Sun Front-Load ½-Inch Tape Drive Field Service Manual

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1

Product Overview

1.1. Introduction to the Front-Load Tape Drive

The Sun Microsystems Front-Load ½-Inch Tape Drive is a ½-inch reel-to-reel tape drive with autoloading capability. The tape drive operates as a tabletop unit or, when appropriately mounted, in a Sun Microsystems 56-inch data center cabinet.

The front-load tape drive offers the following features:

- Compact, ergonomic design with front autoload
- High performance
- Low power consumption
- 125 inches-per-second (ips) tape speed
- Start/Stop performance using 512 Kbyte buffering
- SCSI bus arbitration with disconnect/reconnect capability for multi-target or multi-initiator systems
- Higher capacity when using 1 mil thick, 3600 feet-per-reel tape
- Custom operating features, selected by the operator from the control panel
- Easy to use built-in diagnostics
- Extra capacity data storage at 6250 bit cell-per-inches (cpi), selectable by operator or through host

Density may be configured as needed. The drive supports the following formats:

- 800 bpi (bits per inch) Non Return to Zero Inverted (NRZI)
- 1600 bpi Phase Encoded (PE)
- 6250 bpi Group-Coded Recording (GCR) format.

1.2. Software Requirement

The Sun Microsystems Front Load Tape Drive requires a minimum level of at least SunOS Release 4.0.3 software on the host system. If the customer has SunOS Release 4.0, they will need to upgrade to 4.0.3. If they have SunOS Release 3.5, SunOS 4.0.3 will need to be fully installed.

1.3. General Operation

The tape drive has an intelligent controller and an embedded Small Computer System Interface (SCSI) board which interfaces with a SCSI connector. The SCSI connector can either be a built-in connector on the CPU board or one on a separate SCSI Host Adapter.

The logical unit address (Drive ID) is set according to the other SCSI devices that are part of your system. The procedure for changing the drive ID, and a full description of other defaults is covered in Chapter 3. In particular, see Table 3-4—Initial Configuration of the Front-Load Tape Drive.

The command set includes support for random access processing and applications. Support is also provided for applications that maintain strategic block address.

1.4. Physical Data

Table 1-1 lists the physical dimensions for an unmounted tape drive without skins.

Table 1-1 *Physical Dimensions, Front-Load Tape Drive*

Dimensions	***Measurement***
Height	8.75 inches (222 mm)
Width	19.0 inches (483 mm)
Depth	26.5 inches (673 mm)
Weight	85 pounds (38.5 kg)

1.5. Media

Data is recorded on computer grade tape that meets or exceeds ANSI X3.40-1983. Table 1-2 lists the tape specifications.

Table 1-2 *Tape Specifications, Front-Load Tape Drive*

Item	***Specification***
Width	0.5 inches (12.7 mm)
Thickness	1.5 mil overall (0.038 mm)
Type	Computer Grade, to meet or exceed ANSI X3.40-1983
Tension	10 oz +/– 3 oz. operating (283 gm)
Reel Sizes	10.5 in. (267 mm) 8.5 in. (216 mm) 7.0 in. (178 mm) 6.0 in. (152 mm)

1.6. Data Specifications

Table 1-3 contains data specifications for the tape drive.

Table 1-3 *Data Specifications, Front-Load Tape Drive*

Feature	***Specifications***
Capacity, 2400-ft Reel	140 Megabytes GCR 40 Megabytes PE 20 Megabytes NRZI
Capacity, 3600-ft Reel	210 Megabytes GCR 60 Megabytes PE 30 Megabytes NRZI
Data Density	6250 bpi GCR 1600 bpi PE 800 bpi NRZI
Average Transfer Rate	747 Kb/second GCR 186 Kb/second PE 93 Kb/second NRZI
Maximum Transfer Rate	769 Kb/second GCR 208 Kb/second PE 104 Kb/second NRZI
Minimum Gap	.28 inches (0.71 cm) GCR .50 inches (1.27 cm) NRZI, PE
Tape Speed Read/Write Rewind–Average Rewind–Maximum Rewind–2400-ft reel Rewind–3600-ft reel	 125 ips (8.2 m/s) 320 ips (8.1 m/s) 450 ips (11.5 m/s) 90 seconds 135 seconds

SCSI Compliance

The tape drive is in compliance with ANSI X3.131, the sequential storage device implementation standard.

1.7. Reliability

Table 1-4 *Hard Error Rate*

Format	***Will Not Exceed***	
GCR	Read Write	1 in 10E11 1 in 10E10
PE	Read Write	1 in 10E10 1 in 10E09
NRZI	Read Write	1 in 10E10 1 in 10E09

1.8. Using One Mil Tape

The use of one mil tape (3600 feet) is supported. Thin tape was designed for low-speed data logging operations. One mil tapes are more susceptible to deformation and breaking and conform to the read/write heads differently; therefore, it wears the heads differently than 1.5 mil tapes. The Front- Load Tape Drive will handle the one mil tapes physically without deforming or breaking them. However, because of different head-wear patterns, the Front Load Tape Drive critical read/write head wears at an increased rate with one mil tape and forms a different profile than that made by 1.5 mil tape. Increased read/write errors can occur if a 1.5 mil tape is mounted on a drive on which the read/write area of the head has been worn by frequent use of one mil tape. This effect is true for all industry-standard half-inch tape drives.

Due to the difference in head wear profiles, Sun Microsystems supports the use of one mil tapes on the Front-Load Tape Drive only if the following guidelines are used:

- If a significant portion of the tapes used (more than one tape in 10) are one mil tapes, the drive should be dedicated to the use of thinner tapes.
- If less than one tape in 10 used on the drive is a one mil tape, *AND* at least 10 1.5 mil tapes are mounted between mountings of one mil tape, both tape thicknesses can be used on the same drive.

2

Site Preparation Guidelines

2.1. Environmental Considerations

Table 2-1 presents environmental specifications for guidance. (These specifications take into account the conditions required by the magnetic tape itself.)

Location

The drive should be located away from sources of particulate contamination, such as frequently-used doors and walkways, stacks of supplies that collect dust, and smoke-filled rooms. If possible, allow enough room at the rear of the cabinet to access the power switch easily.

Temperature

The ambient temperature for operating the tape drive should range between 15 to 32 degrees C (60 to 90 degrees F) non-condensing, with a temperature rate of change not to exceed 20 degrees C (36 degrees F) per hour. See also the section on *Cooling Requirements* for the recommended operating range.

NOTE

Note that the drive's operational temperature range limits the allowable operational temperature range of the data center cabinet.

Cooling Requirements

Allow a minimum of 70-80 mm (3 inches) clearance behind the rear for air circulation. For the rackmount, make sure there is at at least a one meter (39 inches) space in front of the cabinet so you can open the front door and pull out the cabinet during servicing. The tabletop unit only requires space in front for tape insertion and removal.

The area does not have to be air-conditioned, but maintaining an operating room temperature between 18 to 24 degrees C (65 to 75 degrees F) is recommended.

Table 2-1 *Environmental Characteristics, Front Load Tape Drive*

Characteristics	***Specifications***
Temperature	
Operating*	+15 to 32 degrees C (+59 to 90 degrees F)
Non-operating*	-40 to 70 degrees C (-40 to 158 degrees F)
Storage	–40 to +70 degrees C (–40 to +158 degrees F)
Shipment	–40 to +70 degrees C (–40 to +158 degrees F)
Rate of Change	20 degrees C/hour (36 degrees F/hour)
Relative Humidity	
Operating*	25 to 80% RH @ 20 degrees C maximum wetbulb
Storage	5% to 90% RH @ 40 degrees C maximum wetbulb
Shipment	90% without media @ 40 degrees C maximum wetbulb
Rate of Change	30% RH /hour 10 degrees C/hour
Altitude (max)	
Operating	10,000 ft (3.0 km)
Non-Operating	50,000 ft (15.3 km)
Shock	
Trapezoidal wave	30 g, 188 ips, 15 ms
Half-sine wave	159 g, 57 ips, 3 ms
Vibration	
Operating, Random	5–500 Hz,˜0.2 g rms
Non-operating, Swept sine	5–500 Hz–5 Hz, 0.5 g rms
Non-operating, Random	5–500 Hz, approx 0.2 g rms
Noise	
Read/write	6.6 Bels (A)
Operating	7.2 Bels (A)
Heat Dissipation	
Maximum	1280 BTU/hr
Typical	850 BTU/hr

* The ambient temperature and humidity ranges for operating your tape drive are limited by the tape medium used.

2.2. Power and Grounding

This is a Safety Class I product and is provided with a protective earthing terminal. Permitted voltage ranges, depending on configuration and assuming a line frequency of 50-60 Hz, are 100-120 VAC (120 VAC) nominal and 200-240 VAC (220 VAC nominal). Also check the earth (safety) ground in the power outlet.

Observe common sense safety precautions as you would for any electrical or electronic equipment. Always plug the tape drive into the proper outlet of the cabinet's power sequencer.

Table 2-2 *Power Specifications*

Input Frequency	46-66 Hz	46-66 Hz
Input Voltage	100-120 VAC ± 10%	200-240 VAC ± 10%

Table 2-3 *Power Consumption*

State	***Current***	***Power***
Maximum	2.6 Amps	250 Watts
Idle	1.60 Amps (max)	170 Watts

3

Drive Operation and Configuration

This chapter covers the information you need to know about operating and configuring the Front-Load Tape Drive. Topics include:

- Power-on
- How to use the operator control panel
- How to load and unload tape
- How to verify the voltage and fuse setting
- SCSI connection and cabling
- How to clear non-volatile RAM
- How to compute autogain values
- How to set drive configurations

For specific information on the available configurations, see Appendix C—Summary of Configuration Descriptions.

3.1. Power-on Sequence

The main AC power switch is located in the rear panel. Make sure the tape door is closed before pressing the rocker switch. If a tape is present, it will automatically load at this point.

When transfering the tape drive from a very cold environment to a warm environment, or vice versa, it is very important to let the drive adapt to the new conditions for maximum autoload performance. Apply power to the drive for at least one hour before autoloading. If the new environment is extremely humid or cold, allow at least two hours.

The main AC power switch controls input power to the drive and should remain on continuously during normal operations. If no display appears on the control panel, make sure the main AC power switch is on, and the tape door closed.

When the drive is powered up, all segments of the control panel display will light up and `TESTING` will appear on the display. The drive runs through a series of power-on tests and performs a test of all display lights.

After a few moments one of the following sequences of messages will appear on the front panel display, depending on whether there is tape in the drive.

Display Sequence	*With Tape*	*Without Tape*
First	TESTING	NO TAPE
Second	LOADING	LOADING
Third	BOT*	NO TAPE

*BOT = Beginning of Tape

3.2. Operator Controls

The control panel contains option keys, status indicators, and an LED display with tape odometer. You can select operating, diagnostic, and addressing and configuration functions from this panel. The keys in the top row are *option keys*, the keys in the bottom row are *operation keys.* Status indicators and error messages appear in the area to the left of the keys.

Figure 3-1 *Front-Load Tape Drive Front Panel*

Operation Keys

The four keys on the bottom row of the panel are as follows:

ONLINE: Selects online or offline operation.

UNLOAD/REWIND: Rewinds tape to Beginning of Tape (BOT). Unloads tape and opens door. (Unit must be offline).

RESET: Aborts operations, both from the control panel and host (if busy is displayed).

DENSITY: Changes the write density of the tape. This key is active before a tape is loaded or when a loaded tape is at BOT and the drive is offline.

Option Keys

The four keys on the upper row of the panel are as follows:

OPTION: Enables or exits the Option Select mode. The options are: Test, Config, Info, and ID. See section on Selections for information on their usage.

PREV: Displays the previous option choice or decrements the displayed number.

NEXT: Displays the next option choice or increments the displayed number.

ENTER: Selects the displayed option and choices within the option.

Status Indicators

There are eight status indicators on the left side of the control panel:

OPTION: Lit when option mode is selected.

ONLINE: Lit when drive is online. Flashes if command is queued.

UNLOAD/REWIND: Lit when drive is unloading the tape. Flashes if queued.

WRT EN: Lit when a write-enabled tape is loaded.

800, 1600, 6250: The one that's lit indicates the density of the tape.

TAPE ODOMETER: Shows the relative position of the tape between BOT and EOT.

Option Selections

Here are the general instructions to access the Test, Config, Info, and ID selections. See the individual sections on the selections for detailed information.

1. Make sure the drive is offline, and then press the OPTION button.
2. `TEST*` will appear in the display. Pressing `NEXT` allows you to access the subsequent options; pressing `PREV` allows you to access the previous options.
3. Pressing `ENTER` selects the displayed option.

3.3. Loading/Unloading Tape

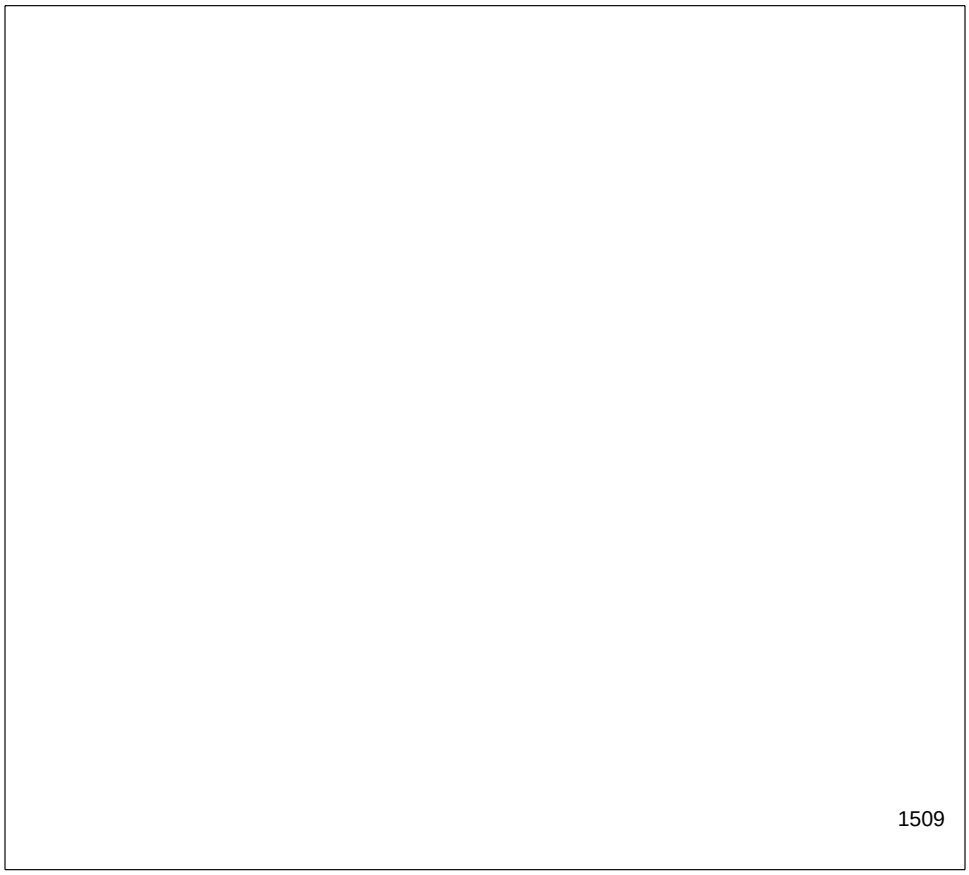
Things you should be aware of:

- Do not smoke when handling the tape or drive, or allow cigarette ashes to contaminate the area.
- To write to tape, the BOT (Beginning of Tape) marker and EOT (End of Tape) marker must be in place and a write-enable ring installed.
- To read-only from tape, remove the write-enable ring to prevent accidental overwriting.
- Keep tape away from magnetic sources.
- The tape end should be rounded and crimped.
- The use of one-mil tape is supported under certain conditions. See Chapter One, Using One Mil Tape for details.

The drive loads and unloads the tape automatically, centers the reel, and ensures proper tension and velocity.

The tape end is blown off the supply reel by compressed air, fed into the tape path and drawn onto the takeup reel. The drive then properly tensions the tape and advances it to the BOT marker.

Figure 3-2 *Front Panel Features*



Loading Tape

Step 1 Press Unload/Rewind

The drive must be offline to load or unload tape. Unlatch the front loading door of the drive by pressing the front panel key marked `UNLOAD/REWIND`.

NOTE:

If the tape end is damaged, cut off only what is necessary to remove the damaged section. To ensure that the tape can be loaded on any drive that conforms to ANSI standards, do not shorten the tape leader to less than 14 feet.

Step 2 Insert Tape

Put the tape into the drive with the tape running clockwise and leave a few inches of tape trailing. Make sure the side with the write-enable ring is facing downward. (If you put the tape in backwards, the `INVERT` message will appear on the front panel after you close the tape loading door.)

Step 3 Close Loading Door

At first, the tape reel will move back and forth as the drive tests how big the reel is. The drive will display `ONLINE` when the tape is finally loaded.

Step 4 Check Tape Density

The density of the loaded tape is displayed on the front panel (`800`, `1600`, `6250`, `BLANK`, or `UNKNOWN`). Selections made using the `DENSITY` key are always overridden by software instructions that set the write density.

Unloading Tape

Step 1 Press Online

Always press `UNLOAD` to open the door or to stop a load operation. Do not try to force the tape door open.

If the `ONLINE` message is showing in the front display panel, take the drive offline by pressing the `ONLINE` key.

Step 2 Press Unload/Rewind

The drive will unload the tape and open the tape door. If the tape is not at BOT, the first pressing of the `UNLOAD/REWIND` key will rewind the tape to BOT; a second pressing of `UNLOAD/REWIND` will unload the tape.

3.4. Verifying Voltage Configuration and Fuse

Verify that the power supply matches the voltage required, and that the correct fuse is installed.

A fuse for 115 VAC (nominal) operation and a fuse for 230 VAC (nominal) operation may be held in the module at the same time, but **Sun ships drives containing only the correct fuse for the particular unit**.

Permitted voltage ranges, depending on configuration and assuming 48-66 Hz, are 90-120 VAC (115 VAC nominal) and 198 to 250 VAC (230 VAC nominal). Check that the power cord from the power module has the proper connector for the country.

Table 3-1 *Fuse Ratings*

Use	***Voltage***	***Rating***	***Sun Part. No.***
Tabletop	110V (115 VAC)	6.0A,250V Fast-blow	140-1021-01
Rack	220V (230 VAC)	3.0A, 250V Fast-blow	140-1039-01
International	220V (230 VAC)	3.15A, 250V Fast-blow	140-1002-01

Figure 3-3 *Drive Rear Panel*

Changing Voltage Configuration

1. Turn off the main AC power switch on the rear panel.
2. Disconnect the power cable.
3. Slide the fuse module out. The AC line fuse is located beneath the power cable receptacle on the rear panel. Insert your fingernail or a small screwdriver into the slot to help slide the module out from its flush-mounted position.
4. See Figure 3-4 for a picture of the fuse module. Rotate the fuse module so that the desired voltage rating arrow aligns with the lower edge of the receptacle. Viewed from the end of the fuse holder as you insert the holder, the **active** fuse will be on the right side of the holder. Ensure that the correct fuse is on the right size.
5. Reconnect the power cable and reapply power to the unit.

Figure 3-4 *Fuse Module*

3.5. Device Termination

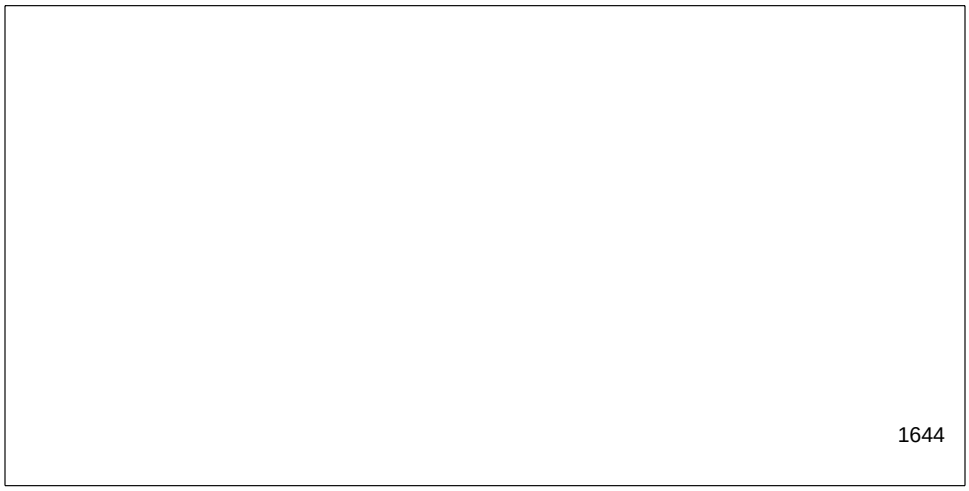
This tape drive has been configured as "Device Term Power," which means the drive can supply power to an external SCSI termination connector. It is recommended that the Front-Load ½-Inch Tape Drive be the last device on its SCSI bus and have the termination connector attached to its SCSI OUT connector.

- If a Front-Load ½-Inch Tape Drive is in the main data center cabinet, it is always terminated.
- If a Front-Load ½-Inch Tape Drive is mounted in the top of a data center expansion cabinet, it is always terminated.
- If a Front-Load ½-Inch Tape Drive is the lower of two drives mounted in a data center expansion cabinet, it is never terminated.

For a Front-Load ½-Inch Tape Drive, termination is provided by attaching a terminating connector to the drive's SCSI OUT connector. Verify that the terminating connector is properly installed by pushing the pins in firmly and securing the latches. See Figure 3-5 for an illustration of the connector.

Extra terminating connectors may be ordered from the Sun Microsystems Spare Parts Price List (the connector is Part No. 150-1407).

Figure 3-5 *Terminating Connector*



3.6. SCSI Connection

The single-ended SCSI requires a shielded cable, terminated and grounded to the shielded cable connector. The total cable length in a configuration, both external and internal, must not exceed the total cable lengths supported by the devices in that configuration. Cables normally shipped with the Front Load Tape Drive are four meters long. A SCSI-3 Host Adapter is limited to six meters overall length, measuring from the Host Adapter to the terminator of each device.

CAUTION:

Data errors may occur if power and data cables are not routed separately. This separation and bundling of like cables is required to ensure FCC compliance. This Front Load Tape drive is provided with a protective earthing terminal. Always use a grounding type, 3-wire power cord, and plug the tape drive into a grounded wall outlet.

SCSI Cabling

1. Plug one end of the SCSI cable into the back of the Front Load Tape Drive.
2. Plug the other end of the SCSI cable into the connector on the host system.
3. Ensure that all data cables are bundled together where possible, and that power cables are together. Use reusable tie-wraps and clamps to bundle the cables. Open the clamps by pulling up and away from the bundle before releasing.

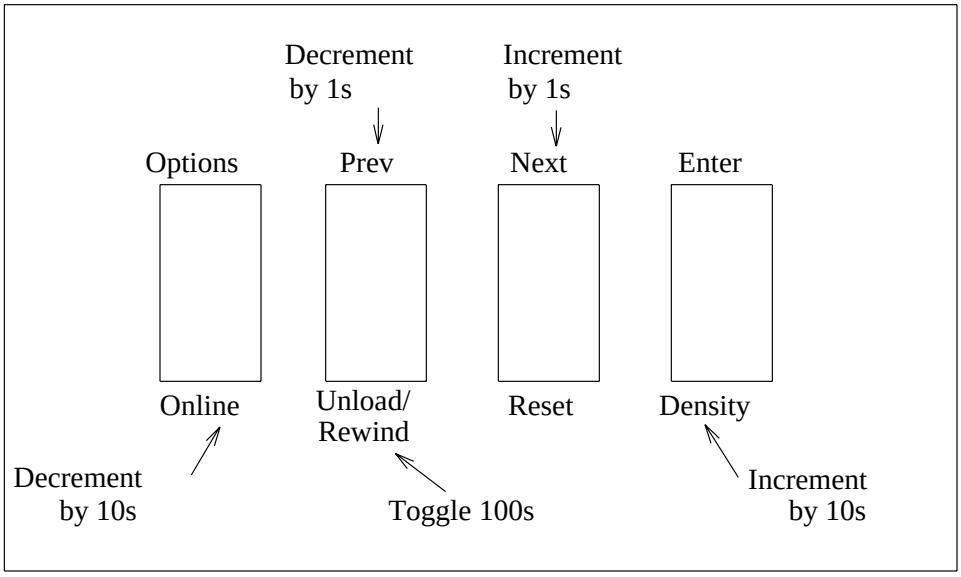
3.7. Setting the Tape Density

Density may be set from the control panel or the host keyboard. The default density set at the factory is 6250 bpi. The following is the procedure to change density at the control panel.

1. Take the drive OFFLINE by pressing ONLINE. Density may be set with or without a tape loaded.

2. Press the DENSITY key. Continue to press the key until the desired density selection is displayed.
3. Press ONLINE to select the desired density. If the density is not selected within five minutes, the drive automatically selects the one displayed.

Figure 3-6 *Incrementing/Decrementing Numbers on the Front Panel*



3.8. Setting the Device ID

The host system requires an address, known as the Device ID, to send information to. This is set at the factory, but may require changing, depending on the configuration. The Device ID is generally set in conjunction with the write density.

The first four device IDs (0,1,2, and 3) are reserved for any disk drives that may be installed.

1. Take the drive offline by pressing ONLINE.
2. Press OPTION to enter the option mode.
3. Press NEXT until “ID” is in the display.
4. Use the ENTER key to select the ID option.
5. Use the PREV or NEXT keys to change the counter until the desired ID number is displayed.
6. Press the ENTER key to accept the number. The display will flash the SET# to confirm the selection before returning to ID. See Table 3-2 to select the correct drive ID dependent on the SCSI controller number.

Table 3-2 *First Device ID*

First SCSI-3 Controller Commands		
Format	***1st Drive***	***2nd Drive***
	ID#4	***ID#5***
NRZI, 800 bpi	rst0	rst1
PE, 1600 bpi	rst8	rst9
GCR, 6250 bpi	rst16	rst17

Table 3-3 *Second Device ID*

Second SCSI-3 Controller Commands		
Format	***1st Drive***	***2nd Drive***
	ID#4	***ID#5***
NRZI, 800 bpi	rst2	rst3
PE, 1600 bpi	rst10	rst11
GCR, 6250 bpi	rst18	rst19

3.9. To Change any Configuration Option

Please see Appendix C—Summary of Configuration Descriptions for individual configuration descriptions. See Table 3-4 for a summary of configuration options.

1. Take the drive offline by pressing the `ONLINE` key on the front panel. There is no need to turn off the back panel On/Off switch or unplug any cables.
2. Press `OPTION` to enter the options mode.
3. Press `NEXT` to bring a series of option names into the display. `TEST*`, `CONF*`, `INFO*`, and `ID*` will cycle into the display as you continue to press `NEXT.` To return to a previous choice, press `PREV.`
4. When `CONF*` appears in the display, press `ENTER` to select the configuration option. any others.
5. Using `NEXT` or `PREV`, bring `40` into the display. The “Enable Change to the Non-Volatile Memory” configuration must be set before any others. See Figure 3-6 for a guide on incrementing and decrementing numbers from the front panel.
6. Press `ENTER` to accept the displayed number. The display will show the message `SET <#>` for about one second to confirm that the value has been accepted. Then the display returns to `CONF*`.
7. Press `RESET` to return to the “ready”, offline state.

Saving and Reloading Changes

When changes have been made, configurations are saved to tape by running Test 128. Configurations are reloaded into non-volatile memory by running Test 129. To run either of these tests, the same general procedure is followed.

1. Load a short tape with a write enable ring. The tape must be at BOT.
2. Run Test 150 to write an ID on the tape.
3. Run Test 128 to dump non-volatile RAM to tape.
4. Unload the tape. Mark the tape as “Stored Configurations” or something similar to identify it.
5. To load the stored configurations into non-volatile RAM, use Test 129.

Table 3-4 *Initial Configuration of the Front-Load Tape Drive*

Configuration Name	***Default Setting***	***Config. Number***	***Lock/ Unlock***
Enable Non-Volatile Change	OFF	40	Unlock
Auto Online	ON	41	Unlock
Media Removal	ON	42	Lock
Operator Timeout	10	43	Lock
Archival Rewind	REW*	44	Unlock
Operator Select Archive	OFF	45	Unlock
Manual Density	6250	46	Unlock
Operator Select Density	OPEN	47	Lock
Language	36	48	Unlock
Recovered Error Report	ON	49	Lock
Immediate Response	ON	50	Lock
Tape Marks to Disable Immediate Reporting	2	51	Lock
Write Retry Count	17	52	Lock
Low Density Gap Size	6	53	Lock
High Density Gap Size	4	54	Lock
Stop at EOT	0	55	Lock
Write Holdoff Time (seconds)	20	56	Lock
Write Startup Point	2	57	Unlock
Retry Before Skip	1	58	Lock
Write Auto-Hitch	37	59	Lock
Readaheads	ON	60	Lock
Tape Marks to Terminate Readaheads	2	61	Lock
Read Retry Count	20	62	Lock
Trailing Buffer	0	63	Lock
Read Startup Point (eighths)	6	64	Unlock
Max. Physical Record Size	15	65	Lock

Table 3-4 *Initial Configuration of the Front-Load Tape Drive— Continued*

Configuration Name	***Default Setting***	***Config. Number***	***Lock/ Unlock***
Max. Files per Physical Record	OFF	66	Lock
Max. Bytes per Physical Record	OFF	67	Lock
Max. Accumulated Tape Marks	0	68	Lock
Max. Accumulated Bytes	99	69	Lock
Expansion Protection	ON	70	Lock
Performance Option	OFF	71	Lock
Record Optimization Threshold	OFF	72	Lock
Data Comp. Optimization Sample Period	2	73	Lock
Data Comp. Optimization Threshold	32	74	Lock
Gauge Usage	0	75	Lock
No Break on Failure	OFF	76	Lock
Activity Indicator	OFF	77	Unlock
Lock Interface Density Select	OFF	78	Lock
Lock Interface Address	OFF	79	Lock
Interface Non-Volatile RAM Change	OFF	80	Lock
Block Length	0	81	Lock
Bus Inactivity Limit	9	82	Lock
Disconnect Time Limit	1	83	Lock
Disconnect Length	0	84	Lock
Inquiry Field	0	85	Lock
Reset Method	ON	86	Lock
Read EOM Reported	OFF	87	Lock
SCSI II Compatible	ON	88	Lock
Report EOT at Early EOT	OFF	89	Lock
Check Incoming Parity	ON	90	Lock
Vendor-Unique Density	ON	91	Lock
Reserved	–	92–96	Lock

NOTE:

The customer will not have access to the “Locked” configurations unless the locks are turned OFF. Normally a field engineer will be called on to change a particular locked configuration.

Changing a Locked Configuration

The locked configurations require two passwords to change them. The access passwords are located in CONF100 and CONF101:

The password for CONF100 is 48. The password for CONF101 is 76. Entering the two passwords enables you to change locked configurations 40 through 96 and to change the locks to ON or OFF.

1. Select CONF100 and set it to 48. Hold down the NEXT or PREV button to scroll through the numbers quickly.
2. Select CONF101 and set it to 76.
3. Select CONF40 and set it to ON. This setting will keep the changes in NVRAM.
4. Now select the CONF number that needs changing and set the parameter according to Table 3-4.
5. Select CONF40 and set it to OFF, so that the NVRAM will not be cleared when you power cycle the drive. If desired, continue to the next section to unlock the particular configuration.

Unlocking a Configuration

This procedure enables a user to change a configuration from the front panel without passwords.

Configuration locks are stored in the CONF number plus decimal 100. For example, to change CONF82, you must unlock location 182. To unlock a configuration, select the lock location and set it to OFF.

To lock the location again, you must enter the passwords as described in the previous section, select the lock location, and set it ON again. Then you must power cycle the drive to enable the lock.

Other Passwords

To clear the odometer and power cycle the logs, you will need the following passwords:

The password for CONF 100 is 63. The password for CONF 101 is 21.

Example: To clear and reset the odometer to zero from its present number, do the following:

1. Select CONF100 and set it to 63.
2. Select CONF101 and set it to 21.
3. Select CONF10 and set it to CLEAR. Selecting INFO10 should now display 0.

3.10. Clearing the NVRAM

CAUTION:

There are serious consequences to clearing the NVRAM. Please read this section to ascertain whether it is necessary for you to do so. Reasons to clear the NVRAM are:

- If all the configuration parameters need to be changed;
- If firmware has been upgraded.

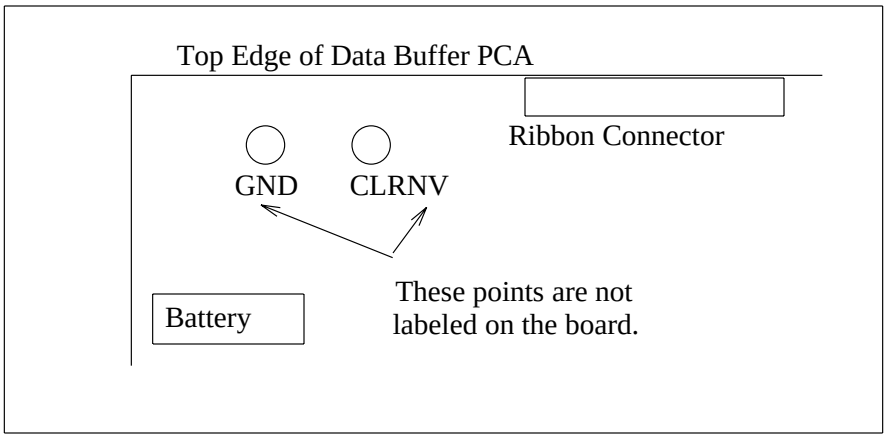
After you clear the NVRAM, you must:

- Run the 800 bpi NRZI skew tape or the drive may retain a bug associated with improper skew values. Clearing NVRAM zeros the skew values;
- Recompute the autogain values.

To clear the NVRAM, do the following:

1. Attach a jumper wire between the GND and CLRNV points on the Data Buffer PCA. Reference the figure below.
2. Apply power to the drive. The display should show `FAIL 0`.
3. Remove power from the drive.
4. Remove the jumper from the GND and CLRNV points.
5. Apply power to the drive. Power on test should PASS (drive will display `READY`). At this point, the NVRAM is clear, and all configurations must be reconfigured.
6. Replace the RFI cover over the PCAs.

Figure 3-7 *Clearing the NVRAM*



Computing Autogain Values

The read/write performance of the drive depends on how well the drive is tuned to cover the range of tapes used at a site. The factory setting of the gain values (as shipped) will most probably not be correct for the typical tapes found at a particular site.

1. Load a typical customer tape. Select a tape that represents the “mean” rather than the “average.” Consider the range of tapes used (hot to cold), the relative amount of each “type” of tape used, and the age of each of these “types.”
2. Run Test 99, choosing ONCE, 1600, and SAVE.
3. Run Test 99 again, choosing ONCE, 6250, and SAVE.

4

Diagnostics and Troubleshooting

The goal of this chapter is to help you

- Run and interpret the built-in diagnostics
- Use the error logs to check error history
- Identify and isolate malfunctions to the FRU level

The companion appendices for this chapter are:

- A—Summary of Diagnostic Tests
- B—Summary of Error Messages and Codes
- D—Accessing Logs

4.1. Potential Problems

High Error Rates:

- Head dirty: clean head with freon-TF and swabs
- SCSI bus cabled wrong: cable correctly
- SCSI bus improperly terminated: use correct terminator scheme
- PCAs become loose; reseat boards in cardcage
- Worn tape: use known good tape
- SCSI fuse: replace with good fuse

Hard Errors:

- Operation fails: run diagnostics and try known good tape

Soft Errors:

- Retries: message if error count over threshold. Tape may be worn or need cleaning.

Autothread

- Autothread will not work with the tape cover up. Remove tape by hand after rewind.

4.2. Front Panel Self-tests

Troubleshooting the drive is primarily done with the aid of the self-tests selected at the front panel. The categories and test ranges are:

Table 4-1 *Self-Test Categories*

Power-on Test	General check of digital circuitry
0-36	General drive function test sequences
37-39	User-defined test sequences of up to 3 tests each
40-49	Kernal tests
50-59	Processor communication tests
60-69	Loopback tests
70-129	Drive controller/buffer controller tests
140-149	Interface tests
150-199	Tape motion and read/write tests
--	Servo tests (see subsection)

These tests are organized, called, and run as sequences to provide the capability of isolating failures to a single FRU. All tests may be initiated from the front panel. All tests, except interactive tests, can be run remote. Failure messages and isolation information is logged and displayed either on the front panel or remotely. The four test groups check out increasingly larger portions of the drive:

1. Power-on test (runs whenever a drive is powered on) checks out:
   - Full operation of each controller
   - Controller communications
   - All digital data storage
   - Digital data path
2. General checkout test:
   - Runs all power-on tests
   - Loads tape
   - Verifies read/write analog circuitry
   - Checks data path components
3. Interactive checks: Requires operator interaction. Allows all testable portions of the drive to be fully checked out.
4. Downloaded diagnostics: Allows executable code to be downloaded into the drive for unlimited diagnostic capability.

4.3. Troubleshooting Procedures

When a failure occurs, use the flow chart provided and the following procedures to help isolate the cause of the failure.

Step 1 Power On/General Check Test

Start with the Power-on test, followed by the General Check Test Sequence (0-36). Passing these tests indicates that the digital circuitry and basic drive functions are working.

Step 2 Check error logs

See the section, Viewing Error Logs, for information on how to access the logs for drive error history.

Step 3 If the Test Fails

When the general sequence test fails, an error code is displayed. The next step is to run the test which exercises the suspected failing component.

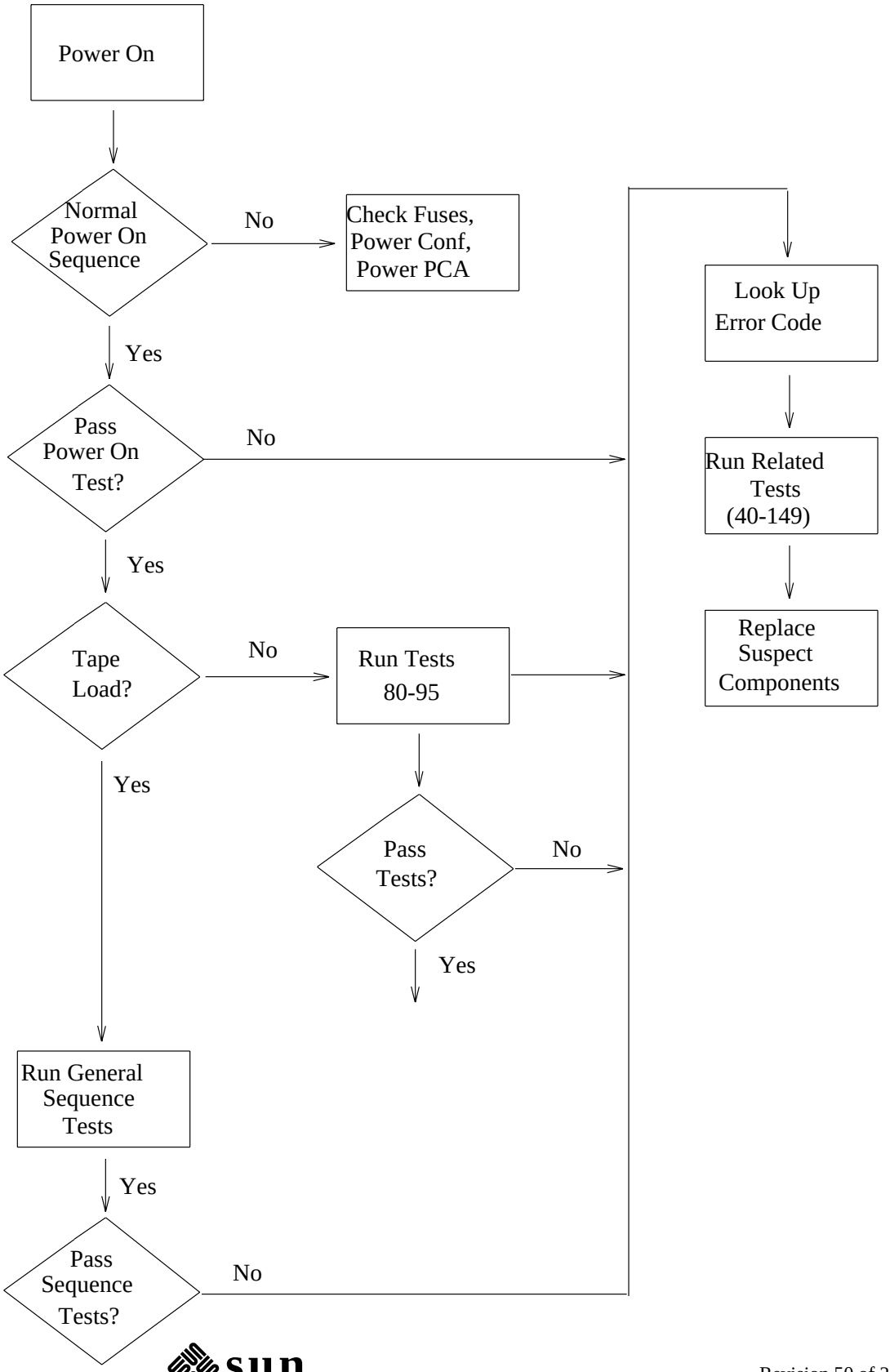
Step 4 If the Test Passes

If the general sequence test passes, run the interactive tests to test analog circuitry and electromechanical devices. These tests normally do not detect and report errors; rather, they exercise an assembly and require the operator to watch for proper operation.

Table 4-2 *Error Messages at Self-Test*

Message	***Action***
`RUN <###>`	No action required
`PASS <###>`	Test <###> has passed —no action required.
`FAIL <###>`	Test <###> has failed —press “Enter” to display error code.
`ERR 01`	Test needs tape to execute —mount tape.
`ERR 04`	Tape is write-protected —add ring or use new or scratch tape.
`ERR 06`	Close top cover.
`ERR <other>`	Field service call

Figure 4-1 *Troubleshooting Flowchart*



4.4. Test Selection

Tests are executed from the front panel by entering the test number, desired number of test passes, and parameters, when necessary. Test results will be displayed as either a PASS or FAIL.

1. Make sure the drive is offline by toggling the ONLINE key. The ONLINE display should disappear from the front panel.
2. If the test calls for a tape, press the UNLOAD key to open the tape drive door. Insert a write-enabled scratch tape. Close the tape door. Wait until the tape is automatically loaded.
3. Press the OPTION key. TEST* should appear in the display. If a message other than TEST* appears, press NEXT until TEST* is shown.
4. Press ENTER to accept the test option.
5. The display will show TEST 0. Press NEXT to display TEST 1. Press ENTER to accept this test.
6. You are asked to enter the number of passes you want the test to be performed. Press the NEXT or PREV keys if you want to change the number of passes.
7. If the test asks for additional parameters, use the NEXT or PREV key to choose the parameter and press ENTER.
8. If no parameters are required, press ENTER. A test will continue to execute until the test count is met, an error occurs, or until RESET is pressed.
9. When the test is completed, either PASS or FAIL is displayed, followed by the number of the test.

   If the test passed, and you want to repeat the test or select another test, press ENTER or RESET. The display will return to TEST #. If you press ENTER at this point you can rerun the test.
10. If the test fails, press ENTER to display the error that caused the failure. Error codes are listed in full in Appendix B—Summary of Error Messages and Codes.

4.5. Error Logs

Predictive information can lead to early detection of a drive problems through the extensive use of runtime logs and runtime error monitoring. Logs are maintained in non-volatile RAM on the data buffer board and are accessible from either the front panel or remotely through a memory dump and decoding. The logs provided are:

Error Log: Time stamps the past 30 errors; indicates the failure and suspect FRU.

Error Rate Log: Shows the number of soft and hard errors and bytes passed for the last 20 times a tape was loaded.

Error Rate Warning: Monitors the most recent error in the Error Rate Log during runtime. The warning will be displayed on the front panel if the error rate exceeds specification. Usually corrected by cleaning the heads.

Cumulative Error Rate: Total number of head errors, soft errors, and byte count. Provides a history of drive performance.

Tape Odometer: Amount of tape that has passed the head. Aids in monitoring head wear.

Viewing Error Logs

The `INFO` utilities are described in full in Appendix D—Accessing Logs.

1. Take the drive offline.
2. Press `OPTION` and then `NEXT` until `INFO*` appears.
3. Press `ENTER` and set the number corresponding with the utility to be displayed.

Table 4-3 *Error Log Utility*

INFO 0	Displays error log entries*
INFO 1	Displays error rate log entries*
INFO 2	Displays soft error rate of the current tape*
INFO 3	Displays cumulative GCR error data*
INFO 4	Displays cumulative PE error data*
INFO 5	Displays the cumulative soft error rate in bytes/error
INFO 10	Displays the odometer
INFO 12	Displays the system clock
INFO 13	Displays the number of power cycles the drive has received
INFO 15	Displays the last two digits of the year the battery was installed*
INFO 20	Displays drive repositioning statistics*
INFO 21	Displays tape autoload statistics*
INFO 25	Displays code revision numbers of all processors (firmware)

NOTE:

The utilities marked with an asterisk can be cleared when you enter that number in `CONF` mode, eg., `CONF 0` clears the error log entries.

4. Press the `ENTER` key again to display the log information. For the logs that contain multiple entries, the drive automatically scrolls through all the displays in the entry. Either the `ENTER` or `RESET` keys will exit the display.

The notation of the displays is as follows:

```
| "LABEL"   HHHH | DDDDDD | DeDD |

Double quotes indicate labels;
H indicates a hexidecimal digit;
D indicates a decimal digit;
DeDD indicates exponential notation of D times ten to the DD.
```

4.6. Testing the Servo

The servo self-tests in the drive can be used to isolate failures to the component level. Servo failures must be tested in the open loop because once the loop is closed it is no longer possible to determine which component caused the failure. The following discussion assumes that the drive passed the power-on self-tests. This means that the drive controller can perform the interactive diagnostics.

Autoload Failures

The following tests determine failures which affect the autoload before the tape is tensioned.

1. If the autoload sequence does not begin at all, check the door with Test 88.
2. First check the tape-in-path sensor with Test 87. Block the beam with a tape. Lay the tape in the casting to block the tape in path. A * should show on the front panel.
3. Test the reel encoder and write enable (Test 89). Load a tape on the hub. There should be three reel encoder pulses per revolution and one write enable pulse.
4. If these pass, then check hub lock (Test 91) and unlock (Test 92). Then check the load fan (Test 93).

Closed Loop Operation

First determine whether the servo loop operates in general. The most common indicator of a servo problem is loss of tension.

1. Run the close loops self-test (Test 97) without a tape.
   - First notice that the motors attempt to load a tape. Move the tension arm to its operating position. The motors should come to a stop.
   - As the arm is disturbed from this position the motors will move in opposition to the sensor. More tension will pay tape out and less tension will reel it in with the supply motor.
   - While holding the tension arm so as to stop the motors, turn the speed sensor slowly. Both motors should rotate to oppose the sensor. This test should give a quick indication of any obvious problem with the sensors, motor drive, or motors.

2. Check the tension arm (Test 85). The number on the front panel should range smoothly from about 30 to 255, with the nominal arm position at about 150.
3. Test the shutdown limits (Test 84). The limits should occur before the arm has reached its hard stops.
4. Test the speed encoder (Test 86). As the encoder is spun by hand the value should change smoothly from 0 to 4095. Check for any stuck bits.
5. If the encoder seems to malfunction, run the position counter test (Test 82). This verifies that the counter on the drive controller is operational. If Test 82 passes but Test 86 fails, then the encoder or its cable is faulty.
6. If the motors fail to rotate during the close the loops test, rerun the test and listen for a click of the relay. A single click indicates that the motors are being enabled, a double click indicates that the shutdown circuits are not working.

Motion Tests

If the problem appears to be loss of position or tension shutdown while the servo operates, check the TDU (Test 75 or 90).

If the tape runs off the BOT or EOT, check the BOT/EOT sensor assembly with Test 94. To do this test, run a piece of tape over the tape path at least one foot per second over the BOT/EOT sensor. The top sensor is the BOT, and the bottom is EOT.

5

Field Replaceable Units

This chapter contains the FRU list with Sun Part Numbers, and detailed instructions and diagrams to help you identify, remove and replace PCAs and other parts. (PCA stands for Printed Circuit Assembly).

5.1. Tools Required

- Medium and large flatblade screwdrivers
- Large Phillips screwdriver
- T7, T9, T20, and T25 Torx™ screwdrivers
- #2 Pozidriv™ screwdriver
- Anti-static mat and wrist strap

Other items commonly used in servicing ½-inch tape drives:

- Master skew tape
- Standard amplitude reference tape

5.2. Servicing the Rackmounted Drive

The drive is best serviced when it is pulled out on its slide rails. The tape module and board assemblies are accessible from the top, and the motors and other components are accessible from the bottom of the drive.

CAUTION

Always extend the cabinet's anti-tilt bars before extending the tape drive on the slide rails. To extend the anti-tilt bar, pull on the front metal bumper at the bottom of the cabinet until it is fully extended. Then adjust the threaded nylon-tipped leveler feet to further ensure stabilization.

Step 1 Pull Out the Drive

1. Remove the restraint bracket holding the drive in the rack. Some units will have a clear plastic (prototype) restraint under the front bezel. Remove its two screws.

   Others will have a metal restraint located in the rear of the unit, on the right slide rail. Remove the Torx screw so that the key-slotted restraint hangs freely. It is not necessary to remove the bracket. **Ensure that the restraint is in place whenever the rack is moved**.

2. Pull out on the plastic handle that's mounted flush in the front operator control panel to start pulling the drive out on its rails.

3. Remove the two screws on each slide rail.

4. There are two locking points on each slide. When the first button engages, you will need to depress it to pull the unit out to its farthest position. The second button should be in its locked position before continuing.

Step 2 Rotate the Drive

You will need to turn the drive over to access the bottom of the drive.

1. Turn off the power and remove the SCSI and AC power cables.

2. Make sure the drive is slid out to the second locking point before rotating the drive.

3. Standing in front of the drive, place two fingers in "finger-shaped" depressions on both sides of the rails and pull the latches toward you to release them.

4. Rotate the drive upwards until the drive is flipped 180 degrees. The latch should be in locked position.

Step 3 Remove the Sheetmetal Cover

You will need to remove the sheetmetal cover protecting the components. Use a Torx screwdriver to remove the retaining screws and pull off the cover.

5.3. Field Replaceable Units

The following tables list the field-replaceable units and their Sun part numbers. The old parts should be returned to Sun.

The column, Ref. #, references the numbered parts illustrated in Figures 5-1 and 5-2.

Table 5-1 *Exchange Parts*

Ref.#	*FRU*	*Sun Part Number*
1	Formatter and Read/Write Board	**370-1276**
2	Drive Controller Board	**370-1277**
3	Buffer Board	**370-1279**
5	Power/Motor Drive	**811-1242**
6	Buffer Arm Bearing (Roller Guide)	**811-1209**
7	Power Switch Assembly	**811-1227**
8	Power Switch Button	**811-1210**
9	SCSI, Single-Ended	**811-1241**
10	Front Panel Display PCA	**811-1212**
11	Tape Sensor Assembly	**811-1213**
12	Speed Sensor Assembly	**811-1215**
13	EOT/BOT Sensor Assembly	**811-1214**
14	Head Plate Assembly	**811-1238**
15	Supply Head Assembly	**811-1219**
16	Arm Buffer Assembly	**811-1216**
17	Tape Displacement Unit	**811-1237**
18	Door Latch Assembly	**811-1228**
19	Cover Latch	**811-1231**
20	3V Battery	**811-1232 or 150-1204**
24	Cover Hinge	**811-1235**
25	DC Cooling Fan	**811-1245**
27	Buffer Spring	**811-1233**
28	Power Module	**811-1229**
29	Mother Board PCA	**811-1211**
30	Hub Lock Assembly	**811-1226**
31	Front Bezel Assembly	**811-1236**
32	Takeup Hub Assembly	**811-1218**
33	Takeup/Supply Reel Motor	**811-1217**
34	Blower Motor	**811-1230**
35	Transformer	**811-1292**
37	6.0A 250V Fuse (115V systems)	**140-1021**
38	3.15A 250V Fuse (240V systems)	**140-1002**
38	3.0A 250V Fuse (230V systems)	**140-1039**
39	Expansion Cabinet Front Bezel	**540-1947**
-	Motor/Power 6.0A Fuse (2)	**140-1021**
-	SCSI Terminator	**150-1407**

Table 5-1 *Exchange Parts— Continued*

Ref.#	***FRU***	***Sun Part Number***
-	Speed Sensor Cable	**811-1220**
-	Front Panel Cable	**811-1221**
-	Interface Cable	**811-1222**
-	Cable Harness	**811-1223**
-	Read Head Cable	**811-1224**
-	Write Head Cable	**811-1225**
-	Door Microswitch	**811-1234**
-	Motor Control Cable	**811-1240**
-	Firmware Kit	**811-1243**
-	NRZI Speed Sensor	**811-1244**

Figure 5-1 *Exploded View (1 of 2)*

Figure 5-2 *Exploded View (2 of 2)*

5.4. FRU and Diagnostic Test Cross Reference

The column, FRU# references Figures 5-1—Exploded View (1 of 2) and 5-2—Exploded View (2 of 2).

Evaluation of the following FRUs must be done by inspection: fan, mother board/cardcage, hubs, and transformers.

Table 5-2 *Printed Circuit Boards/Test Cross-Reference*

Printed Circuit Boards			
FRU#	***Abbreviation***	***FRU Name***	***Applicable Tests***
01	Rw	Read/Write/PLL	62,63,64,65,98,100
02	Fm	Formatter	61,62,63,64,65
03	Dc	Drive controller	40-44,46,49,50-54,62-65,76-80,78, 80,82,88,95,97
04	Db	Data buffer	40,41,43,44,46,48,50-54,61,120-122
05	Md	Motor drive/power supply	80,81,91,92,95
06	Gi	Generic (any) interface	40-44,50-54,60
08	Fp	Front Panel (display)	70-72
09	Sb	Supply Reel Sensor PCB	87-89
10	Sd	SCSI differential interface	40-44,50-54,60,140,141
11	Ss	SCSI single-ended interface	40-44,50-54,60,140,141
12	Pt	Pertec-compatible interface	40-44,50-54,60,140,141
13	Dc	7979 Drive controller	40-44,46,49,50-54,62-65,76-80,78,80,82, 88,95,97
14	Db	Data buffer non XC	40,41,43,44,46,48,50-54,61,120-122
21	Fm+Rw	Formatter/R/W/PLL	61,62,63,64,66,98,100
24	Db	Data buffer 7980 XC	40,41,43,44,46,48,50-54,61,120-122,130-133
31	+NRZI Fm+Rw	Formatter/R/W/PLL	61,62,63,64,66,98,100,105,106
34	Db	Data Buffer w/ 1MB RAM	40,41,43,44,46,48,50-54,61,120-122

Table 5-3 *Assemblies/Test Cross-Reference*

Assemblies			
FRU#	***Abbreviation***	***FRU Name***	***Applicable Tests***
40	Es	EOT/BOT sensors	45,84,85,94
41	Se	Speed encoder	82,86
42	Hd	Head assembly	64,65,100
44	Hl	Hub lock	89,91,92
45	Ba	Buffer arm	45,84,85,97
51	Td	Tape displacement unit	75,90

Table 5-4 *Cables/Test Cross-Reference*

Cables			
FRU#	***Abbreviation***	***FRU Name***	***Applicable Tests***
62	Sc	Speed sensor cable	45
64	Fc	Front panel cable	45
65	Mc	Motor cable	45
66	Sc	Slave connector	45
67	Ic	Interface cable	45
70	Sv	Servo cable	-
71	Rc	Read cable	64,65
72	Wc	Write cable	64,65

Table 5-5 *Miscellaneous/Test Cross-Reference*

Miscellaneous			
FRU#	***Abbreviation***	***FRU Name***	***Applicable Tests***
50	Mo	Motors	-
-	Ds	Door solenoid	88

Figure 5-3 *Inside the Front Panel*

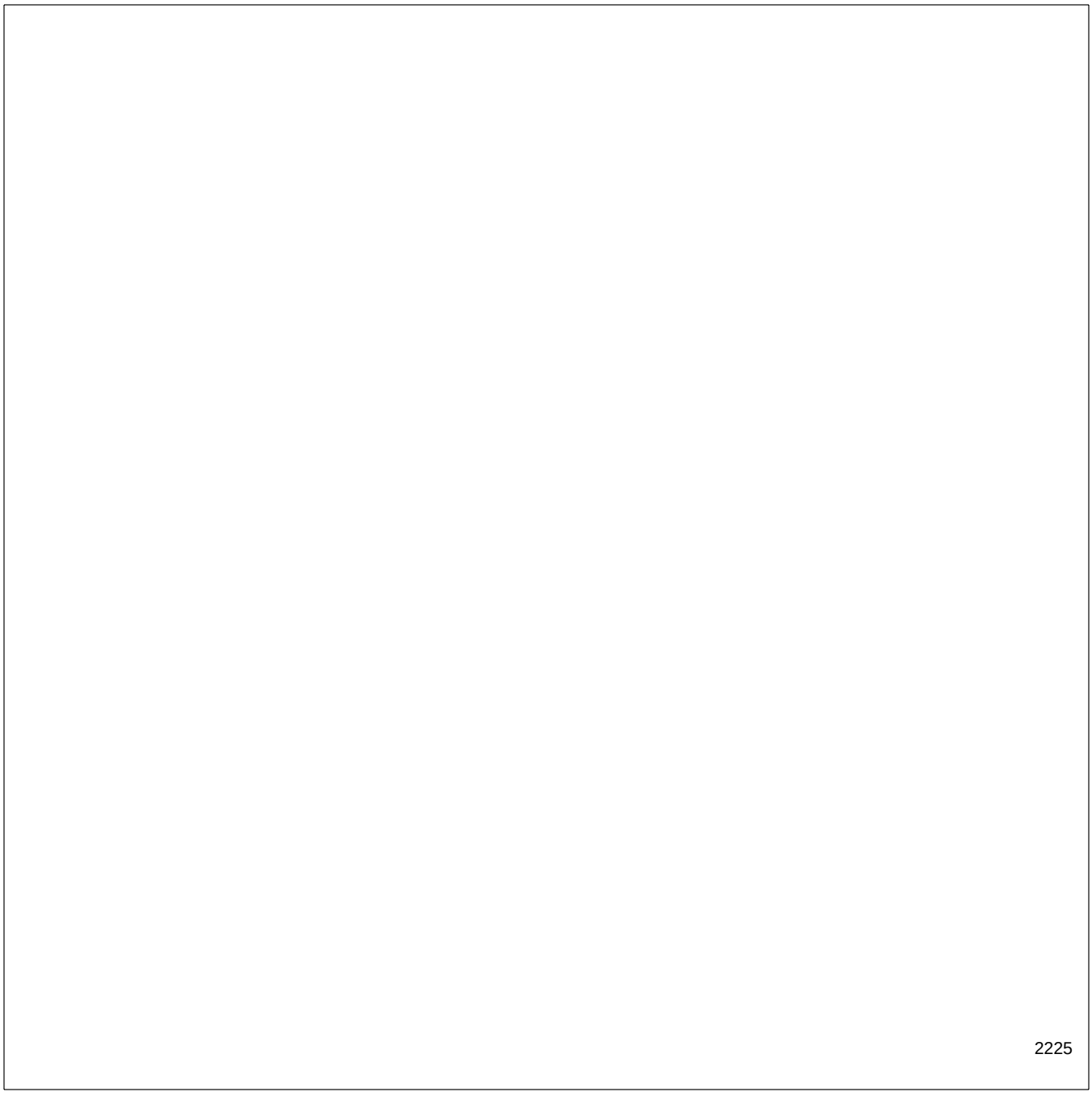


Figure 5-4 *Inside the Chassis*

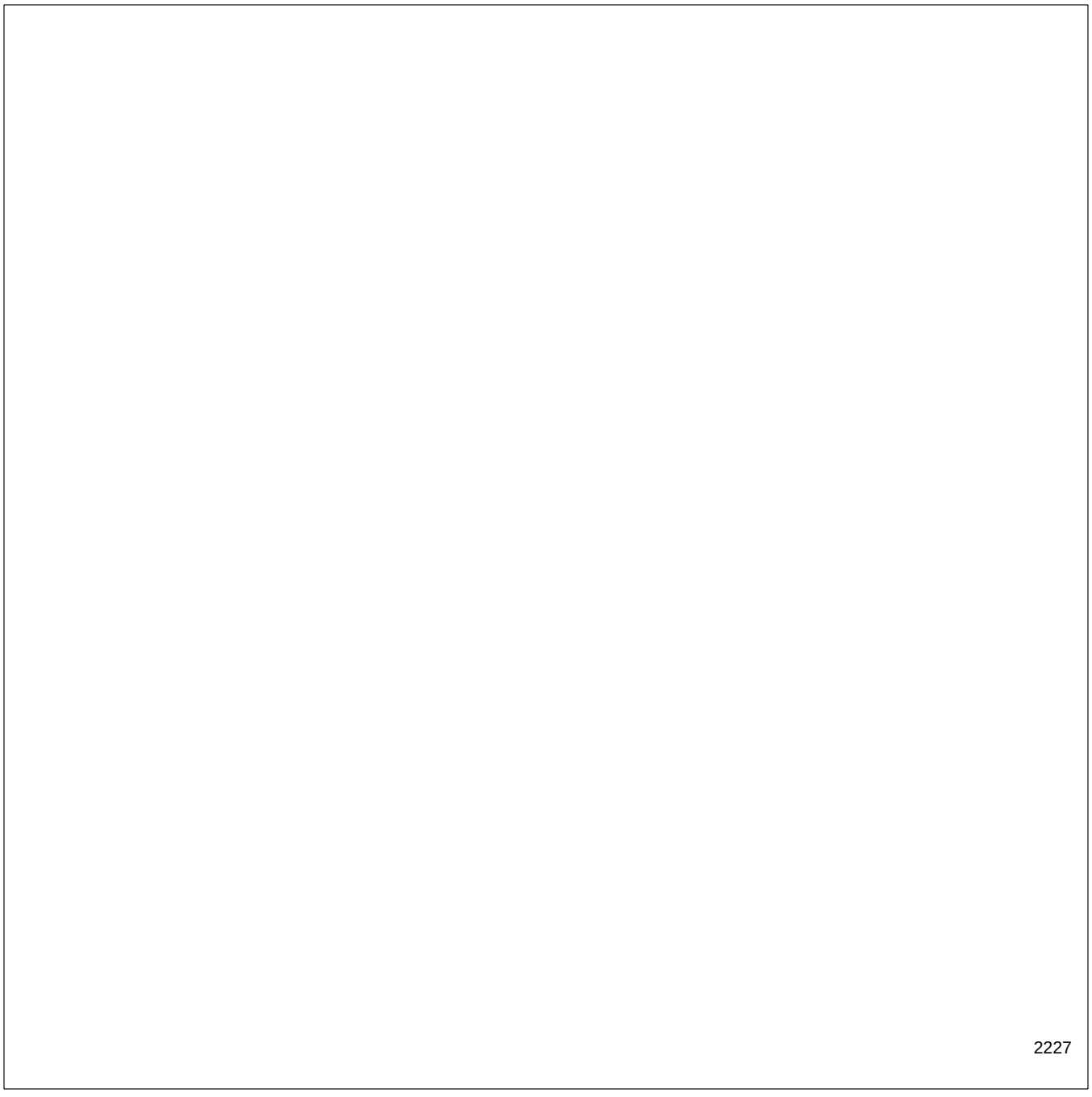


Figure 5-5 *Tape Path Components*

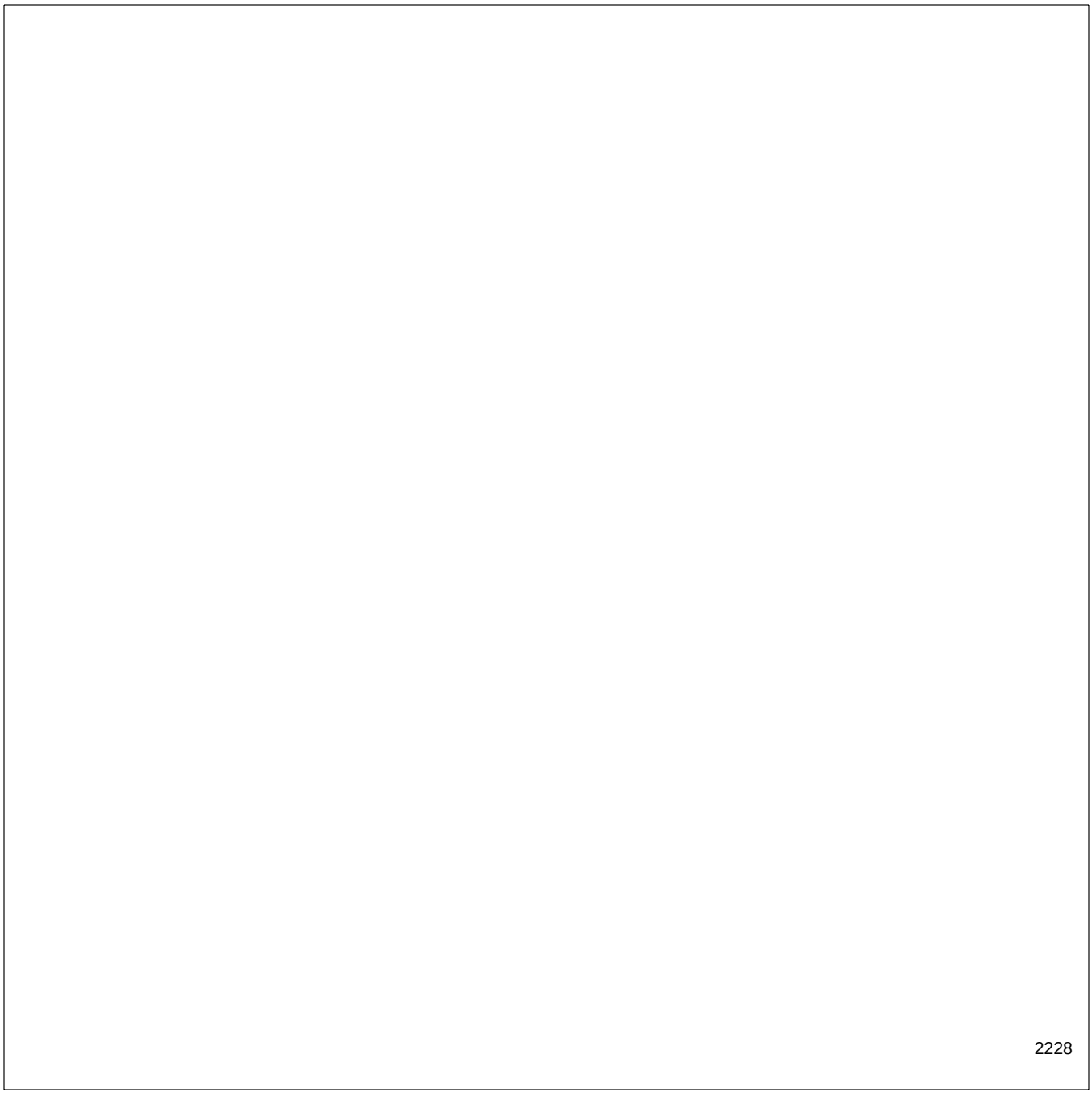


Figure 5-6 *Supply Motor Mounting and Sensor PCA*

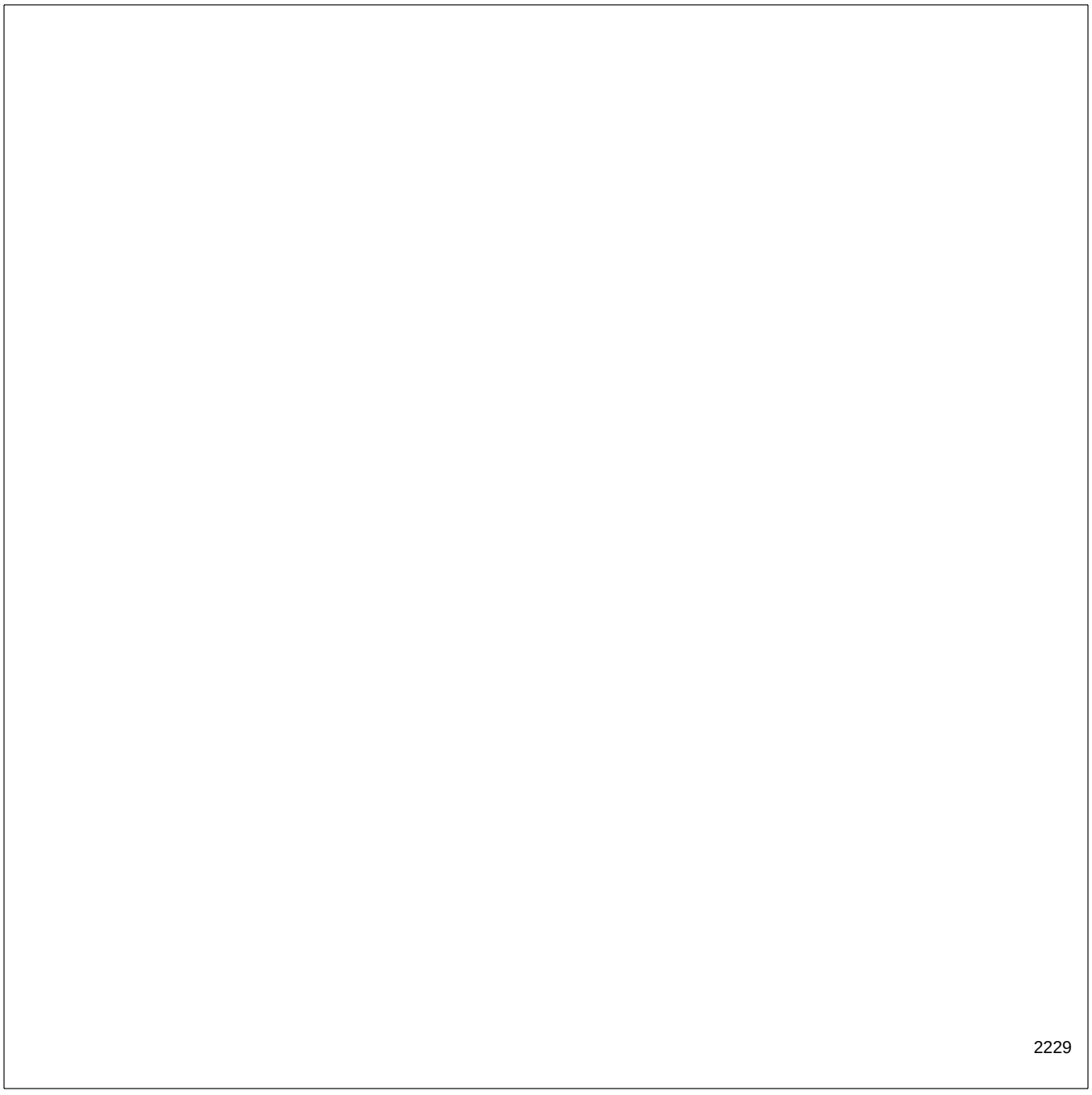


Figure 5-7 *Motherboard PCA Connections*

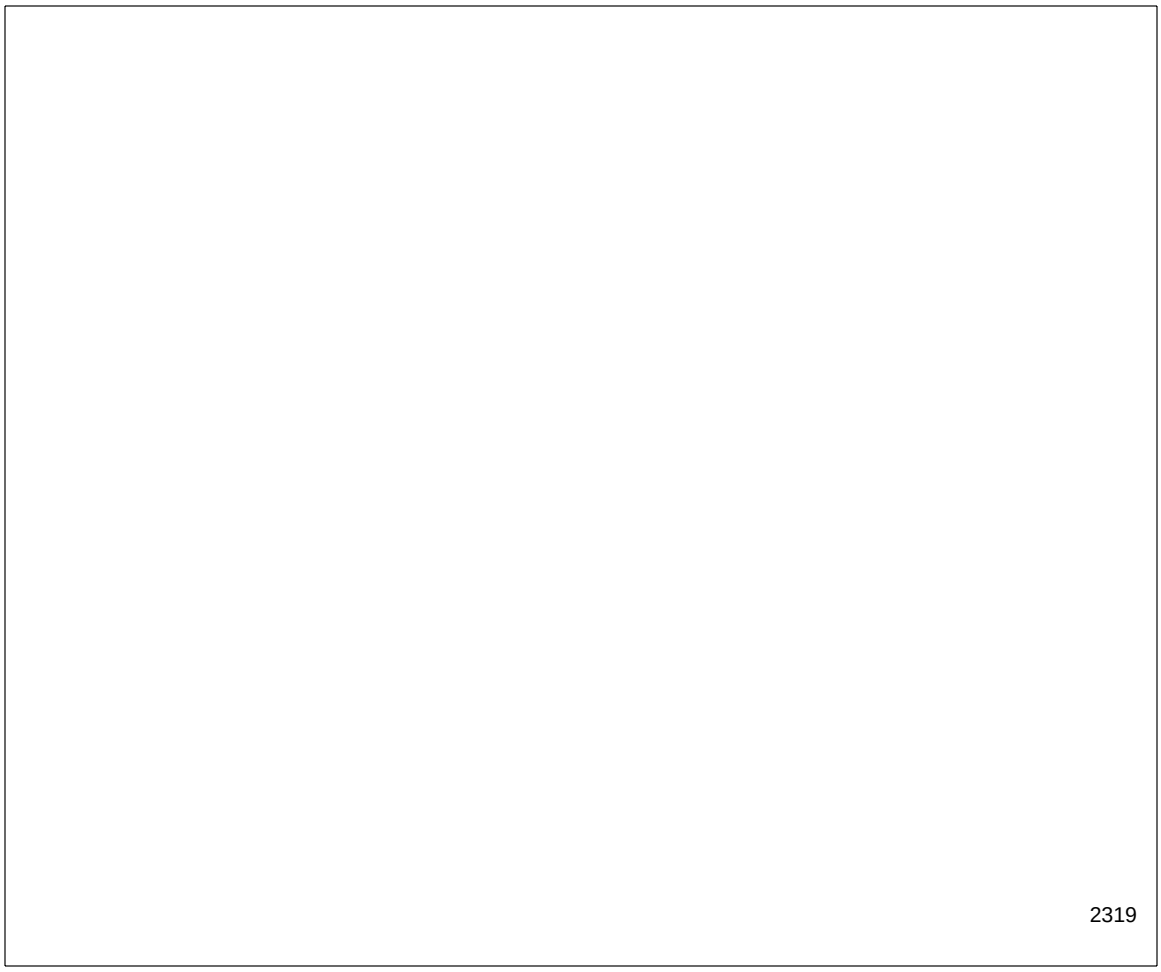


Figure 5-8 *Motor/Power PCA Connections*

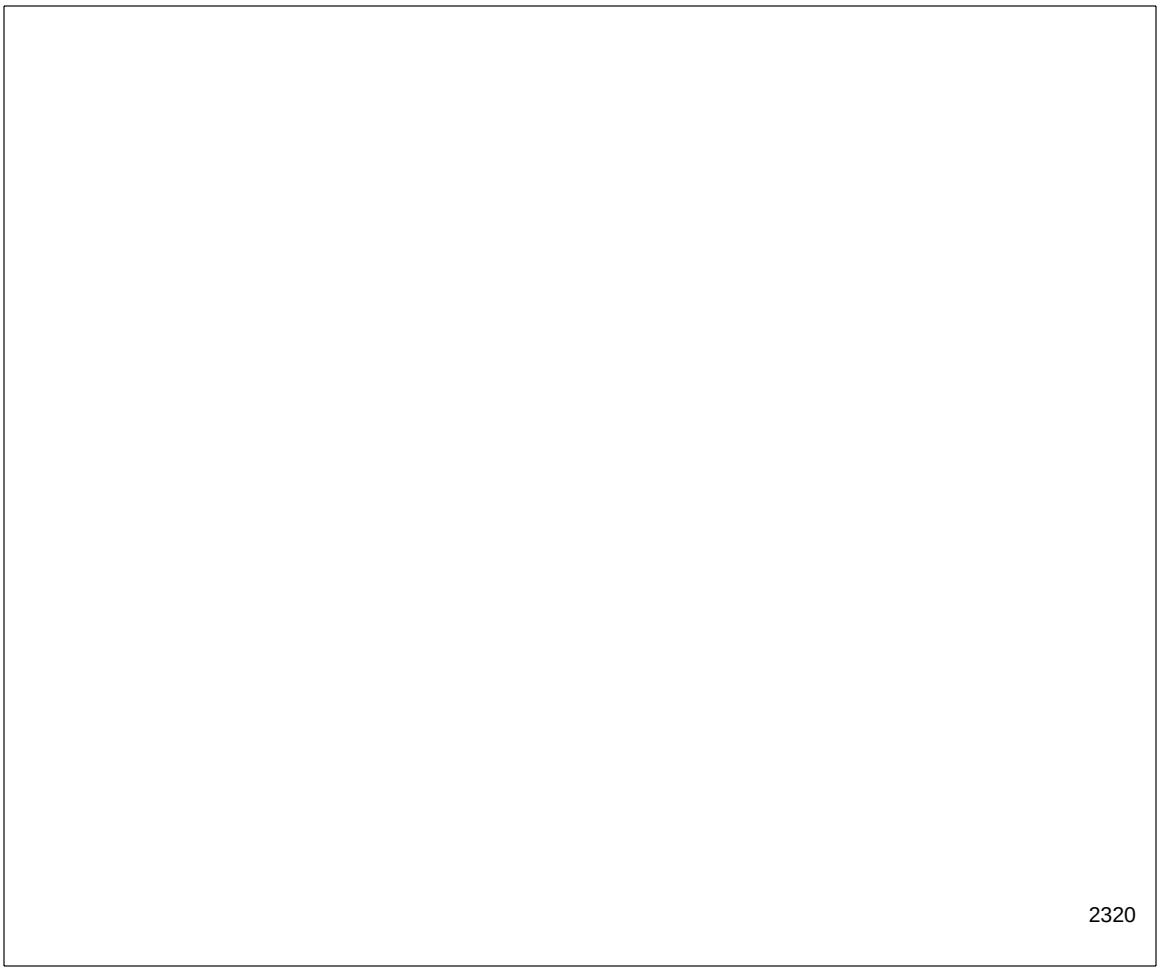
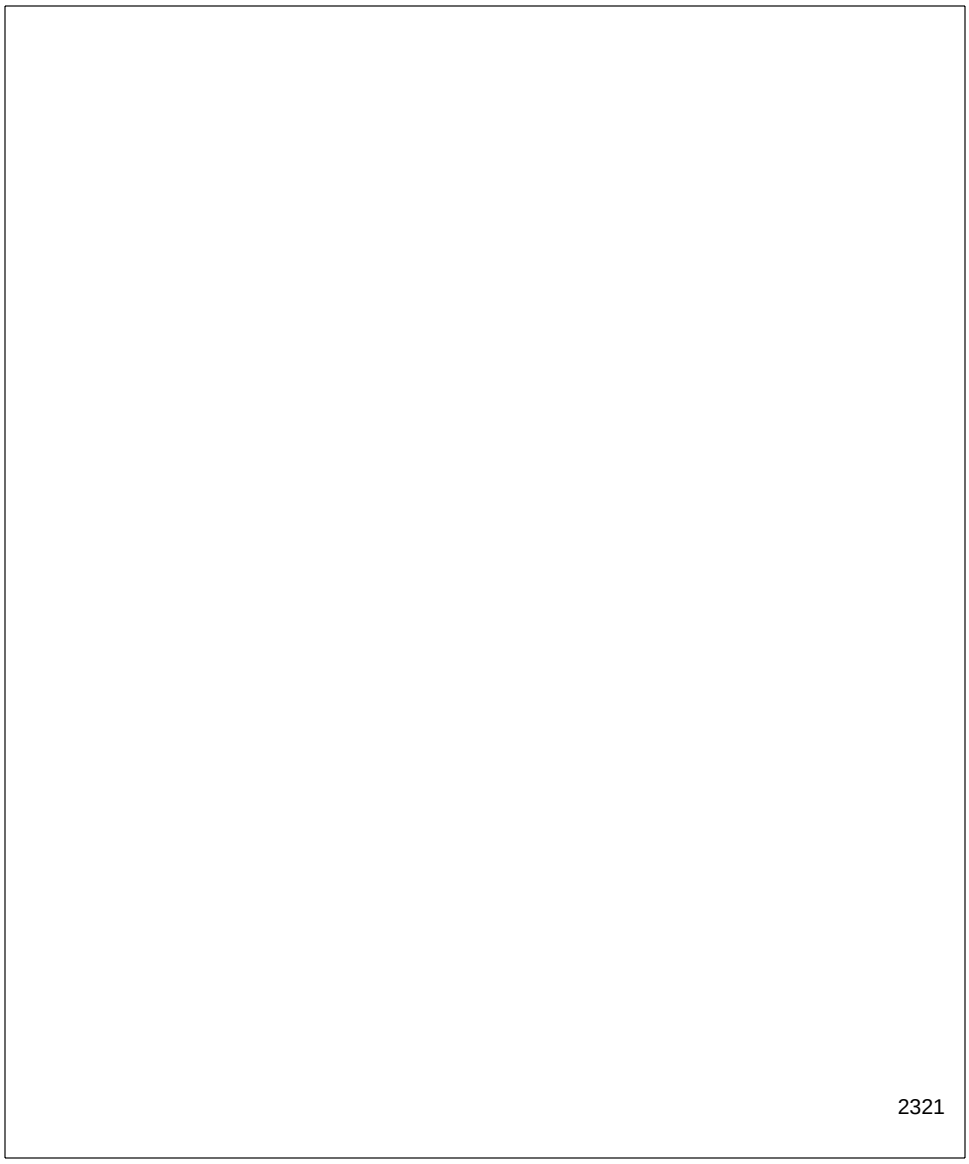


Figure 5-9 *Sensor PCA*



5.5. Remove and Replace Instructions

The instructions are divided into four general areas, where components may have to be accessed:

- Tape deck area (top of casting)
- Front panel area
- Inside the chassis (bottom of the drive)
- Rear panel area

Start at the top level of the area that contains the component to be replaced, do the common procedures, and then skip to the instructions on the specific component desired.

Tape Deck Area Disassembly

These instructions tell you how to replace the PCAs in the tape deck area and the non-volatile RAM backup battery.

Instructions for replacing the head plate assemblies (visible from the tape deck area) are found in the subsection, *Head Plate Disassembly*.

1. If the Data Buffer PCA or its battery is going to be replaced, run Test 128, "Dump Non-Volatile RAM to Tape" before removing power.
2. Disconnect power from the drive.
3. Pull the drive out on its rails.
4. Remove the PCA cover on the right side of the casting. Each end of the cover is held by two captive, spring-loaded screws. Use a flatblade screwdriver to loosen the screws, if necessary.

NOTE:

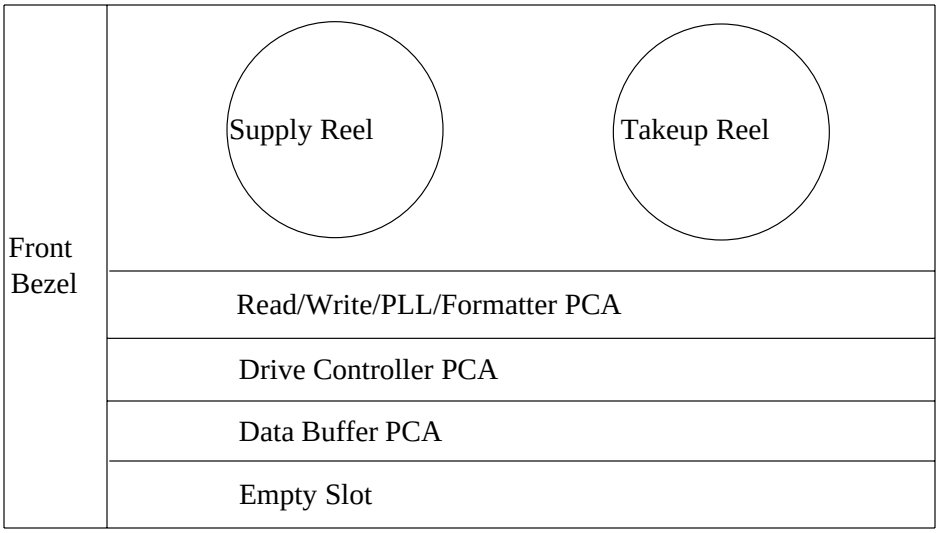
Use an anti-static mat and wrist strap to prevent static damage while you handle the PCAs.

5. Remove the PCAs as needed. See Figure 5-10 to identify the PCAs. The PCAs are keyed, which assures proper installation.
   - Disconnect the read and write cables from the Formatter/Read/Write/PLL PCA by pushing down on the retaining clips. Move the cables aside before removing the board.
   - All PCAs are removed by pulling up on the retaining clips at the board egdes and lifting up the board by the clips.
   - To replace the battery on the Data Buffer PCA, lift up on the battery clip to remove the battery. If a battery protect tab is present between the clip and battery, remove it.

BATTERY WARNING:

If the battery on the Data Buffer PCA is removed, do not recharge, disassemble, or dispose of it in fire. The battery may explode if mistreated.

Figure 5-10 *Printed Circuit Assembly Layout*



Tape Deck Area Reassembly

1. If the battery on the Data Buffer PCA was changed, or if a new Data Buffer PCA was installed, check the voltage on the new battery. The voltage should be between 2.5V and 3.0V. Do not use the battery if the voltage is below 2.5V.
2. Carefully reinsert and fully seat the PCA(s).

   If the Formatter/Read/Write/PLL PCA is being inserted, reconnect the read and write cables to the top edge of the PCA.
3. Replace the PCA cover and tighten the captive screws.
4. Connect power to the drive and turn it on.
5. If either the battery on the Data Buffer PCA was changed, or if a new Data Buffer PCA was installed, load the customer's configuration tape and run Test 129, "Load Non-Volatile RAM from Tape," to restore any customized configurations. If the configuration tape is not available, run Test 99, "Read Channel Calibration Test," with Parameter B on SAVE to retain values in non-volatile RAM. (Use tapes typical of those used at the customer site and run Test 99 for each density.) Use CONF 15 to set the battery date in non-volatile RAM. Use other CONF choices to replace any other configurations previously set by the customer.

Front Panel Area Disassembly

The front panel assemblies are:

- Front panel display PCA
- Door interlock microswitches
- Door solenoid

General Front Panel Procedures

1. Disconnect power in the rear panel.
2. If rackmounted, pull out the stabilizer bars before pulling the drive out on its rails.
3. Remove the screws holding the front panel to the chassis, using a Torx screwdriver. There are two Torx screws at the top of the panel and three on the bottom.

CAUTION:

Hold onto the front panel as you remove the retaining screws. There are many small loose parts behind the panel, and the panel remains connected to the chassis by many cables.

4. Remove the following cables attached to the front panel. See Figure 5-3 to aid in identifying the parts and wires. Be careful not to bend or break off the bayonet clips.
   - □ Front panel cable and wire (ribbon, black wire)
   - □ Door interlock microswitch (black, blue wires)
   - □ Top cover microswitch (green, blue wires)
   - □ Door solenoid (black, yellow wires)
5. Remove the T7 Torx screws that hold the door microswitch.
6. Remove the Phillips head screw that holds the door solenoid.

Front Panel Area Reassembly

1. If the door solenoid was removed, remount the door solenoid with the two Torx screws and continue to the next paragraph. If not, go to Step 2.

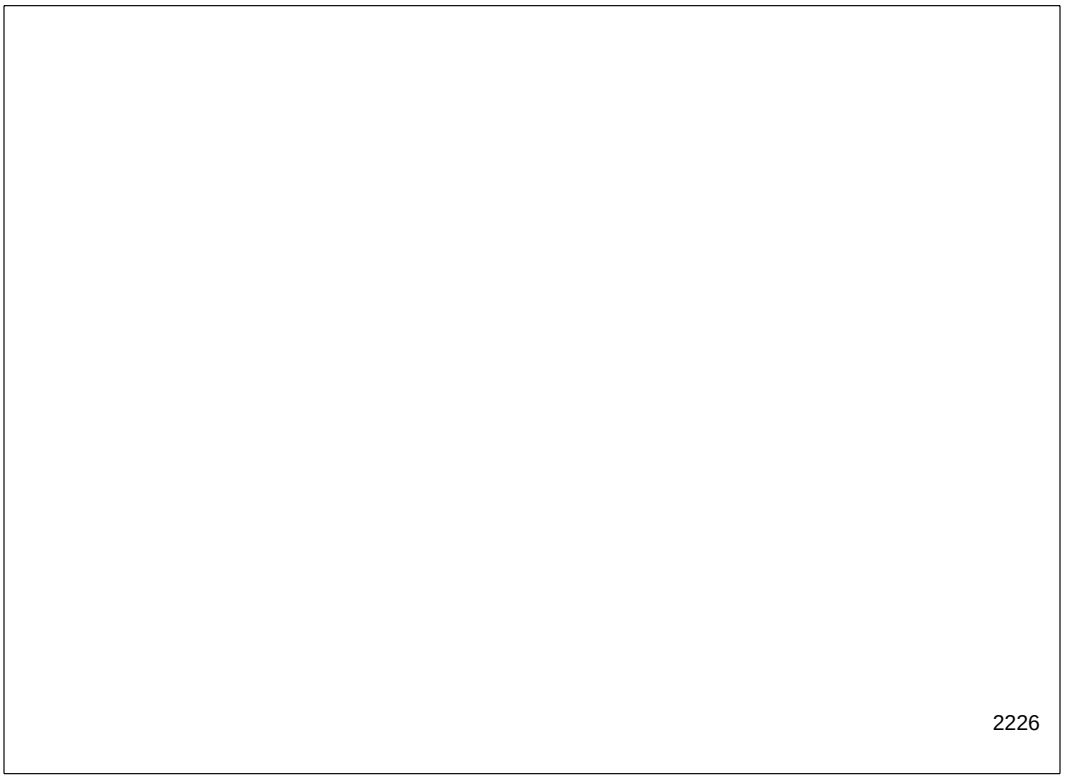
   Adjust the position of the solenoid on its mounting pedestal until there is about 1.5 mm of play between the door and the front panel when the door is closed.

   Grasp each side of the front panel and flex it a little. The door should not open. Check that the door opens correctly at the end of an `UNLOAD` sequence.
2. If either of the door microswitches were removed, reinstall them.
3. Install all wires in their bayonet clips inside the front panel.

CAUTION:

Open the top (tape) cover before placing the front panel into position. The top door microswitch actuating lever—the plastic extension that projects downward from the right side of the top cover—can break the lever on the front panel door microswitch when the front panel is moved into position.

Figure 5-11 *Tape Door Solenoid Adjustment Screw*



4. Position the front panel onto the front of the chassis. Fasten the front panel with the two Torx screws on the top and the three on the bottom. (You may need to extend the handle before tightening the bottom center screw.)
5. Connect power.
6. Run the power-on selftest. If the test passes, push the drive back into the rack.

5.6. Inside the Chassis

The chassis contains the following remove and replace assemblies. To access any of these assemblies, follow the general procedures and continue with the specific subsection for the assembly.

- Motor/power PCA
- Sensors and sensor PCA
- Head plate assemblies
  - —Speed encoder
  - —Tape displacement unit
  - —Buffer arm assembly: buffer arm, BOT/EOT assembly, tape-in-path sensor
  - —Heads/frame

- Motors and hubs
  - —Supply motor and hub
  - —Takeup motor and hub
- Blower motor
- Fuses
- Reel lock assembly: reel lock lever, solenoid

General Chassis Procedures

1. Disconnect power and SCSI.
2. If rackmounted, pull out the stabilizer bars before pulling the drive out on its rails. Invert the drive.
3. Remove the three screws on the lower edge of the front panel, using a Torx screwdriver.
4. Remove the two screws on the bottom cover plate near the front and rotate the bottom plate away from the chassis. The back edge of the cover plate is inserted into the rear panel frame; the plate has to be pulled forward a little to come free of the frame.

Motor/Power PCA Disassembly

See Figure 5-8 for cabling and Figure 5-4 for PCA location.

1. Remove the ribbon cable that goes from the motor/power PCA to J41 on the mother PCA. See the illustration showing the chassis for board location.
2. Detach the seven connectors on the motor/power PCA.
3. Remove the six screws holding the PCA to the casting. Because of the screw location, you will need to use a Torx screwdriver that is at least six inches.
4. Slide a flatblade screwdriver under the plastic insulating sheet underneath the PCA and raise the edge of the sheet up onto the edge of the chassis. If this is not done, the sheet will catch on the chassis and prevent the PCA from sliding out.
5. Slide the motor/power PCA out from the chassis.

Motor/Power PCA Reassembly

1. Slide the motor/power PCA into the chassis.
2. Insert and tighten the six screws that hold the PCA to the casting. Because of the location of these screws, use a long Torx screwdriver.
3. Attach the seven connectors on the motor/power PCA.

CAUTION:

Do not install the motor drive ribbon cable backwards in its connectors. Be sure to put the cable connector keys into the key slots on the motor/power PCA and the mother PCA connectors.

4. Attach the ribbon cable that goes from the motor/power PCA to J41 on the mother PCA (in the cardcage).
5. After you have powered on the drive, run Test 2, the "Wellness Test." If the test passes, push the drive back into the rack.

Fuses on the Motor/Power PCA

Refer to Figure 5-4 for the location of the motor/power PCA. Follow the disassembly instructions given in the Subsection, Motor/Power PCA Disassembly, to the point where the motor/power PCA has been removed and then continue with these instructions.

(The fuses are located on the middle rear of the PCA. You will not be able to access the fuses without removing the board.) Replace the old fuses with two 6.0A, 250V, fast-blow fuses. See Table 5-1 for the fuse part number.

Follow the subsection on motor/power reassembly to put everything back.

Sensors and Sensor PCA Disassembly

Remove the screws from each tape-in-path sensor and pull sensor away from casting. Refer to Figure 5-5 for location and Figure 5-9 for cabling.

At this point, the sensor PCA is still attached to the casting by a single screw and to the front panel by the tape door open sensor wires. The connectors for these wires are located next to the tape door and are not accessible until the front panel is moved away from the chassis.

To change sensor wires without having to completely remove the front panel (and have to disconnect all the connectors inside), get the new sensor PCA and refer to the reassembly instructions.

Sensors and Sensor PCA Reassembly

1. Thread the connectors for the door open sensor into the front panel PCA area and temporarily store them there.
2. Switch the old door open sensor wires with the new set:
   - Remove the two screws from the top of the front panel.
   - Move the front panel far enough away from the chassis to reach in and remove the two door open sensor wires from the bayonet connectors on the door open sensor microswitch.
   - Retrieve the new door open wires from where you stored them and connect the wires to the door open microswitch, letting the new sensor PCA hang free.

CAUTION:

Open the top (tape) cover before placing the front panel into position. The top door microswitch actuating lever—the plastic extension that projects downward from the right side of the top cover—can break the lever on the front panel door microswitch when the front panel is moved into position.

Place the front panel back into position and insert and tighten the two screws that hold the top of the front panel to the chassis.

3. Remove the screw that holds the old sensor PCA to the casting. Remove the PCA and the two tape-in-path sensor wires and the tape door sensor wires.
4. Place the new sensor PCA into position and insert and tighten the screw that holds it to the casting.
5. Put the two tape-in-path sensors into position and insert and tighten the screw that holds each sensor in place.
6. Slide the bottom cover plate into the rear panel frame and bring the bottom cover plate into position. The tabs along the sides should enter the slots in the side rails.
7. Fasten the lower edge of the front panel with three Torx screws.
8. Connect power and load a tape. If the tape loads correctly, push the drive back into the rack.

Tape Path Components

The tape path area contains the head plate assemblies which are located under the plastic cover *on top of the drive*. The head plate assemblies consist of the speed encoder, tape displacement unit, buffer arm assembly (buffer arm, BOT/EOT assembly, tape-in-path sensor) and the heads/frame.

See Figures 5-5 and 5-4 for component locations.

NOTE:

To service the head plate assemblies, you will need to access both the top and bottom of the drive. To raise the tape path cover, place your fingers in the indentation near the front edge of the cover and pull up.

Speed Sensor Disassembly

1. Inspect the bottom of the drive and do the following: remove the speed sensor cable assembly at both ends. One end is on the connector labeled “Encoder” on the mother PCA, and the other end is on the bottom of the sensor assembly.
2. Remove the three Torx screws that hold the speed encoder baseplate to the casting.
3. Pull the speed sensor up through the casting.

Speed Sensor Reassembly

1. Put the speed sensor through the casting with the tape deflector closest to the tape path guide.
2. Insert and tighten the three Torx screws that hold the speed encoder baseplate to the casting.
3. Attach one end of the speed sensor cable to the bottom of the speed encoder and the other end to the connector labeled “Encoder” on the mother PCA.
4. Slide the bottom cover plate into the rear panel frame and bring the plate into position. The tabs along the sides should enter the slots in the side rails.

5. Insert and tighten the two screws on the front-panel end of the bottom cover plate.
6. Insert and tighten the three screws on the lower edge of the front panel.

Tape Displacement Unit Disassembly

Refer to Figure 5-5 for component location inside the chassis.

1. Remove the two wires from the bayonet clips on the tape displacement unit servo.

CAUTION:

DO NOT LOOSEN OR REMOVE THE POZIDRIV™ SCREWS ON THE HEAD PLATE ASSEMBLY. These screws set the head skew adjustment. This is a factory adjustment only.

2. Remove the two Torx screws in the black plastic casting that hold the tape displacement unit in place. Carefully move aside the interface ribbon cable above the screws. Remove the unit.

Tape Displacement Unit Reassembly

1. Position the tape displacement unit so that the rod passes between the head and the tape cleaner block.
2. Insert and tighten the two Torx screws that hold the tape displacement unit in place.
3. Attach the two wires to the bayonet clips on the servo.

Buffer Arm Disassembly

See Figures 5-7 and 5-8 for cabling information.

The buffer arm assembly consists of the buffer arm, the BOT/EOT assembly, and the tape-in-path sensor.

1. Locate the mother and motor/power boards. Remove the motor drive ribbon cable from J41 on the mother PCA and J2 on the motor/power PCA.
2. Locate J61, the buffer arm position sensor cable marked “Tension,” on the mother PCA. The connector has a capture clip. Press the release on the underside of the clip before attempting to release the cable.
3. Next locate J51, the buffer arm BOT/EOT sensor cable marked “BOT/EOT,” on the mother PCA. Release the ribbon cable.
4. In the tape deck area, disconnect the spring from the buffer arm.
5. Remove the three screws that hold the buffer arm baseplate to the casting.
6. Pull the buffer arm assembly out of the casting (the BOT/EOT sensor Assembly remains attached).

BOT/EOT Sensor Disassembly

The BOT/EOT sensor assembly consists of the BOT/EOT sensor and buffer arm position sensor.

1. Follow steps 1 through 6 from the buffer arm disassembly subsection.
2. On the assembly underside, use a large Phillips screwdriver to remove the screw that holds the sensor to the buffer arm baseplate.
3. Remove the sensor assembly from the baseplate. You may have to wiggle the assembly a little and also rotate the buffer arm a little to loosen the assembly.

BOT/EOT Sensor Reassembly

NOTE:

Whether the BOT/EOT sensor is replaced or the buffer arm is replaced (retaining the good BOT/EOT sensor), reassembly remains the same.

1. Put the BOT/EOT sensor assembly over the metal flag near the hub of the buffer arm.
2. Position the sensor. The locator pin on the bottom of the sensor goes in the hole on the buffer arm baseplate. Adjust as necessary to align the mounting screw hole on the sensor over the hole on the buffer arm baseplate. If everything is aligned, the sensor assembly should fit into the depression machined out of the buffer arm baseplate.
3. Insert the screw and tighten.
4. Insert the assembly into the casting. The sensor cable (coming out from the bottom of the arm) goes directly through the hole. The BOT/EOT cable (the wider cable) goes alongside through the gap in the casting.
5. Insert and tighten the three screws that mount the buffer arm baseplate to the head plate.
6. Put the spring back on the the pin of the buffer arm.
7. Attach the buffer arm BOT/EOT sensor cable to the connector marked J51, “BOT/EOT” on the mother PCA.
8. Attach the buffer arm position sensor cable to the connector marked J61, “Tension” on the mother PCA.
9. Attach the motor drive ribbon cable to J41 on the mother PCA and J2 on the motor/power PCA.

CAUTION:

Do not install the motor drive ribbon cable backwards in its connectors. Be sure to put the cable connector keys into the key slots on the motor/power PCA and the mother PCA connectors. The side opposite to the slotted side of these PCA connectors is open and can act as a slot.

Head Plate Disassembly

Follow the instructions to remove the buffer arm assembly before continuing. The head assembly includes the speed sensor, the head, the tape displacement unit, the cleaner block, BOT/EOT sensor, and buffer arm assembly. Refer to Figure 5-5 to identify the assembly from the top.

1. From inside the chassis, disconnect and move aside cables J41 through J91 on the mother PCA. See Figure 5-7 for cabling.
   - Motor drive ribbon cable (J41)
   - BOT/EOT ribbon cable from the connector marked "BOT/EOT" (J51)
   - Buffer arm position sensor ribbon cable from the connector marked "Tension" (J61)
   - Speed encoder ribbon cable from the connector marked "Encoder" (J71)
   - Interface ribbon cable (J91)
2. Disconnect the two bayonet connections to the tape displacement unit servo.
3. From inside the chassis, open the plastic cable retaining clip that holds the larger of the read/write PCA cables to the side of the cardcage. To open the clip, pull down on the horizontal edge.
4. Disconnect the read cable and the write cable from the top of the formatter/read/write/PLL PCA.
5. Remove the formatter/read/write/PLL PCA from the cardcage. (This makes it easier to pull the cable connections back through the cardcage.)
6. Remove the three Torx screws that hold the head plate assembly to the casting.

CAUTION:

Cover the tape head during removal. The head can be easily scratched.

7. Pull the head plate assembly out of the chassis, carefully pulling the read and write cables through the cardcage on the way out.

Head Plate Reassembly

Cover the tape head during reassembly. The head can be easily scratched.

1. Place the head plate assembly into its position in the casting; thread the read and write cables into the cardcage as the head plate assembly is put into position. The read and write cable connectors should face the PCAs in the cardcage.
2. Insert and tighten the three screws that hold the head plate assembly to the casting.
3. Insert the formatter/read/write/PLL PCA into the cardcage.
4. Connect the read and write cables to the formatter/read/write/PLL PCA.
5. Fasten the plastic cable retaining clip that holds the cable to the cardcage side.

6. Connect the two tape displacement unit servo wires.

CAUTION:

Do not install the motor drive ribbon cable backwards in its connectors. Be sure to put the cable connector keys into the key slots on the motor/power PCA and the mother PCA connectors. The side opposite to the slotted side of these PCA connectors is open and can act as a slot.

7. Connect all of the cables to the mother PCA: J41, J51, J61, J71, and J91.
8. Slide the bottom cover plate into the rear panel frame and bring the cover into position. The tabs along the sides should enter the slots in the side rails.
9. Insert and tighten the two screws on the front-panel end of the bottom cover plate.
10. Insert and tighten the three screws on the lower edge of the front panel.
11. Connect power and run Test 2, the "Wellness Test."
12. Run Test 99, "Read Channel Calibration Test" with parameter B on save to retain head gain values in non-volatile RAM.
13. Push drive back into the cabinet.

Motor and Hub Disassembly

Follow these directions for both the supply and takeup motors. See Figure 5-6 for reference.

1. Disconnect the applicable motor power cable from the motor/power PCA. The supply motor connector is J1, and the takeup motor connector is J3.
2. Loosen the Torx screw in the center of the hub. The screw does not have to be removed; it can be held by the hub as you take the hub off.
3. Lift the hub off.
4. Loosen the four T25 screws that are exposed when you removed the hub.
5. Rotate the motor until the screws enter the wide part of the slot in the casting.

CAUTION:

When removing the supply motor, make sure that the sensor PCA is not scraped by one of the mounting screws.

6. From underneath, pull the motor away from the casting.

Motor and Hub Reassembly

1. Place the motor into position, passing the T25 mounting screws through the large part of the screw slot. When inserting the supply motor, make sure that sensor PCA is not scraped by one of the mounting screws.
2. Rotate the motor until the mounting screws go to the end of the narrow part of the slot.

3. Tighten the mounting screws.
4. Slide the hub onto the motor shaft.
5. Tighten the T25 (or T20 in older units) screw into the center of the hub.
6. Connect the applicable motor power cable to the motor/power PCA. The supply motor cable connects to J1, and the takeup motor cable connects to J3.
7. Slide the bottom cover plate into the rear panel frame and bring the bottom cover plate into position. The tabs along the sides should enter the slots in the side rails.
8. Fasten the lower edge of the front panel with three Torx screws.
9. Connect power and perform Test 2, the "Wellness Test."
10. If the test passes, push the drive back into the rack.

Blower Motor Disassembly

The blower motor is located in between the supply and takeup motors. See Figures 5-4 and 5-8.

1. To get to the blower motor, remove the following cables from the motor/power PCA:
   - Motor drive cable from J2
   - Takeup motor power cable from J3 PCA.
   - The connector from J5 (next to J3)
   - The connector from J4 (behind J5)
2. Release all of the capture clips around the blower motor. The clips hold the motor to the plenum.
3. Disconnect the fan power cable on the motor.
4. Pull the assembly out of the chassis.

Blower Motor Reassembly

1. Position the blower fan assembly and insert the motor, ensuring that the capture clips are holding properly.
2. Connect the fan power cable to the clip.
3. Connect the cables J4, J5, J3, and J2 to the motor/power PCA.
4. Slide the bottom cover plate into the rear panel frame and bring the bottom cover plate into position. The tabs along the sides should enter the slots in the side rails.
5. Fasten the lower edge of the front panel with three Torx screws.
6. Connect power and load a tape to test the blower motor.

Reel Lock Disassembly

The reel lock assembly consists of the reel lock lever and solenoid. It is located above the supply motor, at the front of the chassis.

1. Disconnect the two bayonnet clips at the solenoid.
2. Remove the screw that holds the solenoid to the casting.
3. Remove the screw at the reel lock arm pivot point.

Reel Lock Reassembly

1. Position the reel lock arm and insert the screw into the pivot point. Tighten the screw.
2. Insert and tighten the screw that holds the solenoid to the casting.
3. Connect the two solenoid power cables at the clip connection near the supply motor.
4. Slide the bottom cover plate into the rear panel frame and bring the bottom cover plate into position. The tabs along the sides should enter the slots in the side rails.
5. Fasten the lower edge of the front panel with three Torx screws.
6. Connect power and load a tape to test the lock solenoid.
7. If the hub locks properly, push the drive back into the unit.

5.7. Rear Panel Area

The rear panel area is at the rear of the unit. The FRU assemblies in the rear panel area are:

- Interface PCA (all interfaces)
- Fuses (in the rear panel fuse receptacle)
- Cooling Fan

Interface PCA Disassembly

1. Disconnect power and SCSI cables. Use an anti-static mat and wrist strap to prevent static damage to the new board.
2. Remove the two interface panel mounting screws (The interface PCA is attached to the panel.)
3. Slide the interface panel out enough to gain access to the power and ribbon cables.
4. Disconnect the power cable and the ribbon cable. Pull the panel clear of the chassis.

Rear Panel Fuses

To remove and replace the rear panel fuses, see Chapter 3 for the section titled, Verifying Voltage Configuration and Fuse.

Interface PCA Reassembly

1. Put the tabs on the interface PCA panel into the slots in the chassis. Rotate the PCA panel close enough to the chassis to allow connection of the power cable and ribbon cable.
2. Connect the two cables.
3 Insert and tighten the two screws that hold the interface panel onto the rear of the unit.
4. Connect power and run Test 12, “Interface Specific Test.”
5. If the test passes, push the drive back into the rack.

Cooling Fan Disassembly

1. Disconnect power and SCSI cables before pulling the slide out on its rails.
2. Remove the three screws holding the lower edge of the front panel.
3. Remove the two screws on the bottom cover plate near the front and rotate the bottom plate away from the chassis.
4. Disconnect snap connectors J6, J7, and J8 on the motor/power PCA. They are located inside the chassis closest to the cooling fan.
5. Cut enough of the wire wraps on the large bundle of wires to release the red and black fan wires.
6. Remove the four T25 screws that hold the fan onto the rear panel.
7. Slide the fan down and out of the chassis. Part of the lower edge of the rear panel frame is cut away enough to allow the fan to slide out.

Cooling Fan Reassembly

1. Slide the fan into position behind the rear panel. The red and black power wires face toward the Interface Assembly. The airflow arrow must point to the rear of the drive (the exhaust exits through the rear panel).
2. Fasten the fan to the rear panel with four T25 screws.
3. Connect the fan power connector. Make sure the clip is snapped securely.
4. Route the fan power wires next to the large wire bundle in front of the fan. Wire-wrap the wires as necessary.
5. Slide the bottom cover plate into the rear panel frame and bring the bottom cover plate into position. The tabs along the sides should enter the slots in the side rails.
6. Fasten the lower edge of the front panel with three Torx screws.
7. Connect power and turn the drive on.
8. Check that the fan is operating properly.
9. Run Test 2, the “Wellness Test.” If the test passes, push the drive back into the rack.

6

Firmware Upgrades

6.1. Installing Firmware Kits

You may need to upgrade firmware to fix a bug, or make a replacement board compatible with other boards. This chapter instructs you how to upgrade the EPROMs on the data buffer, drive controller, and interface PCAs.

NOTE:

After firmware has been upgraded, you will need to clear the NVRAM. Please see Chapter 3, Clearing the NVRAM for instructions on how to do this.

Tools Required

- Anti-static mat and wrist strap
- T25 Torx™ screwdriver
- #1 and #2 Pozidriv™ screwdrivers

6.2. Procedures

CAUTION--RACKMOUNTED UNIT

Always extend the cabinet's anti-tilt bars before extending the tape drive on the slide rails. To extend the anti-tilt bar, pull on the front metal bumper at the bottom of the cabinet until it is fully extended. Then adjust the threaded nylon-tipped leveler feet to further ensure stabilization.

Step 1 Save the drive logs and configurations in non-volatile RAM.

1. Apply power to the drive.
2. Select INFO 0.
3. Write down the drive logs. There may be up to 30 drive logs. The next steps save the NVRAM to tape. but the drive logs must be recorded manually.
4. Load a scratch tape.
5. Run TEST 150 to write a GCR ID on the scratch tape.
6. Run TEST 128 to store the configurations on the scratch tape.
7. Power down the drive from the system console.

Step 2 Remove power from the drive.

1. Remove the power cord from the drive.
2. Remove the SCSI interface cable from the drive.

CAUTION:

During the next part of the installation, observe ESD precautions. Do not lay the printed circuit assemblies on the plastic top cover. This cover is not electrically conductive and may hold a charge.

Step 3 Replace EPROMS on the data buffer PCA.

1. Remove the RFI cover.
2. Remove the data buffer PCA from the cardcage.
3. Change the EPROMs as instructed.
4. Remove the two EPROMs from sockets U603 and U803.
5. Install the EPROM labeled U602-504 in socket U603.
6. Install the EPROM labeled U803-504 in socket U802.
7. Reinsert the data buffer PCA in the cardcage.

Step 4 Replace EPROMS on the drive controller PCA.

1. Remove the drive controller PCA from the cardcage.
2. Change the EPROMs as instructed.
3. Remove the three EPROMs from sockets U1, U4, and U19.
4. Install EPROM U1-503 in socket U1.
5. Install EPROM U4-503 in socket U4.
6. Install EPROM U19-503 in socket U19.
7. Reinsert the drive controller PCA in the cardcage.

Step 5 Replace EPROMS on the interface PCA.

1. Remove the interface assembly from the rear of the drive: remove the two Torx screws that hold the interface to the rear panel of the drive. Rotate the interface plate out and disconnect the two cable connectors (2-pin and 50-pin) from the PCA.
2. Place the interface assembly on the anti-static mat.
3. Detach the interface cable connections from the metal panel. Use a #1 Pozi-driv screwdriver to remove the four screws holding the two connectors. See Figure 6-1.

Figure 6-1 *Screws on the SCSI Connectors*

4. Remove the interface PCA from the metal panel by doing the following.
5. Turn the assembly over (metal panel facing down on the mat). Use a #2 Pozidriv to remove the five screws that hold the printed circuit board to the metal panel. See Figure 6-2.

NOTE:

Do not remove the four #1 Pozidriv screws holding the SCSI connectors to the circuit board.

6. Lift the printed circuit board up off the metal panel. Move the metal panel aside.
7. Turn the board over, placing the circuit side down on the mat. Place the board on the mat so that the interface connectors are facing away from you. See Figure 6-3. When the board is properly oriented, the internal bus cable connector is on the lower right side. Just off the upper left corner of the microprocessor, labeled MC68B09, is the 28-pin socket U51 that will hold the EPROMs.
8. Remove the current EPROM from socket U51.
9. Install the new EPROM in the 28-pin socket.

CAUTION:

Insert the EPROM into its socket correctly. The 28-pin socket for the EPROM has a notch on its left side (the end facing the microprocessor). The EPROM also has a notch on one end. Be sure to have these notches line up when inserting the EPROM.

10. Install the interface assembly panel: Place the metal panel on the component side of the interface board. Hold the metal panel and interface board together and turn them over. Lay the interface board down on the anti-static mat, with the circuit side of the board facing up. Reattach the interface board to the metal panel using the #2 Pozidriv screws removed during disassembly.
11. Install the four #1 Pozidriv screws that hold the SCSI connectors to the metal plate.
12. Bring the interface assembly close enough to the chassis to connect the 50-pin ribbon interface cable to the bottom of the interface PCA. The interface assembly is positioned correctly when the three metal tabs on the assembly are pointing down.
13. Rotate the interface close enough to the rear of the chassis to connect the 2-pin power connector to the right side of the interface.
14. Put the metal tabs at the bottom of the interface panel into the slots on the back panel of the drive. Rotate the interface assembly up flat against the rear panel.
15. Fasten the interface to the back panel with the two Torx screws.

Figure 6-2 *SCSI Mounting Screws*

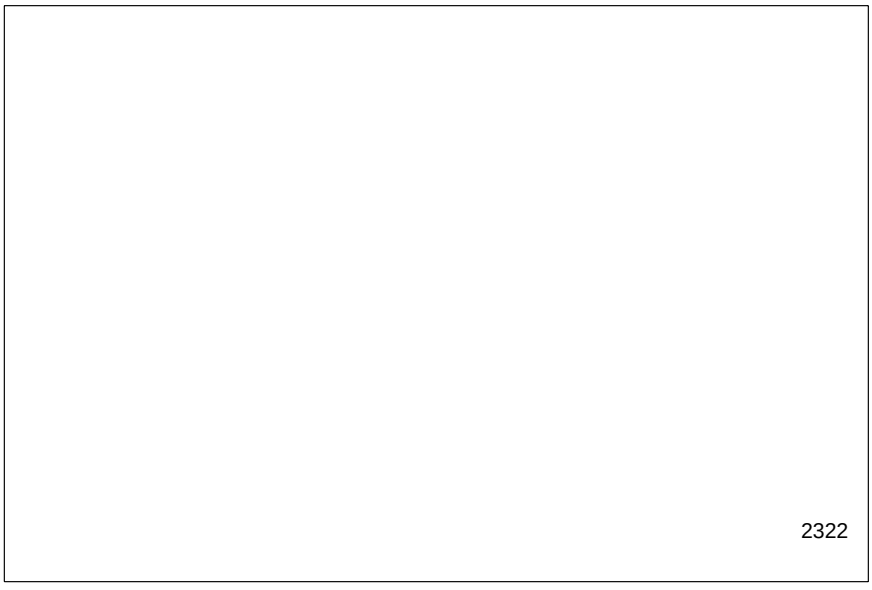


Figure 6-3 *EPROM location on Interface PCA*

Step 6 Verify drive operation.

1. On the data buffer PCA, connect a jumper between the two test holes located above and to the right of the battery.
2. Connect the power cord and power on the drive.
3. FAIL0 should appear in the display after a few seconds.
4. Switch off the drive and remove the jumper installed in Step 1.
5. Switch on the drive and load the scratch tape used earlier in this section.
6. Run TEST 129. (This reloads the configurations stored in Step 6 in the last section.
7. Run TEST 99 to set up the preamp gain levels (do for 6250 cpi and 1600 cpi.) Use a tape that is a typical brand and condition used by the customer. The tape should preferably *not be* brand new, very old, or damaged.
8. Reset the error log by setting CONF 0 to CLEAR.
9. Run TEST 2 to verify drive operation (a 600 ft. tape is adequate.)
10. Reconnect the interface cable to the drive.
11. Power up the drive from the system console.
12. Do a system test/store and observe tape motion.

A

Summary of Diagnostic Tests

The three classes of diagnostic tests are the following:

Interactive Checks:

Requires operator intervention. Front panel immediately displays results. Checks continue until the reset button is pressed, and always return a diagnostic result if passed. The loop count parameter is ignored during these tests.

Exercisers:

Causes the drive to perform a specific function to be observed or monitored by the operator. Does not return an error unless an invalid set-up prevents the test from proceeding.

Tests:

Written so that the drive can detect a failure. A PASS or FAIL is returned on test completion.

Sequence Tests (0 - 36)

TEST 0 - POWER-ON

Checks out all digital data paths and normal machine operation. This sequence runs tests that are similar to those normally run at power-on. The tests for each controller are run serially here rather than in parallel as in actual power-up.

Sequence Order:

13 - Drive Controller power-on sequence
14 - Buffer Controller power-on sequence
15 - Interface power-on sequence
9 - Multi-processor sequence

TEST 1 - GENERAL CHECKOUT (scratch tape required)

This test performs a complete machine checkout. It runs all power-on tests, then loads a tape and checks out all sensors. It then runs the tests in the multi-processor, sensor, and wellness sequences.

Sequence Order:

0 - Power-on
165 - Load Tape
75 - TDU Test
95 - Servo Performance Test
2 - Wellness Test

TEST 2 - WELLNESS (scratch tape required)

This test checks out the general read/write capability of the HP 7979A or 7980A. The sequence includes the tests necessary to write a GCR tape, rewind and read the tape, rewind, write the tape in PE, rewind and read the PE tape, rewind, write the tape in NRZI (if available), rewind and read the NRZI tape, then rewind.

During the write process, the enter key causes the write to end early so that the entire tape is not written. The subsequent read pass will only read as far as the write pass had written.

Sequence Order:

165 - Load Tape
174 - Clear Data Buffer
171 - Create Record in Buffer (A = 1, all ones, B = 4K)
171 - Create Record in Buffer (A = 2, alternating, B = 16K)
171 - Create Record in Buffer (A = 3, rotating, B = 32K)
* 150 - Write Density ID (A = 6250)
** 177 - Write Density ID (A = 6250)
172 - Write Buffer to Tape (A = 1, LOOP *)
176 - Write Tape Mark
176 - Write Tape Mark
166 - Rewind
173 - Read From Tape to Buffer (A = 0, LOOP *)
166 - Rewind
174 - Clear Data Buffer
171 - Create Record in Buffer (A = 1, all ones, B = 4K)
171 - Create Record in Buffer (A = 2, alternating, B = 16K)
171 - Create Record in Buffer (A = 3, rotating, B = 32K)
* 150 - Write Density ID (A = 1600)
** 177 - Write Density ID (A = 1600)
172 - Write Buffer to Tape (A = 1, LOOP *)
176 - Write Tape Mark

176 - Write Tape Mark
166 - Rewind
173 - Read From Tape to Buffer (A = 0)

166 - Rewind
174 - Clear Data Buffer
171 - Create Record in Buffer (A = 1, all ones,
B = 4K)
171 - Create Record in Buffer (A = 2, alternating,
B = 16K)
171 - Create Record in Buffer (A = 3, rotating,
B = 32K)
177 - Write Density ID (A = 800)
172 - Write Buffer to Tape (A = 1, LOOP *)
176 - Write Tape Mark
176 - Write Tape Mark
166 - Rewind
173 - Read From Tape to Buffer (A = 0, LOOP *)
166 - Rewind
174 - Clear Data Buffer

* = FRU 4 Buffer
** = FRU 14 or 24 Buffer

TEST 3 - INITIALIZE ERROR RATE SEQUENCE

Sequence 3 initializes the cumulative logs in preparation to running error rate.

Sequence Order:
175 - Initialize cumulative logs

TEST 4 - ERROR RATE SEQUENCE (scratch tape required)

Sequence 4 writes a tape in GCR, rewinds and reads it, then performs the same operations in PE and NRZI (if available). While the sequence runs, read/write errors are recorded in the cumulative error rate log. The error rate results are viewed in the cumulative error rate logs from INFO 3, 4, and 5. Error rate results are accumulated until sequence 3 is used to initialize the log.

The error rate sequence operates very similar to the wellness test but differs in that hard read and write error do not terminate the error rate test. Hard errors are only logged.

Sequence Order:
165 - Load Tape

174 - Clear Data Buffer
171 - Create Record in Buffer (A = 1, all ones, B = 4K)
171 - Create Record in Buffer (A = 2, alternating, B = 16K)
171 - Create Record in Buffer (A = 3, rotating, B = 32K)
* 150 - Write Density ID (A = 6250)
** 177 - Write Density ID (A = 6250)
172 - Write Buffer to Tape (A = 5, LOOP *)
176 - Write Tape Mark
176 - Write Tape Mark
166 - Rewind
173 - Read From Tape to Buffer (A = 4, LOOP *)
166 - Rewind
174 - Clear Data Buffer
171 - Create Record in Buffer (A = 1, all ones, B = 4K)
171 - Create Record in Buffer (A = 2, alternating, B = 16K)
171 - Create Record in Buffer (A = 3, rotating, B = 32K)
* 150 - Write Density ID (A = 1600)
** 177 - Write Density ID (A = 1600)
172 - Write Buffer to Tape (A = 5, LOOP *)
176 - Write Tape Mark
176 - Write Tape Mark
166 - Rewind
173 - Read From Tape to Buffer (A = 4, LOOP *)
166 - Rewind
174 - Clear Data Buffer
171 - Create Record in Buffer (A = 1, all ones, B = 4K)
171 - Create Record in Buffer (A = 2, alternating, B = 16K)
171 - Create Record in Buffer (A = 3, rotating, B = 32K)
177 - Write Density ID (A = 800)
172 - Write Buffer to Tape (A = 5, LOOP *)
176 - Write Tape Mark
176 - Write Tape Mark
166 - Rewind
173 - Read From Tape to Buffer (A = 4, LOOP *)
166 - Rewind
174 - Clear Data Buffer

* = FRU 4 Buffer
** = FRU 14 or 24 Buffer

TEST 5 - NRZI ERROR RATE SEQUENCE (scratch tape required)

Sequence 5 writes a tape in NRZI then rewinds and reads it. While the sequence runs, read/write errors are recorded in the PE cumulative error rate log. The error rate results are viewed in the cumulative error rate logs INFO 4 and 5. Error rate results are accumulated until sequence 3 is used to initialize the log.

The NRZI error rate sequence operates very similar to the wellness test but differs in that hard read and write errors do not terminate the error rate test. Hard errors are only logged.

Sequence Order:

165 - Load Tape
174 - Clear Data Buffer
171 - Create Record in Buffer (A = 1, all ones, B = 4K)
171 - Create Record in Buffer (A = 2, alternating, B = 16K)
171 - Create Record in Buffer (A = 3, rotating, B = 32K)
177 - Buffer Write Density ID (A = 800)
172 - Write Buffer to Tape (A = 5, LOOP *)
176 - Write Tape Mark
176 - Write Tape Mark
166 - Rewind
173 - Read From Tape to Buffer (A = 4) (loop)
166 - Rewind
174 - Clear Data Buffer

TEST 9 - MULTI-PROCESSOR SEQUENCE

This sequence will execute all multi-processor tests to check out the communication between processors, the message bus, and data transfer paths. It will normally be called after each processor has executed its individual power-on sequence and established communications at power-up.

Sequence Order:

11 - Dual-Port RAM Test Sequence
62 - Formatter Initiated Loopback Test
61 - Buffer Initiated Loopback Test (param B = 3)
60 - Interface Initiated Loopback Test

TEST 11 - DUAL-PORT RAM SEQUENCE

This sequence will perform all tests on the dual-port RAM between all target processors.

Sequence Order:

50 - DPR On Board Test (A = 3, DC)
51 - DPR Off Board Test (A = 4, BC)
50 - DPR On Board Test (A = 4, BC)
51 - DPR Off Board Test (A = 6, IF)
53 - DPR Interrupt Test (A = 4, DC to BC)
54 - DPR Interrupt Test (A = 3, BC to DC)
54 - DPR Interrupt Test (A = 4, IF to BC)
52 - DPR Collision Test (A = 3, BC to DC)
52 - DPR Collision Test (A = 4, IF to BC)

TEST 12 - LOOPBACK ISOLATION SEQUENCE

This sequence will execute all Interface, Buffer initiated, and Formatter initiated loopback isolation sequences. All hardware areas used by loopbacks will be checked out. Each loopback test is stepped through and a loopback problem should be isolated. Each test will be executed with a loopback check number (param A) of zero and will run all loopback checks.

Sequence Order:

62 - Formatter Initiated Loopback test
19 - Buffer Hardware Sequence
61 - Buffer Initiated Loopback test (param B 3, rotating)
20 - Interface Specific Hardware Sequence
60 - Interface Loopback Test

TEST 13 - DRIVE CONTROLLER POWER-ON TEST SEQUENCE

This sequence will be executed by the drive controller at power-up to check out all paths and operation of the servo and motor drive circuitry.

Sequence Order:

41 - Rom Checksum
40 - Processor Test
43 - Non-Destructive RAM Test
45 - Connectivity Test
49 - Timer Circuitry Test
70 - Front Panel Test
17 - Servo/Motor Drive Electronics Sequence

TEST 14 - BUFFER CONTROLLER POWER-ON TEST SEQUENCE

This sequence will be executed by the buffer controller at power-up and will check out all paths and operation of the buffer circuitry.

Sequence Order:

41 - Rom Checksum
40 - Processor Test
48 - Non-volatile RAM Checksum
43 - Non-destructive RAM Test
45 - Connectivity Test
19 - Buffer Hardware Sequence

TEST 15 - INTERFACE POWER-ON TEST SEQUENCE

This sequence will be executed by the interface controller at power-up and will check out all paths and operation of the specific interface.

Sequence Order:

41 - Rom Checksum
40 - Processor Test
43 - Non-Destructive RAM Test
45 - Connectivity Test
20 - Interface Specific Hardware Sequence

TEST 17 - SERVO/MOTOR DRIVE ELECTRONICS SEQUENCE (no scratch tape)

This sequence will check out the operation of the servo and motor drive circuitry. These sequence tests are non-interactive.

Sequence Order:

78 - ADC Test
76 - DAC Test
82 - QDC Test
77 - Tachometer Test
81 - 48 Volt PSU Test
80 - Motor Drive Loopback

TEST 18 - SERVO/MOTOR DRIVE CHECKOUT SEQUENCE (scratch tape required)

Sequence Order:

165 - Load Tape

95 - Servo Performance Test
96 - Servo Repositioning Test
166 - Rewind Tape
167 - Unload Tape

TEST 19 - BUFFER HARDWARE SEQUENCE

This sequence will checkout the data path and operation of the data buffer registers and RAM. It will isolate any problems specific to the data buffer.

Sequence Order:
120 - Buffer Register Test
121 - Buffer Function Test
122 - Buffer RAM Test
** 130 - Data Compression Register Test
** 131 - Data Compression Functionality Test
** 132 - Data Compression RAM Test

** = 7980XC product only

TEST 20 - INTERFACE-SPECIFIC HARDWARE SEQUENCE

This sequence will run through all of the interface specific hardware tests.

Sequence Order:
140 - Interface Specific Test 1
141 - Interface Specific Test 2

User-Defined Sequence (38 - 39)

A sequence consisting of up to twenty tests may be defined by the user during runtime. The sequence entries may consist of any existing tests or sequences. The sequence is defined by invoking Test 38 and entering the test or sequence numbers in the correct order. The user-defined sequence is run using Test 39. The current definition remains until another sequence is defined using Test 38.

TEST 38 - ENTER USER-DEFINED SEQUENCE

This test will allow a user-defined sequence to be entered. When tests are run while defining Test 39, they will complete with a "SEQ 39" message immediately, instead of the normal "PASS" or "FAIL." Running Test 38 a second time terminates the sequence of definition mode.

TEST 39 - RUN USER-DEFINED SEQUENCE

This test will run the current user-defined sequence. If Test 39 is currently being defined, this test completes the sequence definition and then runs the test.

Kernal Tests (40 - 49)

All kernel tests and certain multi-processor tests require a target processor parameter. These tests are common to more than one processor and as such the processor must be specified. The possibilities are as follows:

TARGET PROCESSOR

0 - All processors
3 - Drive controller
4 - Buffer controller
6 - Interface controller
7 - HP-IB Interface controller
10 - SCSI differential interface controller
11 - SCSI single ended interface controller
12 - Pertec interface controller

The default processor is "All processors" With all processors set, each processor which has the test defined, will execute the test, beginning with the interface controller, and ending with the drive controller.

TEST 40 - MICROPROCESSOR OPERATION (param A - processor (0,3,4,6))

A functional check of the microprocessor is performed

TEST 41 - ROM CHECKSUM (param A - processor (0,3,4,6))

A checksum verification of the ROM is performed

TEST 42 - DESTRUCTIVE RAM TEST

Volatile RAM is tested and checked for data acceptance and retention. The test insures that writing to one location has no affect on other locations. This test is destructive and as such will only run at power-on.

TEST 43 - NON-DESTRUCTIVE RAM TEST (param A - processor (0,3,4,6))

RAM is tested, checking for data acceptance and retention. The test is non-destructive. This test is used at power-on for non-volatile RAM and while running the power-on test sequence for

all RAM areas.

TEST 44 - COMPLETE RAM TEST (param A - processor (0,3,4,6))

RAM is fully tested for data acceptance and retention. The test also insures that no memory cells affect other cells within the RAM. This test is non destructive and may be used without power cycling the drive, but does require extended times to run.

param A	processor	time required for test
3	Drive_controller	17 minutes
4	Buffer controller	72 minutes (504 buffer)
		1.5 minutes (514/524 buffer)
6	Interface controller	4 minutes HP-IB and PERTEC
		17 minutes SCSI
0	All of above	22.5 to 106 depending on buffer and interface frus (see above).

TEST 45 - CONNECTIVITY TEST (param A - processor (0,3,4,6))

All connectors are checked for proper connectivity.

TEST 46 - DESTRUCTIVE DUAL-PORT RAM TEST

The dual-port RAM is tested using the destructive RAM test. This test is destructive and is only run at power-on. It is NOT accessible from the front panel.

TEST 48 - NON-VOLATILE RAM CHECKOUT

A RAM test and checksum verification of the controlled portion of non-volatile RAM is performed.

TEST 49 - TIMER CIRCUITRY

The PTM is checked for proper counting. The oscillator is used to verify the STS has the proper period.

Processor Communication Tests (50 - 59)

TEST 50 - ONBOARD DUAL-PORT RAM (param A - processor (0, 3, or 4))

This test allows the DPR to be checked out from the subordinate side. The test performs a walking ones and zeros test in a non-destructive manner. All of the RAM may be accessed for checking with the exception of the master interrupt location.

TEST 51 - OFFBOARD DUAL-PORT RAM (param A - processor (0, 4, or 6))

This test allows the DPR to be checked out from the master side. The test performs a walking ones and zeros test in a non-destructive manner. All of the RAM may be accessed for checking with the exception of the subordinate interrupt location.

TEST 52 - DUAL-PORT RAM COLLISION (param A - processor (0, 3, or 4))

This test checks DPR arbitration by creating read/write collisions at the DPR. The two processors then pass incrementing information back and forth through the diag message area (DPR location 084H).

TEST 53 - SUBORDINATE DPR INTERRUPT (param A - processor (0, 4, or 6))

This test verifies the ability of the master to be interrupted by the subordinate through the DPR. The test is initiated by the target processor sending a multi-processor command with the parameter set to "subordinate interrupt". The receiving processor will write the interrupt test value to the interrupt location of the DPR then report on the command.

TEST 54 - MASTER DPR INTERRUPT (param A - processor (0, 3, or 4))

This test verifies the ability of the subordinate to be interrupted by master through the DPR. The test is initiated by the target processor sending a multi-processor command with the parameter set to "master interrupt". The receiving processor will write the interrupt test value to the interrupt location of the DPR then report on the command.

Loopback Tests (60 - 69)

TEST 60 - INTERFACE LOOPBACK (param A - loopback check number)

The interface uses manual CCL commands to communicate with the data buffer. Test will pass if expected result occurs.

Parameter A indicates the extent of the test:

```
param A       Loopback Check                    Expected Result

0 - run all loopback checks from 1 thru 3
1 - loopback correct data                  = no error
2 - data to buffer with a parity error     = data parity error
(This test option is not available on HP-IB interface)
3 - data from buffer with a parity error   = data parity error
```

TEST 61 - BUFFER INITIATED LOOPBACK (param A - loopback type) (param B - data pattern)

Data is generated within the buffer then looped through the formatter using the multi-processor loopback command. Parameter A indicates the extent of the test:

param A loopback check

0 - run all loopback checks from 1 thru 5
1 - correct PE data
2 - correct GCR data
3 - correct GCR data underrun (PE for 7979 drives)
4 - correct GCR data overrun (PE for 7979 drives)
5 - GCR data with a parity error (PE for 7979 drives)
6 - correct NRZI data

param B data pattern

0 - All zeros
1 - All ones
2 - Alternating ones and zeros
3 - Rotating 0 - 255
4 - Pseudo random

TEST 62 - DRIVE-INITIATED DIGITAL LOOPBACK (param A - loopback block type)

Loopback data or a write pattern is generated by the drive controller and passed through the formatters.

number loopback block type

0 - run all block types form 1 thru 16
1 - 1600 PE data block
2 - 1600 PE data block with 1 track in error
3 - 1600 PE density ID
4 - 1600 PE tape mark
5 - 1600 PE gap
6 - 6250 GCR data block

7 - 6250 GCR data block with 1 track in error
8 - 6250 GCR data block with 2 tracks in error
9 - 6250 GCR density ID
10 - 6250 GCR ARA burst
11 - 6250 GCR ARA ID
12 - 6250 GCR tape mark
13 - 6250 GCR gap
14 - 800 NRZI data block
15 - 800 NRZI tape mark
16 - 800 NRZI gap

TEST 63 - DIGITAL LOOPBACK EXERCISER (param A - density) (param B - tracks selector)

Digital loop back is performed using a data block in the selected density with the selected tracks turned off. Tracks selector is in the form of 'XY' where X and Y are combinations of two tracks to disable. Tracks may be specified as 1 thru 9 with 0 indicating no tracks.

TEST 64 - DRIVE-INITIATED ANALOG LOOPBACK (param A - loopback block type) (requires scratch tape)

Loopback data or a write pattern is generated by the drive controller and passed through the formatters and the tape.
Loopback block type is defined in test 62.

BECAUSE THIS TEST DOES NOT DO RETRIES, TAPE DEFECTS WILL CAUSE ERRORS
WHEN RUNNING THIS TEST.

TEST 65 - ANALOG LOOPBACK EXERCISER (param A - density) (param B - tracks selector)

Analog loop back is performed using a data block in the selected density with the selected tracks turned off.
Tracks selector is in the form of 'XY' where X and Y are combinations of two tracks to disable. Tracks may be specified as 1 thru 9 with 0 indicating no tracks.

BECAUSE THIS TEST DOES NOT DO RETRIES, TAPE DEFECTS WILL CAUSE ERRORS
WHEN RUNNING THIS TEST.

Drive Controller Tests (70 - 119)

TEST 70 - FRONT PANEL LIGHT SHOW

TEST 71 - FRONT PANEL BUTTON CHECK (interactive test)

Displays the name of each button for one second after they are pressed. The test is terminated by pressing reset twice.

TEST 72 - FRONT PANEL MESSAGE CHECK (interactive test)

This test displays all the front panel messages.

The front panel buttons are defined as follows for the duration of the test:

NEXT : Selects the next message to be displayed, cycling thru all the messages for the current language.

PREV : Selects the previous message to be displayed, cycling thru all the messages for the current language.

OPTION : Selects the next language, cycling thru all the languages (English, German, French, Spanish). The odometer indicates the current language (0=English, 1=German, 2=French, 3=Spanish).

ONLINE : Resets the message pointer back to the first message.

ENTER or RESET : TERMINATES the test.

TEST 75 - TDU (scratch tape required)

Performs a write/read test with TDU engages and disengages to verify proper TDU operation. The scratch tape must have a PE or GCR density id and be positioned at BOT.

TEST 76 - DAC (tape must be unloaded)

Values are written to the DACs and check with an A/D converter.

TEST 77 - TACHOMETER (tape must be unloaded)

The tach circuit at the speed encoder inputs is simulated. Proper speed translation at the A/D converter is checked for.

TEST 78 - ADC

Test the A/D converter for proper operation.

TEST 80 - MOTOR DRIVE LOOPBACK (tape must be unloaded)

Values are written to the motor DAC and read back at the A/D converter.

TEST 81 - 48-VOLT POWER SUPPLY

The A/D converter is read for the 48 volt PSU

TEST 82 - POSITION COUNTER (tape must be unloaded)

CHAN_A and CHAN_B bits are toggled on the QDC. Proper counts are checked for.

TEST 84 - TENSION SHUTDOWN CHECK (interactive test, tape must be unloaded)

As the operator moves the tension arm (buffer arm), the front panel displays "*" when a tension shutdown limit is reached.

TEST 85 - TENSION SENSOR CHECK (interactive test)

The front panel displays the tension arm value obtained from the A/D converter in the range of 0 - 255. The midpoint of the readings (seen when no tension arm is installed) is approximately 122.

TEST 86 - SPEED ENCODER CHECK (interactive test)

As the operator rotates the speed encoder, the front panel displays QDC counts in the range of 0 - 4095.

TEST 87 - TAPE-IN-PATH SENSOR CHECK (interactive test) (tape must be unloaded)

The front panel displays "*" whenever the optical sensor beam is blocked.

TEST 88 - DOOR SENSORS CHECK (interactive test)

The front panel displays "DOOR" whenever the door or the top cover is open. The unload key allows the door to be opened during this test. When the unload key is pressed, if the door is not detected open within one half second, then "CHECK" is displayed in the front panel.

TEST 89 - REEL ENCODERS/ WRITE ENABLE RING SENSOR CHECK (interactive test) (requires scratch tape) (tape must be unloaded)

The user loads a write enabled scratch tape and spins it with his hand. The front panel displays "*" each time a reel encoder pulse is seen. The front panel illuminates the "wrt en" annunciator when the write enable encoder is seen. The "wrt en" annunciator remains lit until cleared.

TEST 90 - TDU FUNCTIONALITY CHECK (interactive test)

The TDU is engaged. After one half second it will be retracted.

TEST 91 - HUB LOCK CHECK (interactive test)

This check causes the hub to be locked

TEST 92 - HUB UNLOCK CHECK (interactive test)

This check causes the hub to be unlocked

TEST 93 - LOAD FAN CHECK (interactive test)

The load fan is turned on for thirty seconds.

TEST 94 - EOT/BOT SENSOR CHECK (interactive test)

The front panel displays "BOT " when a BOT sticker is detected. The front panel displays " EOT" when an EOT sticker is detected. This test should be performed with a tape threaded through the tape path (not tensioned). The operator can then manually turn the tape reels to to move the BOT/EOT sticker past the sensors.

TEST 95 - SERVO PERFORMANCE (scratch tape required)

A complete check of the servo system is performed. The test performs worst case repositions, forward and reverse speed checks, high speed rewinds, etc. The buffer arm is tested for displacement, the velocity is checked for specifications, and the servo ramp rate is checked.

TEST 96 - SERVO REPOSITION EXERCISER (param A - forward time in seconds) (param B - reverse time in seconds)
(scratch tape required)

The drive will continuously reposition to EOT then rewind, if param A is greater than or equal to param B. Otherwise, the drive repositions until BOT.

TEST 97 - SERVO CLOSE LOOPS (scratch tape required)

The ability to close the servo loops is tested.

TEST 98 - READ CHANNEL GAIN PROFILE DISPLAY (param A - Density)

This test displays the read channel gain profile for the selected density. The display will show "TX YYY" where X is the track number (1...9 and A) and YYY is the gain required for that track. The next/previous keys can be used to view all the tracks. Track A is the average of all 9 tracks. The enter key is used to terminate the gain display. The gain profiles are generated by test #99 and typically saved in non-volatile memory.

TEST 99 - READ CHANNEL CALIBRATION (param A - density, param B - cntl) (write enabled tape required)

This test is used to calibrate the read channel gain profile. A tape which is typical of those used in the unit should be used for the calibration. This test will write a calibration pattern on the tape and then read the pattern to calibrate the drive. When the test is complete it will display the gain (see test #98). Dual density drives should be calibrated in both densities. If parameter B is set as "SAVE" then the calculated gain profile will be saved in non-volatile RAM. If parameter B is set as "TEMP" then the calculated gain profile will be after this test is complete.

TEST 100 - ERASE TAPE (param A - prewrite control) (scratch tape required)

This test verifies an erase from the current tape position to the end of tape marker. The tape is rewound upon encountering EOT.

param A prewrite control

0 - erase only
1 - write tape at GCR data rate first (PE for 7979)
2 - write tape at PE data rate first
3 - write tape at NRZI data rate first

TEST 101 - WRITE ELECTRONICS EXERCISER (param A - density) (scratch tape required)

This exerciser writes an all ones pattern in the specified density from the current tape position to the end of tape marker. The tape is rewound when EOT is encountered.

TEST 102 - READ ELECTRONICS EXERCISER (param A - density) (scratch tape required)

This exerciser runs from the current tape position to the end of tape marker with the read electronics turned on and setup in the specified density. The tape is rewound when EOT is encountered.

TEST 103 - READ REVERSE EXERCISER (param A - density) (scratch tape required)

This exerciser positions the tape at EOT then runs in the reverse direction to the beginning of tape marker with the read electronics turned on and set-up in the specified density.

TEST 104 - HEAD CROSSTALK EXERCISER (param A - density) (scratch tape required)

This exerciser rewinds the tape, then runs to the EOT marker with the erase head on in order to prepare the tape for crosstalk. It then runs in the reverse direction to the beginning of tape marker with the read and write electronics on and set-up in the specified density.

TEST 105 - NRZI READ SKEW CALIBRATION (param A - control) (master head alignment tape required) (test valid for option 800 drives only)

This test is used to calibrate the NRZI read deskewing hardware. A master head alignment (skew) tape is required for this test. The test will make a forward pass from BOT to EOT during which 2000 skew measurements will be taken and then will make a reverse pass from EOT to BOT during which an additional 2000 measurements in the reverse direction are taken. If the required number of samples in either direction is not achieved in one pass the tape will be repositioned at the other end and sampling will continue. After the read passes are completed the skew correction values are calculated and displayed (see test #107). IF parameter A is set as "SAVE" the calculated read skew correction values will be saved in non-volatile RAM. IF parameter A is set as "TEMP" then the resulting values will be used by the hardware until either this test is executed again or the tape drive is power cycled.

TEST 106 - NRZI WRITE SKEW CALIBRATION (param A - control) (write enabled tape required) (test valid for option 800 drives only)

NOTE:

TEST 105 "NRZI READ SKEW CALIBRATION" MUST BE EXECUTED PRIOR TO THE EXECUTION OF THIS TEST AND THE DRIVE MUST NOT BE POWER CYCLED BETWEEN THE EXECUTION OF TEST 105 AND THIS TEST.

This test is used to calibrate the NRZI write deskewing hardware. A tape typical of those used in the unit should be used for this calibration. This test will write a calibration pattern on the scratch tape from BOT to EOT. The pattern will be read, the write skew correction values will be calculated and the results will be displayed (see test #107). IF parameter A is set as "SAVE" the calculated read skew correction values will be saved in non-volatile RAM. IF parameter A is set as "TEMP" then the resulting values will be used by the hardware until either this test is executed again or the tape drive is power cycled.

TEST 107 - NRZI SKEW CALIBRATION VALUE DISPLAY (param A - value set)

This test displays the skew correction values currently in use for each track for the selected value set.

For read correction values the display will show "XRTY ZZ" where X is "F" (forward) or "R" (reverse), Y is the track number (1..9) and ZZ is the correction value. Each value represents the amount of correction for the selected track and direction in increments of 78 micro inches.

For write correction values the display will show "FWTY ZZ" where Y is the track number (1..9) and ZZ is the correction value. Each value represents the amount of correction for the selected track in increments of 19.5 micro inches.

The next/previous keys can be used to view each track's correction value and the enter key is used to terminate the value display.

param A value set

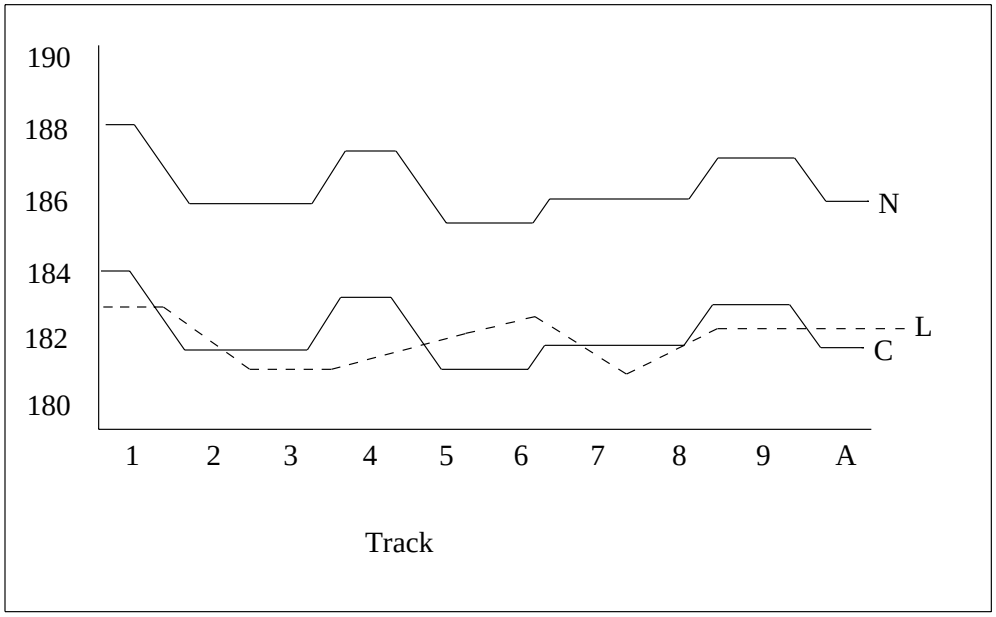
0 - read correction values
1 - write correction values

TEST 108 - CURRENT GAIN PROFILE DISPLAY (param A - display select)

This test will display the gain profile for the currently loaded tape. The gain profile is read whenever a tape is identified

(following a load or a rewind) or a density ID is written. select 0 will display the load gain profile for the current tape. Display select 1 will display the load gain profile for the current tape relative to the non-volatile profile. Display select 2 will the current profile used for reading and writing the tape. It is the non-volatile profile normalized to match the average gain current tape. Gains are displayed as described in test #98. For PE tapes, display select 0 and 1 will show track 4 only (the PE ID track).

Figure A-1 *Gain Profile Example*



N = NVRAM gain profile (from test #99)
L = Load gain profile (when tape was loaded)
C = Current R/W gain profile

The non-volatile gain profile is normalized such that its average N[A] is the same as the average of the load gain L[A].

TEST 109 - NRZI DYNAMIC SKEW (write enabled tape required) (test valid for option 800 drives only)

NOTE:

TEST 106 MUST BE EXECUTED PRIOR TO THE EXECUTION OF THIS TEST.

This test measures the dynamic skew present in the tape system (ie tape path + current tape). The test will alternately write and then read a test pattern with tracks 1 and 9 offset by a known amount of static skew. After the measurements

are complete the result is calculated and displayed.

The display will show "DSW xxx" where xxx represents the percentage of the measurements that fell within +- 39 micro inches of the expected offset of tracks 1 and 9. A higher value corresponds to less dynamic skew. A value >= 64 indicates the the dynamic skew is within acceptable limits.

TEST 110 - TAPE PACK CONDITIONER (any tape)

TEST 120 - BUFFER REGISTER

Write to and read values from all of the buffer registers to verify their data acceptance and retention.

TEST 121 - BUFFER FUNCTION

Perform push and pop operations from the buffer controller, verifying counter and address operation, parity circuitry, and prefetch latching.

TEST 122 - BUFFER RAM

Buffer RAM is tested for data acceptance and retention. The test is destructive to data in the data buffer.

TEST 128 - DUMP NVRAM TO TAPE (scratch tape required)

The non-volatile RAM of the data buffer is dumped and written onto the tape as the first record, and with the appropriate header. This test should be run prior to replacing the battery.

TEST 129 - LOAD NVRAM FROM TAPE (pre-written dump tape required)

The non-volatile RAM of the data buffer is loaded from a tape written using Test 128. This test is used to reload non-volatile RAM information following the changing of the battery. After this test is run the drive must be power cycled for the interface and drive controller to receive the new non-volatile RAM values.

SCSI Interface Controller Tests (140 - 145)

TEST 140 - SCSI INTERFACE CONTROLLER CHIP

Checks out operations of the SCSI interface controller chip.

TEST 141 - ONBOARD HARDWARE TESTS

Checks out additional onboard functions.

TEST 142 thru 144- (reserved tests, These tests will always pass)

TEST 145 - SCSI CONNECTOR LOOPBACK

This test performs a loopback thru SCSI connectors checking proper operation of the SCSI drivers, receivers and cables. This test requires an external loopback hood with terminator power.

Drive Command Execution (150 - 177)

All of these commands with the exception of host to buffer commands require that a scratch tape be loaded.

Test 150-167 are run by the drive controller and will not perform retries.

TEST 150 - WRITE DENSITY ID (param A density 800, 1600, 6250) (tape must be at BOT)

TEST 151 - WRITE TEST RECORD (param A test record size)

A single record is generated within the drive controller and written to tape.

param A	test record size
0	1 byte
1	256
2	512
3	768
4	1024
5	1280
6	1536
7	1792
8	2048
9	2304
10	2560
11	2816
12	3072
13	3328
14	3584
15	3840

TEST 152 - WRITE TAPE MARK

TEST 153 - WRITE GAP (param A gap length)

param A gap length

0 - 2.0 inch (5.08 cm) write gap
1 - 4.0 inch (10.16 cm) write gap
2 - 8.0 inch (20.32 cm) write gap
3 - 12.0 inch (30.48 cm) write gap
4 - 16.0 inch (40.64 cm) write gap
5 - erase to EOT

TEST 160 - VERIFY RECORD (param A runaway control)

A single record is read from the tape verifying the data but without the results being placed in the data buffer. The runaway control parameter sets the maximum amount of blank tape the drive will cover while looking for the record. 0 = 25 feet (7.62 meters), 1 = 12 inches (30.48 cm).

TEST 161 - FORWARD SPACE BLOCK

Single blocks are spaced over without verifying any data in the blocks.

TEST 162 - BACKSPACE BLOCK

Single blocks are spaced over without verifying any data in the blocks.

TEST 163 - FORWARD SPACE FILE

Blocks are spaced over until a file mark in encountered.

TEST 164 - BACKSPACE FILE

Blocks are spaced over until a file mark in encountered.

TEST 165 - LOAD TAPE

TEST 166 - REWIND

TEST 167 - UNLOAD TAPE (param A door control)

param A door control

0 - remain closed
1 - open door

NOTE:

Test 170-177 are run by the buffer controller and will perform retries.

TEST 170 - WRITE TAPE MARK TO BUFFER

A tape mark entry is generated in the buffer without writing it to tape.

TEST 171 - CREATE RECORD IN BUFFER (param A pattern) (param B record size)

A record is created in the buffer without writing it to tape.
The pattern parameter indicates the type of data to be generated.

param A pattern

0 - all zeros
1 - all ones
2 - alternating all zeros, all ones
3 - rotating data bytes (0 .. 255)
4 - pseudo random data
5 - use existing data in buffer RAM
6 - rotating data with parity error on the last byte

param B record size

0 - 1 byte
1 - 256 bytes
2 - 1K
3 - 4K
4 - 16K
5 - 32K
6 - 64K
7 - 128K
8 - 256K

TEST 172 - WRITE BUFFER TO TAPE (param A - retain data/next write control)

Write the contents of the next entry in the queue to tape.
The following parameters affect the write.

remove - remove record from buffer following the write
Note that if the test is looped more times than there are buffer entries, the test will fail with an empty buffer.
retain - retain record in buffer following the write
stream - attempt to stream by starting to write the next record

in the buffer. If no write is received, the startup is aborted and the tape repositioned.
single - do not startup the next write. Streaming will not occur.
err normal - fail on all errors.
err bypass - fail on all errors except write errors.
write errors will be logged in the error and error rate logs and can be displayed using INFO.

param A

0 - remove / stream / err normal
1 - retain / stream / err normal
2 - remove / single / err normal
3 - retain / single / err normal
4 - remove / stream / err bypass
5 - retain / stream / err bypass
6 - remove / single / err bypass
7 - retain / single / err bypass

TEST 173 - READ FROM TAPE TO BUFFER (param A - retain data/readahead control)

A record is read from the tape into the data buffer. The following parameters affect the read.

remove - remove record from buffer following the read
retain - retain record in buffer following the write
Note that if the test is looped more times than there is room left in the buffer, the test will fail with a full buffer.
stream - attempt to stream by starting to read the next record from the tape. If no read command is received, the startup is aborted and the tape repositioned.
single - do not startup the next read. Streaming will not occur.
err normal - fail on all errors.
err bypass - fail on all errors except read errors.
read errors will be logged in the error and error rate logs and can can be displayed using INFO.

param A

0 - remove / stream / err normal
1 - retain / stream / err normal
2 - remove / single / err normal
3 - retain / single / err normal
4 - remove / stream / err bypass
5 - retain / stream / err bypass
6 - remove / single / err bypass

7 - retain / single / err bypass

TEST 174 - CLEAR DATA BUFFER

All entries in the data buffer are removed.

TEST 175 - INITIALIZE CUMULATIVE LOG

The PE and GCR cumulative logs are cleared.

TEST 176 - BUFFER WRITE TAPE MARK

A tape mark is written to the tape, with retries performed if necessary. The contents of the buffer are not affected. This test will not stream if looped.

NOTE:

THIS TEST IS NOT AVAILABLE ON UNITS WITH A FRU 4 BUFFER CONTROLLER (FIRMWARE BELOW 6.00).

TEST 177 - BUFFER WRITE DENSITY ID (param A density - 800, 1600, 6250) (tape must be at BOT)

The selected density ID is written to the tape, with retries performed if necessary. The contents of the buffer are not affected.

NOTE:

THIS TEST IS NOT AVAILABLE ON UNITS WITH A FRU 4 BUFFER CONTROLLER (FIRMWARE BELOW 6.00).

Table A-1 *Test Reference Table, Tests 40-82*

TT=Test Type	***PR=Processors***	***PO=Power On***
C=Check (no remote access) E=Exerciser T=Test X=Cmd Execution	A=All F=Front Panel D=Drive Controller B=Buffer Controller I=Interface	P=Used at Power On — = Not Used at Power On ∗For FRUs, see Tables 5-3 and 5-4

Test#	***Description***	***TT***	***PR***	***PO***	***Para.***	***Seq.# Used***	***FRUs Tested****
40	Microprocessor Test	T	A	P	1	0,1,13,14,15	Dc,Db,Gi
41	ROM Checksum	T	A	P	1	0,1,13,14,15	Dc,Db,Gi
42	Destructive RAM	T	D,I	P	-	-	Dc,Gi
43	Non-Destructive RAM	T	A	P	1	0,1,13,14,15	Dc,Db,Gi
44	Complete RAM	T	A	-	1	-	Dc,Db,Gi
45	Connectvty Test	T	A	P	1	0,1,13,14,15	Ic,Sc,Fc,Es,Ba,Mc
46	Destructive DPR	T	D,B	P	-	-	Dc,Db
48	Non-Volatile RAM	T	B	P	-	0,1,14	Db
49	Timer Circuitry	T	D	P	-	0,1,13	Dc
50	Onboard DPR	T	D,B	P	1	0,1,9,11	Dc,Db,Gi
51	Offboard DPR	T	B,I	P	1	0,1,9,11	Dc,Db,Gi
52	DPR Collision	T	A	P	1	0,1,9,11	Dc,Db,Gi
53	Sub DPR Intrpt	T	D,B	P	1	0,1,9,11	Dc,Db,Gi
54	Master DPR Intrpt	T	B,I	P	1	0,1,9,11	Dc,Db,Gi
60	Interface Loopbck	T	I	P	1	0,1,9,12	Gi
61	Buffer Init.Loopbck	T	B	P	2	0,1,9,12	Db,Fm
62	Drive Init. Loopbck	T	D	P	1	0,1,9,12	Dc,Fm,Rw
63	Digital Loopbck	E	D	-	2	-	Dc,Fm,Rw
64	Drive Init Analog Loop	T	D	-	1	-	Hd,Dc,Fm,Rc,Wc,Rw
65	Analog Loopback	E	D	-	1	-	Hd,Dc,Fm,Rc,Wc,Rw
70	Front Panel Light	C	F	P	-	0,1,13	Fp
71	Front Panel Button	C	F	-	-	-	Fp
72	Front Panel Msg	C	F	-	-	-	Fp
75	TDU Test	T	D	-	-	1	Td
76	DAC Test	T	D	P	-	0,1,13,17	Dc
77	Tachometer Test	T	D	P	-	0,1,13,17	Dc
78	ADC Test	T	D	P	-	0,1,13,17	Dc
80	Mtr Drive Loopbck	T	D	P	-	0,1,13,17	Dc,Md
81	48V Power Supply	T	D	P	-	0,1,13,17	Md
82	Position Counter	T	D	P	-	0,1,13,17	Dc,Se

Table A-2 *Test Reference Table, Tests 84-121*

TT=Test Type	***PR=Processors***	***PO=Power On***
C=Check (no remote access) E=Exerciser T=Test X=Cmd Execution	A=All F=Front Panel D=Drive Controller B=Buffer Controller I=Interface	P=Used at Power On — = Not Used at Power On ∗For FRUs, see Tables 5-3 and 5-4

Test#	***Description***	***TT***	***PR***	***PO***	***Para.***	***Seq.# Used***	***FRUs Tested****
84	Tension Shutdown	C	D	-	-	-	Ba,Es
85	Tension Sensor	C	D	-	-	-	Ba,Es
86	Speed Encoder	C	D	-	-	-	Se
87	Tape-in-Path Sensor	C	D	-	-	-	Sb
88	Door Sensors	C	D	-	-	-	Sb,Dc
89	Reel Encodr/Wr En Ring Sens	C	D	-	-	-	Hl,Sb
90	TDU Functionality	C	D	-	-	-	Td
91	Hub Lock	C	D	-	-	-	Hl,Md
92	Hub Unlock	C	D	-	-	-	Hl,Md
93	Load Fan	C	D	-	-	-	Fan
94	EOT/BOT Sensor	C	D	-	-	-	Es
95	Servo Performance	T	D	-	-	1,18	Dc,Md
96	Servo Exposition	E	D	-	2	18	-
97	Servo Close Loops	T	D	-	-	-	Dc,Ba
98	Read Ch Gain Profile	C	D	-	1	-	Rw
99	Read Channel Calib	T	D	-	2	-	-
100	Erase Tape	T	D	-	1	-	Hd,Rw
101	Write Electronics	E	D	-	1	-	-
102	Read Electronics	E	D	-	1	-	-
103	Read Reverse	E	D	-	1	-	-
104	Head Crosstalk	E	D	-	1	-	-
105	Read Skew Calibration	T	D	-	1	-	-
106	Write Skew Calibration	T	D	-	1	-	-
107	NRZI Skew Value Displ	C	D	-	1	-	-
108	Current Gain Profile	C	D	-	1	-	-
109	NRZI Dynamic Skew	T	D	-	-	-	-
110	Tape Pack Conditioner	E	D	-	-	-	-
120	Buffer Register	T	B	P	-	0,1,12,14,19	Db
121	Buffer Function	T	B	P	-	0,1,12,14,19	Db

Table A-3 *Test Reference Table, Tests 122-177*

TT=Test Type	***PR=Processors***	***PO=Power On***
C=Check (no remote access) E=Exerciser T=Test X=Cmd Execution	A=All F=Front Panel D=Drive Controller B=Buffer Controller I=Interface	P=Used at Power On — = Not Used at Power On ∗For FRUs, see Tables 5-3 and 5-4

Test#	***Description***	***TT***	***PR***	***PO***	***Para.***	***Seq.# Used***	***FRUs Tested****
122	Buffer RAM	T	B	P	-	0,1,12,14,19	Db
128	Dump NVRAM to Tape	X	B	-	-	-	-
129	Load NVRAM to Tape	X	B	-	-	-	-
130	Data Comp Register	T	B	P	-	Db	
131	Data Comp Function	T	B	P	1	Db	
132	Data Comp RAM	T	B	P	-	Db	
133	Data Comp Ext Function	T	B	P	1	Db	
140	SCSI Controller	T	I	P	-	0,1,12,15,20	Sd,Ss
141	Onboard Hardware	T	I	P	-	0,1,12,15,20	Hp,Sd,Ss,Pt
150	Write Density ID	X	D	-	1	1,2,3,4	-
151	Write Test Record	X	D	-	1	-	-
152	Write Tape Mark	X	D	-	-	1,2,3,4	-
153	Write Gap	X	D	-	1	-	-
160	Verify Record	X	D	-	1	-	-
161	Forward Space Block	X	D	-	-	-	-
162	Backspace Block	X	D	-	-	-	-
163	Forward Space File	X	D	-	-	-	-
164	Backspace File	X	D	-	-	-	-
165	Load Tape	X	D	-	-	1,2,3,4,18	-
166	Rewind	X	D	-	-	1,2,3,4,18	-
167	Unload Tape	X	D	-	1	18	-
170	Write Tape Mark to Buff	X	B	-	-	-	-
171	Create Record in Buff	X	B	-	2	1,2,3,4	-
172	Write Buffer to Tape	X	B	-	1	1,2,3,4	-
173	Read from Tape to Buff	X	B	1	1,2,3,4	-	
174	Clear Data Buffer	X	B	-	-	1,2,3,4	-
175	Initialize Cumul. Log	X	B	-	-	3	-
176	Buffer Write Tape Mark	X	B	-	-	-	-
177	Buffer Write Density	X	B	-	-	-	-

B

Summary of Error Messages and Codes

All error messages are of the same format. All fields within the error message may not be known or applicable. An unknown field is cleared to zero. When no error is detected (test passed), the diagnostic result is "all zeros."

Table B-1 *Result Message Structure*

Power On Error	***Time Re-Sync***	***Unused***	***Error Set***	***Error Code***	***FRU 1***	***FRU 2***	***Test#***
7	6	5 4		3 2 1 0			
Byte 1				Byte 2	Byte 3	Byte 4	Byte 5

Power-on error- This bit is set when an error occurs during power-on selftest.

Time resync - This bit indicates that the time stamp saved with the error log has no relation to that of the previous entry. It is only set by the logging routine within the data buffer as an error is logged.

Complete error-The complete error message which is displayed on the front panel consists of the error set combined with the error code.

Error set - Various sets of error codes exist. The definition of the error is dependent upon which set it is taken from, as follows:

0 - runtime errors
3 - Drive Controller diagnostic errors
4 - Buffer Controller diagnostic errors
6 - Interface Controller diagnostic errors
C - Multi-processor errors (loopback and DPR)
F - Operational status (for internal use, not logged)

Error code - Error codes for error sets 0-C are defined after this subsection.

FRU 1 and 2 - Up to two FRUs may be identified by the drive as being at fault. Two isolated FRUs may be specified if the fault involves

the interaction of the two FRUs. If only one FRU is being identified, the remaining FRU should be set to zero.

Both FRUs are set to zero if an error is merely detected, or if an operational status message is being sent.

Test number - The individual test number (not sequence number) which failed is included.

B.1. Error Codes

Error codes are grouped into three categories. Each group begins with a specific number.

0xx-- Runtime/Operational Status Codes
3xx, 4xx, Exx, and 6xx-- Kernal Test Error Codes
Cxx-- Multi-Processor Error Codes

General Operation Errors

0xx	= Error
000	= No error
001	= No tape is loaded
002	= Drive is not online
003	= Drive is not offline
004	= Drive is write protected
005	= Tape loaded prevents access to test
006	= Front door or top cover is open
007	= Test is currently in diagnostic mode
008	= Drive is not in diagnostic mode
009	= Not streaming error
00A	= Invalid format on read
00B	= Invalid format on write
00C	= Not at BOT for a write ID
00D	= Backspace at BOT requested
00E	= Tape past EOT during diagnostic analog loopback
00F	= Tape ten feet past EOT, cannot write to tape
010	= Invalid command error
011	= Invalid parameter error
012	= Invalid test/info number
013	= Test not remotely accessible
014	= Test aborted by reset
015	= Nested sequence error
016	= Density NA error
017	= Invalid target ID
018	= Requested record length exceeded maximum supported
019	= Write record request did not precede write record transfer
01A	= Write record transfer did not follow write record request

01B = Command rejected due to power-on selftest failure
01C = Buffer is full, cannot retrieve a record from buffer
01D = Buffer is full, cannot place a record in buffer
01E = Block header or tape format invalid on a non-volatile memory load
01F = Record length or checksum error on a non-volatile memory load

Read Errors

0xx	= Error
020	= Buffer overrun error
021	= Gap before EOD error
022	= 3 or more tracks in error
023	= 2 tracks in error
024	= 1 track in error
025	= CRC error
026	= ACRC error
027	= Residual error
028	= Syndrome detected 1 track in error
029	= Formatter CRC error
02A	= Unknown RF error
02B	= Block timeout error
02C	= Block detect error
02D	= End block error
02E	= Bad gap after ID error
02F	= Gap check error
030	= Short post-gap error
032	= False ID block error
033	= Bad tape mark error
039	= Bad NRZI tape mark read
03A	= Tracks w/ gain too low during read channel autocalibration
03B	= Tracks w/ gain too high during read channel autocalibration
03C	= Tracks w/ gain too low and high during read channel autocalibration
03F	= Tape runaway during diagnostic test

Write Errors

0xx	= Error
040	= Buffer underrun error
041	= Gap before EOD error
042	= 3 or more tracks in error
043	= 2 tracks in error
044	= 1 Track in error
045	= CRC error
046	= ACRC error
047	= Residual error
048	= Syndrome detected 1 track in error
049	= Formatter CRC error
04A	= Unknown RF error

04B = Block timeout error
04C = Block detect error
04D = End block error
04E = Bad gap after ID error
04F = Gap check error
050 = Erase verify error
051 = PE ID detect error
052 = PE ID verify error
053 = GCR ID detect error
054 = GCR ID verify error
055 = GCR burst detect error
056 = GCR burst verify error
057 = GCR ARA detect error
058 = GCR ARA verify error
059 = Bad TM detect error
05A = Bad TM verify error
05B = Bad pre-gap error
05C = Buffer parity error
05D = No data detect error
05E = No TM detect error
05F = No ID detect error

Servo Errors

0xx = Error
--- ----------

060 = Tension shutdown
061 = Tape speed error
062 = Tape ramping error
063 = Servo unresponsive
06E = No reel found
06F = Hub lock error
070 = Reel not seated
071 = Reel inverted
072 = Tape stuck to reel
073 = Tape stuck in path
074 = Tape tensioning error
076 = Door open error
077 = Failure to re-identify tape on rewind
078 = No BOT detected
079 = Operator reset abort of tape operation
07A = Host reset abort of tape operation
07D = Block missing error
07E = Gap recapture error
07F = Block recapture error
080 = Reel encoder failure
083 = Unable to thread tape
084 = Open loop motor error
085 = Gap timer circuitry check failed

NRZI Skew Errors

0xx = Error
--- ---
086 = Invalid measurement error
087 = Read skew test not executed
088 = Skew measurement verify error
089 = Corrupt skew measurement data
08A = Measurement limit exceeded
08B = Excessive write skew
08C = Excessive write correction
08D = Excessive dynamic skew

Buffer Errors

0xx = Error
--- ---
0A0 = Pop parity error
0A1 = Push parity error
0A2 = Byte count mismatch
0A3 = Prior error reject
0A4 = Write stopped at EOT
0A5 = Zero byte record read or requested
0A6 = Final report not valid
0A7 = Tape runaway during manual commands
0A8 = Tape position synchronization mismatch
0A9 = Physical data record too small to deblock
0AA = Invalid pointer found during deblocking of physical record
0AB = Invalid access table contents
0AC = Incomplete access table contents
0AD = Improper byte count sum of access table entries
0B0 = Hardware error in data compression circuitry
0B1 = Bad parity from data compression circuitry
0B2 = Data improperly flushed from data compression circuitry
0B3 = Bad parity from interface into data compression hardware
0B4 = Bad parity from buffer into data compression hardware
0B5 = Data compression-to-interface byte count mismatch
0B6 = Data compression-to-buffer byte count mismatch
0BF = Fatal error encountered

Interface Errors -- SCSI Only

0xx = Error
--- ---
0C0 = Unsupported command
0C1 = Drive not online
0C2 = Illegal field in command datablock
0C3 = Illegal mode select parameter
0C4 = Illegal mode length
0C5 = Fixed mode but fixed bit not set in command byte

0C6 = Microprocessor halted
0C7 = Byte compare not supported
0C8 = Front panel reset
0C9 = Suppress. incorrect length indic. ON and fixed bit set
0CA = Rewind while offline
0CB = Clear log occurred correctly (reported to host only)
0CC = Parity error
0CD = Bad log page (error code for SCSI bus)
0CE = Power-on has occurred (reported to host only)
0CF = Tape changed (reported to host only)
0D0 = Spurious reset
0D1 = Spurious SCSI controller interrupt
0D2 = Write length too long
0D3 = Verify immediate not supported
0D4 = Illegal message abort
0D5 = Invalid Logical Unit Number
0D6 = Diagnostic failure (reported to host only)
0D7 = Immediate bit set without IR mode
0D8 = Unsupported page in mode select
0D9 = Invalid length
0DA = Invalid header
0DB = Non-zero reserved fields
0DC = Write byte count mismatch
0DD = Power-on selftest failure
0DE = Bus protocol error
0DF = Reselection error
0E0 = Reset due to lost data
0E1 = Error detected from the target during copy
0E2 = Illegal request during copy
0E3 = Invalid command op code during copy
0E4 = Illegal function requested for the device type (copy)
0E5 = Unsupported function requested during copy
0E6 = Reserved field used during copy
0E7 = Invalid field in the parameter list during copy
0F0 = Target went to an incorrect phase or sent an unexpected status

Kernal Test Errors

3xx Drive Controller Diagnostic Error Codes

3xx	= Error
301	= ROM checksum error
302	= RAM or DPRAM test error (destructive data)
303	= RAM test error (non-destructive)
304	= Complete RAM test error
308	= Timer error
309	= Microprocessor test error

346 = Supply Reel Optical sensors cable not connected
348 = Speed Encoder cable not connected
349 = BOT/EOT Sensors cable not connected
34A = Front Panel cable not connected
34B = Interface cable not connected
34C = Interface cable plugged into Slave connector
34D = Slave cable plugged into Interface connector
34E = 48-Volt PSU failure
34F = A to D converter failure
350 = Speed DAC failure
351 = Feed Forward circuit failure
352 = Gain/Load DAC failure
353 = Supply Motor loopback failure
354 = Take-up Motor loopback failure
355 = Quadrature Decoder failure
356 = Tachometer circuit failure
357 = Door failed to open
358 = Excess tension arm motion
359 = Servo ramps too slow
361 = Tape speed error
362 = Tape ramping error
364 = TDU inoperative
365 = TDU is slow
366 = TDU is slightly slow
372 = Missing or unsupported revision of Read/Write Assembly
3FF = Buffer controller not responding

4xx, Exx Buffer Controller Error Codes

4xx = Error
--- ----------
401 = ROM checksum error
402 = RAM test error (destructive data)
403 = RAM test error (non-destructive data)
404 = Complete RAM test error
405 = Error in testing controlled area of non-volatile RAM
407 = Connectivity test error
409 = Microprocessor test error
40A = Error in checksum of controlled area of non-volatile RAM
40E = DPRAM test error (Test 51) in offboard DPRAM
433 = Parity error in Push data
434 = Parity error in Pop data
435 = Error found in pre-fetch circuitry
436 = Pop data mismatch in buffer function test
437 = Push end of data status error
438 = Push interrupt circuit error
439 = Pop end of data status error
43A = Pop interrupt circuit error
43E = Error in buffer dynamic RAM test

446 = Error in Push counter extend register of buffer USM
447 = Error in Push counter upper register of buffer USM
448 = Error in Push counter lower register of buffer USM
449 = Error in Push address extend register of buffer USM
44A = Error in Push address upper register of buffer USM
44B = Error in Push address lower register of buffer USM
44C = Error in Pop counter extend register of buffer USM
44D = Error in Pop counter upper register of buffer USM
44E = Error in Pop counter lower register of buffer USM
44F = Error in Pop address extend register of buffer USM
450 = Error in Pop address upper register of buffer USM
451 = Error in Pop address lower register of buffer USM
481 = Checksum error in non-volatile RAM load from tape
482 = Byte count mismatch in non-volatile RAM load from tape
483 = Buffer header mismatch in non-volatile RAM load from tape
484 = Attempt to load data from tape into illegal address (not RAM)
490 = Hardware error in data compression circuitry
491 = Bad parity from data compression circuitry
492 = Data improperly flushed from data compression circuitry
493 = Bad parity from interface into data compression hardware
494 = Bad parity from buffer into data compression hardware
495 = Data compression-to-interface byte count mismatch
496 = Data compression-to-buffer byte count mismatch
4A0 = Data compression chip status byte 0 error
4A1 = Data compression chip status byte 1 error
4A2 = Data compression input byte count error
4A3 = Data compression output byte count error
4A4 = Data compression chip interrupt circuit error
4A5 = Data compression chip functional error
4FF = Interface not responding

Exx = Error
--- ----------
Exx = Fatal internal error (xx) encountered.

6xx Interface Controller Error Codes

GENERAL

6xx = Error
--- ----------
601 = ROM checksum error
602 = RAM test error (destructive data)
603 = RAM test error (non-destructive)
604 = Complete RAM test error
607 = Connectivity test error
609 = Microprocessor test error
66E = Error in write loopback with good data
66F = Error in read loopback with good data

670 = Parity error in write loopback not detected
671 = Parity error in read loopback not detected
672 = Loopback compare error

SCSI-SPECIFIC INTERFACE ERROR CODES

6xx = Error
--- ---
646 = SCSI controller register error
647 = SCSI controller RAM error
648 = SCSI controller message error
649 = SCSI controller command error
64A = SCSI controller kill error
64B = SCSI controller request error
64C = SCSI controller target sequence error
64D = SCSI controller command sequence error
64E = SCSI controller status sequence error
65B = SCSI controller request error
650 = Hardware clear error
651 = Hardware EOD error
652 = Hardware "walking ones" error
660 = Connector loopback error in DB0 or I/O
661 = Connector loopback error in DB1 or C/D
662 = Connector loopback error in DB2 or MSG
663 = Connector loopback error in DB3 or REQ
664 = Connector loopback error in DB4 or ACK
665 = Connector loopback error in DB5 or ATN
666 = Connector loopback error in DB6 or SEL
667 = Connector loopback error in DB7 or BSY
668 = Connector loopback error in DBP or RST

MULTI-PROCESSOR CODES

Cxx = Error**
--- ---
C07 = Connectivity test error
C0E = Onboard dual-port RAM test error
C0F = Offboard dual-port RAM test error
C10 = Subordinate detected dual-port RAM collision test error
C11 = Master detected dual-port RAM collision test error
C12 = Error in master dual-port RAM interrupt test
C13 = Error in subordinate DPR interrupt test
C66 = Pop count mismatch in loopback to formatter
C67 = Push count mismatch in loopback to formatter
C68 = Parity error not detected in loopback to formatter
C69 = Data mismatch in loopback to formatter (return data)
C6A = Buffer overrun not detected

C6B = Buffer underrun not detected
C6E = Error in write loopback with good data
C6F = Error in read loopback with good data
C70 = Parity error in write loopback not detected
C71 = Parity error in read loopback not detected
CC8 = Loopback timeout

** If a "Cxx" code appears that is not in this list, check under "4xx" and "6xx" error codes to see if the "xx" appears after these prefixes.

C

Summary of Configuration Descriptions

This appendix lists all of the available configurations, their parameters, and their descriptions.

The first four configurations are used for clearing logs.

CONF 0
- Allows the ERROR LOG to be cleared.

CONF 1
- Allows the ERROR RATE LOG to be cleared.

CONF 3
- Allows the cumulative GCR data to be cleared.

CONF 4
- Allows the cumulative PE + NRZI data to be cleared.

CONF 40 - ENABLE FRONT PANEL NVRAM CHANGE

Allows setting to OFF or ON.

Allows changes to the non-volatile configurations to be made from the front panel. This configuration is NOT maintained in non-volatile RAM, and is initialized to OFF at power-up.

CONF 41 - AUTO ONLINE

Allows setting to OFF or ON.

Causes the drive to place itself online automatically when the tape has completed loading.

CONF 42 - MEDIA REMOVAL

Allows setting to OFF or ON.

This variable controls the ability of the operator to remove media from the drive. When OFF, only the host can release the media. This configuration is provided for use with the SCSI host interface, and may not be applicable to other interfaces.

CONF 43 - OPERATOR TIMEOUT

Allows setting to OFF, or 1-99 seconds.

This configuration controls the timeout used with interactive operator selections. THIS CONFIGURATION IS ONLY AVAILABLE ON CCL II DRIVES.

CONF 44 - ARCHIVAL REWIND

Allows setting to ATC or REW.

When set to ATC (Archival Tape Rewind), the drive performs all rewinds operations at a slower archive speed which allows precise packing of the tape. This configuration is read each time a tape is loaded. Changing this configuration while a tape is loaded will not change how the current tape rewinds.

CONF 45 - OPERATOR SELECT ARCHIVE

Allows setting to OFF or ON.

When ON, the drive will prompt the operator when loading a new tape to select the archive speed (ATC) or the normal speed (REW) for rewind.

CONF 46 - DENSITY

Allows setting to a value of 800, 1600, OR 6250

This configuration is the default density for a written tape. This density will automatically be written on a tape when a record is written with the drive positioned logically at BOT. The densities are as follows.

800 - 800 BPI NRZI format will be written.
1600 - 1600 BPI PE format will be written.
6250 - 6250 BPI GCR format will be written.

CONF 47 - FP DENSITY CONTROL (non- HP 7980XC)

Allows setting to OPEN, LOCK, I* OPEN, I* LOCK

This configuration controls front panel selection of write density. THIS CONFIGURATION MODE IS ONLY AVAILABLE ON NON-XC DRIVES.

OPEN - Either the host or the front panel can select density
LOCK - Only the front panel can select density.
I* OPEN - Flash the current density in the front panel before loading a tape to allow the operator to select between the density.
If the operator timeout elapses, load the tape using the selection which is presently flashing. This selection can be host overridden.
I* LOCK - Same as I* OPEN but the host can not override the selection.

CONF 47 - COMPRESSION CONTROL (HP7980XC)

Allows setting to XC OFF, XC ON, IXC OFF, and IXC ON

This configuration controls front panel selection of data compression. THIS CONFIGURATION IS ONLY AVAILABLE ON A HP7980XC TAPE DRIVE.

XC ON - Write only 6250 tapes in compressed format unless overridden by the host.
XC OFF - Do not write any tapes in compressed format unless overridden by the host.
IXC ON - Flash XC ON on the front panel before loading a tape to allow the operator to select between XC ON and XC OFF. If 10 seconds elapse, load the tape using the selection presently flashing. This selection can be host overridden.
IXC OFF - Same as IXC ON but flash XC OFF on the front panel. This selection can be host overridden.

CONF 48 - LANGUAGE

Allows setting values of 0 - 63.

0 - English
1 - German
2 - French
3 - Spanish

add 4 to language - replaces 'READY ' message with 'NO TAPE'
add 8 to language - replaces 'READY ' message with 'UNIT #'
add 16 to language - replaces 'READING' (during retries) with 'RETRY'
add 32 to language - distributor version of front panel (with DENSITY key)

CONF 49 - RECOVERED ERROR REPORT

Allows setting to OFF,1,2.

When configured to OFF, recovered (soft) errors are not reported to the host.

When configured to 1, all soft errors are reported, including soft errors which required retries or data records corrected "on the fly" during reads.

When configured to 2, only soft errors requiring retries are reported.

CONF 50 - IMMEDIATE RESPONSE ENABLE

Allows setting to OFF or ON.

This variable controls the use of immediate response on write operations by the buffer controller. It must be enabled for the drive to stream writes.

CONF 51 - TAPE MARKS TO DISABLE IMMEDIATE RESPONSE

Allows setting to OFF, or 1 - 99.

This variable contains a tape mark limit. If consecutive tape marks are received equal to or beyond this limit, Immediate response will be disabled for that command.

CONF 52 - WRITE RETRY COUNT"

Allows setting values of 0 - 40.

This variable contains the maximum retry count used by write commands.

CONF 53 - PE & NRZI GAP SIZE

Allows setting values of 0 - 15.

This variable sets minimum and maximum PE and NRZI gap sizes (in inches).

PE GAP SIZE SELECTION		
	MIN	***MAX***
0	0.50	0.50
1	0.50	0.60
2	0.50	1.00
3	0.50	1.50
4	0.50	2.00
5	0.60	0.60
6	0.60	1.00
7	0.60	1.50
8	0.60	2.00
9	1.00	1.00
10	1.00	1.50
11	1.00	2.00
12	1.50	1.50
13	1.50	2.00
14	2.00	2.00
15	0.60	6.00

CONF 54 - GCR GAP SIZE

Allows setting to a value of 0 - 22.

This variable sets minimum and maximum GCR gap sizes (in inches).

GCR GAP SIZE SELECTION		
	MIN	***MAX***
0	0.28	0.30
1	0.30	0.30
2	0.30	0.45
3	0.30	0.60
4	0.30	1.00
5	0.30	1.50
6	0.30	2.00
7	0.45	0.45
8	0.45	0.60
9	0.45	1.00
10	0.45	1.50
11	0.45	2.00
12	0.60	0.60
13	0.60	1.00
14	0.60	1.50
15	0.60	2.00
16	1.00	1.00
17	1.00	1.50
18	1.00	2.00
19	1.50	1.50
20	1.50	2.00
21	2.00	2.00
22	0.30	6.00

CONF 55 - STOP AT EOT

Allows setting to OFF or ON.

This variable controls the stopping of writes at EOT. When set, all write data within the buffer when EOT is encountered must be handled manually by the interface.

CONF 56 - WRITE HOLD-OFF TIMEOUT

Allows setting to a value of 0 - 20 seconds. (FRU 4 Buffer Controller)

Allows setting to a value of 0 - 99 seconds. (FRU 14 or 24 Buffer Controller)

With immediate response ON, write data will be held within the buffer no longer than this timeout.

CONF 57 - FIXED WRITE START-UP POINT

Allows setting to OFF,1 - 7 eights of buffer or queue size.

With immediate response ON, the tape will be started up to write data when either the buffered data or the number of queued commands reaches the startup threshold. OFF disables fixed selection allowing the drive to auto select the

startup point based on the conditions encountered. The OFF option is only available on units with an FRU 14 or 24 Buffer Controller.

CONF 58 - WRITE SKIP START

Allows setting to 0 - 3 retries.

This configuration will select the number of write retries to attempt before performing a write skip (gap) operation, except in diagnostics, which always uses 3 retries.

CONF 59 - WRITE CONTROL

Allows setting to a value of 0 - 63.

This configuration controls write related functions. The configuration is defined in bits as follows:

B0 - Performs automatic write reposition when the tape is stopped during writes (add 1 to CONFIG value)

B1 - Short trailing erase during writes. Normally about 18 inches are erased when the tape is stopped during writes. (Add 2 to CONFIG value)

B3,B2 - Hard write error control at 10 feet beyond EOT marker

0,0 = Hard write after 10 feet beyond EOT marker and beyond Early EOT point
X,1 = No hard write after 10 feet beyond EOT marker (adds 4 to CONFIG value)
1,0 = Hard write after 10 feet beyond EOT marker (adds 8 to CONFIG value)

B4 - For specific OEM use only. Should be set to zero for normal operations.

B5 - Select data/gap threshold level (firmware revision dependent).

0 = normal head value (revision 3.85), low amplitude head value (revision 6.55 only).

1 = normal head value (revision 6.55 only), low amplitude head value (revision 3.85).

CONF 60 - READAHEAD ENABLE

Allows setting to OFF or ON.

This variable controls the use of readaheads by the buffer controller. It must be enabled for the drive to stream reads.

CONF 61 - TAPE MARKS TO TERMINATE READAHEADS

Allows setting to OFF, or 1 - 99.

This variable contains a tape mark limit across which the drive will not readahead. This configuration is inoperative when blocked format is used.

CONF 62 - READ RETRY COUNT

Allows setting to a value of 0 - 40.

This variable contains the maximum retry count used by read commands. NRZI retry count is two times the specified retry count.

CONF 63 - TRAILING BUFFER

Allows setting to a value of 0 - 6.

The drive has the capability of performing electronic backspacing without moving the tape, if there is data within the buffer that can be recovered. A portion of the buffer may be reserved as a trailing buffer, guaranteeing that electronic backspacing can always be performed. This configuration is inoperative when blocked format is used. The amount reserved is as follows:

0 - No trailing buffer. The entire buffer is used for readaheads
1 - Up to 1 record or 16K bytes reserved
2 - Up to 2 records or 32K bytes reserved
3 - Up to 3 records or 48K bytes reserved
4 - Up to 4 records or 64K bytes reserved
5 - Up to 5 records or 80K bytes reserved
6 - Up to 6 records or 96K bytes reserved

CONF 64 - READ START-UP POINT

Allows setting to 1 - 7 eighths of buffer or queue size.

With readaheads ON, the tape will be started up to read additional data when either the buffered data or the number of queued commands decreases to the startup threshold.

XC Option Configurations

CONF 65 - PHYSICAL RECORD SIZE

Allows setting to 1 - 32.

In XC format, all records and tape marks from the host are put into data records on the tape. These data records are termed "physical" records. The nominal size

of them is specified in multiples of 4 K bytes as follows:

1 - 4 Kbytes
.
N - N*4 Kbytes
.
32 - 128 Kbytes

CONF 66 - MAXIMUM FILES PER PHYSICAL RECORD

Allows setting to OFF, or 1 - 99.

This configuration specifies the limit to the number of files or parts of files allowed within a single physical record. For example, if a value of 3 is specified, a physical record may contain up to three complete files and no more.

CONF 67 - MAXIMUM BYTES PER PHYSICAL RECORD

Allows setting to OFF, or 1 - 99.

This configuration specifies the limit to the number of bytes from the host that is allowed within a single physical record. It is specified in multiples of 16 Kbytes.

CONF 70 - EXPANSION PROTECTION

Allows setting to ON or OFF.

The data compression hardware can expand data that has already been compressed. If this occurs, the benefits of compressing the data are lost. The drive has the ability to watch for expansion and turn it off until it sees it compress. It is enabled or disabled by this configuration.

CONF 73 - DATA COMPRESSION OPTIMIZATION SAMPLE PERIOD

Allows setting to OFF, or 1 - 4.

The drive has the ability to monitor the compression rate of the data as it is being received. A significant degradation in this rate indicates that the type of data has changed. If this occurs, the drive can adapt to the new data. This process of monitoring and adapting is called "optimization". This configuration enables or disables the optimization feature as follows:

OFF - No optimization will be performed.
1 - The compression rate will be sampled every 512 bytes.
2 - The compression rate will be sampled every 1 Kbytes.
3 - The compression rate will be sampled every 2 Kbytes.
4 - The compression rate will be sampled every 4 Kbytes.

CONF 74 - DATA COMPRESSION OPTIMIZATION THRESHOLD

Allows setting to OFF or 0 - 63.

The sensitivity of the optimization feature to changes in data may be specified by a threshold. If the compression rate ever falls below this threshold, the drive will adapt to the new data. The threshold is specified as follows:

Where N is the value of configuration 74, Threshold = (64/(64-N))

Front Panel Configurations

CONF 75 - GAGE USAGE

Allows setting to 0 - 3

The gage at the bottom of the front panel may be used to indicate the one of three things:

0 - Relative position between BOT and EOT. (uses BOT,EOT and 10 lights)

1 - Amount of data in the buffer (64K per light - uses 8 lights)
revision 6.0 and later firmware (50K per light - uses 10 lights)

2 - Number of commands/reports in the queue. (10 per light - uses 10 lights)
revision 6.0 and later firmware (24 per light - uses 10 lights)

3 - Tape write compression ratio (7980XC only)
(# of lights = compression ratio)

CONF 76 - NO BREAK ON FAILURE

Allows setting to OFF or ON.

Failures which occur while looping diagnostic tests or running a test sequence will not cause the test to terminate, The errors will be logged in the error log and the test continued. Each individual test, will however only run until a single error occurs.

CONF 77 - ACTIVITY INDICATOR

Allows setting to OFF, 1 - 3.

Displays an indicator in the right most digit of the front panel when there are host commands being processed during drive idle time.

1 - indicator = ’-’
2 - indicator = ’--’
3 - indicator = ’*’

CONF 78 - LOCK HOST DENSITY CHANGE

Allows setting to OFF or ON.

This configuration determines whether the host can change the configured density of the drive. If this configuration is ON the host cannot change the tape drive's configured write density. This configuration is supported by the PERTEC and SCSI interfaces only. This configuration is NOT supported by HP-IB.

CONF 79 - LOCK INTERFACE ADDRESS/ID

Allows setting to OFF or ON.

This configuration determines whether the interface address (or ID) can be changed from the front panel. If this configuration is ON the interface address (or ID) is locked. When locked, the interface address (or ID) can be viewed from the front panel, but attempts to change it with the NEXT and PREV keys will display "INVALID".

CONF 80 - ENABLE INTERFACE NV CHANGE

Allows setting to OFF or ON.

Not available from the front panel. This configuration allows the interface to make changes to the non-volatile configurations.

SCSI Interface Configurations

CONF 81 - BLOCK LENGTH

Allows setting to 0 - 9

The block length is the size that records will be written to the tape.

Configuration Value	*Block Length (in bytes)*
0	0
1	8
2	256
3	512
4	1K
5	4K
6	16K
7	32K
8	128K
9	256K

CONF 82 - BUS INACTIVITY LIMIT

Allows setting to 0 - 9

The bus inactivity limit indicates the maximum time that the target is allowed to maintain the bus busy without handshakes until it must disconnect.

For firmware revisions up to (but not including) 3.78:

Configuration Value	*Bus Inactivity Limit (in 200 usec)*
0	0FFFFH (default value)
1	0100H
2	0200H
3	0400H
4	0800H
5	1000H
6	4000H
7	6000H
8	8000H
9	0H*

NOTE: *Always disconnect as soon as possible.

For firmware revisions 3.78/6.30 and beyond:

Configuration Value	*Limit Word (in 240 msec)*	*Bus Inactivity Limit (in msec)*
0	0FFFFH	15000
1	00008H	
2	00020H	
3	00080H	
4	00200H	
5	00400H	
6	00800H	
7	01000H	
8	04000H	
9	Auto Disconnect	

CONF 83 - DISCONNECT TIME LIMIT

Allows setting to 0 - 9

The disconnect time limit indicates the minimum time that the target should remain disconnected until it attempts to reselect.

Configuration Value	*Time Limit (in 100 usec)*
0	0*
1	1
2	8
3	256
4	512
5	1K
6	4K
7	16K
8	32K
9	64K-1

NOTE: *reselect immediately.

CONF 84 - DISCONNECT LENGTH

Allows setting to 0 - 9

The disconnect length indicates the amount of data that is to be transferred between SCSI bus disconnects.

Configuration Value	*Length (bytes)*
0	0*
1	512
2	1K
3	2K
4	4K
5	16K
6	32K
7	64K
8	128K
9	256K

NOTE: *no limit on data transferred.

CONF 85 - INQUIRY FIELD

Allows setting to 0 - 127.

The inquiry field allows the user to set a seven bit user specified code in the device-type qualifier field of the inquiry data.

CONF 86 - INTERFACE ONLY RESET

Allows setting to OFF or ON.

OFF - full power-on reset when bus reset is received.

ON - interface only reset when bus reset is received.

CONF 87 - READ EOM REPORTED

Allows setting to OFF or ON.

OFF - no EOM reported

ON - EOM reported

CONF 88 - SCSI II COMPATIBILITY

Allows setting to OFF or ON.

OFF - not SCSI II compatible

ON - SCSI II compatible

CONF 89 - EOT REPORTING MODES

Allows setting to 0 - 3.

Bit map

B0 = 0 report EOT at EOT marker

B0 = 1 report EOT at early EOT point

B1 = 0 set only EOM bit in sense data at EOT

B1 = 1 set EOM and volume_overflow sense key at EOT

CONF 90 - SCSI PARITY CHECKING

Allows setting to OFF or ON.

OFF - SCSI bus parity is not checked

ON - SCSI bus parity is checked

CONF 91 - VENDOR UNIQUE DENSITY REPORTING

Allows setting to OFF or ON.

OFF - Vendor unique density not reported (bits 6 & 7 of density code cleared)

ON - Vendor unique density reported (in bits 6 & 7 of density code)

Configuration Passwords

Configurations 100 and 101 must be set to their proper values to enable access to the configuration locks (located in Configurations 140 through 196) or to allow clearing of PROTECTED CONFIGURATIONS (Configuration 10, Odometer and Configuration 13, Power Cycle Log).

CONF 100 - CONFIG LOCK PASSWORD #1

Allows setting to 0 - 99.

48 - proper password to access configuration locks

63 - proper password to access clearing protected configurations

CONF 101 - CONFIG LOCK PASSWORD #2

Allows setting to 0 - 99.

76 - proper password to access configuration locks

21 - proper password to access clearing protected configurations

Configuration Locks

Configuration 140 thru 196 represent the configuration locks for configuration 40 thru 96 respectively. A value of "ON" indicates that the configuration is locked. If the configuration password is not set these configurations will return as "INVALID" when accessed with the "CONFIG" utility.

D

Accessing Logs

Utilities provide access to the configuration variables and logs within the drive. Each of the variables and data structures are accessible from the host and from the front panel. A description of each is given below.

To display a particular utility, first take the drive offline then press the OPTION key on the front panel. "TEST *" will appear on the display. Press the NEXT key until "INFO *" appears then press the ENTER key and then using PREV and NEXT for 1's and the ONLINE and UNLOAD keys for 10's enter the number corresponding the utility to be displayed. Press the ENTER key. The information will now appear.

For those logs which contain multiple entries, the NEXT and PREV keys provide a mechanism to move through the entries. For those entries which have multiple displays, the drive automatically scrolls through all of the displays in the entry. Either the ENTER or RESET key can be used to exit the display.

The header display will be displayed for approximately two seconds. Each additional display will then be shown for approximately one second.

In this description displays will be described as:

| "LABEL" HHHH | DDDDDD | DeDD |

Where vertical bars separate displays, Double quotes indicate labels, 'H' indicates a hexadecimal digit, 'D' indicates a decimal digit, and 'DeDD' indicates exponential notation of 'D' times ten to the 'DD'. Each display show on the same line below will be shown and then repeated until an applicable front panel button is pressed for the next desired action.

D.1. Summary of Logs

INFO 0 - ERROR LOG

Displays current log entries.

The error log maintains the last 30 errors which occurred within the drive . The initial error log display is for the most recent entry. The PREV and NEXT keys are used to view other entries in the log. Note that the entry number ("E"DD) of the initial display also indicates the number of entries in the log.

Error | "E"DD HHH | "FRU" DD | "T" DDD | "*P" DDDDD |

"E"DD - indicates the DD entry within the Error log.
HHH - is the complete error code (see SECTION C).

Ex. | E10 010 | : entry 10 in the log, a run time error (0), the error being no tape loaded (10).

"FRU" - DD is the detected FRU (this field may occur 0 to 2 times)
Ex. | FRU 40 | : the detected FRU is the EOT/BOT sensor assembly (#40).

"T" - DDD is the test number during which the error occurred if appropriate (see SECTION B for test descriptions). This display will appear only if the error occurred during the execution of a diagnostic test.

Ex. | T 41 | : the error occurred during the execution of the ROM CHECKSUM test (#41).

"*P" DDDDD - A two byte time stamp (in seconds) with "*" indicating that a power-on occurred since the last error was logged (ie. no time correlation with previous entries) and "P" indicating that the error occurred during power-up. The "P" maybe replaced by an additional digit in the time stamp.

Ex. - | * 78978| : the error was logged 78978 seconds after the drive was powered on and this is the first entry since the drive was powered on (the clock rolls over approximately every 11.5 days).

Error Rate Logs

Two error rate logs are maintained. A short term and a long term log. The short term log, the "ERROR RATE LOG" contains multiple entries, one entry for each load or density change of the tape. Each log entry indicates what the density for the entry was. The "CURRENT ERROR RATE" is based on the data being accumulated for the next error rate log entry. At load time or density change time, the data being accumulated is entered into the log and is then zeroed.

The error rate log is intended for use during normal drive operation. During diagnostic sequences, density changes occur often enough to make the error rate log roll through entries too fast. In order to keep from losing history in the log, entries are not made in the error rate log during diagnostic sequences. Only a single entry is made which makes no distinction between PE or GCR. In short, the error rate log is not intended for use during diagnostics.

The "CUMULATIVE ERROR RATE LOG" is a long term history containing a separate PE and GCR log of data and errors. It does not however maintain how recent the information is or which load of tape it occurred on. The cumulative error is useful during normal runtime and is also used during certain diagnostic

tests. Before error rate or wellness sequences are run, the cumulative log may be initialized, allowing the accumulated data to be related to the test at hand. The side effect of initializing the cumulative log is that all accumulated data up until that time is lost. The cumulative log is updated at least on every load or density change, but may be updated more often. It is not associated with the current error rate information as is the error rate log.

INFO 1 - ERROR RATE LOG

Displays current log entries.

An error rate log is maintained which contains a history of hard and soft errors for the past 20 loads of the tape. The results are displayed as two entries with the same log entry number. The initial error rate log display is the most recent entry in the log. The PREV and NEXT keys are used to move from the write to read displays and from one log entry to the next. Note that the entry number ("W"DD or "R"DD) of the initial display also indicates the number of entries in the log.

Write displays : |"W"DD "NRZ / PE / GCR" | "WH" HH | "WS" HHHH | "WD" DeDD |

Read displays : |"R"DD "NRZ / PE / GCR" | "RH" HH | "RS" HHHH | "RD" DeDD |

"W"DD - indicates the beginning of write displays for entry DD

"R"DD - indicates the beginning of read displays for entry DD

"NRZ/PE/GCR"- The density the tape was written in

"WH" HHHH - Hard write errors in hexadecimal (unrecovered errors)

"RH" HHHH - Hard read errors in hexadecimal (unrecovered errors)

"WS" HHHH - Soft write errors in hexadecimal (recovered errors)

"RS" HHHH - Soft read errors in hexadecimal (recovered errors)

"WD" DeDD - Amount of data written in bytes

"RD" DeDD - Amount of data read in bytes

Ex. - |W17 PE | WH 01 |WS 0003|WD 3e06|
|R17 PE | RH 02 |RS 0005|RD 4e07|

The preceding two lines represent displays that could appear on the front panel display. The entry is number 17 in the error rate log and PE format was used for the operation. One hard write error and three write soft errors occurred and 3x10**6 bytes of data were written. The read displays for the entry indicate that 2 read hard errors and 5 read soft errors occurred while 4x10**7 bytes of data were read.

INFO 2 - CURRENT ERROR RATE

Displays soft error rate of the current tape.

| "W" DeDD | "R" DeDD |

"W" DeDD - write soft error rate in bytes per write soft error

"R" DeDD - read soft error rate in bytes per read soft error

Ex. - | W 2e07| R 3e06|

The previous line represent displays that indicate that the current write soft error rate is approximately 20 Kbytes of data per error and the current read soft error rate is approximately 3 Kbytes of data per error.

INFO 3 and INFO 4 - CUMULATIVE ERROR DATA

INFO 3 - Displays cumulative GCR error data.

INFO 4 - Displays cumulative PE + NRZI error data.

Cumulative error data logs are maintained containing all past occurrences of hard and soft errors as well as the total amount of data written and read. The PREV and NEXT keys are used to move from the write to the read displays.

Write displays : | "WH" HH | "WS" HHHH | "WD" DeDD |
Read displays : | "RH" HH | "RS" HHHH | "RD" DeDD |

"WH" HH - Hard write errors in hexadecimal (uncorrected errors)
"RH" HH - Hard read errors in hexadecimal (uncorrected errors)
"WS" HHHH - Soft write errors in hexadecimal (corrected errors)
"RS" HHHH - Soft read errors in hexadecimal (corrected errors)
"WD" DeDD - Amount of data written in bytes
"RD" DeDD - Amount of data read in bytes

The displays are analogous to those of the error rate log.

INFO 5 - CUMULATIVE ERROR RATE

Displays the cumulative soft error rate in bytes per error.

| "GCR" | "W" DeDD | "R" DeDD | "PE" | "W" DeDD | "R" DeDD |

"GCR" - indicates that the following two displays are the cumulative write and read soft error rates for operations using GCR density.
"PE" - indicates that the following two displays are the cumulative write and read soft error rates for operations using PE + NRZI density.
"W" DeDD - write soft error rate in bytes per write soft error
"R" DeDD - read soft error rate in bytes per read soft error

The displays are analogous to those of the current error rate.

INFO 10 - ODOMETER

Displays the Odometer.

The odometer is a 6 byte value containing the amount of tape covered in 0.1 foot increments. It requires three displays:

| "1" DDDDD | "2" DDDDD | "3" DDDDD |

The odometer must be initialized at some point from a configuration tape. Until it is initialized, it will display "*****" indicating that it is inoperative.

INFO 12 - SYSTEM SOFTWARE CLOCK

Displays the system clock.

The system clock is four bytes long with a least count of (approx 1/20) sec. The system clock is initialized to zero when the drive is powered up. It is maintained by the drive controller within the drive controller DPR. All time stamps used within machine logs use the system software clock. Time is displayed in hours, minutes, and seconds of operation.

| DDDDD | DD| DD|
(hrs) (min) (sec)

INFO 13 - POWER CYCLES

Displays the number of times the drive power has been cycled.

| DDDDD |

The power cycle log must be initialized at some point from a configuration tape. Until it is initialized, it will display "*****" indicating that it is inoperative.

INFO 15 - BATTERY DATE

Displays last two digits of the year the battery was installed.

| DD |

INFO 20 - DRIVE REPOSITIONING STATISTICS

Displays drive repositioning statistics.

| "FM" DD | "FV" DD | "RM" DD | "RV" DD |

"FM" DD - forward reposition error mean in mils.
"FV" DD - forward reposition error variance in mils squared.
"RM" DD - reverse reposition error mean in mils.
"RV" DD - reverse reposition error variance in mils squared.

INFO 21 - TAPE AUTO LOAD STATISTICS

Displays tape auto load statistics.

| "LS" DDD | "LR" DDD | "LA"DDDDD |

"LS" DDD - the percentage of successful loads.
"LR" DDD - the percentage of successful loads requiring retries.
"LA"DDDDD - the total number of loads attempted.

INFO 24 - INTERFACE OPTION IDENTIFICATION

Displays the interface option identification message.

The identification of the interface option message is displayed.

INFO 25 - FIRMWARE REV NUMBER

Displays code revision numbers of all processors.

The revision number of code within each of the processors is be displayed. Four displays are sequenced with each display having the following format.

| D DDD |

D - Processor ID number
DDD - Version number (D), Revision number (DD)

INFO 30 - TAPE WRITE COMPRESSION RATE (HP7980XC)

Displays the current tape compression rate as a percentage.

The tape write compression rate for the last compressed (XC format) tape written is displayed. The number displayed shows the amount of tape required for a normal GCR tape compared to the XC format tape generated. A value of 240 would indicate a 2.4 to 1 tape compression.

| DDDDD |

DDDDD - tape compression rate percentage.

E

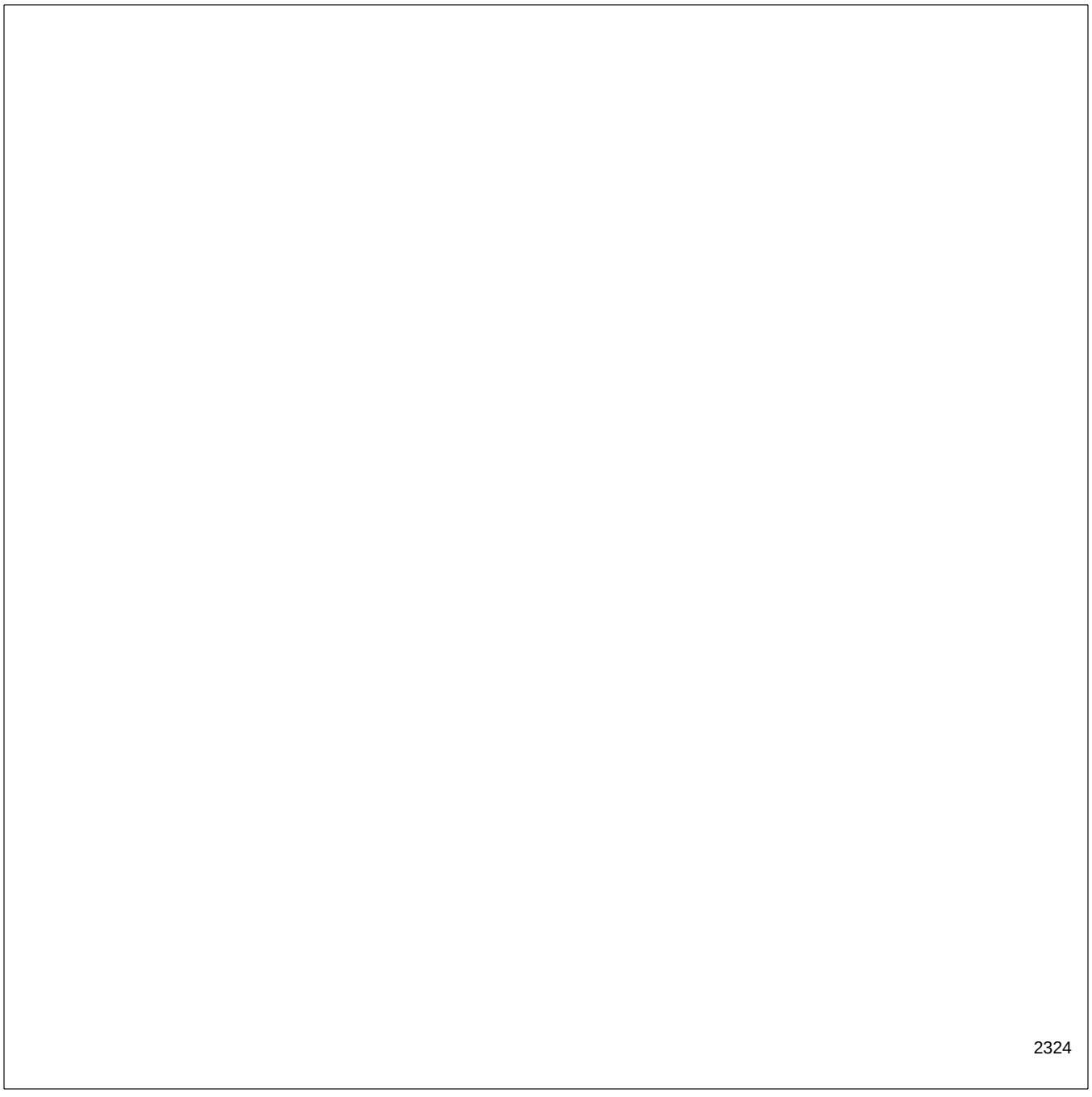
Functional Description

E.1. General System Overview

The following is the summary of events that take place during write and read operations.

1. The Interface receives a write command from the host computer.
2. The write command is separated into two lower level commands, write request and execute write.
3. The Data Buffer sends the write request to the Drive Controller and also accelerates the tape to its read/write speed of 125 ips.
4. The Drive Controller returns a completion status to the Interface via the Data Buffer.
5. The Interface issues execute write to the Data Buffer, and opens the port into the Data Buffer so the buffer can transfer data from the host to the buffer memory.
6. When the buffer is full, the Data Buffer sends the execute write command to the Drive Controller.
7. The Controller has the data sent from the Data Buffer to the Read/Write/PLL/Formatter to be formatted and written to tape. Data is verified as it is written to tape. If errors are detected, the data is automatically rewritten for the host.
8. When the write operation is completed, the Drive Controller erases the gap following the data and repositions itself for the next operation.
9. The Data Buffer returns the completion status to the Interface, which is followed by a completion signal from the Interface to the host. The tape is stopped until the next write command.
10. Read sequences are almost identical to the write sequence except: read commands are not separated into two commands; the write and erase electronics are not activated; direction of data transfer is reversed; the entire record is read into the buffer; and if the read fails, the host must tell the drive to read data again. When the host issues a read command, it is ready to receive data.

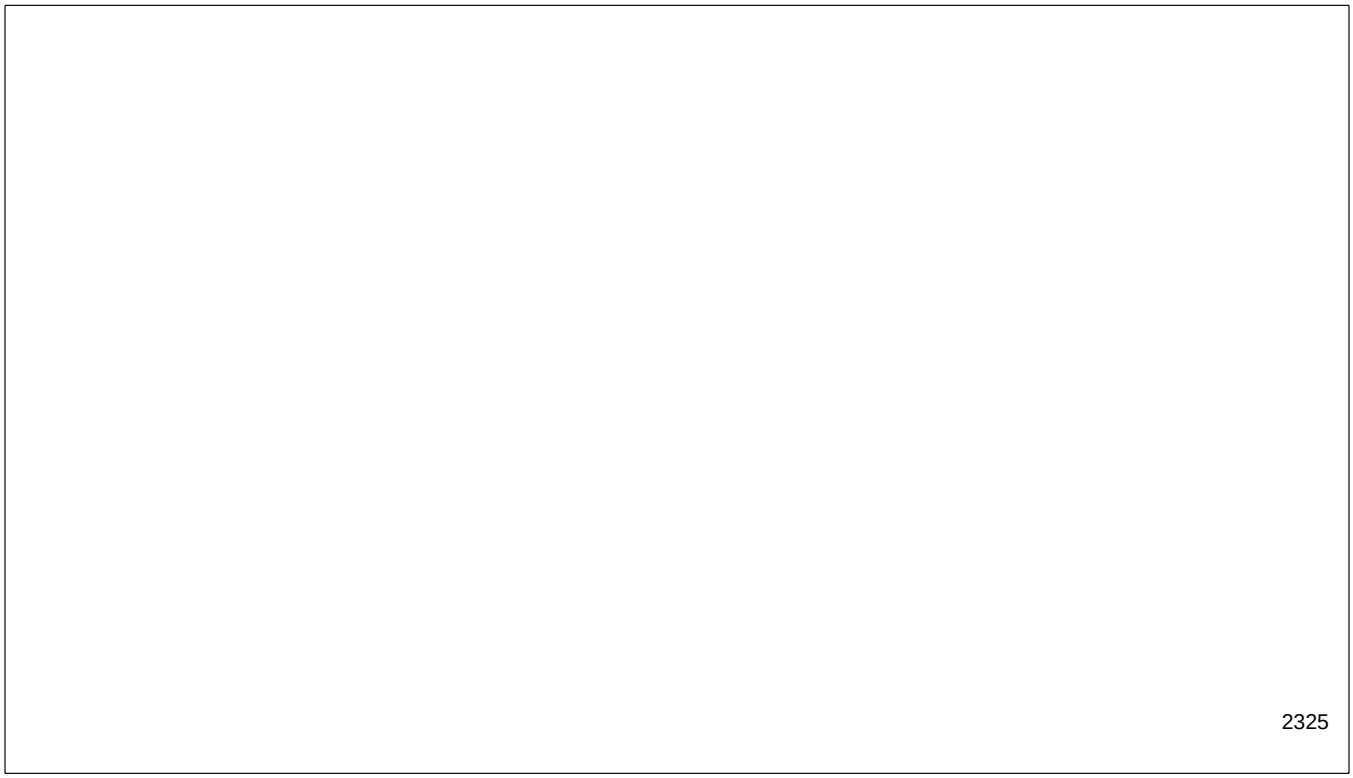
Figure E-1 *System Block Diagram*



E.2. Data Path Summary

The data and servo processes are managed by three 6809 processors located in the Control PCA, Data Buffer PCA, and the Interface PCA. The three PCAs communicate constantly during drive operation. The data path flows through the Interface, to the Data Buffer, to the Read/Write/PLL/Formatter, to the Read/Write Heads. The Controller controls servo operations, as well as the read/write subsystems. Voltages are provided by the Motor/Power PCA. See the figure below.

Figure E-2 *Data Path Diagram*



E.3. Major Subsystems

This section contains a brief statement on the major subsystem functions. The major subsystems are:

- Interface (Data Path PCA with 6809 processor)
- Data Buffer (Data Path PCA with 6809 processor)
- Drive Controller (Data Path 6809PCAwith PCA)
- Read/Write/PLL/Formatter
- Motor/Power (power distribution)
- Drive Mechanism (Servo and Drive Controllers)

Interface PCA

1. Translates commands, status, and data.
2. Talks to host computer via HP-IP, SCSI or PERTEC protocols.
3. Talks to tape drive via Data Buffer PCA, using a Common Communication Link (CCL) command set.
4. Adaptable to new interface types.

Data Buffer PCA

1. Processes all communications to/from the Interface PCA.
2. Sends/receives commands and status to/from the Drive Controller PCA.
3. Maintains streaming performance and aids in retry operations by passing read/write data through a 512 Kbyte Data Buffer.
4. Buffer transfers data rapidly, independent of other operations.
5. Contains a lithium battery for drive configuration storage.

Read/Write/PLL/Formatter

1. Encodes binary data from the host computer into flux data to be written to tape.
2. Contains the read/write circuitry for the read/write head.
3. Sends write formatter status to the Drive Controller after each data record is written. (Each write operation is initiated by the Drive Controller).
4. Initiates data records, tape marks, and ID burst.

Formatting functions:

5. Decodes nine tracks of synchronized flux data frame the tape into usable binary to be sent to the host computer.
6. Detects, identifies, and corrects data records, tape marks, and ID burst.
7. Controlled by Drive Controller through read control and status commands.

Motor/Power PCA

- Regulated 48 volts to power the switching motor drive amplifiers.
- Regulated 48 volts to DC—DC forward converter, which produces the +5, +12, and -12 volt system supply.
- Regulated 48 volts to power the autoload blower fan, the cooling fan, and the drive solenoids.
- Two fuses on the Motor/Power PCA:

  F1 is 6A, motor protection

  F2 is 6A, 48 volt power supply protection, includes +5, +12, -12V supplies.

Servo Controller

The Servo Controller is responsible for motion and analog control.

- Automatically loads and unloads tape.
- Moves tape under closed loop control to ensure proper tension and speed.
- Includes some diagnostic capability: No tape, inverted tape, BOT, EOT, and tape tension.

Drive Controller

The Drive Controller is responsible for digital control.

- Contains circuits for all internal diagnostics.
- Communicates with user through control panel, or through the interface to the host.
- Overall control of the drive through a Data Processing Register, (a dual port RAM), to the Data Buffer PCA, to send and receive messages and status reports.
- Receives information from the Data Buffer via the DPR.

F

Preventive Maintenance

This chapter covers tape handling procedures and preventive maintenance tasks.

NOTE:

PREVENTIVE MAINTENANCE IS PERFORMED BY CUSTOMERS. THIS IS SUPPLEMENTAL INFORMATION FOR FIELD ENGINEERS.

F.1. Tape Handling

Keep tapes in a clean environment at all times. Maintain constant temperature and humidity. Around 70 degrees F (21 degrees C) and 40% humidity is recommended.

Maintain proper tension to ensure smooth tape movement and proper data transfer. Secure the end of the tape with a vinyl strip or foam pad when removing it from the drive. Do not use adhesive tape; it leaves a sticky residue which contaminates tape head and path.

For the best possible auto-load performance, the tape end should be crimped (for example with a Pericomp-brand crimper). Most new tapes are prepared this way. If the end of the tape is crumpled, cut off only what is necessary. A minimum of 10 feet from the physical end of the tape to the BOT marker is required to effectively autoload; 16 feet is recommended.

The BOT (Beginning of Tape) marker and EOT (End of Tape) marker must be in place and a write-enable ring installed if you are to write to tape. Remove the write-enable ring when planning to read-only from tape in order to prevent accidental overwriting.

CAUTION **Do not hold the reel by the rims or apply weight or pressure on the edge of the reel. Hold the tape reel by the hub or as close to the hub as possible.**

Tape Storage

Tapes that have been stored in areas with different temperature or humidity level must be acclimated before use. Remove the storage rings or cases and let the tapes sit for at least one hour for minimal temperature/humidity differences, two hours for radical differences.

For optimum read/write performance, allow the tapes to acclimate for 24 hours. This provides enough time for the tape humidity to equalize with that of the environment in which they will be used.

Archiving Tape

An optional method of rewinding tape slows the rewind speed to approximately 50 inches per second so that air pockets are eliminated. Air pockets cause uneven tape stacking. You may choose one of three methods to rewind tape:

- Always using regular, high-speed rewind
- Always using archival tape conditioning rewind
- Always using selectable High-speed/Archival; this option will prompt the operator at the end of the tape load cycle, as explained in "Sun Front-Load ½-Inch Tape Drive Configuration Procedures," Part No. 813-2080.

Tape Transportation

Avoid physical shock and extreme temperature changes. Secure the tape ends to maintain proper tension, and pack tapes in moisture-proof containers for transporting. Take care to avoid electromagnetic fields such as metal-detection screening devices.

Winding problems can result if you stop spinning a reel abruptly. Outer layers of tape may continue to spin and cause loose windings. "Pack slip" may occur if the vinyl strip or foam pad is omitted and the tape is handled roughly or submitted to impact, vibration, or thermal stress.

F.2. Tape Path Care

The tape path should be cleaned regularly. Watch for the following problems:

- Brown staining is caused by brown deposits of oxide accumulating on the head. This problem is caused by low humidity. Tape-to-head separation occurs until the head ceases to function.
- Clear filming is caused by oxide and binder being deposited on the head. If clear film is allowed to accumulate, cleaning with solvent is no longer effective. Clean the tape path before tape-to-head separation occurs.

Cleaning Schedule Guidelines

Frequency of cleaning depends on the amount of use the drive receives, the environment in which it is operated, and the kind of tape used.

Minimum Schedule

Clean the tape path every shift or after eight hours of use if:

- Less than 10 reels are used per shift.
- There is no visible debris on the tape head.
- There is no reason to expect high dust levels due to vacuuming, delivery of supplies or major disturbances.

Normal Schedule

Clean the tape path after every 10 reels of tape (or after 1.5 hours of continuous running) if:

- More than 10 reels are used per shift.
- There is no visible debris on the tape head.

- There is no reason to suspect a high level of dust in the computer center.

Heavy Schedule

Clean the tape path thoroughly after each reel of tape if:

- Visible debris appears on the tape head after each reel of tape.
- Uncleaned interchange tapes from outside your computer center are being read.
- Uncleaned new tapes which have been used only once or twice are being used. New tapes usually contain additional debris from the manufacturing process.

A special, thorough cleaning of the tape path is recommended if the tape drive has been inactive for a period of several days, or if there has been abnormal dust activity in the computer center.

CAUTION:

If the error message **CHECK** appears regularly, the tape path should be cleaned more frequently.

Figure F-1 *Front Load Tape Drive Cleaning Points*

Cleaning Supplies

- Use only LIQUID Freon TF or trichlortrifluoroethane (TCE) as a tape path cleaning solvent.

CAUTION:

DO NOT use aerosol cleaners or cleaner solutions that contain lubricants, soap and water, or strong (greater than 20%) alcohol solutions.

- Use non-abrasive lint-free cloths or swabs. DO NOT use facial tissues.

Cleaning Procedure

CAUTION

Always extend the cabinet's anti-tilt bars when the tape drive is extended on the slide rails. To extend the anti-tilt bar, pull on the front metal bumper at the bottom of the cabinet until it is fully extended. Then adjust the threaded nylon-tipped leveler feet to further ensure stabilization.

Lift the top cover to read cleaning directions displayed on the metal PC board access panel. The steps are repeated here for your convenience.

- Pour a small amount of solvent into a clean container such as an UNWAXED paper cup. Solvent dissolves wax from a waxed cup, which then transfers to the tape path.
- Dip the cloth or swab into the solvent as needed.
- Clean at the following points:
  1. Buffer Arm movable roller
  2. Buffer Arm fixed guide
  3. Tape Cleaner Block (scraping surfaces and inside debris traps)
  4. Read/Write/Erase Head
  5. Speed Encoder Roller and Washer
  6. Use a lint-free wipe to brush out debris in the Supply Reel Bed (a depression in the casting)
  7. Periodically check and wipe off rubber gripping fingers on the Supply Reel Hub

Revision History

Dash Number	Revision	Date	Comments
01	**01**	20 October 1989	First draft of this Service Manual.
02	**02**	30 December 1989	Second draft of this Service Manual.
10	**50**	22 January 1990	Production release of this Service Manual.