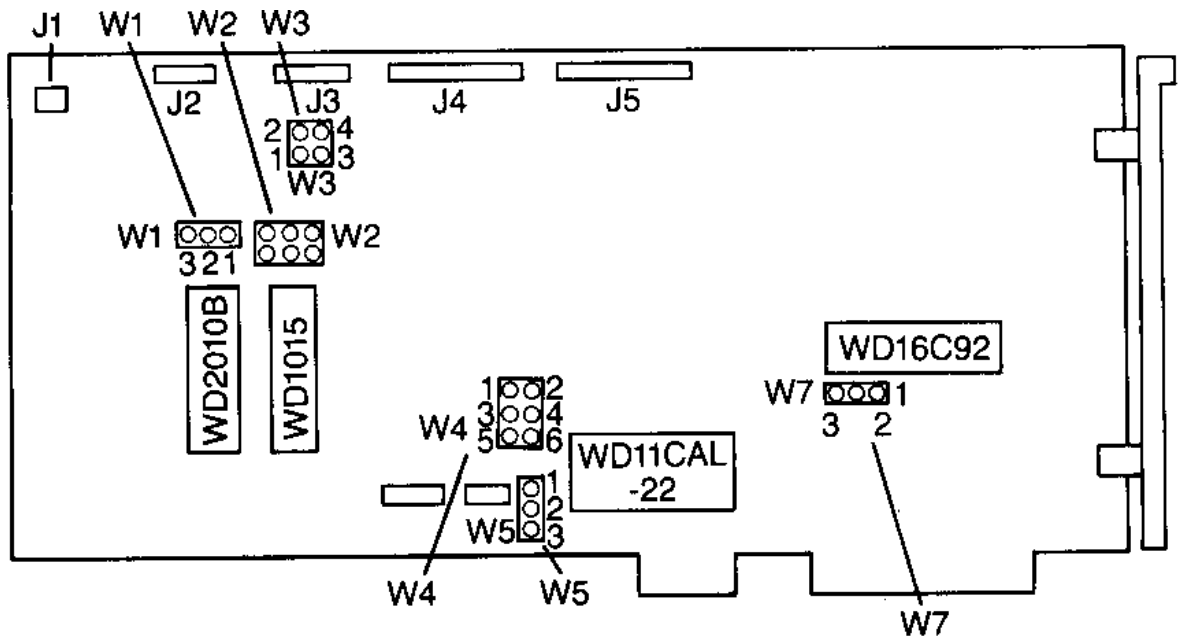
**WD1003-RA2 JUMPER LOCATIONS**



**WD1003-RA2 JUMPER SETTINGS**

JUMPER	PIN CONNECTS	DESCRIPTION
E1 E2 E3	E2-E3  E1-E2	Standard factory setting. Selects primary addresses, 1F0 through 1F7 hex, for the hard disk controller. Do not modify the primary address jumper unless your operating system is configured to accept more than two hard disk drives. Also verify that E5 and E6 are connected if E2 and E3 are jumpered.  Selects secondary addresses, 170 through 177 hex, for the hard disk controller. Also verify that E4 and E5 are connected if E1 and E2 are jumpered.
E4 E5 E6	E5-E6  E4-E5	Standard factory setting. Selects primary addresses, 3F0 through 3F7 hex, for the floppy disk controller. Do not modify the primary address jumper unless your operating system is configured to accept more than two hard disk drives. Also verify that E2 and E3 are connected if E5 and E6 are jumpered.  Selects secondary addresses, 370 through 377 hex, for the floppy disk controller. Also verify that E1 and E2 are connected if E4 and E5 are jumpered.
E7 E8 E9	E7-E8 E8-E9	Standard factory setting. Supports 300 or 360 RPM floppy disk drives. Selects dual speed spindle floppy disk drives.





**WD1003A-RA2 JUMPER LOCATIONS**

## WD1003A-RA2 JUMPER SETTINGS

JUMPER	PIN CONNECTS	DESCRIPTION
W1	1-2 2-3	This configuration used with a WD11C00C-22 at board location U16. Required only on early units with WDI IC00-22 at board location U8 and W5 is jumpered 1 to 2. DO NOT JUMPER WITH WD11C00C-22 INSTALLED.
W2	1-2 OPEN 1-2 CLOSED	Standard factory setting. No translation for drive 0.  Enables translation for drive 0. Translation is only available for 615 cylinders and four headed drives. In translation mode, the controller translates the 26 physical sectors per track into 17 sectors. The extra sectors are "translated" into logical heads. To use the translation mode, select through the Setup program a 615 cylinder and six head drive type. (This is drive type three for IBM Personal Computer AT users. Not all AT-compatible systems use the same drive tables as IBM.) This configuration must be used when running an operating system or application program which requires a 17 sector per track disk drive.
W2	3-4 OPEN CLOSED	Standard factory setting. No translation for drive 1.  Enables translation for drive 1.
W3	3-4 1-2	Standard factory setting. DO NOT OPEN. Standard factory setting. DO NOT OPEN.
W4	3-5  4-6  1-3  2-4	Standard factory setting. Selects primary addresses, 1F0 through 1F7 hex, for the hard disk controller. Do not modify the primary address jumper unless your operating system is configured to accept more than two hard disk drives. Also verify that W4 positions 4 and 6 are connected if 3 and 5 are jumpered.  Standard factory setting. Selects primary addresses, 3F0 through 3F7 hex, for the floppy disk controller. Do not modify the primary address jumper unless your operating system is configured to accept more than two hard disk drives. Also verify that W4 3 and 5 are connected if 4 and 6 are jumpered.  Selects secondary addresses, 170 through 177 hex, for the hard disk controller. Also verify that W4 2 and 4 are connected if 1 and 3 are jumpered.  Selects secondary addresses, 370 through 377 hex, for the floppy disk controller. Also verify that W4 1 and 3 are connected if W4 2 and 4 are jumpered.
W5	1-2  2-3	Standard factory setting. Closed by etch on the solder side of the board. Configures the board to control drives with a maximum of eight heads or Reduced Write Current (RWC).  Carefully cut etch and jumper to operate the controller with hard disk drives having a maximum of 16 heads.
W6		Removed from final release.
W7	2-3 1-2	Standard factory setting. Supports 300 or 360 RPM floppy disk drives. Supports dual speed spindle floppy drives.

## **Software Installation Instructions**

This section contains instructions for preparing (low level format) the drive to be recognized by the operating system. Formatting the drive uses one of several software programs, the Advanced Diagnostics (or equivalent in AT compatibles), Disk Manager from Ontrack Computer Systems, or Speedstor 4.02 from Storage Dimensions. Use of the programs depends on the controller configuration. Configuring the controller to use the translation feature requires running the Advanced Diagnostics program, Setup. Setup defines the drive type for the system and low level formats the drive. Without translation, Advanced Diagnostics can low level format the drive if the system BIOS recognizes the 26 sector RLL format. (Storage Dimensions' Speedstor 286 BIOS is a replacement set of BIOS ROMs for the AT system board.) Run the DOS programs, FORMAT and FDISK, after performing the low level format, regardless of the controller configuration.

## **Software Installation Instructions for Non-Translation Mode**

### **NOTE**

**Formatting disk media with this operational mode requires a host system with a 26 sector BIOS. If the system does not contain a 26 sector BIOS, Ontrack and Storage Dimensions produce programs to support the 26 sector RLL drives. For further information on these programs, contact:**

**Ontrack Computer Systems  
6222 Bury Drive  
Eden Prairie, Minnesota 55344  
(612) 937-1107**

**Storage Dimensions  
14127 Capri Drive, Suite 1  
Los Gatos, California 95030  
(408) 370-3304**

**The Disk Manager and Speedstor products are the only products that have been tested by Western Digital at this publication date. Both work well, providing full usage of the RLL capacities. However, these are not the only alternatives for removing system limitations. Contact your dealer for further information.**

1. Boot the system with the Advanced Diagnostics. Define the drive type(s) through the Setup option. After defining the drive types, run System Checkout. Enter 0 after the "Select the action desired" prompt.
2. Select fixed disk option 17.
3. Select the Format Menu from the Fixed Disk Diagnostic Menu.
4. Unconditionally format the drive with the Format Selection Menu.
5. Enter bad block in the Defect Entry table.

6. Formatting begins. After formatting the drive, press "ENTER". Boot and operate the system normally.

If you require further information or other technical support, please contact your authorized dealer.

### **Software Installation Instructions for Translation Mode**

1. Insert your system diagnostic diskette (or equivalent) in drive A.
2. Turn on the system power.
3. Boot diagnostic and select Setup option.

#### **CAUTION**

**Avoid system damage by consulting your Technical Reference Manual to ensure that your drive type is supported by your host BIOS ROM drive tables. Not all AT-compatibles share the same drive tables as IBM.**

4. Set up the system for the proper configuration of diskette and fixed drives (drive type 3 for IBM), base memory size, expansion memory size, and display.

#### **CAUTION**

**The following step requires execution of low level formatting. Formatting a drive destroys any data on the drive. If your drive contains useful data, backup the drive before execution of the low level format. Use of Advanced Diagnostics (or similar program) is necessary since the controllers contain no on-board BIOS ROM.**

5. After performing Setup, execute a low level format using the Advanced Diagnostics diskette. Follow the menu and reference manual instructions.
6. Load and execute the FDISK and FORMAT programs. Follow the menu and reference manual instructions.

## **If You Have a Problem. . .**

Eliminate the obvious fault causing problems; i.e., reversed cables, improper drive selection or termination, etc. This section lists some of the common problems and possible solutions encountered when installing a drive controller.

**PROBLEM:** 1790 Disk 0 Error.

**CAUSE:** No low level format on hard disk. Wrong drive type selected. Not enough drive power. Bad cables. Improper drive selection or termination.

**PROBLEM:** Drive does not partition.

**CAUSE:** Check drive types. Note that drive types for the AT and AT-compatibles differ.

**PROBLEM:** "Error Reading Fixed Disk" appears when booting from hard drive.

**CAUSE:** DOS partition not active.

**PROBLEM:** Winchester activity LED continuously lit.

**CAUSE:** No problem! Drive LED selected for latched mode.

**PROBLEM:** For systems with two drives, both Winchester activity LEDs light at the same time.

**CAUSE:** Improper drive selection or termination. Inspect the drive cables. If the data cables are straight, then set drive C's drive select switches for drive select 1 and drive D's drive select switches for drive select 2. If the data cables have a twist, set both drives' select switches for drive select 2. Consult your drive manuals or dealer for drive switch settings. Finally, under no circumstance, use twisted floppy cables for the Winchester drive. Floppy and Winchester drive interface connections differ significantly.

**PROBLEM:** Slow and inefficient operation.

**CAUSE:** The biggest culprit for this problem is an incorrect interleave factor. Therefore, some experimentation with the interleave factor may be necessary. (Refer to the format instructions for setting interleave factor.) Interleave factors are very dependent on the host operating system and application.

**PROBLEM:** Controller does not format a Seagate ST225 to 30 MB.

**CAUSE:** The ST225 is a 20 MB MFM drive. The ST238 is a 30 MB RLL drive. This is a good time to point out the differences between RLL and Modified Frequency Modulation (MFM) disk drives and controllers. First, RLL equipment is able to record 50% more data on the drive. Second, RLL drives must be physically formatted with 26 sectors because of the greater data density. This leads to an important point:

**DO NOT UNDER ANY CIRCUMSTANCES CONNECT A RLL CONTROLLER TO AN MFM DRIVE!**

RLL controllers physically format any attach drive into 26 sectors. Therefore, the RLL controller squishes 26 sectors onto a drive designed for 17 sectors. Squishing the RLL data onto an MFM drive results in corrupted data, to say the least. Finally, the chip sets on RLL and MFM controllers significantly differ as a result of the first and second points.