



## **TKZ60 Service Manual**

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**Order Number: EK-A0662-SM.001**

**Digital Equipment Corporation**

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| Product            | Sound Power Level<br>$L_{WA}$ , B |         | Sound Pressure Level<br>$L_{pA}$ , dBA |         |
|--------------------|-----------------------------------|---------|----------------------------------------|---------|
|                    | Idle                              | Operate | (bystander positions)                  |         |
|                    |                                   |         | Idle                                   | Operate |
| TKZ60 (tabletop)   | 5.8                               | 5.8     | 46                                     | 46      |
| TKZ60 (rack-mount) | 5.8                               | 5.8     | 39                                     | 40      |

[Current values for specific configurations are available from Digital representatives.  
1 B = 10 dBA.]

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For Federal Republic of Germany  
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|---------------------|----------------------|---------|------------------------|---------|
|                     | L <sub>WAd</sub> , B |         | L <sub>pAm</sub> , dBA |         |
|                     |                      |         | (Zuschauerpositionen)  |         |
|                     | Leerlauf             | Betrieb | Leerlauf               | Betrieb |
| TKZ60 (tabletop)    | 5,8                  | 5,8     | 46                     | 46      |
| TKZ60 (rack- mount) | 5,8                  | 5,8     | 39                     | 40      |

[Aktuelle Werte für spezielle Ausrüstungsstufen sind über die Digital Equipment Vertretungen erhältlich. 1 B = 10 dBA.]

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# Preface



## **Introduction**

This manual describes how to service the following products

- TKZ60- AA, Rack- mount, Without Loader
- TKZ60- AC, Rack- mount, With Loader - 5 or 10 slot magazine
- TKZ60- BA, Table- top, Without Loader
- TKZ60- BC, Table- top, With Loader - 5 or 10 slot magazine

## **Product History**

The TKZ60 product was first sold and serviced by Digital in the US area only, (FCS 1991) first as a custom, and then as a US Area supported product. The product was acquired from the vendor Cipher and distributed by Digital using the Digital Distributed Hardware (DDH) process as the 2R- TKZ60.

In 1992 the same product was introduced into Europe and sold as the 2E- TKZ60.

In 1993 Digital decided to fully qualify the product to be supported on a range of hardware and software platforms, also supplying the product with the Digital and TKZ60 logo.

In 1993 also, the supplying vendor (Cipher) migrated the product to a new company Overland Data Inc. (ODI) who are now the suppliers to Digital.

Note: The T480 (Cipher) product has also been serviced in both the US and European areas as a VES product.

Therefore this document will be useful for servicing any of the following product variants:

- 00- TKZ60- xx
- 2E- TKZ60- xx
- 2R- TKZ60- xx
- Cipher- T480 (VES)

## **Manual Structure**

This manual is divided into the following chapters:

Chapter One - Product Overview

Chapter Two - Hardware Configurations

Chapter Three - Operating Procedures

Chapter Four - Troubleshooting

Chapter Five - Field Replacable Units (FRUs)

Chapter Six - Firmware Updates

Chapter Seven - Product Specification

## **Intended Audience**

This manual is for the use of engineers servicing the TKZ60 family

## **Related Documents**

TKZ60 Installation/User's Manual, EK- A0662- IN.001

TKZ60 Pocket Service Guide, EK- A0622- HR .001



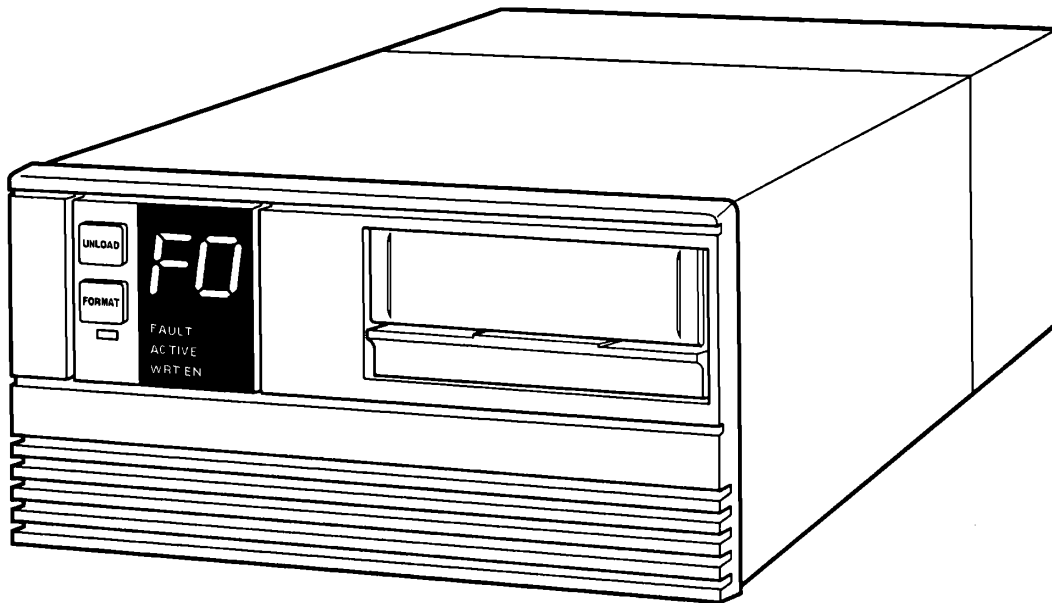
# **1 - Product Overview**



## 1.1 Physical Description

The TKZ60 is a half-inch cartridge streaming tape drive designed for data interchange, archival storage, software distribution, transaction management, and backup of small and large computing systems. Figure 1- 1 (below) illustrates a TKZ60 tape drive.

**Figure 1.1 TKZ60 Tape Drive**



The TKZ60 tape drive reads and writes data in the IBM 3480 format using industry- standard 0.5- inch wide tape cartridges. A computer system may communicate with the tape drive with either of two interfaces, the Small Computer Systems Interface (SCSI).

The tape drive has an eight-inch form-factor. It can be installed in standard 19- inch EIA/RETMA racks and cabinets or in a table- top enclosure.

The drive comprises a tape transport mechanism and a device controller.

The tape transport mechanism is made up of a cartridge loader, tape threader, supply and takeup motors, and a read/write head with integral tape path.

These electromechanical assemblies are attached to a cast- aluminum chassis and controlled by three circuit cards

All operator switches and indicator lights are at the front of the tape drive and the AC power switch is at the rear of the unit.

An optional Automatic Cartridge Loader that can be installed in place of the front panel accepts five or ten- cartridge magazines.

## **1.2 Functional Description**

The drive records data received from the interface bus, and reads recorded data and transmits it to other devices on the bus. It uses a 512-kilobyte cache memory as an electronic tape buffer to decouple the physical and logical tape operations.

The drive is self-loading. The operator inserts a tape cartridge into the opening in the front panel; the drive loads the cartridge, threads the tape, and positions at load point.

The drive contains three main functional elements: the interface, the electronics, and the electromechanical assemblies.

### **1.2.1 Interface**

The interface translates commands from the interface bus into tape-drive-executable commands, and translates tape drive data and status signals into the bus format. The interface is managed by an 80188 microprocessor.

### **1.2.2 Electronics**

A Z8002 microprocessor controls logic functions for read/write, servo control, cache memory, and data and command operations between the drive and the 80188 controlling the interface.

The drive encodes and records data supplied by the interface and reads back recorded information. The Z8002 manages these functions by interpreting the commands from the interface to accelerate and decelerate the tape, position the tape at the read/write head.

The drive features automatic error-recovery capability. Read-after-write circuitry detects write errors so the drive can attempt to rewrite data up to 16 times.

The electronics is also capable of detecting and correcting up to three tracks of read data.

Standard features of the drive electronics include:

- Dual processor architecture (Z8002 for device and 80188 for interface)
- Configuration parameters changed from the front panel and stored in non-volatile memory. 512 kilobytes of cache memory
- Extensive use of large scale integration (LSI) and surface mount technology
- Solid-state tape-tension transducer

### **1.2.3 Electromechanics**

The electromechanical assemblies are managed by the Z8002. The functions of these mechanisms are

- to load the tape cartridge
- engage the cartridge to the supply motor
- thread the tape across the read/write head
- move the tape through the tape path during
  - reading
  - writing
  - and positioning
- unthread the tape
  - disengage the cartridge from the supply motor
  - and eject the cartridge.

## **2 - Hardware Configurations**



## 2.1 Introduction

This chapter provides an overview of the hardware configurations currently available

## 2.2 Fully Supported Configurations

- TKZ60- AA  
—3480 compatible tape drive, rackmount, 1.5 MB/S, SCSI- 2 interface.
- TKZ60- AC  
—3480 compatible tape drive with loader, rackmount, 1.5 MB/S, SCSI- 2 interface.
- TKZ60- BA  
—3480 compatible tape drive, tabletop, 1.5 MB/S, SCSI- 2 interface.
- TKZ60- BC  
—3480 compatible tape drive with loader, tabletop, 1.5 MB/S, SCSI- 2 interface.

## 2.3 Custom Quoted Configurations

- 2E/2R- TKZ60- CA - 3480 compatible tape drive, rackmount, 1.5 MB/S, differential SCSI- 2 interface.
- 2E/2R- TKZ60- CC - 3480 compatible tape drive, rackmount, 1.5 MB/S, differential SCSI- 2 interface, w/tape loader.
- 2E/2R- TKZ60- DA - 3480 compatible tape drive, tabletop, 1.5 MB/S, differential SCSI- 2 Interface
- 2E/2R- TKZ60- DC - 3480 compatible tape drive, tabletop, 1.5 MB/S, differential SCSI- 2 interface, w/tape loader.

## 2.4 Options & Accessories

- TK60R- AA - Rack Mount Kit.
- TK60K- AB - 5 slot cartridge magazine for TK60 tape drive. (4- pack)
- TK60K- BB - 10 slot cartridge magazine for TK60 tape drive. (4- pack)
- TK90K- 30 - 3480, half- inch Tape cartridge (30 pack)
- TK90K- HC - Cleaning cartridge (5 pack)
- 2E/2R- TK60L- AA - TK60 tape cartridge loader mechanism (Custom quote).
- 2E/2R- TK60E- AA - Tabletop enclosure kit for TKZ60 Tape Drive (Custom quote).



## **3 - Operating Procedures**



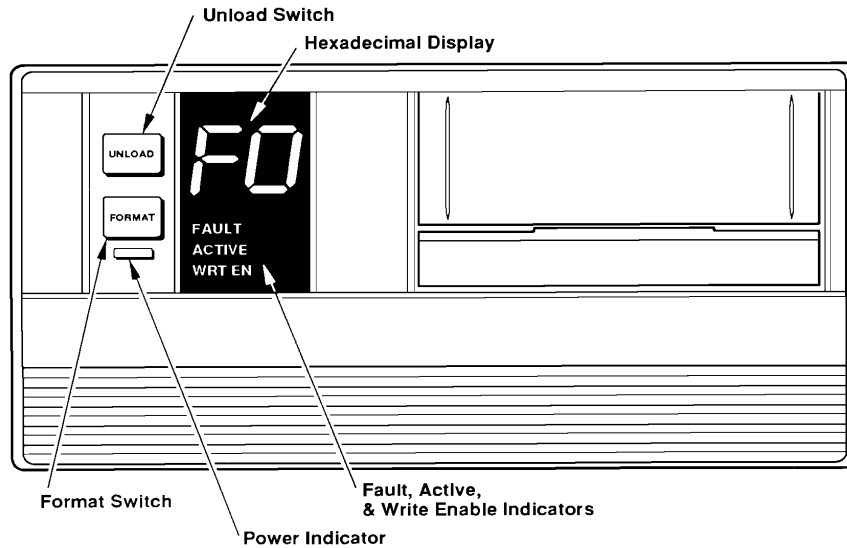
### 3.1 Introduction

This chapter explains how to operate the tape drive and the Automatic Cartridge Loader. It defines the use of all switches and indicators and explains how to load and unload tape.

### 3.2 Switches and Indicators

There are three switches used to control the tape drive and five indicators that allow it to communicate information to the user.

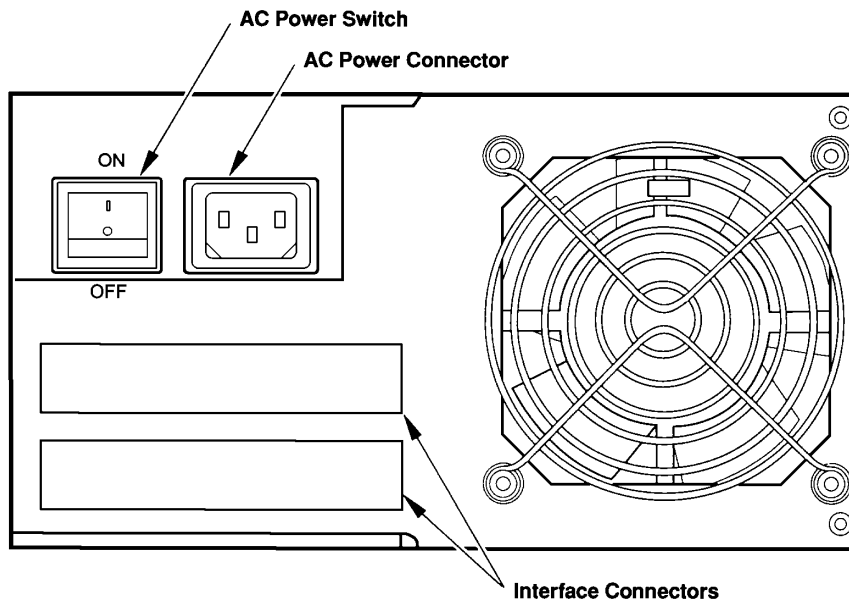
**Figure 3.1 Front Panel**



### 3.3 Switches

Two switches, UNLOAD and FORMAT, are located on the front panel (shown above) and a main AC Power On/Off switch located at the rear of the unit (see below).

**Figure 3.2 Rear Panel**



## 3.4 Switch Functions

### 3.4.1 UNLOAD switch

The UNLOAD switch causes tape to be rewound into a cartridge and the cartridge to be ejected from the drive. The UNLOAD switch also resets the drive to clear a fault if it is pressed without a cartridge loaded. Note: The UNLOAD switch does not function when a cleaning cartridge is in the drive.

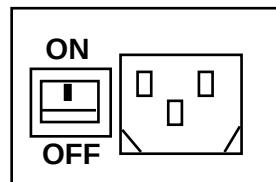
### 3.4.2 FORMAT switch

Field service personnel use the FORMAT switch to execute diagnostics. Users should not need to operate this switch.

### 3.4.3 Power Switch

The AC power switch (the on- off switch) is located on the rear panel, as shown below:

**Figure 3.3 On/Off Switch Detail**



## 3.5 Indicator Functions

All of the indicators are located on the front panel (see Figure 3.1 on the previous page, and the following detail)

**Figure 3.4 Indicators**



### 3.5.1 Hexadecimal Display

The two- digit hexadecimal LEDs display the format code F0 (if this configuration parameter is enabled) and Fault Symptom Codes (FSC).

### 3.5.2 Fault Indicator

The Fault indicator lights when a fault is detected (along with the hexadecimal display).

### 3.5.3 Active Indicator

- The Active indicator lights when:
- A tape motion command is being executed.
- A cleaning cartridge is inserted.
- A cartridge is being loaded or unloaded (the light flashes).
- During power on self testing until the drive is ready to accept a cartridge.

### 3.5.4 Write- Enable Indicator

The Write- Enable (WRT EN) indicator lights when a cartridge that is not write protected is loaded. During the long and short diagnostics read/write tests, indicating that either a write protected cartridge was ejected, or the write portion of the diagnostic is in progress.

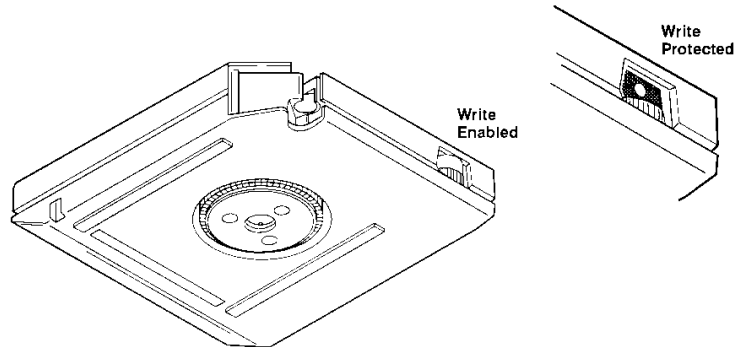
### 3.5.5 Power Indicator

The Power indicator lights whenever the drive is on.

## 3.6 Loading a Cartridge

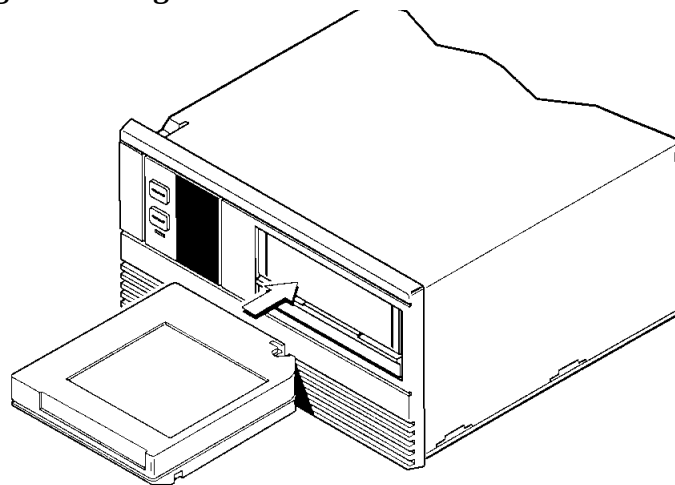
Check that the write- protect switch on the tape cartridge is in the correct position.

**Figure 3.5 Cartridge Detail**



1. Insert the tape cartridge into the drive as shown below, the hub is down and the leader block is on the drive's right. Slide the cartridge in gently until it reaches the physical stop.
2. The drive automatically finishes loading the cartridge and threading the tape. The Active indicator flashes while the drive loads the tape.

**Figure 3.6 Loading A Cartridge**



### 3.6.1 Aborting a Load

1. A load operation can be aborted by pressing the UNLOAD switch. As soon as the loading operation is completed, the drive unloads the cartridge.

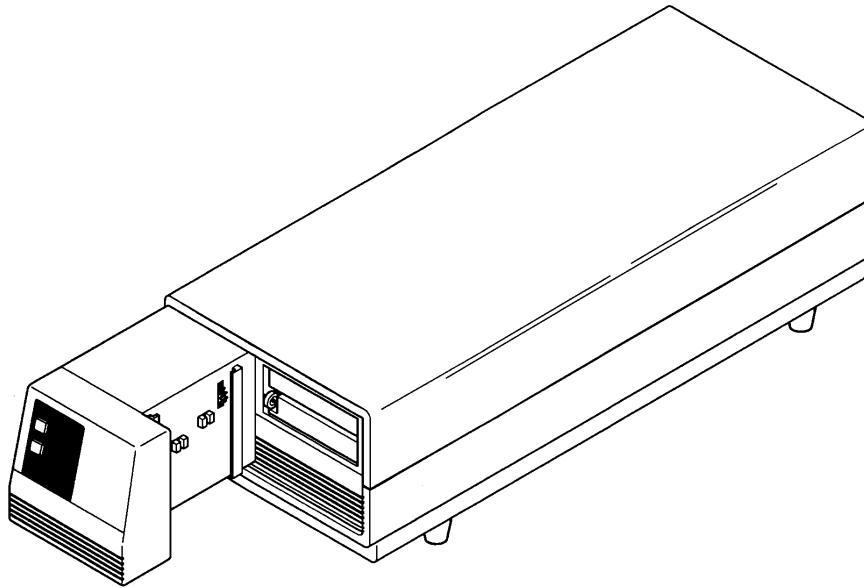
### **3.6.2 Unloading a Cartridge**

1. Press the UNLOAD switch. Any uncompleted drive commands are completed, data in the cache memory is written to tape, the tape is rewound, then the drive unthreads the tape and ejects the tape cartridge.
2. Pull the tape cartridge out of the drive.

## 3.7 Operation With Automatic Cartridge Loader (ACL) Installed

This section explains how to operate the tape drive when an Automatic Cartridge Loader (ACL) is installed.

**Figure 3.7 Unit with Automatic Cartridge Loader**



### 3.7.1 Inserting Cartridges into a Magazine

A magazine does not need to be fully loaded with cartridges to be used. When loading the magazine, always begin loading with the top slot without skipping any slots until the desired number of cartridges are loaded.

Insert cartridges into the magazine so that the front (end with the tape leader block and the write-protect switch) is at the open end of the magazine. Cleaning cartridges may be inserted into a magazine with data cartridges.

### 3.7.2 Loading a Magazine

1. Check that a cartridge is not in the drive; if one is, remove it.  
Align the rails on the side of the magazine with the mating rails in the ACL.
2. Place the magazine into the ACL from the top, with the open end facing the front of the tape drive.
3. Press the UNLOAD switch.  
The ACL lowers the magazine, then loads the cartridge that is in the top slot of the magazine into the tape drive.

**NOTE:** Do not hold the UNLOAD switch pressed. If it is held for longer than 5 seconds, the unit will enter into its diagnostic mode.

### 3.7.3 Unloading a Magazine

1. Check that the ACL is not loading or unloading a cartridge.
2. Remove the magazine from the ACL by lifting up by the handle.

### **3.7.4 Aborting ACL Operation**

ACL operation can be aborted at any time with this procedure:

1. Check that the ACL is not loading or unloading a cartridge.
2. Remove the magazine by lifting up on it up by the handle.
3. Press the UNLOAD switch to unload a cartridge in the drive.

### **3.7.5 Manual Operation**

Individual cartridges may be manually loaded and unloaded into the tape drive if a magazine is not loaded into the ACL.

Operation is the same as if the ACL were not installed.

### **3.7.6 Removing a Trapped Cartridge**

A cartridge trapped between the tape drive and the ACL magazine can be removed as follows.

1. Insert a pencil or similar instrument into the access hole in the back of the magazine and push the cartridge into the tape drive.
2. Remove the magazine from the ACL.
3. Press the UNLOAD switch to eject the cartridge.  
Any uncompleted drive commands are completed, data in the cache memory is written to tape, the tape is rewound, then the drive unthreads the tape and ejects the tape cartridge.

**NOTE:** After *All* of the cartridges have been used in the magazine, you must remove it completely and either reinsert it, or replace it with a fresh magazine, before further access to the tapes can be made.

## 3.8 Routine Maintenance

### 3.8.1 Introduction

The following explains how to perform preventive maintenance to the tape drive, which is limited to cleaning the tape path.

### 3.8.2 Tape Path

The tape path should be cleaned after approximately eight hours tape motion across the heads, using a high- quality cleaning cartridge.

Please follow this procedure.

1. Load a cleaning cartridge into the tape drive (or into a slot in an Automatic Cartridge Loader magazine) as you would a data cartridge.
2. On units without an Automatic Cartridge Loader (ACL), remove the cleaning tape after the drive automatically ejects it.

### 3.8.3 Tape Accessories

Digital recommends the use of the following products to extend the life of your tape transport:

**Table 3.1 Recommended Tape Accessories**

| Digital Part Number | Description                                            |
|---------------------|--------------------------------------------------------|
| TA90K- 30           | 3480 Compatible Half- Inch Tape Cartridge (pack of 30) |
| TA90K- HC           | Cleaning Cartridge (Pack of 5)                         |



## **4 - Troubleshooting**



## **4.1 Introduction**

This chapter describes both the On-Line System diagnostics and the self-diagnostic and troubleshooting capabilities designed into the tape drive. It explains how tape processing errors and tape drive faults are reported and how to use the diagnostics resident in the drive's firmware. It also provides a list of error recovery procedures.

## **4.2 Host Diagnostics - OpenVMS Systems**

### **4.2.1 On-line**

For OpenVMS System, UETP should be run to exercise the tape drive. Log into the SYSTEST account. Make sure the UETINIT.DAT file is set for the device number the tape drive is set for. (The default for TKZ60 is "4"). If it is not, edit the file and change the number. Initialise the tape drive UETP. "RUN UETTAPE00". The tape drive should run through one pass without errors.

### **4.2.2 Off-line**

For MicroVAX systems where the TKZ60 is connected via a KZQSA, the drive can be tested using the MicroVAX Diagnostic Monitor (MDM). Consult the "MicroVAX Diagnostic Monitor User's Guide" for proper MDM operation. Make sure that the magnetic tape that you use is blank or a scratch tape. Failure to do so may result in a loss of data.

MDM release 137 is the first version that recognises the TKZ60. If the unit is being used with OpenVMS 5.4- 1 to 5.5- 1 and its device ID is set to TSZ07, then MDM release 135 onwards can be used.

## **4.3 Host Diagnostics - ULTRIX & OSF/1 Systems**

To verify the operation of the tape drive on ULTRIX and OSF/1 systems, use either the "tapex" or "mtx" diagnostics. For detailed descriptions of how to run these diagnostics, refer to your ULTRIX or OSF/1 manuals.

## 4.4 Power- Up Diagnostics

The Power- Up Diagnostics are ROM- resident tests that verify the integrity of the drive's hardware and firmware at power- up. If the diagnostics detect a fault, a Fault Symptom Code (FSC) appears at the hexadecimal display. The Fault Symptom Codes are listed in Table 4- 1.

## 4.5 Extended Power- Up Diagnostics

The Power- Up Diagnostics test the Protocol Controller (CPC) and the data path between the CPC and the High Speed Buffer (HSB). The Power- Up Diagnostics do not test the SCSI Protocol Controller (SPC) and the data path between the SPC and the High Speed Buffer (HSB). These can be tested with the Extended Power- Up Diagnostics. Note: Before running the Extended Power- Up Diagnostics, the drive should be disconnected from the SCSI bus and terminated.

The Extended Power- Up Diagnostics are invoked by switching on the ac power while pressing one or both of the front panel switches.

Three options are available:

1. Press the FORMAT switch to execute the full SPC chip and SPC- HSB loopback tests.  
**NOTE:** This test is usefull to determine if the drive is correctly terminated, ie if no terminator or TermPWR fuse is blown, then **FSC 05** will be displayed.
2. Press the UNLOAD switch to bypass the 80188 processor power- up test results. This is useful when trying to test the drive- side only, such as the servo and read/write functions. Diagnostics 1 and 2 can be run in this condition. Note: The 80188 is stuck in the power- up state in this condition, and no host communication is supported.
3. Press both the Unload and FORMAT switches to cause the power- up diagnostics to loop continuously. This is useful for trapping an intermittent problem. The Full power- up diagnostics, except for the servo tests, are executed repeatedly as long as all tests pass. As soon as a test fails, that test locks up. Each test has a unique lock- up loop. The drive must be switched off to stop this diagnostic.

## 4.6 Fault Symptom Codes

The drive is capable of detecting operator errors and machine faults. Once detected the drive displays a Fault Symptom Code (FSC) on the hexadecimal display. Error Recovery Procedures (ERP) should then be performed to correct the error or fault. When several ERPs are identified, try the first ERP, then check the drive for the same or a new FSC before trying the second, third, etc. ERPs.

In some cases the ERP requires the replacement of a Field Replaceable Unit (FRU). When several FRUs are identified as possible causes of an FSC, replace the first FRU, then check the drive for the same or a new FSC before replacing the second, third, etc. FRUs.

### 4.6.1 Drive vs. ACL

The tape drive uses two- digit FSCs to report errors and faults. The ACL uses only single- digit codes for reporting. Thus, if the digital display outputs a two- digit code, refer to Table4- 1 to determine the problem; if a single- digit FSC is reported, refer to Table 4- 4. If a recovery procedure does not cause a cartridge to be ejected, cycle the UNLOAD switch.

Table 4- 1 lists a code number for the ERP and FRU's associated with each FSC, as well as a description of the FSC. Table 4- 2 decodes the ERP column and Table 4- 3 decodes the FRU column.

**Note:** The letters B and D appear at the hexadecimal display as lower case b and d.

**Table 4.1 Fault Symptoms Code**

| <b>FSC</b> | <b>Description of Error or Fault</b> | <b>ERP (Table 4.2)</b> | <b>FRU (Table 4.3)</b> |
|------------|--------------------------------------|------------------------|------------------------|
| <b>01</b>  | Z8002 CPU, ROM, or RAM               | 3, 5, 6                | 3                      |
| <b>02</b>  | 80188 RAM or communication buffer    | 3, 5, 6                | 3                      |
| <b>03</b>  | 80188 ALU                            | 3, 5, 6                | 3                      |
| <b>04</b>  | ESP interrupt                        | 3, 5, 6                | 3                      |
| <b>05</b>  | 80188 RAM data path to ESP FIFO      | 3, 5, 6                | 3                      |
| <b>06</b>  | Inter- processor interrupt lines     | 3, 5, 6                | 3                      |
| <b>07</b>  | Communications buffer arbitration    | 3, 5, 6                | 3                      |
| <b>08</b>  | HSB to ESP data transmission         | 3, 5, 6                | 3                      |
| <b>09</b>  | ESP to HSB data transmission         | 3, 5, 6                | 3                      |
| <b>0A</b>  | DBC interrupt absent                 | 3, 5, 6                | 3                      |
| <b>0B</b>  | Z8002 RAM                            | 3, 5, 6                | 3                      |
| <b>0C</b>  | Z8002 CPU                            | 3, 5, 6                | 3                      |
| <b>0D</b>  | CIO register                         | 3, 5, 6                | 3                      |
| <b>0E</b>  | CIO timer accuracy                   | 3, 5, 6                | 3                      |
| <b>0F</b>  | Non- volatile memory                 | 3, 5, 6                | 3                      |
| <b>10</b>  | Z8002- side communication buffer     | 3, 5, 6                | 3                      |
| <b>11</b>  | HSB RAM                              | 3, 5, 6                | 3                      |
| <b>12</b>  | HSB to Z8002 parity                  | 3, 5, 6                | 3                      |
| <b>13</b>  | DMA register                         | 3, 5, 6                | 3                      |
| <b>14</b>  | DMA scratch RAM                      | 3, 5, 6                | 3                      |
| <b>15</b>  | DMA auto- test                       | 3, 5, 6                | 3                      |
| <b>16</b>  | HSB to cache parity                  | 3, 5, 6                | 3                      |
| <b>17</b>  | HSB to cache data transfer           | 3, 5, 6                | 3                      |
| <b>18</b>  | Cache to HSB data transfer           | 3, 5, 6                | 3                      |
| <b>19</b>  | CDM FIFO loopback                    | 3, 5, 6                | 3                      |
| <b>1A</b>  | Write ID failure                     | 3, 5, 6                | 2,3                    |
| <b>1B</b>  | Write filemark failure               | 3, 5, 6                | 2,3                    |
| <b>1D</b>  | Read/write registers                 | 3, 5, 6                | 2,3                    |
| <b>1E</b>  | Z8002 ROM checksum                   | 3, 5, 6                | 3                      |
| <b>1F</b>  | Block size mismatch                  | 3, 5, 6                | 2, 3                   |
| <b>20</b>  | Read CRC error                       | 3, 5, 6                | 2, 3                   |
| <b>21</b>  | ECC failure during loopback          | 3, 5, 6                | 2, 3                   |
| <b>22</b>  | Multi- track error correction        | 3, 5, 6                | 2, 3                   |
| <b>23</b>  | Write formatter overrun detection    | 3, 5, 6                | 2, 3                   |
| <b>24</b>  | Write formatter CRC detection        | 3, 5, 6                | 2, 3                   |
| <b>25</b>  | No GAPOUT signal                     | 3, 5, 6                | 2, 3                   |
| <b>26</b>  | No RIRQ signal                       | 3, 5, 6                | 2, 3                   |
| <b>27</b>  | No WIRQ signal                       | 3, 5, 6                | 2, 3                   |

| <b>FSC</b> | <b>Description of Error or Fault</b>                | <b>ERP (Table 4.2)</b> | <b>FRU (Table 4.3)</b> |
|------------|-----------------------------------------------------|------------------------|------------------------|
| <b>28</b>  | Hard error during loopback test                     | 3, 5, 6                | 2, 3                   |
| <b>29</b>  | Read/Write card command reject                      | 3, 5, 6                | 2, 3                   |
| <b>2A</b>  | Write CRC error                                     | 3, 5, 6                | 2, 3                   |
| <b>2B</b>  | Data overrun                                        | 3, 5, 6                | 2, 3                   |
| <b>2C</b>  | Cache RAM                                           | 3, 5, 6                | 3, 2                   |
| <b>2D</b>  | Single track error correction                       | 3, 5, 6                | 2, 3                   |
| <b>2E</b>  | Invalid host interface                              | 4, 11, 5, 6            | 3                      |
| <b>2F</b>  | Missing EOD during read                             | 4, 11, 5, 6            | 3                      |
| <b>31</b>  | No cartridge ejection                               | 3, 5, 6                | 3, 4, 8                |
| <b>33</b>  | No one- line sensor transitions; take- up reel lock | 3, 5, 6                | 3, 4, 6                |
| <b>34</b>  | Load retries exceeded                               | 8, 7, 2, 3, 5, 6       | 3, 4, 7, 8, 9          |
| <b>35</b>  | Cartridge- in switch                                | 2, 5, 6                | 3, 8                   |
| <b>36</b>  | Supply motor                                        | 3, 5, 6                | 3, 4                   |
| <b>37</b>  | Tape cannot be tensioned                            | 8, 7, 2, 3, 5, 6       | 3, 4, 5, 8             |
| <b>38</b>  | Tape radius illegal                                 | 8, 7, 2, 3, 5, 6       | 3, 4, 5, 6             |
| <b>39</b>  | Cleaner radius illegal                              | 2, 5, 6                | 3, 8                   |
| <b>3A</b>  | No supply motor motion during thread                | 8, 7, 2, 3, 5, 6       | 3, 4, 5, 9             |
| <b>3C</b>  | Threading travel too short                          | 8, 7, 2, 3, 5, 6       | 3, 4, 5, 9             |
| <b>3D</b>  | Excessive supply motor motion during unthread       | 8, 7, 2, 3, 5, 6       | 3, 5                   |
| <b>3E</b>  | Unthread home position out of range                 | 8, 7, 2, 3, 5, 6       | 3, 5, 9                |
| <b>40</b>  | Tachometer                                          | 3, 5, 6                | 3, 5                   |
| <b>41</b>  | Tension sensor output                               | 3, 5, 6                | 3, 7                   |
| <b>47</b>  | Tension sensor A/D converter                        | 3, 5, 6                | 3                      |
| <b>48</b>  | Servo amplifier offset bias                         | 3, 5, 6                | 3, 4                   |
| <b>50</b>  | Attempted to run off BOT end                        | 3, 5, 6                | 3, 4                   |
| <b>51</b>  | Attempted to run off EOT end                        | 3, 5, 6                | 3, 4                   |
| <b>52</b>  | Tach ULA long- term error                           | 3, 5, 6                | 3, 5                   |
| <b>53</b>  | Tach ULA short- term error                          | 3, 5, 6                | 3, 5                   |
| <b>54</b>  | Motor calibration required                          | 9, 5, 6                | 3                      |
| <b>55</b>  | Position error                                      | 3, 2, 5, 6             | 3, 4, 5, 6             |
| <b>56</b>  | Fine- line tachometer                               | 5, 6                   | 3, 5, 6                |
| <b>5C</b>  | Servo positioning routine                           | 5, 6                   | 3                      |
| <b>5D</b>  | Servo interface routine                             | 5, 6                   | 3                      |
| <b>5F</b>  | 1 msec overrun                                      | 5, 6                   | 3                      |
| <b>60</b>  | Thin tape detected and rejected                     | 2                      |                        |
| <b>61</b>  | No supply reel movement                             | 2, 5, 6                | 3, 5                   |
| <b>62</b>  | No spooling                                         | 8, 7, 2, 3, 5, 6       | 3, 4, 5, 6, 9          |
| <b>63</b>  | No tension sensor at spool                          | 3, 5, 6                | 3, 7                   |
| <b>64</b>  | Unable to determine tape thickness                  | 7, 5, 6                | 5, 3                   |
| <b>65</b>  | Slow up- ramp error                                 | 2, 3, 5, 6             | 3, 4, 5, 6             |

| <b>FSC</b> | <b>Description of Error or Fault</b>               | <b>ERP (Table 4.2)</b> | <b>FRU (Table 4.3)</b> |
|------------|----------------------------------------------------|------------------------|------------------------|
| <b>66</b>  | Fast up- ramp error                                | 2, 3, 5, 6             | 3, 4, 5, 6             |
| <b>67</b>  | Slow down- ramp error                              | 2, 3, 5, 6             | 3, 4, 5, 6             |
| <b>68</b>  | Fast down- ramp error                              | 2, 3, 5, 6             | 3, 4, 5, 6             |
| <b>69</b>  | Forward speed too fast                             | 2, 3, 5, 6             | 3, 4, 5                |
| <b>6A</b>  | Forward speed too slow                             | 2, 3, 5, 6             | 3, 4, 5                |
| <b>6C</b>  | Reverse speed too fast                             | 2, 3, 5, 6             | 3, 4, 5                |
| <b>6D</b>  | Reverse speed too slow                             | 2, 3, 5, 6             | 3, 4, 5                |
| <b>6E</b>  | Motor torque measurement                           | 3, 9, 5, 6             | 3, 4, 5, 6             |
| <b>6F</b>  | Motor torque recording error                       | 3, 9, 5, 6             | 3, 9, 6                |
| <b>70</b>  | Invalid servo state in servo loop                  | 3, 5, 6                | 3                      |
| <b>71</b>  | Illegal servo state for request forward            | 3, 5, 6                | 3                      |
| <b>72</b>  | Unknown servo state for request forward            | 3, 5, 6                | 3                      |
| <b>73</b>  | Illegal servo state for request reverse            | 3, 5, 6                | 3                      |
| <b>74</b>  | Unknown servo state for request reverse            | 3, 5, 6                | 3                      |
| <b>75</b>  | Illegal servo state for request stop               | 3, 5, 6                | 3                      |
| <b>76</b>  | Unknown servo state for request stop               | 3, 5, 6                | 3                      |
| <b>77</b>  | Tape did not unspool within 1 minute during unload | 3, 5, 6                | 3 4, 5, 6              |
| <b>7F</b>  | Error in servo table generation                    | 3, 5, 6                | 3                      |
| <b>80</b>  | No WIRQ interrupt                                  | 3, 5, 6                | 2                      |
| <b>81</b>  | Reinstruct error at write                          | 4, 5, 6                | 3                      |
| <b>82</b>  | Reinstruct error at read                           | 4, 5, 6                | 3                      |
| <b>83</b>  | Write command reject                               | 4, 5, 6                | 2, 3                   |
| <b>84</b>  | Read command reject                                | 4, 5, 6                | 2, 3                   |
| <b>85</b>  | No write voltage at write                          | 3, 5, 6                | 2                      |
| <b>86</b>  | Write or erase voltage at read                     | 5, 6                   | 2, 3                   |
| <b>87</b>  | Write CRC                                          | 3, 5, 6                | 2, 3                   |
| <b>88</b>  | Write overrun                                      | 3, 5, 6                | 2, 3                   |
| <b>89</b>  | No GAPOUT at write                                 | 1- 3, 5, 6             | 2, 7                   |
| <b>8A</b>  | No RIRQ with GAPOUT at writ                        | 1- 3, 5, 6             | 2, 7                   |
| <b>8C</b>  | Cache data overrun at read                         | 5, 6                   | 2, 3                   |
| <b>8D</b>  | Hard error at write                                | 1- 3, 5, 6             | 2, 7                   |
| <b>8E</b>  | Multi- track error corrected at write              | 1- 3, 5, 6             | 2, 7                   |
| <b>8F</b>  | Write formatter not enabled                        | 1- 3, 5, 6             | 2, 7                   |
| <b>90</b>  | Block size error at write                          | 3, 5, 6                | 2                      |
| <b>91</b>  | CRC mismatch at write                              | 3, 5, 6                | 7, 2, 3                |

| <b>FSC</b> | <b>Description of Error or Fault</b>       | <b>ERP (Table 4.2)</b> | <b>FRU (Table 4.3)</b> |
|------------|--------------------------------------------|------------------------|------------------------|
| <b>92</b>  | CRC mismatch at read                       | 5, 6                   | 7, 2, 3                |
| <b>93</b>  | Block sequence error at write              | 3, 5, 6                | 3                      |
| <b>94</b>  | Non- standard format read                  | 1- 4, 5, 6             | media,7                |
| <b>95</b>  | Hardware/firmware                          | 5, 6                   | 3                      |
| <b>96</b>  | Hardware/firmware erro                     | 5, 6                   | 3                      |
| <b>97</b>  | IO burst error during read                 | 1 - 3, 5               | 2, 7                   |
| <b>98</b>  | Physical end of tape                       | 5, 6                   | 2, 3                   |
| <b>99</b>  | Block greater than 64k encountered at read | 6                      |                        |
| <b>9A</b>  | GAPIN error at write                       | 3, 5, 6                | 3                      |
| <b>9C</b>  | ID burst error during write                | 1- 3, 5, 6             | 2, 7                   |
| <b>9D</b>  | Read formatter                             | 4, 5, 6                | 2, 3                   |
| <b>9E</b>  | Undefined error                            | 5, 6                   | 2, 3                   |
| <b>B0</b>  | Noise error                                | 3, 5, 6                | 3                      |
| <b>B1</b>  | Firmware error                             | 3, 5, 6                | 3                      |
| <b>B2</b>  | Internal bus                               | 3, 5, 6                | 3                      |
| <b>B3</b>  | Hardware/firmware                          | 3, 5, 6                | 3                      |
| <b>B4</b>  | Noise error                                | 3, 5, 6                | 3                      |
| <b>C0</b>  | Firmware error                             | 3, 5, 6                | 3                      |
| <b>C2</b>  | Hardware malfunction                       | 3, 5, 6                | 3                      |
| <b>C3</b>  | Invalid host type                          | 5, 6                   | 3                      |
| <b>C6</b>  | Block sequence error                       | 10, 5, 6               | media, 3               |
| <b>C7</b>  | Communication buffer interrupt             | 3, 5, 6                | 3                      |
| <b>C8</b>  | Read retries exceeded                      | 1- 3, 9, 5, 6          | 7, 2, 3                |
| <b>C9</b>  | Unrecognizable format                      | 1- 3, 5, 6             | 7, 2                   |
| <b>CA</b>  | Cache to HSB CRC                           | 3, 5, 6                | 3, 2                   |
| <b>CC</b>  | I/O bus parity                             | 4, 11, 3, 5, 6         | 3                      |
| <b>CD</b>  | HSB to cache parity                        | 4, 11, 3, 5, 6         | 3                      |
| <b>CE</b>  | HSB to Z8002 parity error                  | 3, 5, 6                | 3                      |
| <b>CF</b>  | AWR test terminated                        | 3, 5, 6                | 3                      |
| <b>E0</b>  | 80188 firmware error                       | 3, 5, 6                | 3                      |
| <b>E1</b>  | 80188 kernel error                         | 3, 5, 6                | 3                      |
| <b>E2</b>  | HOST bus parity error                      | 4, 11, 3, 5, 6         | 3                      |

**Table 4.2 Error Recovery Procedure**

| Number | Error Recovery Procedure                                                    |
|--------|-----------------------------------------------------------------------------|
| 01     | Clean Tape path                                                             |
| 02     | Change the tape cartridge and retry                                         |
| 03     | Cycle power to run POST and retry                                           |
| 04     | Switch OFF, reseal interface connectors, switch ON and retry                |
| 05     | Replace indicated FRU and retry                                             |
| 06     | Call Product Support                                                        |
| 07     | Check cartridge loaded correctly                                            |
| 08     | Inspect cartridge, check loader block in place                              |
| 09     | Run requested diagnostic then retry                                         |
| 10     | Check command sequence is valid                                             |
| 11     | Check interface cabling, the termination and drive configuration parameters |

**Table 4.3 FRU Table Code Numbers**

| Number | FRU Description            |
|--------|----------------------------|
| 01     | Power Supply               |
| 02     | Read/Write PCB             |
| 03     | Control PCB (Single Ended) |
| 03     | Control PCB (Differential) |
| 04     | Servo PCB                  |
| 05     | Supply Motor               |
| 06     | Takeup Motor               |
| 07     | Head- Tape path            |
| 08     | Loader                     |

**NOTE:** Please refer to Table 5.1 for the FRU Part numbers.

**Table 4.4 ACL Fault Symptom Chart**

| <b>FSC</b> | <b>Cause/Recovery Procedure</b>                                                                                                                                                                                          |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>   | <p>The top slot of the magazine is empty.</p> <p>Remove the magazine, load a cartridge, reload the magazine, and press the UNLOAD switch to restart operation</p>                                                        |
| <b>2</b>   | <p>A magazine load was attempted with a cartridge in the drive.</p> <p>Remove the magazine, press the UNLOAD switch to eject the cartridge, reload the magazine, and press the UNLOAD switch to restart operation</p>    |
| <b>4</b>   | <p>The magazine was moved manually, aborting operation.</p> <p>Remove the magazine, press the UNLOAD switch to eject the cartridge</p>                                                                                   |
| <b>6</b>   | <p>ACL operation cannot be started.</p> <p>If a magazine from a previous operation is still loaded, remove it. If operation still cannot be started, cycle the drive power</p>                                           |
| <b>7</b>   | <p>The drive did not accept the cartridge, the cartridge is in the drive and operation was aborted.</p> <p>Remove the magazine.</p>                                                                                      |
| <b>8</b>   | <p>The drive did not accept the cartridge, the cartridge ejected into the magazine and operation aborted.</p> <p>Remove the magazine, then reload it. Alignment of the ACL to the drive may be required.</p>             |
| <b>9</b>   | <p>The cartridge could not be unloaded into the magazine and was reloaded into the drive; operation was aborted. Remove the magazine.</p>                                                                                |
| <b>A</b>   | <p>The cartridge was trapped between the drive and the magazine during a load.</p> <p>Refer to Trapped Cartridge Removal and Manual Unload.</p>                                                                          |
| <b>B</b>   | <p>The cartridge was trapped between the drive and the magazine during an unload.</p> <p>Refer to Trapped Cartridge Removal and Manual Unload</p>                                                                        |
| <b>C</b>   | <p>The magazine did not lower at the start of operation, which was aborted.</p> <p>Check that the cartridge is not upside down or backwards in the magazine, if not, remove the magazine and check for obstructions.</p> |
| <b>D</b>   | <p>The magazine did not rise to the fully raised position; operation was aborted.</p> <p>Remove the magazine carefully.</p>                                                                                              |
| <b>E</b>   | <p>The ACL's slider mechanism did not initialize.</p> <p>Remove the magazine and cycle the drive power.</p>                                                                                                              |
| <b>F</b>   | <p>The ACL's picker mechanism did not initialize.</p> <p>Remove the magazine and cycle the drive power.</p>                                                                                                              |

## 4.7 Drive Diagnostics

The drive's diagnostics provide the capability of configuring the drive, testing various FRUs, and calibrating motors. There are two levels of diagnostics, **Level 1** and **Level 2**.

All the diagnostics in the following sections are listed with their test number in (brackets). The test number must be entered into the drive using the front panel switches to enter the diagnostic mode and run the diagnostic.

### 4.7.1 Level 1 Diagnostics, Data Integrity Testing

The Level 1 Diagnostics provide a means of performing simple data integrity and hardware tests, as well as of reviewing the configuration parameters.

The following procedure causes the drive to enter the Level 1 Diagnostics mode and allows these diagnostics to be selected and executed.

1. If a cartridge is loaded in the drive, unload it.
2. While pressing the UNLOAD switch, press the FORMAT switch.
3. Release the FORMAT switch, then the UNLOAD switch; the hexadecimal display shows code 00.
4. Press the FORMAT switch to increment the hexadecimal display to the desired test number.
5. Press the UNLOAD switch and release it within two seconds to execute the diagnostic.

If an invalid test number is entered, the drive flashes the Fault indicator and re- enters the operating mode.

To exit the Level 1 Diagnostics mode at any time, even when a diagnostic is executing, and reenter the operating mode, press the UNLOAD switch for at least two seconds.

### 4.7.2 Short Read/Write Test (01)

This diagnostic provides a means of quickly testing the read and write functions of the drive. It begins by flashing 01 at the hexadecimal display to indicate that a write- enabled cartridge should be loaded. (If a write- protected cartridge is loaded, the drive ejects the cartridge and flashes the Write- Enable indicator until a write- enabled cartridge is loaded or the UNLOAD switch is pressed.)

If a cartridge is not loaded within ten seconds, the drive exits the diagnostic mode and re- enters the operating mode.

If a cartridge is loaded, the drive displays 01 continuously and writes 32- kilobyte blocks of incrementing data to the Logical End of Partition, rewinds the tape, reads the data in the forward direction, then reads the data in reverse.

While writing the drive flashes the Write- Enable indicator to distinguish between the read and write portions of the diagnostic.

The diagnostic can be "paused" by pressing the FORMAT switch; pressing the switch a second time causes the diagnostic to resume.

When the test finishes, the tape is unthreaded and the cartridge is ejected.

If the diagnostic is aborted because the UNLOAD switch was pressed, the code CF is displayed.

### 4.7.3 Long Read/Write Test (02)

This diagnostic provides a means of testing the read and write functions of the drive for an indefinite period.

It begins by flashing 02 at the hexadecimal display to indicate that a write- enabled cartridge should be loaded. (If a write- protected cartridge is loaded, the drive ejects the cartridge and flashes the Write- Enable indicator until a write- enabled cartridge is loaded or the UNLOAD switch is pressed.)

If a cartridge is not loaded within ten seconds, the drive exits the diagnostic mode and re- enters the operating mode.

If a cartridge is loaded, the drive displays 02 continuously and writes 32- kilobyte blocks of incrementing data to the Logical End of Partition.

The data is then read in the reverse direction before being read again in the forward direction. This sequence repeats continuously until the diagnostic is stopped by pressing the UNLOAD switch.

While writing the drive flashes the Write- Enable indicator to distinguish between the read and write portions of the diagnostic.

The diagnostic can be "paused" by pressing the FORMAT switch; pressing the switch a second time causes the diagnostic to resume.

When the test is stopped, the tape is unthreaded and the cartridge is ejected and the code CF is displayed.

#### **4.7.4 Indicators Test (03)**

This diagnostic outputs the code 88 on the hexadecimal display and lights the Fault, Active, and Write Enable indicators for two seconds, then re- enters the operating mode.

#### **4.7.5 Firmware Levels (04)**

This diagnostic displays the revision levels of the firmware for the device processor (Z8002) and for the interface processor (80188). It begins by displaying the major revision number of the device firmware, the first code of the table below.

**Table 4.5 Firmware Levels**

| <b>CODE</b> | <b>PARAMETER</b>                |
|-------------|---------------------------------|
| <b>01</b>   | Device major revision number    |
| <b>02</b>   | Device minor revision number    |
| <b>03</b>   | Interface major revision number |
| <b>04</b>   | Interface minor revision number |

Pressing the FORMAT switch causes the code for the next parameter to appear; the code is shown as long as the switch is held down. As soon as the switch is released, the revision number for that code is shown. Once the last code is reached, pressing the FORMAT switch again causes the first code to appear. Press the UNLOAD switch to exit the diagnostic.

#### **4.7.6 Device Settings (05)**

This diagnostic allows the Device Configuration Parameters listed in Table 4- 6 to be checked (but not changed). It begins by displaying the parameter setting (either a 1 or a 2) for the first configuration parameter in Table 4- 6 (Format Display).

Pressing the FORMAT switch causes the code for the next parameter (Power- up Restart) to appear; the code is shown as long as the FORMAT switch is held down.

As soon as the FORMAT switch is released, the parameter setting for that configuration parameter is shown. Once the last parameter is reached, pressing the FORMAT switch again causes the code for parameter 1 to appear.

Press the UNLOAD switch to exit the diagnostic.

**Table 4.6 Device Configuration Parameters**

| <b>Code</b> | <b>Configuration Parameter</b>       | <b>Parameter Settings</b>                                                                                                                                                                                                                              |
|-------------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>01</b>   | Format display                       | 01=enable, 02=disable                                                                                                                                                                                                                                  |
| <b>02</b>   | Power- up restart                    | 01=unload cartridge, 02=load cartridge                                                                                                                                                                                                                 |
| <b>03</b>   | Write synchronization                | 00=nosynchronisation, 01=synchronise on 1 filemark<br>02=synchronise on 2 consecutive filemarks<br>03=synchronise on every write                                                                                                                       |
| <b>04</b>   | Write synchronization before reverse | 01=enable, 02=disable                                                                                                                                                                                                                                  |
| <b>05</b>   | Number of read error retries         | 03=4 Retries, 4=8 R, 5=16 R, 6=32 R                                                                                                                                                                                                                    |
| <b>06</b>   | Number of write error retries        | 01=1 Retry, 02=2 R, 03=4 R, 04=8R, 05=16 R                                                                                                                                                                                                             |
| <b>07</b>   | Block size                           | 00=variable block mode, 01=4Bytes, 02=8B,<br>03=16B, 04=32B, 05=64B, 06=128B, 07=256B,<br>08=512B, 09=1kB, 10=2kB, 11=4kB, 12=8kB,<br>13=16kB, 14=32kB, 15=64kB                                                                                        |
| <b>08</b>   | Vendor ID                            | 01 = Cipher, 02 = NCR, 03 = HP, 04 = Fujitsu,<br>05 = DEC, 06 = STK, 07 = HPCipher, 08 = LMS,<br>09 = Exabyte, 10 = Kennedy                                                                                                                            |
| <b>09</b>   | Product ID                           | 01 = T480, 02 = M995, 03 = F880ES,<br>04 = 0- STD1- 0, 05 = 88780, 06 = M1016A M2481A<br>07 = M1016B, 08 = M1016AD, 09 = M1016BD,<br>10 = TSZ05, 11 = TSZ07, 12 = 4280, 13 = 92160,<br>14 = EXB- 8200, 15 = 96X2 Tape Unit,<br>16 = TKZ60, 17 = TKZ60L |
| <b>10</b>   | Density                              | 00 = 1600 Bpi, 01 = 6250 Bpi, 02 = 3480                                                                                                                                                                                                                |
| <b>11</b>   | EOD Detect length                    | 01 = Short (3mm) special erase gap detect<br>02 = Long (134mm) special erase gap detect                                                                                                                                                                |
| <b>12</b>   | Link Load/Unload                     | 00 = Disable, 01 = Enable                                                                                                                                                                                                                              |

#### 4.7.7 Interface Settings (06)

This diagnostic allows the SCSI configuration parameters listed in Table 4- 7 to be checked (but not changed). It begins by displaying the parameter setting for the first configuration parameter in Table 4- 7 (Address).

Pressing the FORMAT switch causes the code for the next parameter to appear; the code is shown as long as the FORMAT switch is held down. As soon as the FORMAT switch is released, the parameter setting for that configuration parameter is shown.

Once the last parameter is reached, which is signaled by the Fault indicator lighting, pressing the FORMAT switch again causes the code for parameter 1 to appear. Press the UNLOAD switch to exit the diagnostic.

**Table 4.7 SCSI Interface Settings**

| Code | Configuration Parameter      | Parameter Settings                                                |
|------|------------------------------|-------------------------------------------------------------------|
| 01   | Address                      | 00 to 07                                                          |
| 02   | Interface Parity             | 01 = enable, 02 = Disable                                         |
| 03   | Device Type                  | 00 = 80h, 01 = C5h, 02 = 82H                                      |
| 04   | Rewind Ready                 | 01 = enable, 02 = Disable                                         |
| 05   | SCSI synchronous negotiation | 01 = enable negotiation<br>02 = Disable negotiation               |
| 06   | EOT mode                     | 00 = Normal EOT reporting mode<br>01 = Special EOT reporting mode |

## 4.8 Level 2 Diagnostics

The high- level diagnostics allow for changing configuration parameters, exercising various FRUs for troubleshooting purposes, and calibrating the motors.

The following procedure causes the drive to enter the Level 2 Diagnostics mode and allows these diagnostics to be selected and executed.

1. If a cartridge is loaded in the drive, unload it.
2. While pressing the UNLOAD switch, press the FORMAT switch.
3. Release the FORMAT switch, then the UNLOAD switch. The hexadecimal display shows code 00.
4. Press the FORMAT switch to increment the hexadecimal display to code 09.
5. While pressing the UNLOAD switch, press the FORMAT switch.
6. Release the FORMAT switch, then the UNLOAD switch. The hexadecimal display shows code 10.
7. Press the FORMAT switch to increment the hexadecimal display to the desired test number. While pressing the UNLOAD switch, press the FORMAT switch to decrement the hexadecimal display to the desired test number.
8. Press the UNLOAD switch and release it within two seconds to execute the diagnostic. If an invalid test number is entered, the drive flashes the Fault indicator. Diagnostics that do not use the hexadecimal display show their test number while executing; when finished, they show code 00. To exit a diagnostic while it is executing, press the UNLOAD switch. The drive displays code 00 and remains in the diagnostic mode.
9. When the diagnostic is finished, the drive displays code 00 and remains in the diagnostic mode; other diagnostics may be selected and executed.

To exit the Level 2 Diagnostics mode and reenter the operating mode whenever a diagnostic is not executing, press the UNLOAD switch for at least two seconds but no longer than five seconds..

### 4.8.1 Long Read/Write Test with Buffered Log (12)

This diagnostic is identical in operation to the Level 1 diagnostics Long Read/Write test except that buffered log information is provided to the host via a special interface (for manufacturing run- in testing).

### 4.8.2 Automatic Servo Test (13)

This diagnostic tests the servo by moving tape forward to the end of tape, then rewinding it to the beginning of tape.

The diagnostic begins by flashing 13 at the hexadecimal display to indicate that a cartridge should be loaded.

If a cartridge is not loaded within five seconds, the drive exits the diagnostic. If a cartridge is loaded, the drive displays 13 continuously and begins moving the tape forward.

The FORMAT switch can be pressed at any time to change the direction of tape movement. When the diagnostic finishes, it unthreads the tape, ejects the cartridge, and displays 00.

To exit the diagnostic while it is executing, press the UNLOAD switch.

The drive displays code 00 and remains in the diagnostic mode.

### 4.8.3 Manual Servo Test (15)

This diagnostic is similar to diagnostic 13 except that the FORMAT switch can be pressed at any time to stop tape movement. Pressing the switch a second time restarts tape movement in the opposite direction.

To exit the diagnostic, press the UNLOAD switch. The drive unthreads the tape, ejects the cartridge, displays 00 and remains in the diagnostic mode.

### 4.8.4 Default Configuration (30)

This diagnostic initializes the drive's SCSI configuration parameters in the non-volatile memory to the defaults shown in Table 4-8 and runs the Motor Torque Calibration Diagnostic (70). Interface Configuration Parameters are shown in Table 4-8. When finished, 00 appears at the hexadecimal display.

**Note:** If an error code 54 occurs, this diagnostic must be run before loading a cartridge.

### 4.8.5 Power- up Restart (42)

This diagnostic allows the power-up restart configuration parameter to be changed. The setting of the power-up restart parameter determines whether a cartridge in the drive when the power is switched on is unthreaded and ejected or positioned at load point.

The diagnostic begins by displaying the numeric code of the current parameter setting.

Refer to Table 4-8 for the available settings and their numeric codes.

Pressing the FORMAT switch changes the numeric code of the parameter setting. Pressing the UNLOAD switch saves a parameter setting in the non-volatile memory.

The display flashes the setting twice to show that it is being saved, then outputs 00 to indicate the diagnostic is finished. (Be sure the parameter is set as desired before pressing Unload.) If the FORMAT switch is not used during the diagnostic, the setting is not flashed twice.

### 4.8.6 Format Display (43)

This diagnostic allows the display format configuration parameter to be changed. The setting of the format display parameter determines whether the code F0 appears at the hexadecimal display when the drive is operating.

The diagnostic begins by displaying the numeric code for the current parameter setting. Refer to Table 4-8 for the available settings and their numeric codes. Pressing the FORMAT switch changes the numeric code of the parameter setting.

Pressing the UNLOAD switch saves a parameter setting in the non-volatile memory.

The display flashes the setting twice to show that it is being saved, then outputs 00 to indicate the diagnostic is finished. (Be sure the parameter is set as desired before pressing Unload.) If the FORMAT switch is not used during the diagnostic, the setting is not flashed twice.

#### **4.8.7 Write Synchronization (44)**

This diagnostic allows the write synchronization configuration parameter to be changed. The setting of the write synchronization parameter determines when data in the cache is synchronized 1) no synchronization (inhibits host selection of unbuffered mode), 2) on one filemark, 3) on two consecutive filemarks, or 4) on every write.

The diagnostic begins by displaying the numeric code for the current parameter setting. Refer to Table 4- 8 for the available settings and their numeric codes.

Pressing the FORMAT switch changes the numeric code (increments the number, then restarts at 0) of the parameter setting.

Pressing the UNLOAD switch saves a parameter setting in the non- volatile memory. The hexadecimal display flashes the setting twice to show that it is being saved, then outputs 00 to indicate the diagnostic is finished. (Be sure the parameter is set as desired before pressing Unload.)

If the FORMAT switch is not used during the diagnostic, the setting is not flashed twice.

**Table 4.8 Level 2 SCSI Interface Configuration Tests**

| Test #          | Configuration Parameter                                  | Parameter Setting                                                                                                                                                                                                                                       | DEC Defaults |
|-----------------|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 30 <sup>1</sup> | Drive recalibration                                      | N/A                                                                                                                                                                                                                                                     | N/A          |
| 42              | Power- up restart                                        | 01=unload cartridge, 02=load cartridge                                                                                                                                                                                                                  | 01           |
| 43              | Format display                                           | 01=enable, 02=disable                                                                                                                                                                                                                                   | 01           |
| 44              | Write synchronization                                    | 00=no synchronisation,<br>01=synchronise on 1 filemark,<br>02=synchronise on 2 consecutive filemarks,<br>03=synchronise on every write                                                                                                                  | 02           |
| 45              | Write synchronization before reverse                     | 01=enable, 02=disable                                                                                                                                                                                                                                   | 02           |
| 46              | Number of read error retries                             | 03=4 Retries, 4=8 R, 5=16 R, 6=32 R                                                                                                                                                                                                                     | 04           |
| 47              | Number of write error retries                            | 01=1 Retry, 02=2 R, 03=4 R, 04=8R, 05=16 R                                                                                                                                                                                                              | 05           |
| 49              | Select Block size                                        | 00= variable block mode, 01= 4Bytes, 02= 8B,<br>03= 16B, 04= 32B, 05= 64B, 06= 128B, 07=<br>256B, 08=512B, 09=1kB, 10=2kB, 11= 4kB,<br>12= 8kB, 13= 16kB, 14= 32kB, 15= 64kB                                                                            | 00           |
| 50              | Address                                                  | 00 to 07                                                                                                                                                                                                                                                | 04           |
| 51              | Interface parity                                         | 01=enable, 02=disable                                                                                                                                                                                                                                   | 01           |
| 52              | Device Type                                              | 00 =default device (80h), 01 = F880ES (C5h)<br>02 = (82h), 03 to 10 = Reserved                                                                                                                                                                          | 00           |
| 53              | Rewind Ready                                             | 01 = enable, 02 = disable                                                                                                                                                                                                                               | 01           |
| 54              | Synchronous Xfer Negotiation                             | 01 = enable, 02 = disabl                                                                                                                                                                                                                                | 01           |
| 55              | EOT mode reporting                                       | 00 = normal, 01 = special                                                                                                                                                                                                                               | 00           |
| 57 <sup>2</sup> | 2's Compliment                                           | 01=enable, 02=disable                                                                                                                                                                                                                                   | 02           |
| 60              | Vendor ID                                                | 01 = Cipher, 02 = NCR, 03 = HP, 04 = Fujitsu,<br>05 = DEC, 06 = STK, 07 = HPCipher,<br>08 = LMS, 09 = Exabyte, 10 = Kennedy                                                                                                                             | 05           |
| 61              | Product ID                                               | 01 = T480, 02 = M995, 03 = F880ES, 04 = 0- STD1- 0,<br>05 = 88780, 06 = M1016A, M2481A 07 = M1016B,<br>08 = M1016AD, 09 = M1016BD, 10 = TSZ05, 11 =<br>TSZ07,<br>12 = 4280, 13 = 92160, 14 = EXB- 8200, 15 = 96X2<br>Tape Unit, 16 = TKZ60, 17 = TKZ60L | 16           |
| 62              | Density                                                  | 00 = 1600 Bpi, 01 = 6250 Bpi, 02 = 3480                                                                                                                                                                                                                 | 02           |
| 63              | Interface options                                        | 00 = default SCSI, 01 to 15 = special SCSI modes                                                                                                                                                                                                        | 00           |
| 64              | EOD Detect length                                        | 01 = short (3mm) special erase gap detect,<br>02 = long (134mm) special erase gap detect                                                                                                                                                                | 01           |
| 65              | Display custom (vendor) unique mask                      | 01 = LSB, 02 = next to LSB, 03 = next to MSB, 04 =<br>MSB                                                                                                                                                                                               | 01           |
| 66 <sup>3</sup> | Linked load/unload                                       | 00 = disable, 01 = enable                                                                                                                                                                                                                               | 00           |
| 67              | Allow MTEC                                               | 01=enable 02=disable                                                                                                                                                                                                                                    | 02           |
| 70 <sup>4</sup> | Motor calibration                                        | N/A                                                                                                                                                                                                                                                     | N/A          |
| 99 <sup>5</sup> | Unlock "factory" mode, (enable tests in the 80's series) | 01=enable, 02=disable                                                                                                                                                                                                                                   | 02           |

**NOTE:** The following comments apply to Table 4.8 on the preceding page.

- 1 This is a Service Aid that upon entering, re- sets all configuration parameters to default settings then runs Test number 70
- 2 Can only be enabled after setting "99" to 01 (enable Factory Mode)
- 3 May need to be set to "01" if ACL is installed
- 4 This is a Service Aid that upon entering, re- calibrates the servos and stores new values in the NOVRAM (automatically)
- 5 When enabled, will autotisable on exit of diagnostic mode.

#### **4.8.8 Write Synchronization Before Reverse (45)**

This diagnostic allows the write synchronization before reverse configuration parameter to be changed.

The setting of the write synchronization before reverse parameter determines whether data in the cache is synchronized (written to tape) when the drive receives a command that causes reverse tape motion.

The default setting (2) does not cause synchronization.

The diagnostic begins by displaying the numeric code for the current parameter setting. Refer to Table 4- 8 for the available settings and their numeric codes.

Pressing the FORMAT switch changes the numeric code of the parameter setting.

Pressing the UNLOAD switch saves a parameter setting in the non- volatile memory.

The hexadecimal display flashes the setting twice to show that it is being saved, then outputs 00 to indicate the diagnostic is finished. (Be sure the parameter is set as desired before pressing Unload.) If the FORMAT switch is not used during the diagnostic, the setting is not flashed twice.

#### **4.8.9 Read Error Retries (46)**

This diagnostic allows the read error retries configuration parameter to be changed.

The setting of the read error retries parameter determines how many times the drive will attempt to read data that cannot be recovered from the tape.

The diagnostic begins by displaying the numeric code for the current parameter setting. Refer to Table 4- 8 for the available settings and their numeric codes. Pressing the FORMAT switch changes the numeric code (increments the number, then restarts at 3) of the parameter setting.

Pressing the UNLOAD switch saves a parameter setting in the non- volatile memory.

The hexadecimal display flashes the setting twice to show that it is being saved, then outputs 00 to indicate the diagnostic is finished. (Be sure the parameter is set as desired before pressing UNLOAD.)

If the FORMAT switch is not used during the diagnostic, the setting is not flashed twice.

#### **4.8.10 Write Error Retries (47)**

This diagnostic allows the write error retries configuration parameter to be changed.

The setting of the write error retries parameter determines how many times the drive will attempt to write data to the tape when its read- after- write circuitry is signaling that the data is not being correctly written.

The diagnostic begins by displaying the numeric code for the current parameter setting. Refer to Table 4- 8 for the available settings and their numeric codes. Pressing the FORMAT switch changes the numeric code (increments the number, then restarts at 1) of the parameter setting.

Pressing the UNLOAD switch saves a parameter setting in the non- volatile memory.

The hexadecimal display flashes the setting twice to show that it is being saved, then outputs 00 to indicate the diagnostic is finished. (Be sure the parameter is set as desired before pressing Unload.) If the FORMAT switch is not used during the diagnostic, the setting is not flashed twice.

#### **4.8.11 Block Size (49)**

This diagnostic allows the block size configuration parameter to be changed. The setting of the block size parameter determines the size of the data blocks the drive will read and write for SCSI Fixed mode commands if the host does not select a block size.

The diagnostic begins by displaying the numeric code for the current parameter setting. Refer to Table 4- 8 for the available settings and their numeric codes.

Pressing the FORMAT switch changes the numeric code (increments the number, then restarts at 0) of the parameter setting. Pressing the UNLOAD switch saves a parameter setting in the non- volatile memory.

The hexadecimal display flashes the setting twice to show that it is being saved, then outputs 00 to indicate the diagnostic is finished. (Be sure the parameter is set as desired before pressing UNLOAD.) If the FORMAT switch is not used during the diagnostic, the setting is not flashed twice.

#### **4.8.12 Address (50)**

This diagnostic allows the Interface Bus address configuration parameter to be changed.

The diagnostic begins by displaying the numeric code for the current parameter setting. Refer to Table 4- 8 for the available settings and their numeric codes. Pressing the FORMAT switch changes the numeric code (increments the number, then restarts at 0) of the parameter setting. Pressing the UNLOAD switch saves a parameter setting in the non- volatile memory.

The hexadecimal display flashes the setting twice to show that it is being saved, then outputs 00 to indicate the diagnostic is finished. (Be sure the parameter is set as desired before pressing Unload). If the FORMAT switch is not used during the diagnostic, the setting is not flashed twice.

#### **4.8.13 Interface Parity (51)**

This diagnostic allows the interface parity configuration parameter to be changed.

The setting of the interface parity parameter determines whether the drive will check the parity bit.

The diagnostic begins by displaying the numeric code for the current parameter setting. Refer to Table 4- 8 for the available settings and their numeric codes.

Pressing the FORMAT switch changes the numeric code of the parameter setting.

Pressing the UNLOAD switch saves a parameter setting in the non- volatile memory.

The hexadecimal display flashes the setting twice to show that it is being saved, then outputs 00 to indicate the diagnostic is finished. (Be sure the parameter is set as desired before pressing Unload). If the FORMAT switch is not used during the diagnostic, the setting is not flashed twice.

#### **4.8.14 Device Type (52)**

This diagnostic allows the device type configuration parameter to be changed. The setting of the device type configuration parameter determines the content of the Device- Type Modifier field of the Inquiry data, which is sent by the drive in response to a SCSI Inquiry (12h) command.

#### **4.8.15 Rewind Ready (53)**

This diagnostic allows the rewind ready configuration parameter to be changed.

The setting of the rewind ready parameter determines the drive's response to a SCSI Test Unit Ready command following a SCSI Rewind Immediate command; if enabled, the drive responds with Good status, if disabled, it responds with Not Ready status.

#### **4.8.16 SCSI Synchronous Negotiation (54)**

This diagnostic allows the SCSI synchronous negotiation parameter to be changed.

The setting of the synchronous negotiation parameter determines the drive's ability to initiate negotiations for a SCSI synchronous data transfer:

if enabled, the drive is enabled to initiate synchronous data transfer negotiation;

if disabled, it is disabled from initiating synchronous data transfer negotiation.

**Note:** The drive always responds to a negotiation for synchronous transfer from the host. This option should be enabled for systems using synchronous data transfer.

The diagnostic begins by displaying the numeric code for the current parameter setting. Refer to Table 4- 8 for the available settings and their numeric codes. Pressing the FORMAT switch changes the numeric code of the parameter setting. Pressing the UNLOAD switch saves a parameter setting in the non- volatile memory.

The hexadecimal display flashes the setting twice to show that it is being saved, then outputs 00 to indicate the diagnostic is finished. (Be sure the parameter is set as desired before pressing Unload.)

If the FORMAT switch is not used during the diagnostic, the setting is not flashed twice.

#### **4.8.17 EOT Mode Reporting (55)**

Selecting the normal (default) mode (0) will report an End of Partition status when a write block or write filemark command crosses the EOT marker. Selecting the special mode (1) for EOT mode reporting; during write when the EOT marker is crossed the current command completes normally.

The next write command will report a check condition with EOM and VALID BITS set and the info bytes are set to the full transfer length. No data is transferred.

#### **4.8.18 2's Complement (57)**

Required for some Digital systems that look for 2's complement, for residual (REQUEST SENSE) after space Rev., to determine positioning, ie. some boot ROMs, HSC SCSI Controller when NO rewind switch set.

#### **4.8.19 Vendor ID (60)**

This diagnostic allows the vendor ID configuration parameter to be changed. The setting of the vendor ID configuration parameter determines the content of the Vendor Identification field of the Inquiry data, which is sent by the drive in response to a SCSI Inquiry (12h) command.

The diagnostic begins by displaying the numeric code for the current parameter setting. Refer to Table 4- 8 for the available settings and their numeric codes. Pressing the FORMAT switch changes the numeric code of the parameter setting.

Pressing the UNLOAD switch saves a parameter setting in the non- volatile memory. The hexadecimal display flashes the setting twice to show that it is being saved, then outputs 00 to indicate the diagnostic is finished. (Be sure the parameter is set as desired before pressing Unload.) If the FORMAT switch is not used during the diagnostic, the setting is not flashed twice.

#### **4.8.20 Product ID (61)**

This diagnostic allows the product ID configuration parameter to be changed. The setting of the product ID configuration parameter determines the content of the Product Identification field of the Inquiry data, which is sent by the drive in response to a SCSI Inquiry (12h) command.

The diagnostic begins by displaying the numeric code for the current parameter setting. Refer to Table 4- 8 for the available settings and their numeric codes.

Pressing the FORMAT switch changes the numeric code of the parameter setting.

Pressing the UNLOAD switch saves a parameter setting in the non- volatile memory.

The hexadecimal display flashes the setting twice to show that it is being saved, then outputs 00 to indicate the diagnostic is finished. (Be sure the parameter is set as desired before pressing Unload.) If the FORMAT switch is not used during the diagnostic, the setting is not flashed twice.

#### **4.8.21 Density (62)**

This diagnostic allows the density configuration parameter to be changed. The setting of the density configuration parameter determines what the drive will report after power-up in the Density Code field of the Mode Sense Parameter Block Descriptor in response to a SCSI Mode Sense command. Once powered-up, the Density Code field can be changed with a SCSI Mode Select command.

The purpose of this configuration parameter is to allow the drive to emulate drives with operating densities of 1600 and 6250 bits per inch, as well as to report that it is 3480-compatible.

The diagnostic begins by displaying the numeric code for the current parameter setting. Refer to Table 4- 8 for the available settings and their numeric codes.

Pressing the FORMAT switch changes the numeric code of the parameter setting.

Pressing the UNLOAD switch saves a parameter setting in the non-volatile memory. The hexadecimal display flashes the setting twice to show that it is being saved, then outputs 00 to indicate the diagnostic is finished. (Be sure the parameter is set as desired before pressing Unload.)

If the FORMAT switch is not used during the diagnostic, the setting is not flashed twice.

#### **4.8.22 Interface Options (SCSI) (63)**

The SCSI vendor unique interface options are available for use on a restricted basis. Only the modes that the drive has been allowed access to will be displayed; i.e., if standard and Mode 2 are allowed, only a "0" or "2" will be displayed and be able to be selected. If the drive is allowed no special modes, only the standard SCSI mode will be available. Modes selected are stored in EEPROM and will remain in effect until deselected.

#### **4.8.23 EOD Detect Length (64)**

When reading, this diagnostic allows the detection of a short or long "special erase" gap to determine if blank tape has been reached.

When overwriting then reading a previously used tape, errors such as block sequence errors (FSC C6) are usually detected (instead of blank check) when attempting to read past EOD. In this case setting a shorter special erase detect will fix the problem by allowing tape to detect the shorter gaps and reporting them as a blank check.

#### **4.8.24 Display Custom (Vendor) Unique Mask (SCSI) (65)**

This test will display the "mask" or appropriate bits which will define which combinations of Vendor Unique interface modes (test #63) are available.

#### **4.8.25 Linked Load/Unload (66)**

When set if unload command is issued, drive will not return command complete until next cartridge loaded and ready or after approx. 2 minutes, (Manual unload not applicable). Prevents Test Unit Ready loop timeouts.

This option is used to enable special processing of UNLOAD and/or LOAD Host commands when an ACL is being used. These options facilitate multi-volume backup/restore operations on hosts that do not allow for ACL re-load time after an UNLOAD. The default mode is for drives without ACL's and for systems that allow the drive to be NOT\_READY between a completed UNLOAD command and the following re-load by the ACL.

**NOTE:** Since the TKZ60 does not have any status about the ACL, not even whether it exists, this option must be used to enable this special behavior. Since the drive does not know if another cartridge is available in the ACL, a wait of one minute will occur on Host UNLOAD's if the magazine is empty.

**NOTE:** The ACL re-load wait time is measured from the time the cartridge is ejected from the drive until a new cartridge is detected in the drive's loader (cartridge inserted switch). During this wait time the "ACTIVE" LED will flash to advise the operator that the drive is still busy and not in a idle state. The LED will continue flashing when a new cartridge is inserted until the threading process is complete.

To abort the wait process, Press the UNLOAD switch and hold for at least 2 seconds. The "ACTIVE" led will turn OFF when the UNLOAD command has aborted. Release the UNLOAD switch. The drive's loader will execute a reset.

#### **4.8.26 Allow Multi- Track Corrected Errors (67)**

This option allows the drive to accept a Read After Write status of more than one corrected error (MTEC) as a good status.

This option is provided for applications (geophysical) which are quasi-real time when writing and which can accept some loss of data during subsequent Reads.

When the option is disabled (Default), only single track corrected errors are allowed during normal writes. Multi-track recorded errors are only allowed if the errors occur in different track groups. Enabling this option will improve write performance by allowing MTEC errors regardless of what tracks are affected.

**NOTE:** If additional errors occur during later reads, an Unrecoverable Read error may occur.

#### **4.8.27 Motor Torque Calibration (70)**

This diagnostic calculates the torque constants for the supply and takeup motors, then stores them in the non-volatile memory. While the diagnostic runs, the Active indicator lights; when it finishes, 00 appears at the hexadecimal display.

**NOTE:** If an error code 54 occurs, this diagnostic must be run before loading a cartridge; if a cartridge has already been loaded, the power to the drive must be cycled.

#### **4.8.28 Unlock "Factory" Mode (Enable Tests in the 80's Series) (99)**

The "factory" mode was created to avoid the inadvertent selection of the "factory only" tests (80's series) and will always default as disabled.

To enter into the "factory" mode, this test must first be accessed, and the option enabled. This will allow access to any of the 80's series tests, any number of times, just as long as the CE diagnostics mode is maintained. Disabling it via test 99 or exiting the CE diagnostics mode will disable the factory mode.

## 4.9 Manual Unload

If the drive cannot unload a cartridge automatically, the cartridge can be recovered manually with the following procedure.

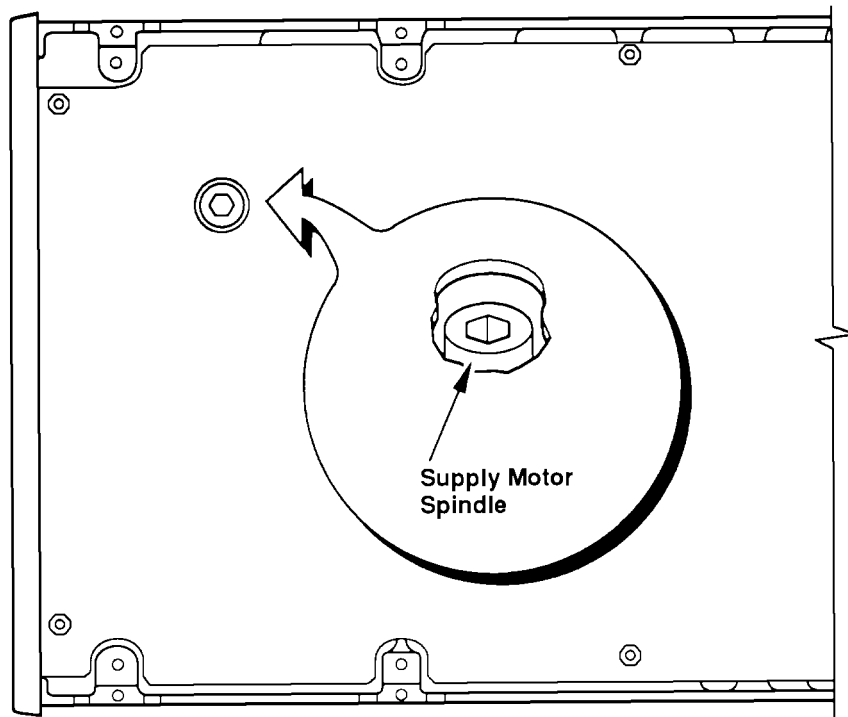
1. Switch off the power to the drive.
2. Disconnect the power cord and the interface cables.
3. Remove the drive from its cabinet or enclosure by reversing the appropriate installation instructions in the TKZ60 Installation and User Manual.
4. Place the drive on an insulated pad.

### **Caution**

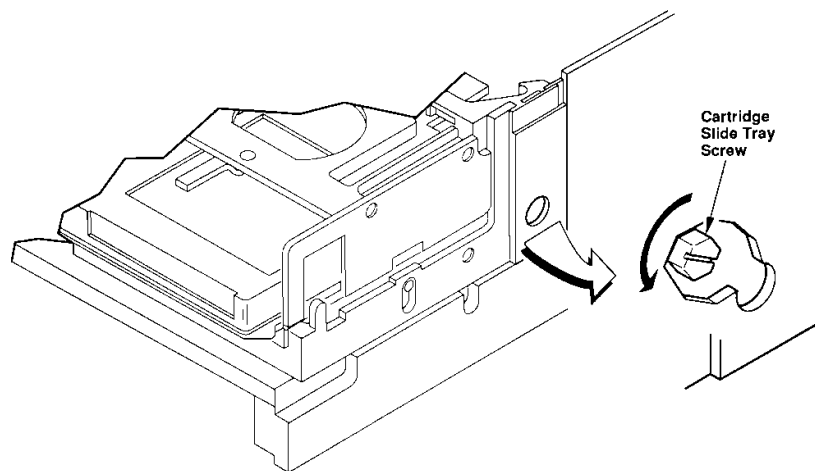
***Ensure you are properly grounded to prevent damaging sensitive components with electrostatic discharge.***

5. Remove the top cover using the instructions in Chapter 5
6. Remove the bottom cover using the instructions in Chapter 5.
7. From the bottom of the drive, insert a 5/64- inch hex driver through the holes in the printed circuit boards into the supply motor spindle (Refer to Figure 4- 1 next page) and wind the spindle counterclockwise until all tape is removed from the takeup hub. Do not attempt to force the threader arm to the home position by rewinding.
8. Move the threader arm to the home position (next to the loader) while continuing to wind the tape. Do not attempt to force the leader block into the cartridge by rewinding.
9. Insert the leader block into the cartridge by moving the threader arm firmly towards the cartridge.
10. Gently turn the cartridge slide tray screw in the right side of the loader counterclockwise with a 3/16- inch hex driver or a large flat blade screwdriver until the tray ejects the tape cartridge (Refer to Figure 4- 2 following page).
11. Replace the bottom and top covers using the instructions in Chapter 5 in reverse order.
12. Reinstall the drive using the appropriate instructions in the TKZ60 Installation Manual.

**Figure 4.1 Location of Supply Motor Spindle**



**Figure 4.2 Location of Cartridge Slide Tray Screw**





## **5 - Field Replaceable Units (FRU s)**



## 5.1 Introduction

This chapter explains how to remove and replace the FRUs and other replaceable parts of the TKZ60 family.

## 5.2 FRU List

When ordering spares, please specify the part description and the unit model number (located at the back of the unit).

**Table 5.1 Recommended Spares List**

| DEC Number    | Vendor Number | Description                       |
|---------------|---------------|-----------------------------------|
| 29- 29333- 01 | 966677- 001   | Supply Motor                      |
| 29- 29334- 01 | 966686- 001   | Take- Up Motor                    |
| 29- 29342- 01 | 965943- 005   | Front Panel Assy                  |
| 29- 29336- 01 | 966698- 001   | Loader Assy                       |
| 29- 29339- 01 | 966697- 001   | Tape Threader                     |
| 29- 29335- 01 |               | Power Supply                      |
| 29- 29485- 01 | 965266- 001   | Fan Assy                          |
| 29- 29486- 01 | 966687- 001   | SCSI Connector                    |
| 29- 29337- 01 | 966701- 002   | Head & Tape Path Assy             |
| 29- 29487- 01 | 966878- 003   | Read/Write Pwb Assy               |
| 29- 29340- 01 | 966985- 001   | Servo Control Pwb                 |
| 29- 29488- 01 | 967080- 001   | Cntl/SCSI- S/E Pwb Assy <b>1</b>  |
| 29- 29489- 01 | 967084- 001   | Cntl/SCSI- Diff Pwb Assy <b>2</b> |
| 29- 29490- 01 | 966812- 001   | Cable/Pwb- Flex Circuit, Write    |
| 29- 29491- 01 | 966813- 001   | Cable/Pwb- Flex Circuit, Read     |
| 29- 29492- 01 | 963955- 001   | Cable Assy, Cue/Servo             |
| 29- 29493- 01 | 966681- 001   | Cable Assy, Ext Power             |
| 29- 29494- 01 | 966741- 001   | Cable Assy, Cue Dist              |
| 29- 29495- 01 | 966762- 001   | Cable Assy, Servo Dist            |
| 29- 29496- 01 | 966912- 001   | Cable Assy, Cue/R- W              |
| 12- 30552- 01 |               | SCSI Terminator S.e <b>1</b>      |
| 29- 29713- 01 | 971240- 001   | SCSI Terminator Diff <b>2</b>     |
| 30- 35933- 03 | 966572- 101   | Auto Cart Loader                  |

**1** for Single Ended variants only

**2** for Differential variants only

## 5.3 FRU Removal and Replacement Procedures

### 5.3.1 Tools

The following tools are required to service the drive:

#### Special Tools

- T6, T10, and T15 Torx drivers

#### Standard Tools

- 5/64- inch hex driver (Allen wrench)
- 9/32- inch wrench or small adjustable wrench
- No. 1 Phillips screwdriver
- Small wire cutters
- 1/4- inch socket and driver
- 3/16- inch socket and driver or a large flat- blade screwdriver

**NOTE:** Before performing any of these procedures, the drive must be removed from its table- top enclosure or cabinet. Refer to the TKZ60 Installation Manual and reverse the appropriate installation procedure to remove the drive.

A T10 Torx driver is required to remove all the screws identified in these procedures unless otherwise specified.

#### **WARNING**

**Always check that the tape drive is switched off and the power cord is disconnected before starting any of these procedures.**

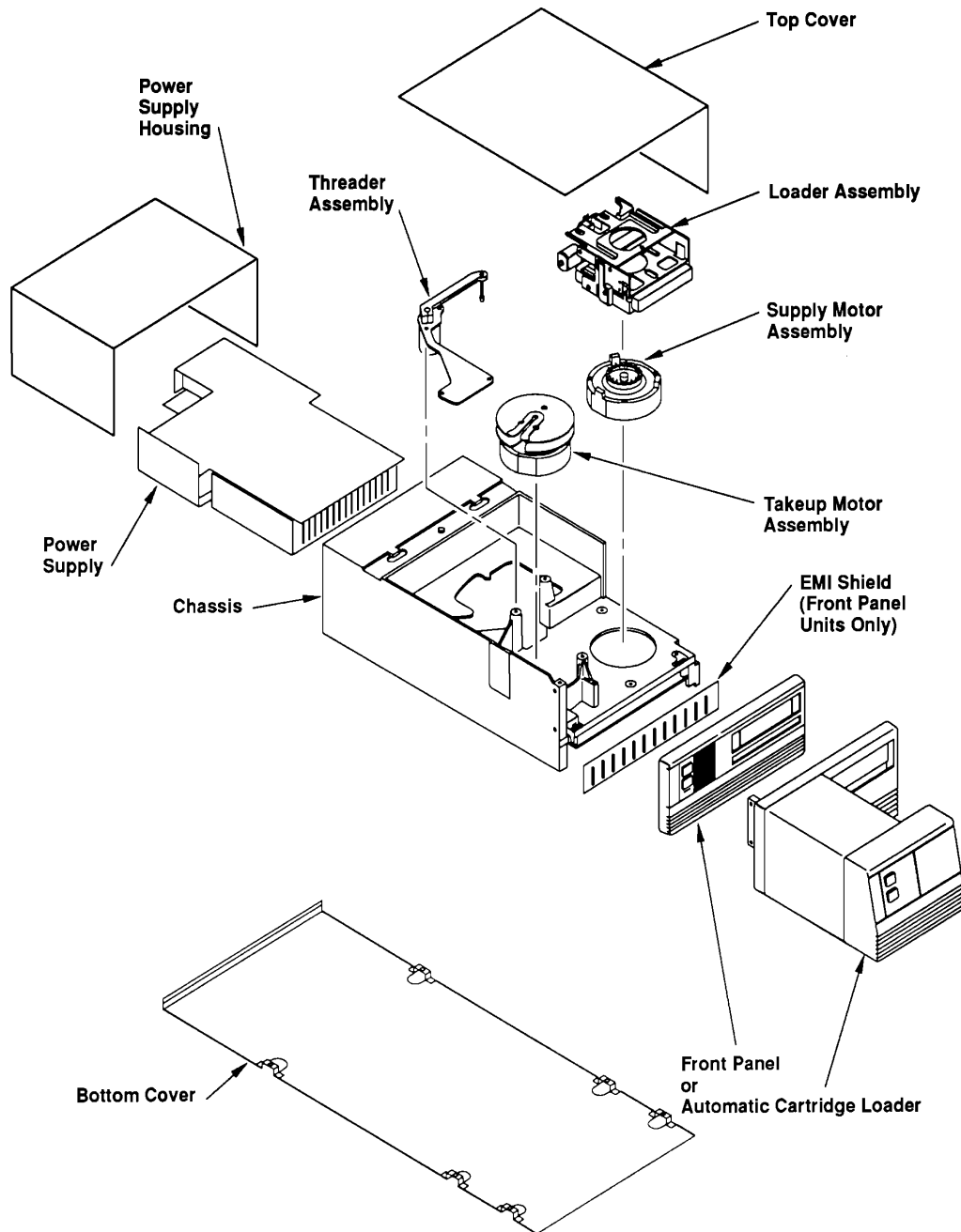
#### **CAUTION**

***Ensure that static damage prevention precautions are taken at ALL times when working in the unit.***

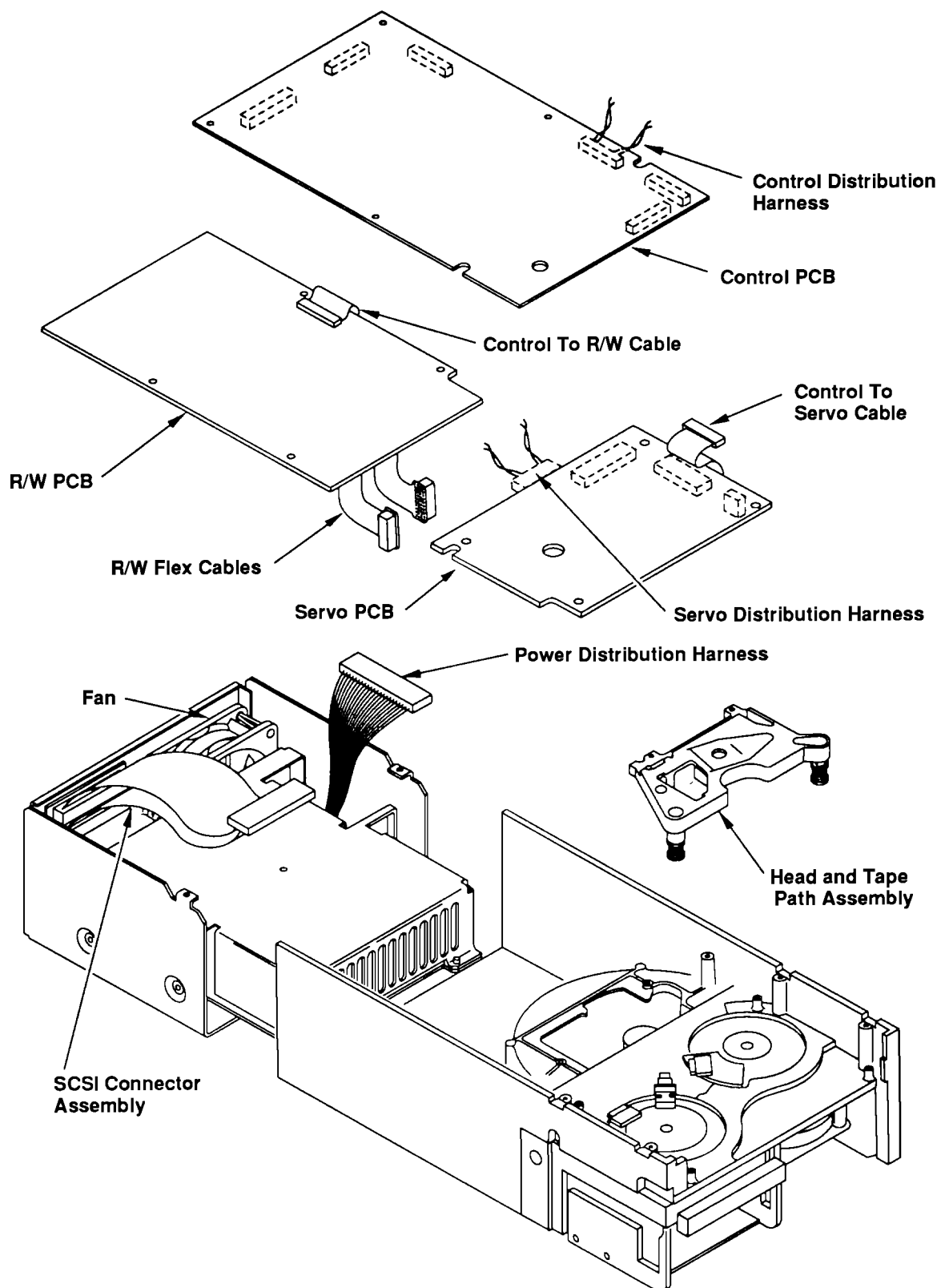
## 5.4 Exploded Views

The following two illustrations provide exploded views of the unit. These should be referred to throughout the dismantling and reassembly of the unit.

**Figure 5.1 Top View**

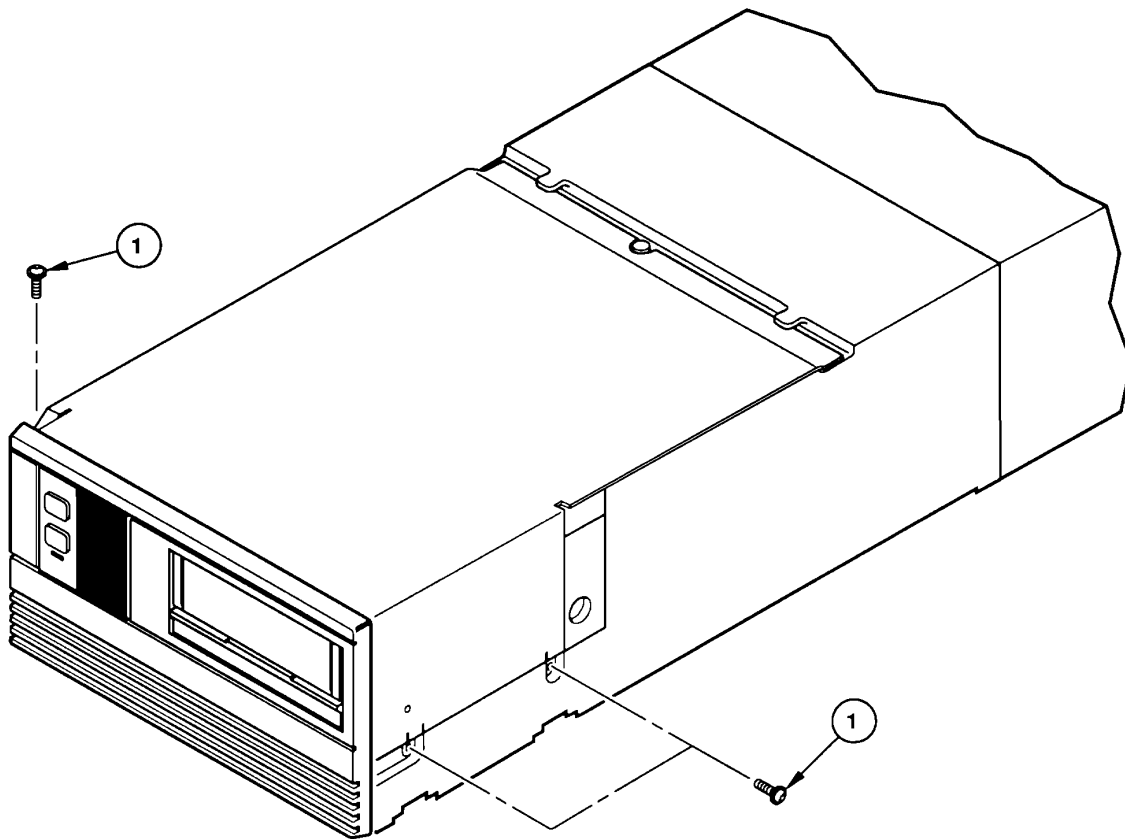


**Figure 5.2 Bottom View**



### 5.4.1 Top Cover

Figure 5.3 Top Cover Detail



#### Removal

1. Remove the three screws (Detail 1).
2. Lift the front of the top cover upward, then slide it forward to remove it.

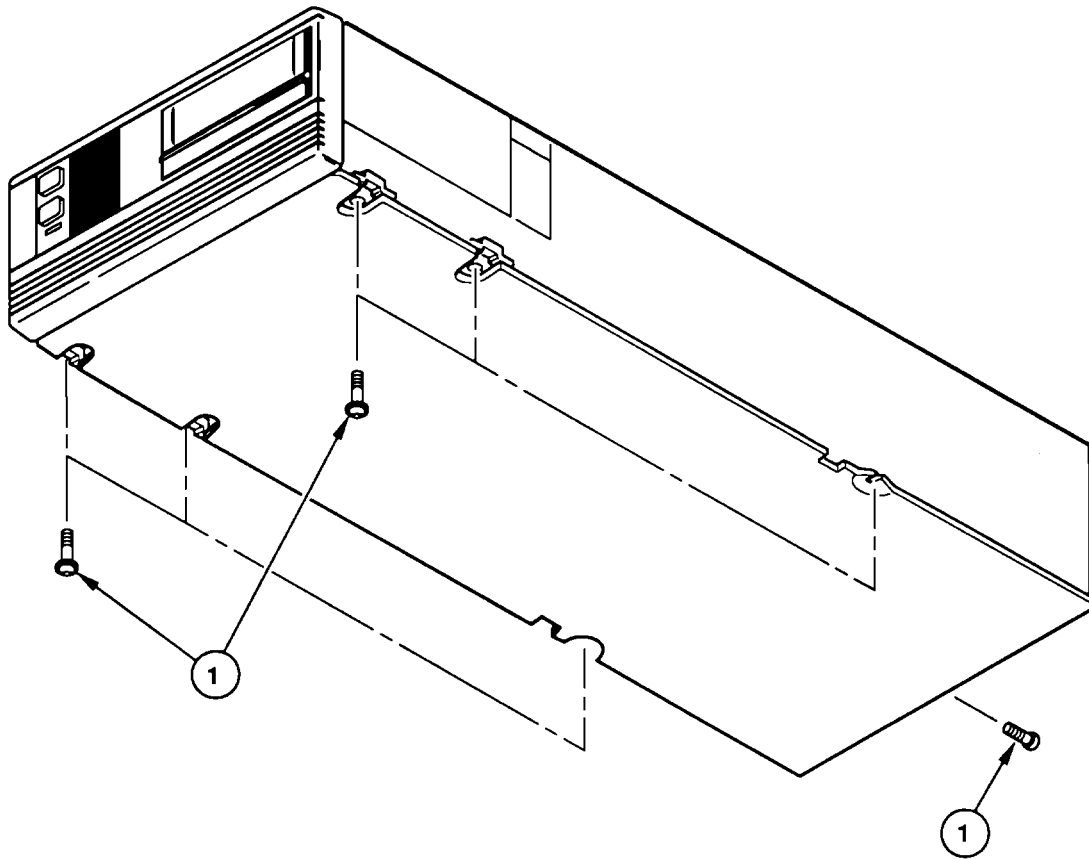
#### Replacement

1. Reverse the removal procedure.

### 5.4.2 Bottom Covers

If the tape drive is equipped with a SCSI, it has only one bottom cover. If the tape drive is equipped with an interface, it has a two-piece bottom cover.

**Figure 5.4 Bottom Covers**



#### **Caution**

*Do not operate the drive without the bottom covers installed; overheating could result.*

#### **Removal**

1. Remove the seven screws Detail 1
2. Remove the bottom cover.

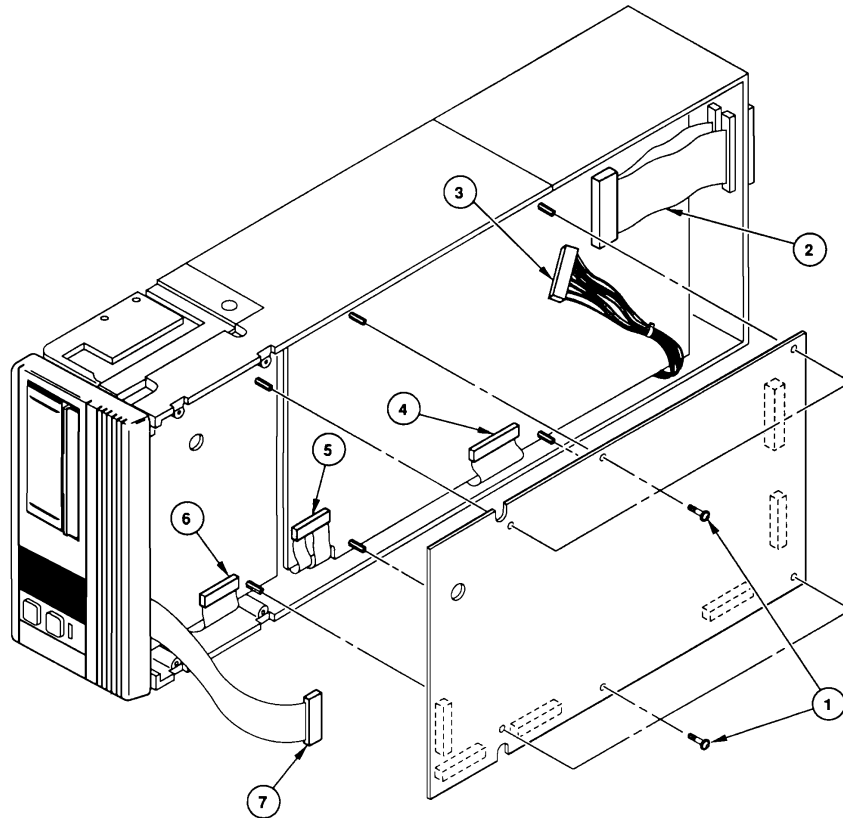
#### **Replacement**

1. Reverse the removal procedure.

### 5.4.3 Control Circuit Board

(29- 29488- 01/29- 29489- 01)

**Figure 5.5 Control Circuit Board**



**IMPORTANT:** *If the control circuit board is being replaced, run the Device Settings (05) and Interface Settings (06) diagnostics and write down the settings of the configuration parameters.*

#### Removal

1. Remove the bottom cover.
2. Place the drive on its left (as you face the drive) side.
3. Remove six screws (1).
4. Disconnect the six cables (2, 3, 4, 5, 6, and 7), then remove the board.

#### Replacement

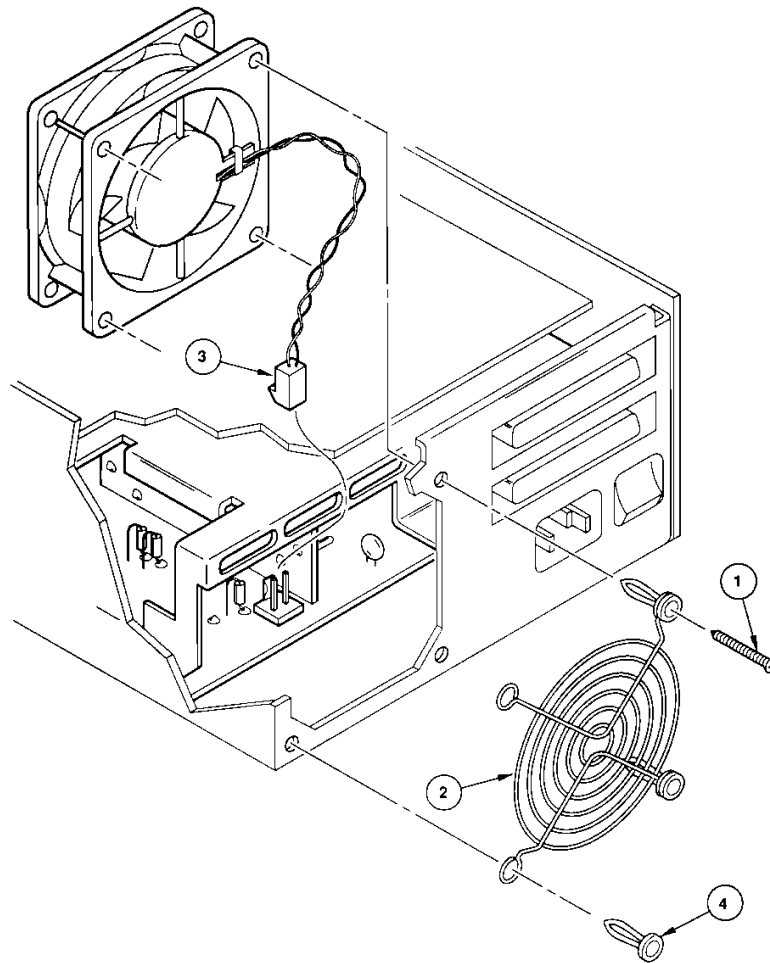
1. Reverse the removal procedure.

**NOTE:** If the control circuit board was replaced, set the configuration parameters to the appropriate values using the diagnostics, and run the Motor Torque Calibration (70) diagnostic.

#### 5.4.4 Fan

(29- 29485- 01)

**Figure 5.6 Fan**



#### Removal

1. Remove the bottom cover.
2. Clip the heads off the four plastic screws (1) with a small wire cutter and remove the screen (2).
3. Lift the fan and disconnect the connector (3), then remove the fan.

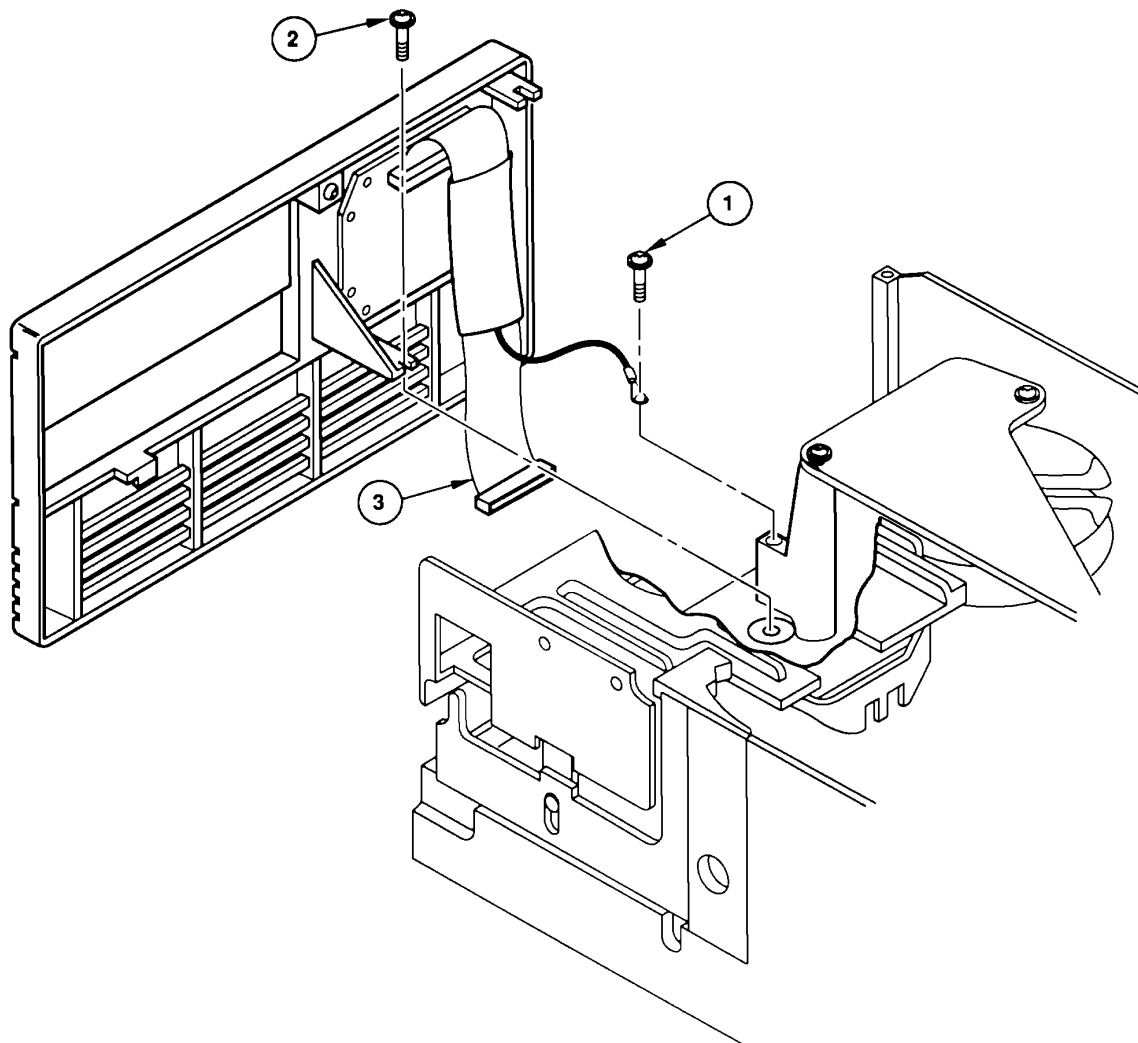
#### Replacement

1. Connect the fan connector (3).
2. Position the fan in the drive so the arrow points to the rear of the drive and the fan wires route to the center of the drive.
3. Insert the four grommets (4) through the mounting holes of the screen (2) and through the mounting holes of the fan.
4. Install four new plastic screws (1) into the grommets (4).
5. Check that the fan's wiring is routed away from the intake of the fan.
6. Install the bottom cover.

### 5.4.5 Front Panel

(29- 29342- 01)

**Figure 5.7 Front Panel**



#### Removal

1. Remove the top cover.
2. Remove the screw (1) attaching the shield ground wire.
3. Loosen the screw (2).
4. Lift the front panel out of its slots in the chassis.
5. Disconnect the front panel cable (3).

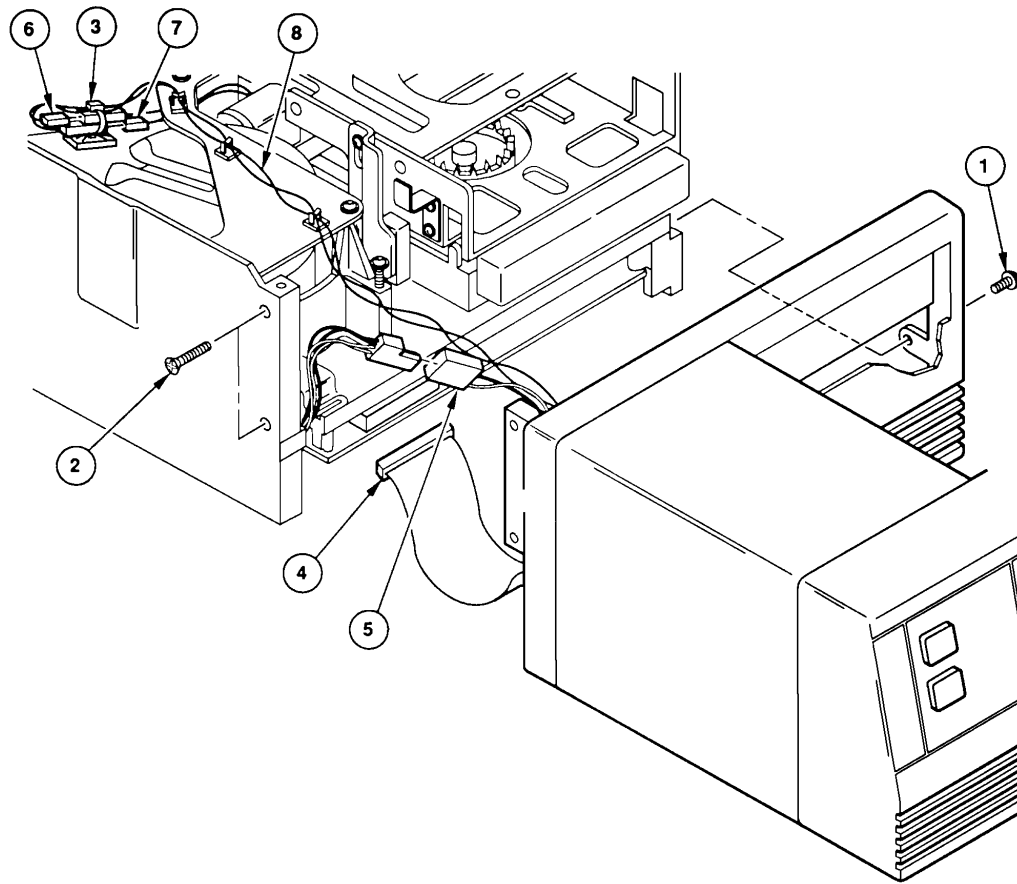
#### Replacement

1. Reverse the removal procedure.

### 5.4.6 Automatic Cartridge Loader

(30- 35933- 03)

**Figure 5.8 ACL**



#### Removal

1. Remove the top cover of the tape drive.
2. Remove screw (1), two screws (2) and nut (9). Gently separate the ACL from the chassis.
3. Cut the TyRap (3) with a pair of wire cutters.
4. Disconnect the four connectors (4, 5, 6, and 7) and remove the wires (8) from the three cable clamps.

#### Replacement

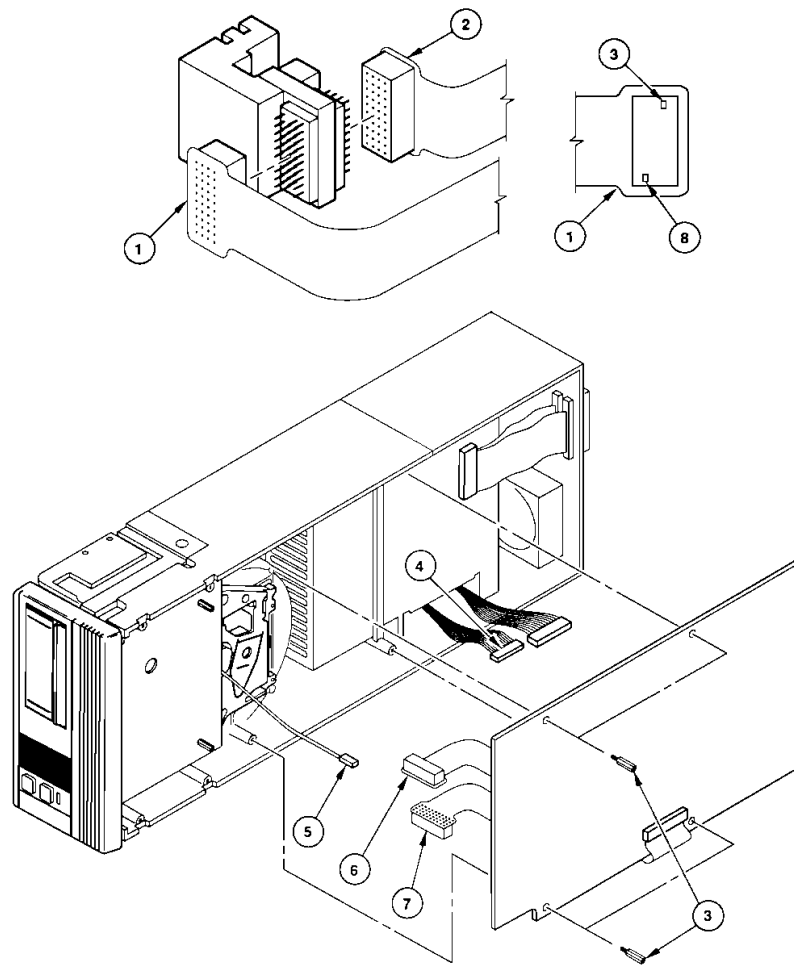
1. Reverse the removal procedure.

### 5.4.7 Read/Write Circuit Board & Flexi Circuits

Read/Write Circuit Board (29- 29487- 01)

Cable/Flexi Circuits (29- 29490- 01/29- 29491- 01)

**Figure 5.9 Read/Write Circuit Board and Cable/Flex Circuits**



#### Removal

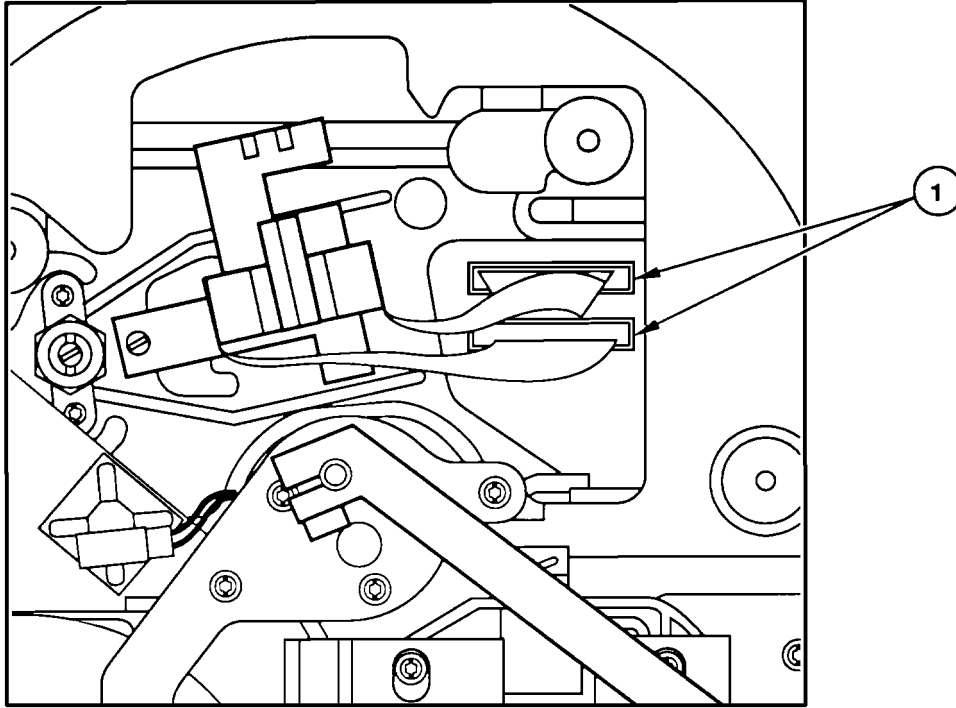
1. Remove the top and bottom covers, and then the control circuit board.
2. Remove the four stand- offs (3) with a 1/4- inch socket.
3. Carefully ease the Read/Write board away from the chassis to gain access to the cables.
4. Disconnect cable (5), then flexi circuits (6) and (7)
5. Disconnect the cable (4 ).
6. If the flexi circuits are to be changed, carefully disconnect the Read flexi circuit (1) and the Write flexi circuit (2), from the head avoiding any contact with the head surface.

## Replacement

Reverse the removal procedure. Be careful with the flex circuits.

The following figure shows the correct installation of the R/W flex circuits. Ensure that the flexi circuits are securely attached by connectors (Detail 1) on the Read/Write Circuit Board.

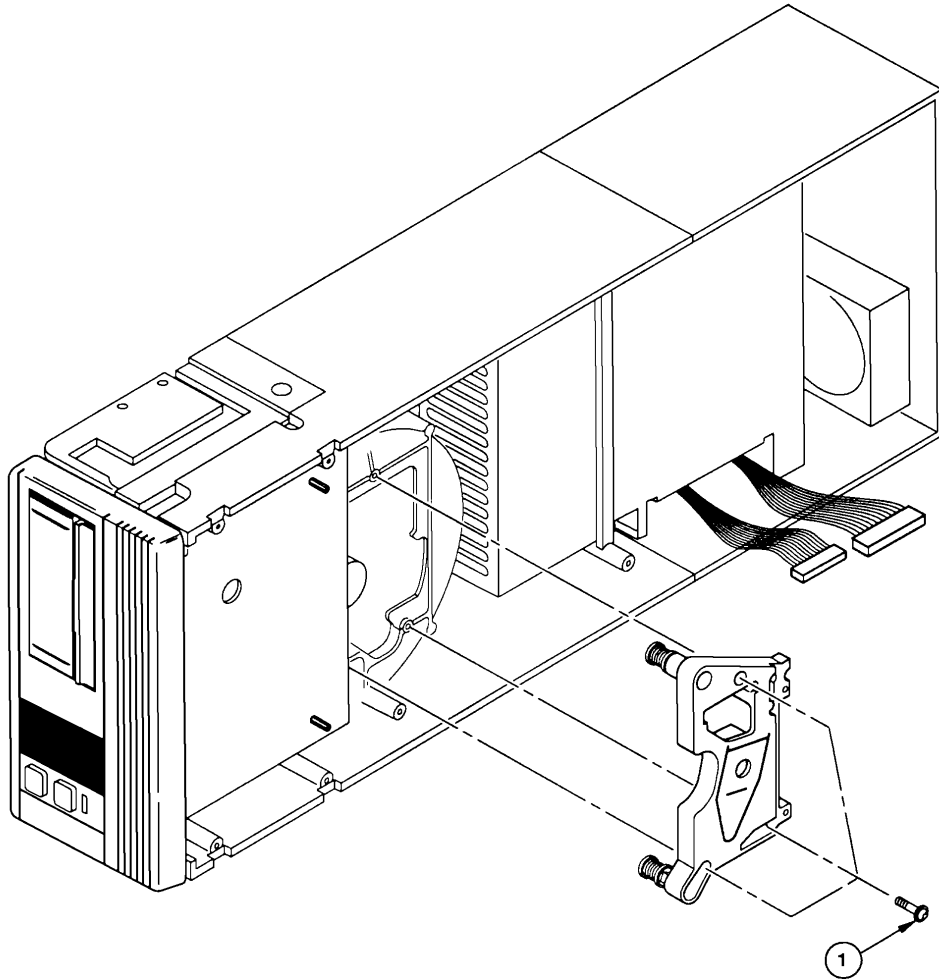
**Figure 5.10 R/W Cable Identification**



### 5.4.8 Head (and Tape Path)

(29- 29337- 01)

**Figure 5.11 Head Detail**



#### Removal

1. Remove the top cover, the bottom cover, the control circuit board, and the read/write circuit board.
2. Remove the three screws (1) that attach the head (and tape path) assembly to the chassis, not the three screws that mount the head to the assembly.
3. Remove the head (and tape path) assembly, being careful not to touch the head against anything.

#### **CAUTION**

***If the R/W surfaces contact anything during installation, it is likely that the head will be damaged.***

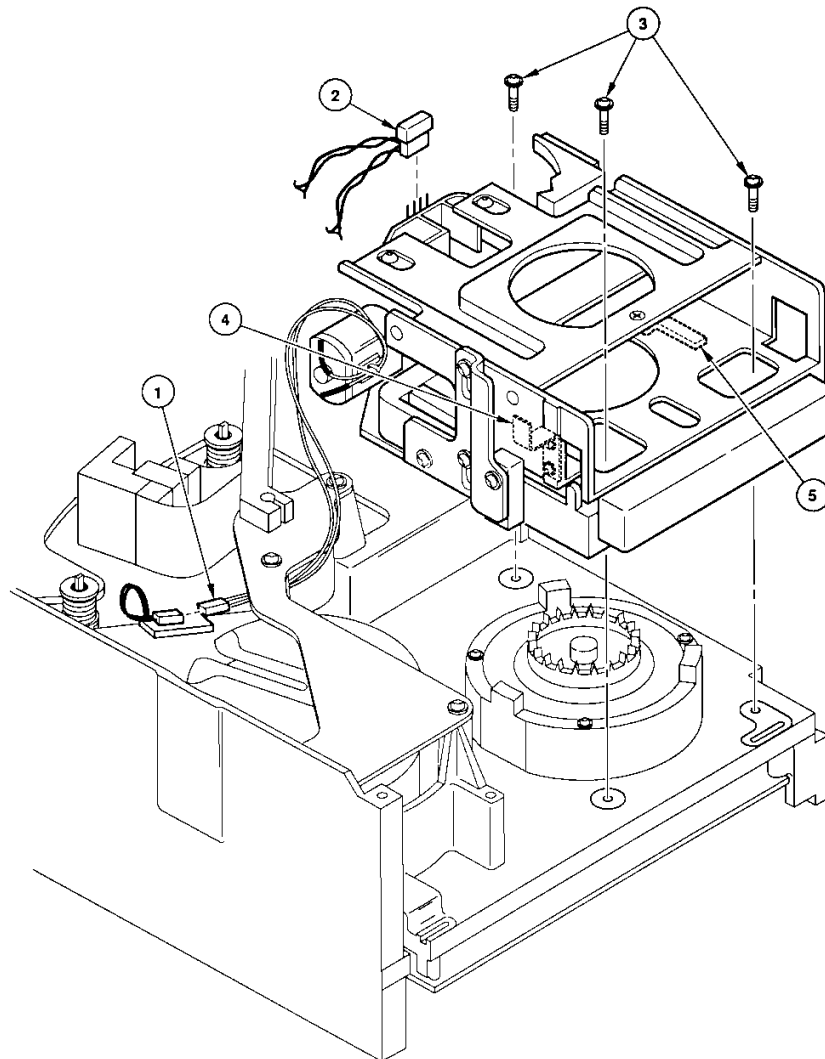
#### Replacement

1. Reverse the removal procedure. Be careful not to touch the head against anything.
2. If the replacement has a plastic head cover, remove it after installation.

### 5.4.9 Loader

(29- 29336- 01)

**Figure 5.12 Loader Detail**



#### Removal

1. Remove the top cover and the front panel or the ACL.
2. Disconnect the two cables (1 and 2). Bring the motor cable (1) through the opening next to the bottom of the threader motor.
3. Remove the three screws (3), at the base of the loader, then remove the loader. Do not remove the two screws securing the printed circuit board where connector 2 attaches.
4. If the loader has a S- bracket (4) attached, remove it with a T6 Torx driver. If the loader has a door stop (5) attached, remove it.

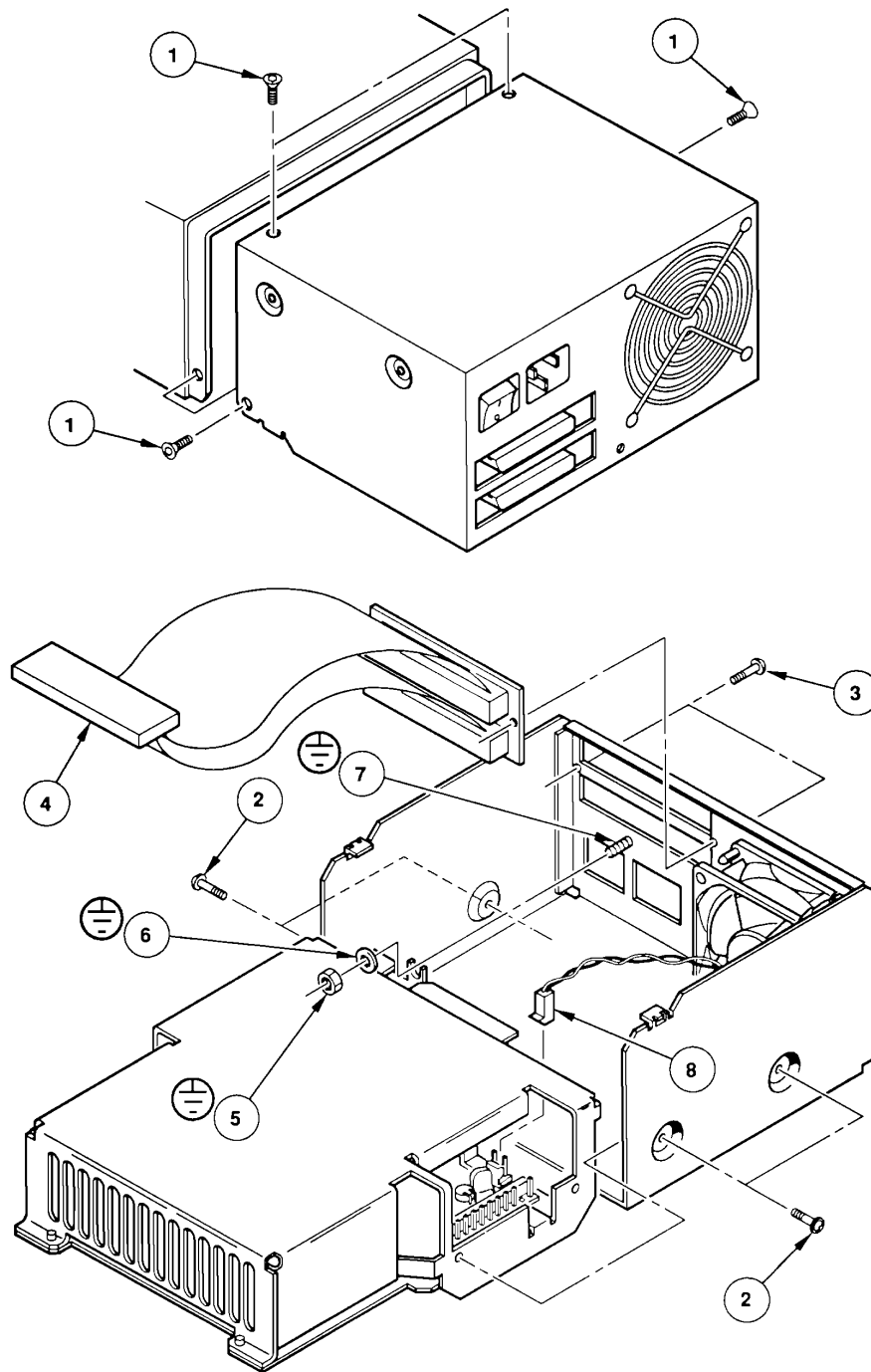
#### Replacement

1. Reverse the removal procedure. Be sure to route the loader cable (1) between the the threader motor boss and the threader motor, not between the boss and the takeup reel.

## 5.4.10 Power Supply

(29- 29335- 01)

Figure 5.13 PSU



## **WARNING**

**The connection of the bracket (or ground lug) to the threaded post on the chassis is the only AC ground for the unit. Be sure it is a secure connection.**

### **Removal**

1. Remove the bottom cover.
2. Remove the four screws (1), attaching the power supply section to the chassis.
3. Remove the four screws (2) attaching the power supply to its enclosure.
4. Remove the two screws (3) attaching the I/O connectors to the rear panel, then position the I/O cables and connectors (4) away from the chassis.
5. Remove the nut (5) with a 9/32- inch wrench, then remove the star washer (6) from the threaded post (7). On some units there may be a lug instead of a star washer or a nut with a captive star washer.
6. Slide the power supply enclosure several inches away from the drive. Disconnect the connector (8), then remove the power supply enclosure.
7. Disconnect the power connector from the power supply PWB (JP1). Remove the power supply.

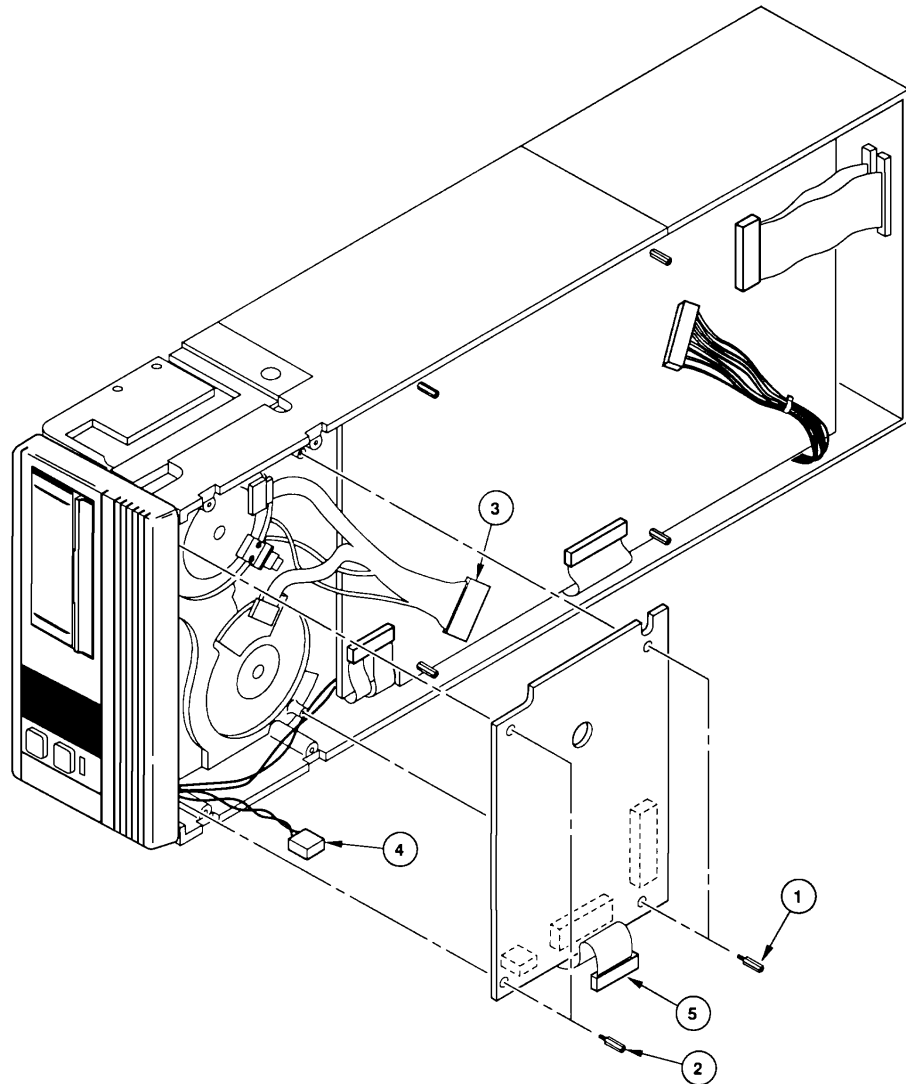
### **Replacement**

1. Reverse the removal procedure. Pin 1 of the I/O connector goes toward the fan and the wide part of the connector goes upward.

### 5.4.11 Servo Circuit Board

(29- 29340- 01)

**Figure 5.14 Servo Circuit Board**



#### Removal

1. Remove the top and bottom covers, and then the control circuit board, front panel or the ACL.
2. Remove the four standoffs (1 and 2) with a 1/4- inch socket.
3. Disconnect the two connectors (3 and 4), then remove the board.
4. Disconnect the cable (5).

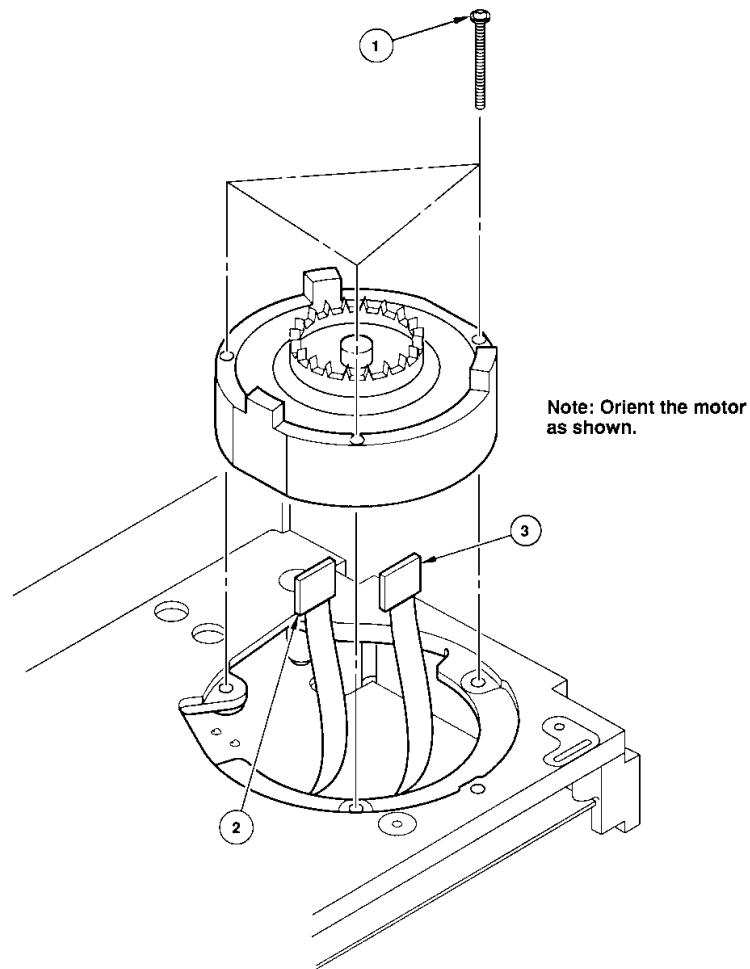
#### Replacement

1. Reverse the removal procedure.
2. Run the Motor Torque Calibration (70) diagnostic.

### 5.4.12 Supply Motor

(29- 29333- 01)

**Figure 5.15 Supply Motor Detail**



#### Removal

1. Remove the top cover, the front panel or ACL, and the loader.
2. Remove the three screws (1).
3. Disconnect the two connectors (2 and 3), then remove the motor.

#### Caution

***Be careful not to touch or damage the tachometer disk on the bottom of the motor.***

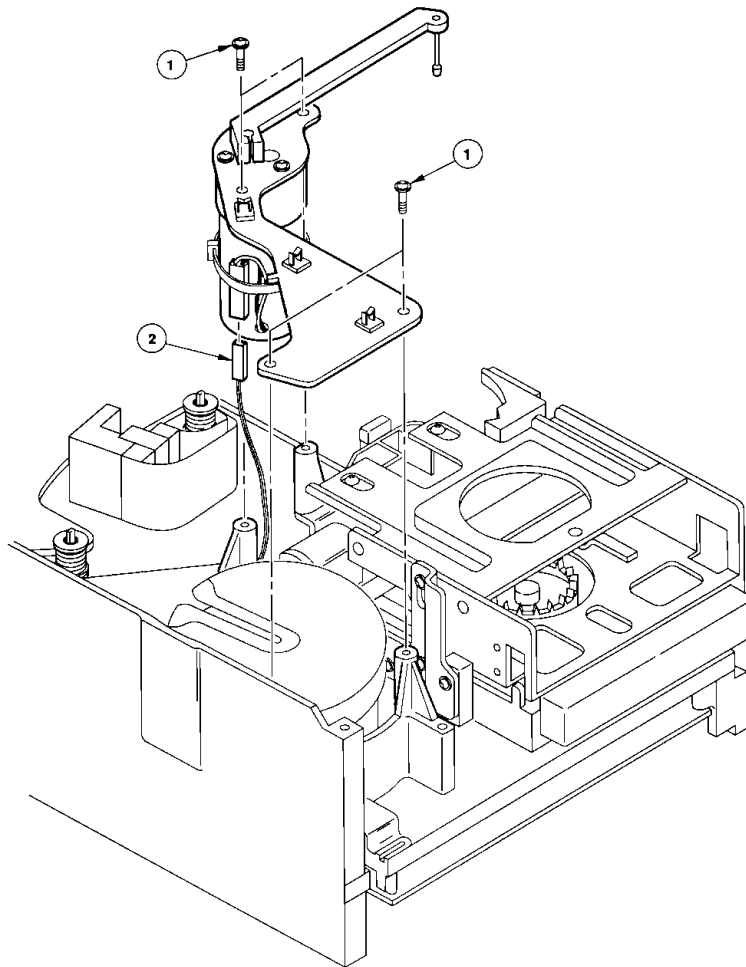
#### Replacement

1. Reverse the removal procedure.  
**Note:** Be sure that the motor is oriented as shown in Figure 6- 17 to avoid damage to any components.
2. Run the Motor Torque Calibration (70) diagnostic.

### 5.4.13 Threader

(29- 29339- 01)

**Figure 5.16 Threader Detail**



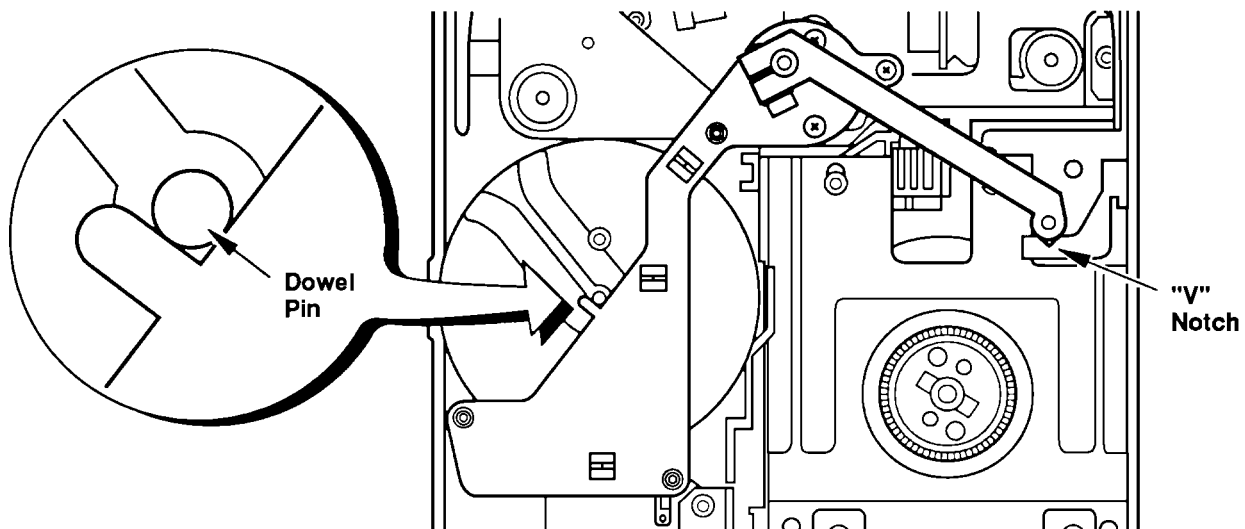
#### Removal

1. Remove the top cover.
2. Remove the four screws (1).
3. Disconnect the cable (2), then remove the threader.

## Replacement

1. Install the connector (2).
2. Install the threader and loosely install the four screws (1) into the chassis.
3. Insert the dowel pin (from the hardware kit) into the spindle hole of the takeup hub.
4. Rotate the threader arm to its "home" position (the V notch in the side of the loader) against the loader.
5. Align the threader plate held gently against the dowel pin, as shown below. If the plate is held too tightly against the pin, the plate will be biased.
6. Tighten the screws (1).
7. Remove the dowel pin.
8. Connect the power cord, switch on the power, and load a cartridge. When the tape is moving, the threader arm should not vibrate.
9. Unload the cartridge, switch off the power, and disconnect the power cord. Check that the threader arm fits into the V notch properly.  
When properly aligned, the arm will contact both sides of the "V" notch.
10. Install the top cover.

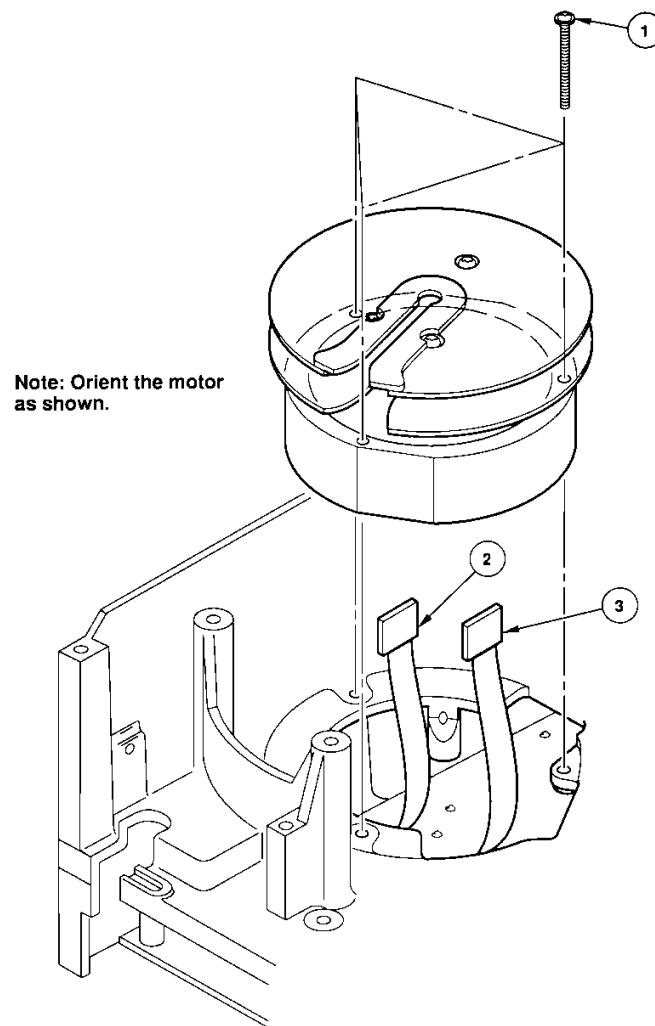
**Figure 5.17 Threader Alignment**



#### 5.4.14 Takeup Motor

(29- 334- 01)

Figure 5.18 Takeup Motor Detail



#### Removal

1. Remove the top cover and the threader.
2. Rotate the takeup spool to locate and remove the three screws (1).
3. Disconnect the two connectors (2 and 3), then remove the motor.

#### Replacement

1. Reverse the removal procedures.  
**Note:** Be sure that the motor is oriented as shown above to avoid damage to any components.  
Refer to Figure 5.17 to align the threader upon replacement of the takeup motor.
2. Run the Motor Torque Calibration (70) diagnostic.



## **6 - Firmware Updates**



## **6.1 Introduction**

Use the following procedure (in conjunction with the dismantling instructions included in Section Five of this document) to remove and replace the PROMS.

The references to the dismantling instructions are given (in brackets) after the instruction in the procedures detailed below.

### **6.1.1 Removal/Replacement of Drive and Read/Write PROMS**

1. Remove the Drive from the enclosure
2. Remove the Top Cover (5.4.1)
3. Remove the Bottom Cover (5.4.2)
4. Remove the Control Circuit Board (5.4.3)
5. Remove the Read/Write Circuit Board (5.4.7)
6. Remove the four (4) Piggy- back circuit board retaining screws, and then carefully unplug it from the Main Board
7. Remove and replace the PROM
8. Reassemble the unit by reversing the dismantling instructions
9. Run Diagnostic Level 2 Test 30 to initialise the EPROM values, then run Test 70 to recalibrate the motor torque values
10. Test the drive with Diagnostic Level 1 Test 01 (short Read/Write test diagnostic)
11. Before reinstalling the drive onto the system, reconfigure the drive to the system requirements



## **7 - Product Specification**



## 7.1 Introduction

This chapter provides various specifications for the tape drive, as well as the product safety standards to which the drive complies. Specifications for the interface are listed in the appropriate interface manual.

## 7.2 Performance

### 7.2.1 Tape Speed

|                               |                    |                                                                      |
|-------------------------------|--------------------|----------------------------------------------------------------------|
| Nominal                       | 1 meter per second |                                                                      |
| Long Term Speed Variation     |                    | ± 4% of nominal                                                      |
| Instantaneous Speed Variation |                    | ± 7% of nominal                                                      |
| Load/Unload Time              |                    | 15 seconds typical                                                   |
| Rewind Time                   |                    | 60 seconds nominal                                                   |
| Reposition Time               |                    | 250 milliseconds maximum                                             |
| Tape Tension                  |                    | 8.0 +0.5, 1.2 ounces                                                 |
| Record Size                   |                    | 1 byte to 64 kilobytes                                               |
| Data Format                   |                    | IBM 360 interchange format as proposed in ANSI X3B5 document 88- 091 |

### 7.2.2 Data Transfer Rates

|                           |               |                                          |
|---------------------------|---------------|------------------------------------------|
| Interface                 |               | Rate (max.)                              |
| SCSI                      | Synchronous:  | 4.0 megabytes per second                 |
|                           | Asynchronous: | 2.0 megabytes per second                 |
|                           |               | 1.3 megabytes per second                 |
| Data Capacity (formatted) |               | 220 megabytes per cartridge <sup>1</sup> |

<sup>1</sup> For 600' cartridge; 200 megabytes for 540' (IBM) cartridge.

### 7.2.3 Reliability (Unit)

|             |                                            |
|-------------|--------------------------------------------|
| MTBF        | 25,000 hours (20% duty cycle)              |
| MTTR        | 30 minutes                                 |
| Head Life   | 4,000 tape motion hours                    |
| Design Life | 5 years at 3,300 power- on hours per year  |
| Loader Life | 20,000 cycles with 99.8 % load reliability |

### 7.2.4 Data Reliability

|                        |                                         |
|------------------------|-----------------------------------------|
| Temporary write errors | 1 in 10 <sup>6</sup> bytes              |
| Permanent write errors | 1 in 10 <sup>11</sup> bytes             |
| Temporary read errors  | 1 in 10 <sup>9</sup> bytesUnrecoverable |
| Read errors            | 1 in 10 <sup>12</sup> bytes             |

### 7.3 Power Requirements

The AC power supply utilizes single- phase AC power. The supply provides auto- range operation in either of two voltage ranges, low (see below) or high (see below).

The power supply automatically selects the appropriate voltage and frequency range without any internal or external modification.

| Voltages          | Nominal                                 | Operating                    |
|-------------------|-----------------------------------------|------------------------------|
| Low range         | 100 to 120 Vac                          | 88 to 140 Vac                |
|                   | 200 to 240 Vac                          | High range<br>176 to 259 Vac |
| Frequency         | 47 to 63 hertz                          |                              |
| Power Consumption | 150 watts operational 180 watts maximum |                              |

### 7.4 Mechanical Specifications

Mounting                      Rack mounting in a standard EIA/RETMA compatible rack or in a table- top enclosure.

#### Dimensions

|        |                                             |                     |
|--------|---------------------------------------------|---------------------|
| Height | 114 mm (4.50 inches)                        |                     |
| Width  | 214 mm ñ .025mm (8.550 ñ .010 inches)       |                     |
| Depth  | 532 mm (21.25 inches) (without front panel) |                     |
| Weight | Without ACL                                 | 11.4kg (25 pounds)  |
|        | With ACL                                    | 13.6 kg (30 pounds) |

### 7.5 Environmental Specifications

#### 7.5.1 Operating Conditions

|                      |                                            |
|----------------------|--------------------------------------------|
| Dry Bulb Temperature | 10 to 40 degrees C                         |
| Temperature Gradient | 1 degree C per minute                      |
| Temperature Shock    | 15 degrees C over two minutes              |
| Wet Bulb Temperature | 26 degrees C                               |
| Relative Humidity    | 15 to 85 percent, non- condensing          |
| Humidity Gradient    | 10 percent per hour                        |
| Altitude             | - 300m to 3,200 m (- 1,000 to 10,000 feet) |

**Note:** The ambient temperature and humidity must remain within ANSI media limits, 89.6 F (32 C), to ensure the data integrity of the media.

### **7.5.2 Short Term Storage**

|                      |                                              |
|----------------------|----------------------------------------------|
| Dry Bulb Temperature | 40 to 70 degrees C                           |
| Temperature Gradient | 25 degrees C per hour                        |
| Temperature Shock    | 15 degrees C over two minutes                |
| Wet Bulb Temperature | 30 degrees C                                 |
| Relative Humidity    | 5 to 95 percent, non- condensing             |
| Humidity Gradient    | 10 percent per hour                          |
| Altitude             | - 300 m to 15,000 m (- 1,000 to 50,000 feet) |
| Acoustical Emissions | 50 dBA at one meter.                         |

### **7.6 Regulatory Requirements**

|                           |                                                                                |
|---------------------------|--------------------------------------------------------------------------------|
| Product Safety            | UL 950 CSA C22.2, number 154 IEC 950                                           |
| Electromagnetic Emissions | FCC Class A computing Devices, Part 15 J,<br>Subpart B. VDE 0871, 0875 Class B |
| Cartridge                 |                                                                                |
| Tape Cartridge            | 360- type tape cartridge defined by<br>ANSI X3B5 document 88- 091.             |
| Cache Size                | 512 kilobytes                                                                  |

