DDC PERTEC

FS2001-2
Formatted Tape Drive with SCSI
Installation and Operation

Manual No. 115903

Revision A, January 1990

FOREWORD

This manual provides operating instructions for the Formatted Tape Drive, Model FS2001-2 with embedded SCSI interface, manufactured by DDC Pertec, Chatsworth, California.

The contents include a general description of the drive, specifications, installation, and operating instructions.

WARNING

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

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SECTION I
GENERAL DESCRIPTION AND SPECIFICATIONS

1.1 INTRODUCTION

This section provides a physical description, functional description, and specifications for the Formatted Tape Drive, Model FS2001-2 with embedded SCSI interface, manufactured by DDC Pertec, Chatsworth, California.

1.2 PURPOSE OF EQUIPMENT

The tape drive has the capability of recording digital data on 9-track magnetic tape that is moving in the forward direction. Data can be read with the tape moving in either the forward or reverse direction. The unit can operate in a repositioning mode, a streaming mode, or a variable gap start/stop emulation mode. The FS2001-2 operates at speeds of 1.27 and 2.54 m/s (50 and 100 ips) using NRZI, PE or GCR formats to read and write at these speeds. The unit also operates at 1.27 m/s (50 ips) using the 126 c/mm (3200 cpi) Double Density PE (DDPE) format. Data recorded using the NRZI, PE, or GCR formats can be recovered when the tape is played back on an IBM digital tape drive or its equivalent.

The drive can also read data from magnetic tape that has been recorded in 9-track NRZI, PE, or GCR (ANSI/IBM-compatible) formats. Data can be read in either the streaming or repositioning modes at tape speeds of 1.27 or 2.54 m/s (50 or 100 ips).

The drive is equipped with a dual-stack head that has the read and write gaps separated by 3.81 mm (0.15 inch). The dual-stack head configuration allows simultaneous write and read operations to be performed. Data recorded by the write head can be read by the read head after the tape has moved approximately 3.81 mm (0.15 inch). This head configuration allows data to be read for verification immediately after being written. The unit uses a full-width dc erase head with the gap located 11.43 mm (0.45 inch), maximum, in front of the write head gap (relative to the forward direction of tape travel).

The drive operates directly from 100, 120, 220, or 240v single phase power with a frequency between 48 and 62 Hz.

1.3 MODEL IDENTIFICATION

The model code employed within the FS2000 family of tape drives is given in Figure 1-1. For example: Model FS2001-2

- Contains an integral formatter
- Contains a Cache Memory
- Has effective data densities of 32, 63, 126, and 246 c/mm (800, 1600, 3200, and 6250 cpi)
- Contains the Embedded SCSI Interface

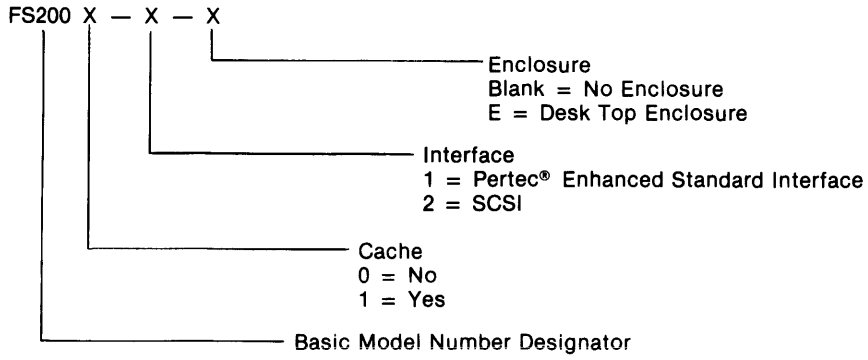

Figure 1-1. Model Identification

1.4 MECHANICAL AND ELECTRICAL SPECIFICATIONS

Mechanical and electrical specifications for the FS2001-2 Tape Drive are given in Table 1-1.

1.5 PHYSICAL DESCRIPTION

Physically, the drive consists of two subassemblies. These are the base and the chassis; see Figure 1-2. All of the tape handling components, the PCBAs (except for the Logic Read and Amplifier Write PCBAs), and the power supply components (except for the ac input connector assembly and line filter), are mounted on the base. The chassis contains the hinges for the base, the gas spring, the Logic Read and Amplifier Write PCBAs and the ac input components. The complete assembly is designed for slide mounting in a standard 482.6 mm (19-inch) EIA equipment rack and requires 222.25 mm (8.75 inches) of vertical space. Power is supplied through a standard domestic or international cord set, depending on equipment configuration.

Access to the tape path area of the drive is via a door in the front bezel and two hinged doors on top. The front panel door is for tape loading and the top doors provide service access. The doors are equipped with interlocks that prevent tape motion when they are open. The interlocks can be defeated by function code when necessary, to allow service access with the equipment in operation. However, the doors should remain closed during normal usage for safety reasons and to protect the magnetic tape, heads, and other components from dust. This will help ensure maximum data reliability.

All operator controls and indicators are located on the front panel of the drive.

For access to the tape path components and the SCSI/Formatter PCBA (mounted on the inside of the top door), the drive must be extended on its mounting slides and the top doors opened. For access to the remaining PCBAs, the unit must be extended, the top doors opened, and the captive screws that secure the base subassembly to the chassis must be loosened. The base subassembly then hinges upwards to provide access to the PCBAs and the components mounted on the underside of the base casting. The power supply components are located within the housing that also encloses the takeup reel motor. For access to these components, the drive must be extended and opened as for access to the PCBAs. The housing can then be opened by removing the two flat-head screws that secure the cover.

1.6 FUNCTIONAL DESCRIPTION

Drive operation depends on a combination of functions, as shown in the simplified block diagram, Figure 1-3.

(1) SCSI/Formatter
(2) Internal Interface
(3) System Control
(4) Write Data Processing
(5) Read Data Processing
(6) Tape Handling
(7) Power Supply

Table 1-1
Mechanical and Electrical Specifications

Tape (Computer Grade) Width Thickness	Conforming to ANSI X3.40-1976 0.498 ± 0.002 inch 1.0 or 1.5 mil nominal
Recording Methods	NRZI (800 cpi) per ANSI X3.22-1973 PE (1600 cpi) per ANSI X3.39-1973 Double-PE (3200 cpi) GCR (6250 cpi) per ANSI X3.54-1976
Tape Tension	9 ounces (± 1 ounce) Tape Creepage None
Reel Sizes	7, 8.5, and 10.5 inches
Autothread Reliability (Tape including retries leader free of creases and folds; tape from vendors approved by Pertec)	95%
Tape Speed (Nominal)	1.27 or 2.54 m/s (50 or 100 ips)
Long-Term Speed Variation (LSV)	Forward: Nominal Speed ± 1% Reverse: Nominal Speed ± 2%
Instantaneous Speed Variation (ISV)	Nominal Speed ± 4%
Rewind Time, 731.52 m (2400 feet)	3 minutes ± 10%
	1.27 m/s (50 ips) / **2.54 m/s (100 ips)**
Repositioning Time (Nominal) (Worst Case)	290 msec / 675 msec 325 msec / 750 msec
Interface Data Transfer Rate Asynchronous Rate Synchronous Rate	 2.5 Mbytes/sec 5 Mbytes/sec
Cache Memory Size	1 Mbyte
Block Size	1k, 2k, 4k, 6k, 8k, 10k, 12k, 16k, 21k, 32k, 48k, or 64k bytes
Error Correction GCR PE	 2 channel (read) 1 channel (read)
MTBF	6,000 hours
MTTR	15 minutes
Input Voltages (RMS)	100, 120, 220, or 240v ac (+ 10%, − 15%)
Input Line Frequency	48—62 Hz
Worst-Case Power Requirement	350 watts (averaged over 10 seconds)
Temperature Operating Non-Operating Shipping	 4.4 to 40 degrees C (40 to 104 degrees F) − 28.9 to 71 degrees C (− 20 to 160 degrees F) − 28.9 to 71 degrees C (− 20 to 160 degrees F)
Humidity Operating Non-Operating Shipping	 15% to 95% (no condensation) 5% to 95% (no condensation) 5% to 95% (no condensation)
Altitude Operating Long-Term Storage Short-Term Storage and Shipping	 0 to 2438m (0 to 8000 feet) 0 to 15,240m (0 to 50,000 feet) 0 to 15,240m (0 to 50,000 feet)

(Continued)

Table 1-1
Mechanical and Electrical Specifications (Continued)

Generated Heat	1300 BTU/Hour
Acoustic Noise	Complies with NR55 curve measurement per ANSI 51.29-1979, Paragraph 7.2.2.
Mechanical Shock	
Operating, rack mounted	Shock machine or hammer: 1G for 10 msec Free-fall drop: 0.25 inch
Non-Operating, rack mounted	Hammer: 2G for 10 msec Free-fall drop: 0.50 inch
Packaged	Hammer: 25G for 15 msec Free-fall drop: 2 inches
Vibration	
Operating	5—14 Hz: 0.002 inch p-p displacement 14—16 Hz: 0.02 G peak 16—51 Hz: 0.0015 inch p-p displacement 52-320 Hz: 0.2 G peak
Non-Operating	5-9 Hz: 0.05 inch p-p displacement 9-350 Hz: 0.2 G peak
Packaged	5-63 Hz: 0.01 inch p-p displacement 63-500 Hz: 2.0 G peak

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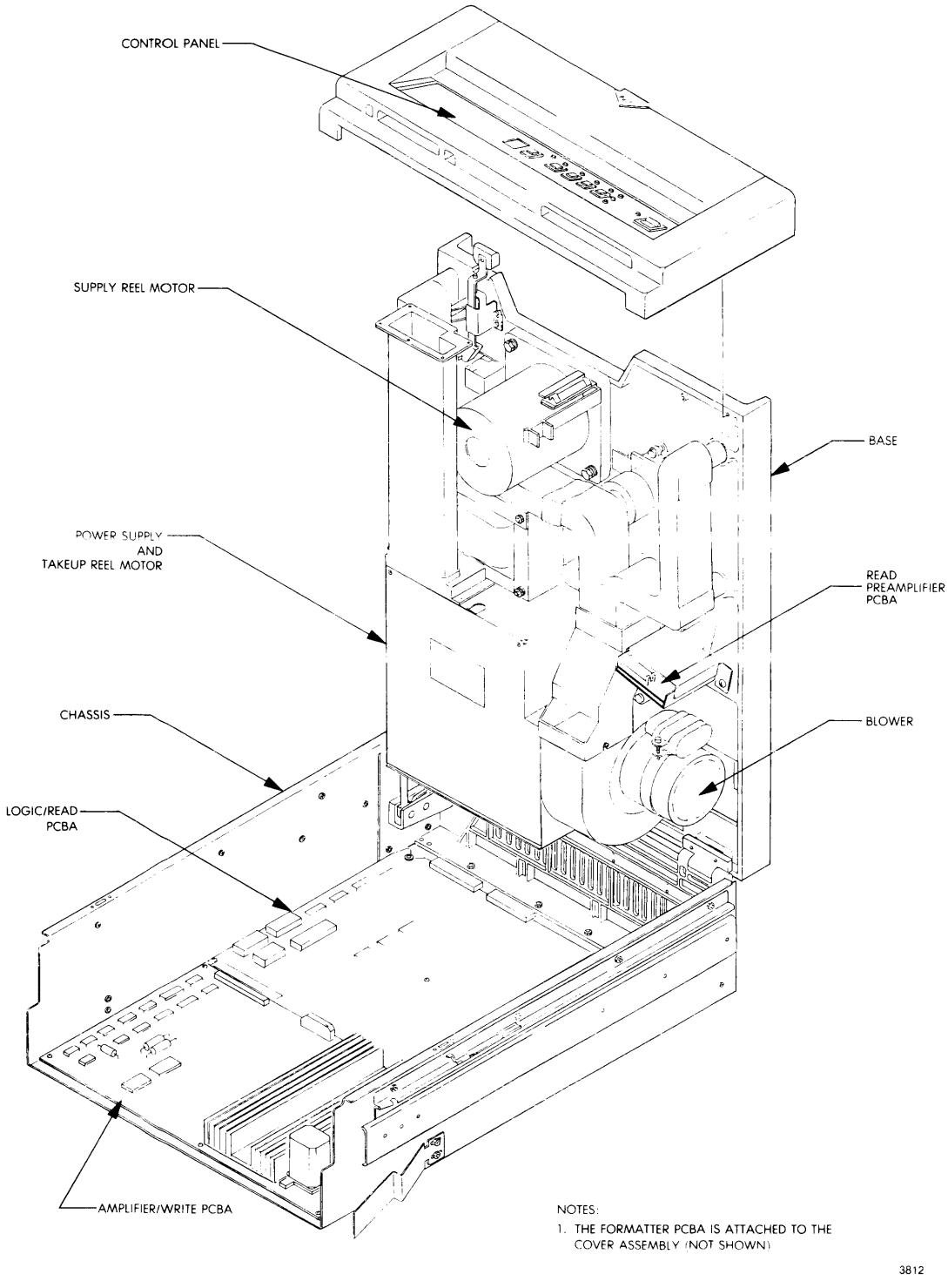


Figure 1-2. FS2000 Major Subassemblies

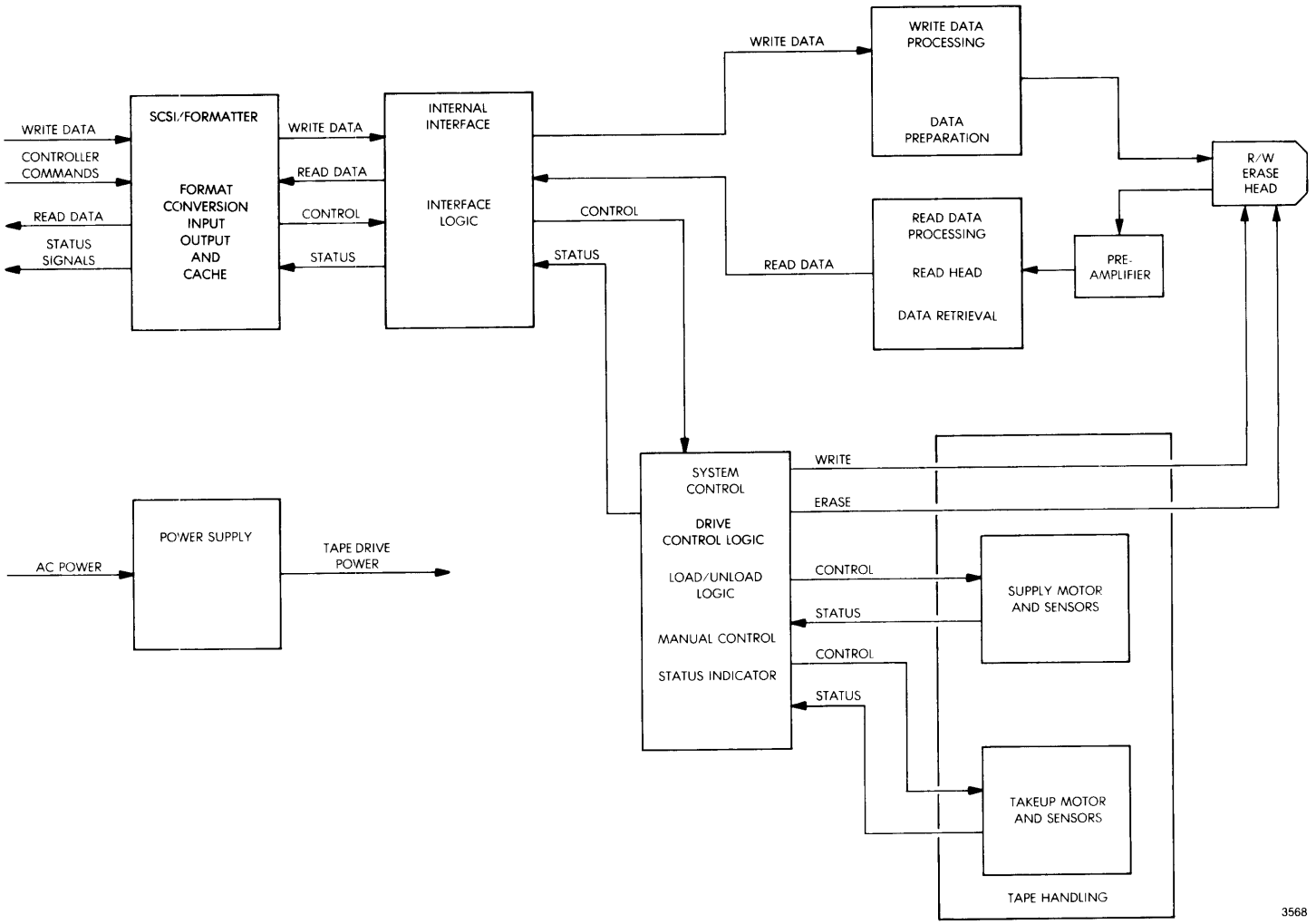


Figure 1-3. FS2000 Simplified Block Diagram

The SCSI/formatter function allows the drive to connect to a SCSI bus and operate as a SCSI sequential access device. It receives data to be written on tape and commands from the SCSI bus, and data read from the tape and status from the drive. It performs the required format conversions in each direction and outputs write data and commands to the internal interface, and read data and status to the bus. The cache and cache management also reside within the formatter function. The SCSI/formatter function is contained on the SCSI/Formatter PCBA.

The internal interface function directs and coordinates the flow of data, status, and control signals between the other functions. The internal interface function is located partially on the Formatter PCBA, partially on the Logic Read PCBA, and partially on the Amplifier Write PCBA.

The system control function processes the controller and manual commands in order to efficiently write and read data on the tape. Tape handling and status reporting is also provided by the system control function. This function is located on the Logic Read PCBA and the Amplifier Write PCBA.

The write data processing function prepares the incoming data for recording and supplies the information to the write head. The write data function is located on the Amplifier Write PCBA.

The read data processing function processes data retrieved from the tape by the read head and supplies the data to the internal interface function. The function includes the read-after-write capability that permits the controller to verify the execution of a write command while writing is in progress. This function is located on the Logic Read PCBA.

The tape handling function includes the takeup and supply reel motors, the tension arm, tachometer, tape-in-path sensors, BOT and EOT sensors, and the air loading system. The tape handling components are located on the base assembly.

The power supply function includes transforming, rectifying, regulating and distributing input power as required to supply the electrical needs of the other functions. The power supply components are located on the base assembly and on the chassis.

SECTION II
INSTALLATION AND INITIAL CHECKOUT

2.1 INTRODUCTION

This section contains instructions for uncrating and mounting the FS2000 drive as well as procedures for electrically connecting the drive and performing the initial checkout. This section also contains a summary of interface information.

2.2 UNCRATING

The drive is shipped in a protective container that meets the National Safe Transit Specification (Project 1A). The container is designed to minimize the possibility of damage during shipment. The following procedure is to be used for uncrating the unit. Refer to Figure 2-1 in conjunction with the procedure.

(1) Place the shipping container on a low, flat surface. Ensure that the carton is positioned so that the model and serial number information are visible on the entrance surface of the carton.

(2) Remove or cut tape from around top of carton and open flaps (see Figure 2-1).

(3) Remove upper foam insert from carton.

(4) Remove installation and operation manual and package containing mounting hardware from carton.

WARNING

THE DRIVE AND PACKING MATERIAL WEIGH IN EXCESS OF 65.9 KILOGRAMS (145 POUNDS). EXERCISE CARE WHEN LIFTING TO PREVENT PERSONNEL INJURY AND EQUIPMENT DAMAGE.

(5) Grasp the unit (in poly bag) and lift it out of the lower foam insert. Place the unit on a convenient work surface.

(6) Cut open the poly bag containing the unit and remove the bag.

(7) Check the contents of the shipping container against the packing slip and inspect the contents for any visible damage. Notify the carrier immediately if the contents are incomplete or any damage is noted.

(8) Check the identification label for correct model number and line voltage requirements.

(9) Retain all packaging material to use for reshipment if necessary.

2.3 PACKAGING FOR RESHIPMENT

When it is necessary to reship the tape drive, perform the following steps.

(1) Remove all power from the tape drive.

(2) Disconnect all external connectors and cables from the unit.

WARNING

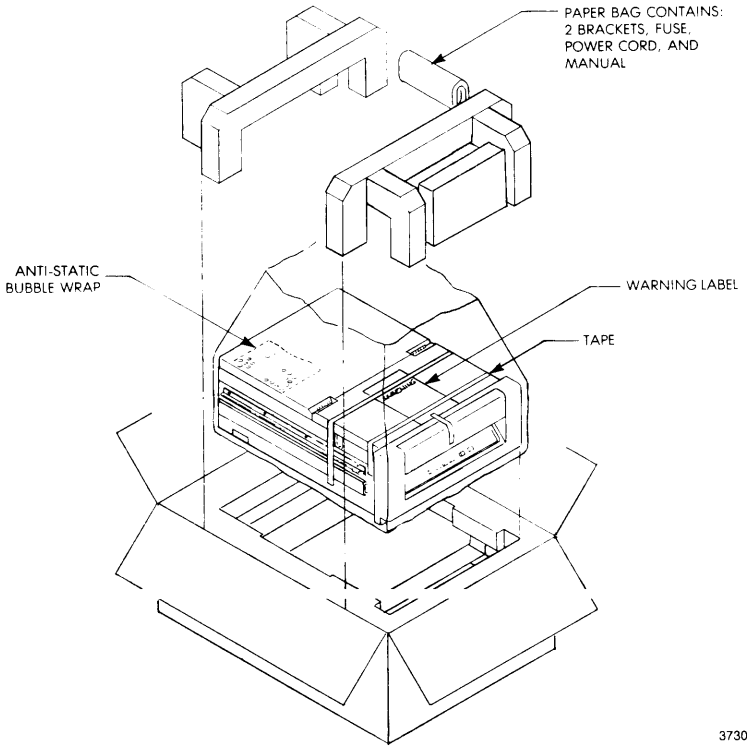
THE DRIVE AND PACKING MATERIAL WEIGH IN EXCESS OF 65.9 KILOGRAMS (145 POUNDS). EXERCISE CARE WHEN LIFTING TO PREVENT PERSONNEL INJURY AND EQUIPMENT DAMAGE

(3) Place the tape drive in the poly bag retained in Paragraph 2.2(9).

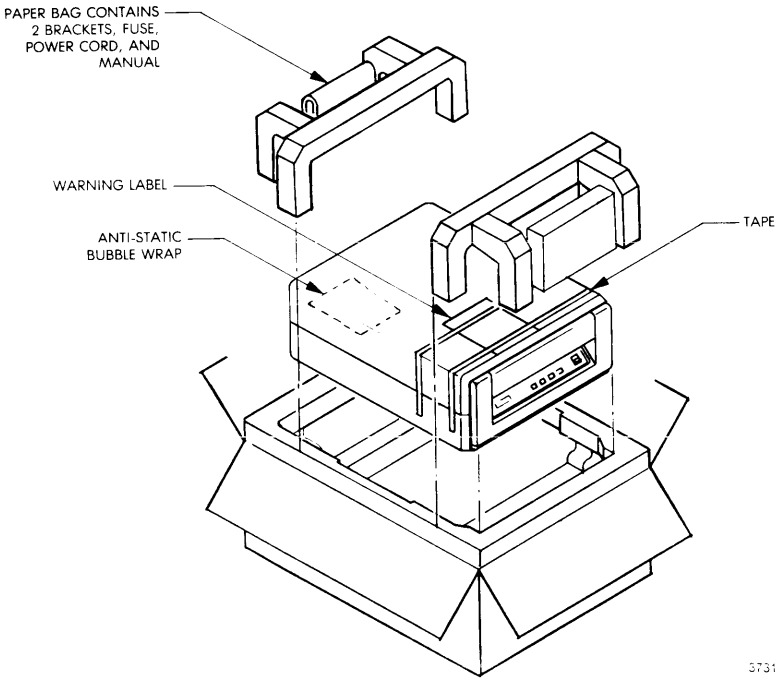
(4) Position the tape drive in the lower foam packing insert within the shipping carton (retained in Paragraph 2.2[9]).

(5) Position the upper foam packing insert (retained in Paragraph 2.2.[9]) over the drive in the shipping carton.

(6) Close the shipping carton flaps and seal them with a strong adhesive shipping tape.



A. RACK MOUNT UNITS



B. ENCLOSURE UNITS

Figure 2-1. Uncrating

2.4 POWER CONNECTIONS

Power connection to the drive is by means of a detachable power cord set that must comply with the following specifications. Table 2-1 lists the color code for the power cord.

North America — U.L. listed and CSA certified. SVT Vinyl jacket, three conductor, 18 AWG, one end terminated with IEC 320, standard sheet C13 style connector (CEE-22, standard sheet VI). Remaining end is terminated with attachment plug: NEMA 5-15P (Parallel Blades), 110/120 volt applications, or NEMA 6-15P (Tandem Blades) for 220/240 volt applications.

Europe — VDE certified. Three conductor 0.75 mm^2, terminated at one end with IEC 320, standard sheet C13 style connector (CEE -22 standard sheet VI). The other end is terminated with a CEE-7, standard sheet VII attachment plug.

Drive operating voltage is selected in one of two ways depending on the unit configuration. If the fuseholder/power connector assembly on the rear of the unit contains a sliding plastic cover, operating voltage is selected by orienting the Line Voltage Configuration PCB located under the sliding cover (see Figure 2-2). If the fuseholder/power connector assembly contains only a round fuseholder cap, operating voltage is selected by changing Voltage Option Plug assembly P501. The option plug is accessible with the unit in the service position, and is located on the left side near the gas spring. Voltage Option Plug information is given in Table 2-2. The ac input voltage and line fuse requirements are listed in Table 2-3.

2.5 INITIAL CHECKOUT PROCEDURE

A detailed description of the operator controls and indicators is contained in Section III. The procedures to be followed during visual inspection and initial checkout of the drive are given in Paragraphs 2.5.1 and 2.5.2 respectively.

2.5.1 VISUAL INSPECTION

Prior to applying power to the drive, perform the following visual inspection procedure.

(1) Visually examine the unit for any evidence of physical damage during shipment.

(2) Check the orientation of the Line Voltage Configuration PCB (see Figure 2-2), located under the sliding fuse cover next to the power connector on the rear of the drive or ensure that the correct Voltage Option Plug is installed (refer to Table 2-2). Verify that a line fuse of the correct rating is installed (refer to Table 2-3).

WARNING

ENSURE THAT THE BASE CASTING IS RAISED HIGH ENOUGH TO ALLOW SAFETY BRACKET ON THE GAS SPRING TO FALL INTO PLACE. IF BASE CASTING FALLS CLOSED, PERSONNEL INJURY AND EQUIPMENT DAMAGE COULD RESULT.

(3) Loosen two socket head captive screws that secure the base casting to the chassis and swing the base casting up to its service position.

(4) Check for any loose cable connectors, screws or mounting hardware.

(5) Disengage the gas spring safety bracket and close and secure the base assembly with the two socket-head captive screws.

(6) Open the tape path access doors on top of the unit and the tape loading door in the front of the unit. Ensure that doors operate properly and show no signs of damage.

(7) Visually inspect the tape path area for cleanliness. loose or damaged hardware, or obstructions (packing materials, etc.).

(8) Close the tape path access doors and the tape loading door.

(9) Connect the power plug to the appropriate power source.

Table 2-1
Power Cord Color Code

Black or Brown AC 'Hot' (Live)	**Nero o Marrone** (Vivo)	**Noir ou Brun** (haut Voltage)	**Negro o Moreno** (Vivo)	**Schwarz oder Braun** (Heiss)
White or Blue AC Return (Neutral) (Common)	**Bianco o Blue** AC Ritorno (Neutro) (Comune)	**Blanc ou Blue** AC Retour (Neutre) (Commun)	**Bianco o Azul** AC Neutro (Neutro) (Comun)	**Weiss oder Blau** AC Zuruck (Neutral) (Gemeinsamer)
Green or Green with Yellow Stripes Chassis (Ground)	**Verde o Verde con le Righe Gialle** Telaio (Terra o massa)	**Vert ou Vert avec Rayure Jaune** Chassis (Terre)	**Verde o Verde con Rayas Amarillas** Chasis (Tierra)	**Grun oder Grun mit Gelben Streifen** Chassis (Grund)

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Table 2-2
Voltage Option Plug Configuration

Dash No.	Voltage	Jumper Connection Pin Numbers/Wire Color			
-01	120v	1—6/Brn	3—9/Blu	4—7/Brn	5—8/Blu
-02	220v	2—6/Brn	3—4/Blu	5—8/Blu	—
-03	100v	1—4/Brn	2—6/Brn	3—9/Blu	5—8/Blu
-04	240v	1—6/Brn	3—4/Blu	5—8/Blu	—

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Table 2-3
AC Input Voltage and Fuse Requirements

Input Voltage	Fuse
100v ac	5A Slow-Blow
120v ac	5A Slow-Blow
220v ac	3A Slow-Blow
240v ac	3A Slow-Blow

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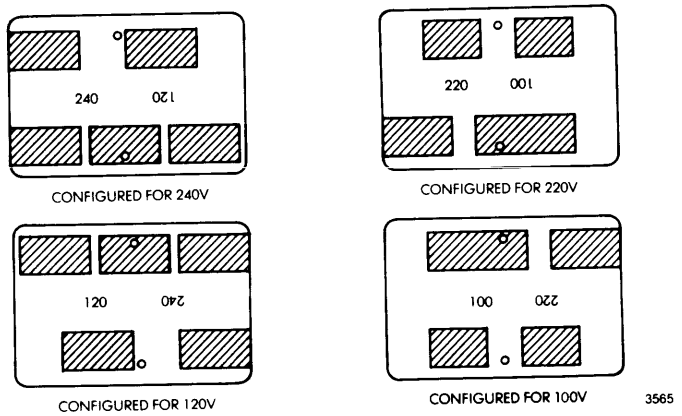

Figure 2-2. Line Voltage Configuration PCB Orientation

2.5.2 CHECKOUT

Perform the initial checkout of the drive as follows. Refer to Section III of this manual for descriptions of the control and indicator functions.

(1) Toggle the POWER switch to the ON position. The power indicator should light. Performance of the CPU/RAM test is shown by the front panel indicators lighting in sequence starting with left-most. Test failure is shown by the sequence stopping with one of the indicators lighted. The five horizontal indicators point to a probable CPU fault. The three vertical indicators suggest a probable RAM failure. During the following lamp test, all indicators will light simultaneously and the 7-segment displays will display the number 88. The lamps and displays will remain on for approximately 1 second. On completion of the tests, the indicators will go out and the 7-segment displays will display the default unit number – 0. Density may also be displayed, depending on the operating configuration selected via the function codes.

(2) Enter the function select mode by pressing and holding the FUNCTION SELECT switch for at least 3 seconds (refer to Paragraph 3.4.8).

(3) Step through the function codes by holding the FUNCTION SELECT switch depressed. Verify that the function codes are correct for your system. (Function codes are listed in Table 3-1.)

NOTE

Optional operating modes are included in the function codes. Function code configuration is stored in non-volatile RAM and need be set only once. Codes selected are stored when power is removed.

(4) Open the tape loading door in the front bezel of the drive.

(5) Position a tape reel, with write enable ring installed, on the supply hub in such a way that the tape will unwind if the reel is turned clockwise (write enable ring down).

(6) Close the tape loading door (an interlock prevents operation when the door is open).

(7) Press the LOAD/ON LINE switch once. Tape will automatically thread and advance to load point. The LD PT indicator should flash during the load cycle and illuminate steadily when tape reaches load point. The WRT EN indicator should also light.

(8) Press the LOAD/ON LINE switch again.

(9) Verify that the ON LINE indicator lights. Additional depressions of the LOAD/ON LINE switch should alternately extinguish and relight the ON LINE indicator.

NOTE

With cache enabled, the ON LINE indicator will flash for 2 seconds before the unit goes from the On Line to the Off Line state. The delay permits completion of internal tasks. The speed and density indicators will also show the presently selected state.

(10) With the drive on line, verify that all front panel switches except POWER and LOAD/ON LINE are disabled.

(11) Depress LOAD/ON LINE switch and verify the ON LINE indicator is extinguished.

(12) Depress the REW/UNLOAD switch. Tape will run slowly in reverse and unload. Verify that the REW/UNLOAD indicator flashes during unloading.

(13) When unloading is complete (REW/UNLOAD indicator extinguishes), open tape loading door, remove the tape reel, remove the write enable ring from the reel, and replace the tape reel on the supply hub.

(14) Close the tape loading door and depress the LOAD/ON LINE switch once. Tape will automatically thread and advance to load point. The LD PT indicator will flash during the load cycle and illuminate steadily when tape reaches load point.

(15) Verify that WRT EN indicator is extinguished.

(16) Perform system diagnostics to check remaining controls and indicators. Refer to operating instructions in Section III.

2.6 RACK MOUNTING THE DRIVE

The FS2000 drive is designed to be mounted either in a standard 482.6 mm (19 inch) EIA equipment rack or the specially designed desk top enclosure. For rack mounting, a vertical panel opening of 222.25 mm (8.75 inches) is required and the depth behind the mounting surface must be a minimum of 558.8 mm (22 inches).

Figure 2-3 shows the critical dimensions of the drive. Figure 2-4 shows the mounting hole pattern and dimensions and should be referred to in conjunction with the following procedure when rack mounting the drive. Refer to Paragraph 2.7 for enclosure mounting procedures.

WARNING

THE RACK IN WHICH THE DRIVE IS TO BE MOUNTED MUST BE SUFFICIENTLY WEIGHTED OR ANCHORED TO SAFELY ACCOMMODATE THE HIGH CENTER OF GRAVITY THAT IS PRESENT WITH THE DRIVE EXTENDED ON ITS MOUNTING SLIDES.

(1) Place the drive on a convenient work surface.

(2) Remove the mounting slides from each side of the drive chassis. Retain all hardware for reinstallation.

(3) Remove the front and rear slide mounting brackets and the attaching hardware from the mounting hardware package.

(4) Secure the front and rear slide mounting brackets to the mounting slides.

(5) One at a time, place the mounting slides in position (refer to Figure 2-4), and secure the front and rear mounting brackets to the mounting rails. Use four 10-32 x 3/8-inch pan-head Phillips screws for each bracket and place a flat washer, a lock washer, and a 10-32 nut on each screw to secure it.

(6) Fully extend the mounting slides out of the mounting rails until they lock.

WARNING

THE DRIVE WEIGHS APPROXIMATELY 56.8 KILOGRAMS (125 POUNDS). EXERCISE CARE WHEN LIFTING TO PREVENT PERSONNEL INJURY AND EQUIPMENT DAMAGE.

(7) Lift the drive (using either sufficient personnel or mechanical means) and place it in position with the mounting rail (connected to the chassis) on the slide lip. The forward stud should be approximately 2 inches in front of the V-shaped slot in the slide.

(8) Slide the unit back so that the front of the slide lip is positioned completely inside the mounting rail wraparound (Figure 2-4). Also ensure that the mounting rail block is positioned inside the receiving slot in the slide.

(9) Using the hardware removed in Step (2), secure the mounting slides to the drive chassis.

(10) Remove any device used to position the drive for mounting and slide the drive into the mounting rack.

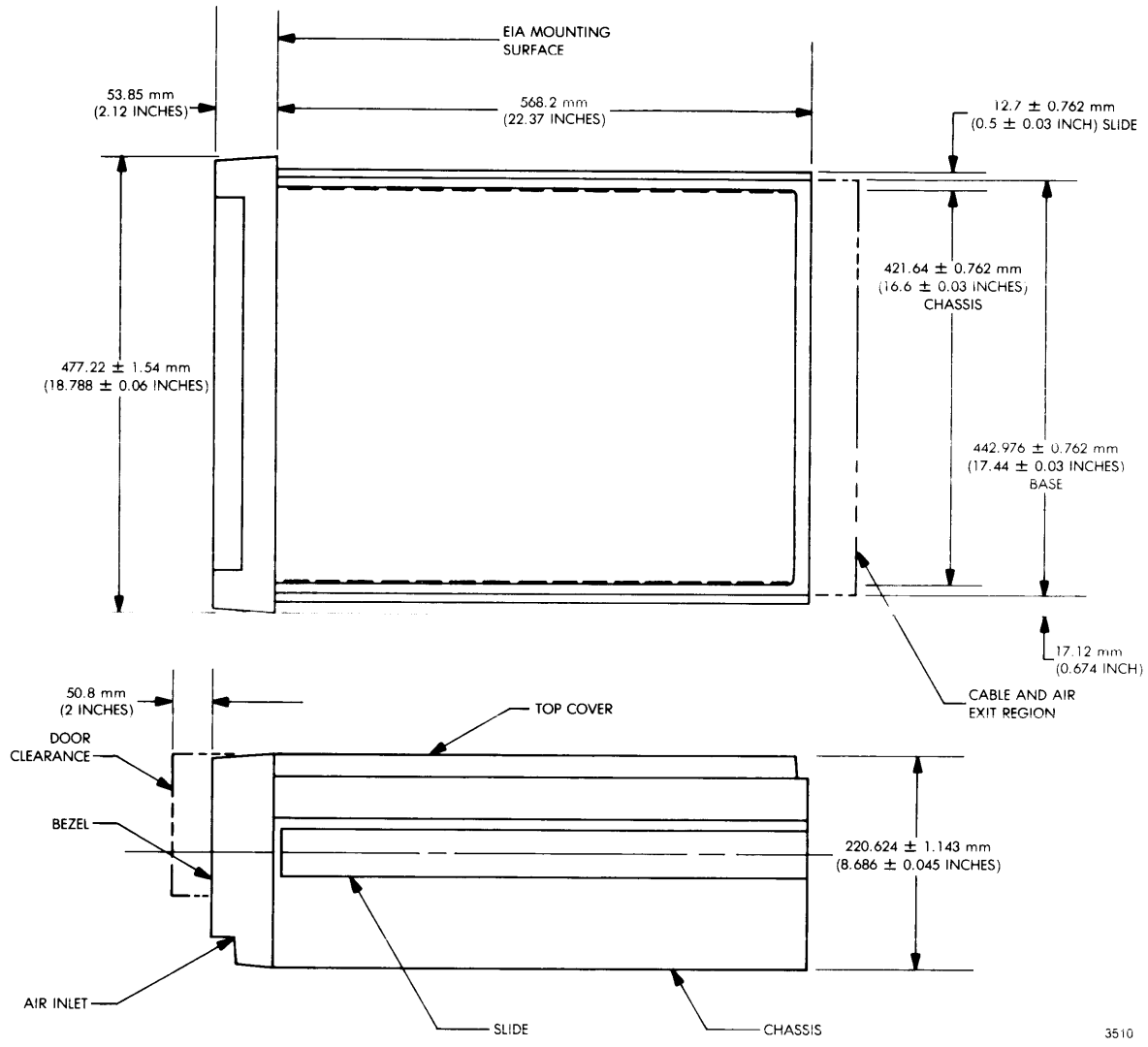

Figure 2-3. Physical Dimensions

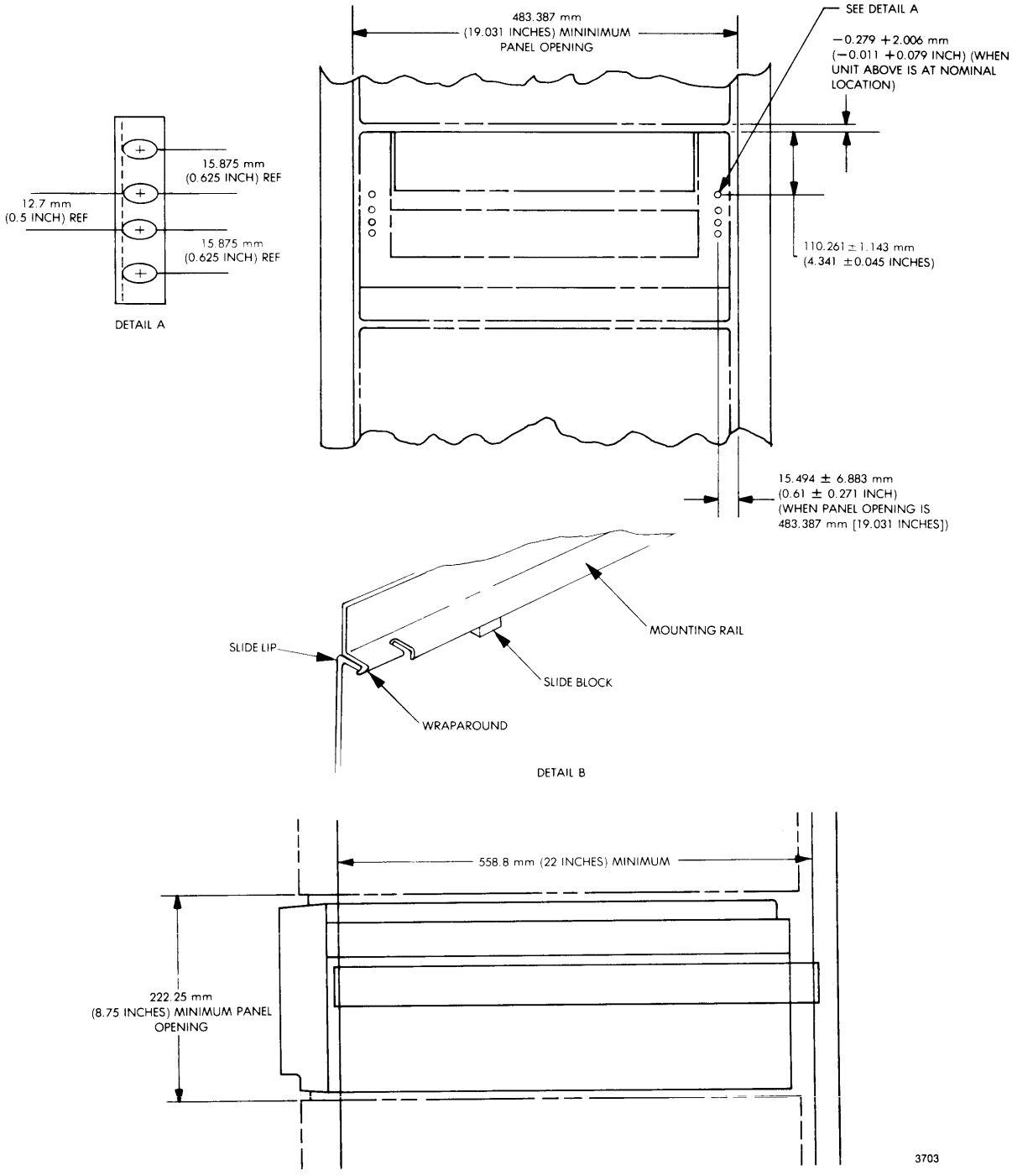

Figure 2-4. EIA Mounting Hole Pattern

2.7 ENCLOSURE MOUNTING THE DRIVE

The FS2000 drive may be mounted in a specially designed desk-top enclosure for installations where rack mounting is not possible or desirable. Perform the following procedure to mount the drive in the desk-top enclosure.

(1) Open the top front cover on the drive and locate the two socket head captive screws that secure the base assembly to the chassis assembly.

WARNING

IF THE SAFETY BRACKET DOES NOT LATCH BASE ASSEMBLY IN THE OPEN POSITION, IT CAN FALL CLOSED RESULTING IN PERSONNEL INJURY AND EQUIPMENT DAMAGE.

(2) Loosen the two socket head captive screws and raise the base to the locked position. Ensure that the base is raised high enough to allow the safety bracket on the gas spring to fall into place.

(3) Remove the slide assemblies and spring latches from each side of the chassis.

(4) Disconnect P201, P202, P203, P204, P205, and P206 from the Amplifier/Write PCBA. Remove six 8-32 screws that secure the Amplifier/Write PCBA to the chassis. Carefully pull the PCBA forward to disconnect P207, then lift the PCBA out of the chassis and place in a safe location for later reinstallation.

(5) Disconnect P301, P302, P304, P305, and P306 from the Logic/Read PCBA, taking note of those connectors that are secured with tie wraps. The tie wraps must be replaced during reassembly. Remove the four 8-32 screws that secure the Logic/Read PCBA to the chassis. Carefully pull the PCBA forward, lift it out of the chassis and place it in a safe location for later reinstallation.

(6) Disengage the gas spring safety bracket, lower the base assembly, and secure it using the two captive socket head screws.

WARNING

THE DRIVE WEIGHS APPROXIMATELY 56.8 KILOGRAMS (125 POUNDS). EXERCISE CARE WHEN LIFTING TO PREVENT PERSONNEL INJURY AND EQUIPMENT DAMAGE.

(7) Lift the drive (using either sufficient personnel or mechanical means), and place it inside the enclosure.

WARNING

IF THE SAFETY BRACKET DOES NOT LATCH BASE ASSEMBLY IN THE OPEN POSITION, IT CAN FALL CLOSED RESULTING IN PERSONNEL INJURY AND EQUIPMENT DAMAGE.

(8) Loosen the two socket head captive screws and raise the base to the locked position. Ensure that the base is raised high enough to allow the safety bracket on the gas spring to fall into place.

(9) Carefully position the chassis so that the four holes in the bottom of the chassis line up with the four tapped holes in the enclosure.

(10) Secure the drive to the enclosure using the hardware provided.

(11) Replace the Logic/Read and Amplifier/Write PCBAs by reversing the procedure given in preceding Steps (4) and (5).

(12) Disengage the gas spring safety bracket, lower the base assembly, and secure it using the two captive socket head screws.

2.8 INTERFACE SPECIFICATIONS AND INFORMATION

The following paragraphs contain a summary of the physical and electrical interface specifications for the FS2000 Formatted Tape Drive with SCSI. The unit may be supplied with either single-ended or differential interface cables.

2.8.1 SINGLE-ENDED CABLES

Either a 50-conductor cable or 25-signal twisted pair cable provides the interconnection between the FS2000 and the SCSI bus. The maximum length for a single-ended cable is 6.0 metres (19.7 feet).

Proper termination for a single-ended SCSI system is shown in Figure 2-5. For proper SCSI operation, only the units at each end of the SCSI network require termination. The signal configuration for the single-ended interface connector is given in Table 2-4.

2.8.2 DIFFERENTIAL ENDED CABLES

Either a 50-conductor or 25-signal twisted pair cable provides the interconnection between the FS2000 and the SCSI bus. The maximum length for a differential cable is 25 metres (82 feet).

Proper termination for a differential SCSI system is shown in Figure 2-6. For proper SCSI operation, only the units at each end of the SCSI network require termination.

An optional differential driver protection circuit may be used, if required, with the differential system. This circuit is shown in Figure 2-7. The signal configuration for the differential interface connector is given in Table 2-5.

2.8.3 INTERFACE CONNECTORS

The SCSI tape drive is normally supplied with the non-shielded device connector shown in Figure 2-8. In this configuration, the unit is supplied with the SCSI bus terminators already installed on the SCSI Formatter PCBA.

CAUTION

INTERNAL SCSI BUS TERMINATORS (RP3 AND RP4, SINGLE-ENDED CABLES OR RP4, RP5, AND RP6, DIFFERENTIAL CABLES) ON THE SCSI FORMATTER PCBA MUST BE REMOVED IF THE UNIT IS NOT INSTALLED AT THE END OF THE SCSI NETWORK.

An optional shielded device connector is available with a loop through connector for daisy chained SCSI connection or termination. The shielded connector is shown in Figure 2-9. When the optional configuration is ordered, the SCSI bus terminators are not installed on the SCSI Formatter PCBA, but are shipped with the unit.

CAUTION

IT IS THE RESPONSIBILITY OF THE SYSTEM INTEGRATOR TO PROPERLY INSTALL THE SUPPLIED TERMINATORS FOR EITHER SINGLE-ENDED OR DIFFERENTIAL OPERATION.

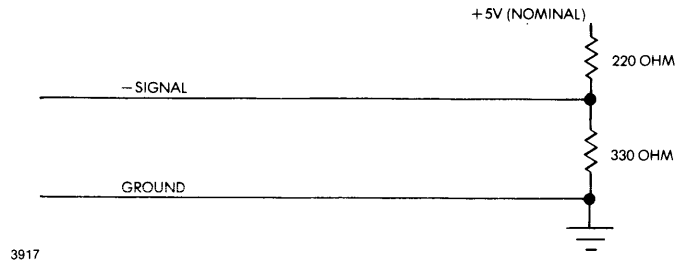

Figure 2-5. Single-Ended Device Termination

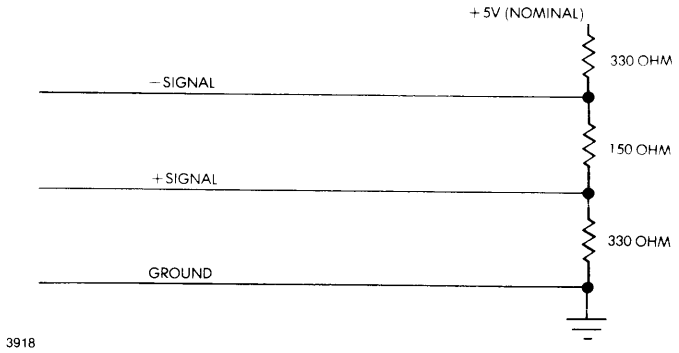

Figure 2-6. Differential Device Termination

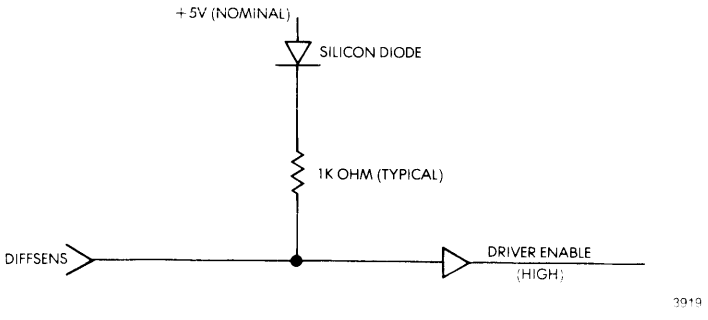

Figure 2-7. Differential Driver Protection Circuit (Optional)

Table 2-4
Single-Ended Pin Assignments

Signal	Pin Number	Signal	Pin Number
– DB(0)	2	GROUND	28
– DB(1)	4	GROUND	30
– DB(2)	6	– ATN	32
– DB(3)	8	GROUND	34
– DB(4)	10	– BSY	36
– DB(5)	12	– ACK	38
– DB(6)	14	– RST	40
– DB(7)	16	– MSG	42
– DB(P)	18	– SEL	44
GROUND	20	– C/D	46
GROUND	22	– REQ	48
GROUND	24	– I/O	50
TERMPWR	26		

NOTES:
(1) All odd pins except pin 25 are connected to ground. Pin 25 is left open.
(2) The minus sign next to the signals indicates active low.

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Table 2-5
Differential-Ended Pin Assignments

Signal	Pin Number	Signal	Pin Number
SHIELD GROUND	1	GROUND	2
+ DB(0)	3	– DB(0)	4
+ DB(1)	5	– DB(1)	6
+ DB(2)	7	– DB(2)	8
+ DB(3)	9	– DB(3)	10
+ DB(4)	11	– DB(4)	12
+ DB(5)	13	– DB(5)	14
+ DB(6)	15	– DB(6)	16
+ DB(7)	17	– DB(7)	18
+ DB(P)	19	– DB(P)	20
DIFFSENS	21	GROUND	22
GROUND	23	GROUND	24
TERMPWR	25	TERMPWR	26
GROUND	27	GROUND	28
+ ATN	29	– ATN	30
GROUND	31	GROUND	32
+ BSY	33	– BSY	34
+ ACK	35	– ACK	36
+ RST	37	– RST	38
+ MSG	39	– MSG	40
+ SEL	41	– SEL	42
+ C/D	43	– C/D	44
+ REQ	45	– REQ	46
+ I/O	47	– I/O	48
GROUND	49	GROUND	50

NOTES: SHIELD GROUND is optional on some cables. (Implementors note: Some shielded flat ribbon cables use pin 1 as a connection to the shield.)

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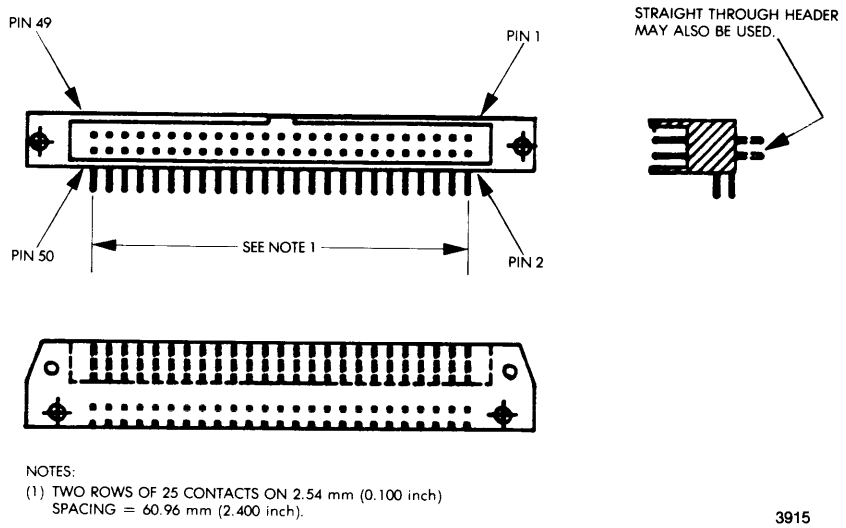

Figure 2-8. Non-Shielded SCSI Device Connector

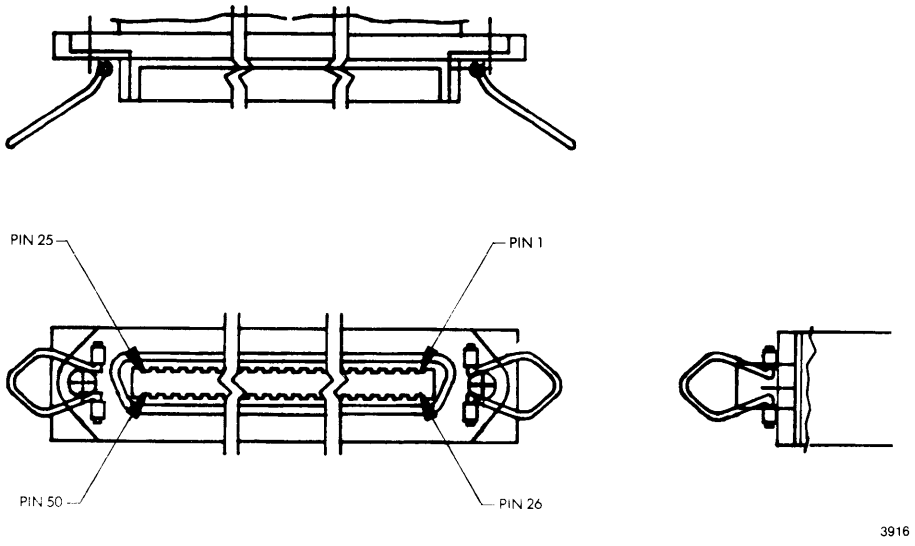

Figure 2-9. Shielded SCSI Device Connector

2.8.4 SINGLE-ENDED INTERFACE CHARACTERISTICS

2.8.4.1 Output Characteristics

The driver output levels measured at the connector, are as follows:

Asserted = True = 0 to 0.4v dc

Negated = False = 2.5 to +5.25v dc

Minimum driver output capability = 48 milliamps at 0.5v dc.

2.8.4.2 Input Characteristics

Input receivers will respond to signals at the following levels (measured at the connector).

Asserted = True = 0 to 0.8v dc, maximum total input load = 0.4 milliamps at 0.4v dc

Negated = False = 2.0 to +5.25v dc, minimum input hysteresis = 0.2v dc.

2.8.5 DIFFERENTIAL INTERFACE CHARACTERISTICS

The driver output levels measured at the connector are as follows.

Low-level output voltage (VOL) = 2.0v maximum at low-level output current (IOL) = 55 milliamps.

High-level output voltage (VOH) = 3.0v minimum at high-level output current = −55 milliamps.

Differential voltage (VOD) = 1.0v minimum with common-mode voltage ranges from −7v dc to +12v dc.

VOL and VOH are measured between the signal pins and ground.

2.8.5.2 Input Characteristics

The input receivers will respond to signals with the following characteristics (measured at the connector).

Input current on either Input (II) = 2.0 milliamps maximum over the range −7 to +12v dc.

If a single-ended device or terminator is inadvertently connected to a differential interface unit, the DIFFSENS signal at the connector is grounded and disables the FS2000 differential drivers.

2.8.6 TERMINATOR POWER

The FS2000 supplies terminator power (TERMPWR) with the following characteristics for both single-ended and differential SCSI connections.

Terminator Voltage (VTERM) = 4.0 to 5.0v dc
1 amp minimum source drive capability

1.0 milliamp maximum sink (except for current to internal terminator when installed).

SECTION III
OPERATION

3.1 INTRODUCTION

This section provides specific information pertaining to operation of the FS2000 Formatted Tape Drive with embedded SCSI interface. The material provided includes loading and unloading procedures, detailed descriptions of the controls and indicators, interface signal information, and diagnostic operating procedures.

3.2 PRELOADING INFORMATION

Perform the following procedure, as applicable, before loading tape.

WARNING

ENSURE THAT THE MOUNTING FRAME IS SUFFICIENTLY WEIGHTED OR ANCHORED TO SAFELY ACCOMMODATE THE HIGH CENTER OF GRAVITY THAT IS PRESENT WITH THE DRIVE EXTENDED.

(1) Extend the drive out of the mounting frame and open the top cover to gain access to the tape path components.

(2) Check the tape path area for dirt, dust, etc. Clean the tape path area daily (or as necessary) as specified in the following steps.

CAUTION

DO NOT USE ROUGH OR ABRASIVE CLOTHS TO CLEAN HEAD OR TAPE GUIDES. USE ONLY 91 PERCENT ISOPROPYL ALCOHOL. USE OF OTHER SOLVENTS MAY DAMAGE HEAD LAMINATION ADHESIVE.

(3) Moisten a cotton swab or foam applicator with isopropyl alcohol. The applicator should be moist, not dripping wet. Shake off any excess solvent.

CAUTION

USE OF AN EXCESSIVE AMOUNT OF SOLVENT MAY CAUSE SEEPAGE INTO THE BEARINGS AND CAUSE CONTAMINATION OR BREAKDOWN OF THE BEARING LUBRICANT.

(4) Wipe the tape contact surface of the head with the moistened applicator. Use only light pressure (do not scrub) and wipe in the direction of tape travel. Be sure that fibers from the applicator do not stick to any part of the head.

(5) Wipe the surface dry using a lintless wiper or dry applicator and light pressure. Once again, wipe in the direction of tape motion.

(6) Clean the tape guides and remaining tape path components using the same technique specified in Steps (4) and (5).

(7) Using a hand-held magnifier, examine the head and tape path components to ensure that all accumulated oxide and dirt have been removed.

(8) Close the top cover and slide the drive into the mounting frame.

(9) If the task requires recording data on the tape, install a write enable ring on the supply reel.

CAUTION

DO NOT HANDLE TAPE REELS SUCH THAT THE FLANGES WILL BE SQUEEZED TOGETHER. IF THE

FLANGES ARE FORCED AGAINST THE TAPE, EDGE DAMAGE MAY RESULT. WHEN THE REEL IS MOUNTED ON THE DRIVE, APPLY PRESSURE ONLY TO THE HUB, NEVER TO THE REEL FLANGE. EXERCISE CARE DURING REMOVAL OR REPLACEMENT OF TAPE REEL COLLARS. IT IS EASY TO INADVERTANTLY SQUEEZE THE REEL FLANGES DURING THIS OPERATION.

(10) Ensure that the tape is free to run, i.e., tape leader is not secured by tape or other retaining material, and that tape leader is not damaged or creased. To ensure proper automatic loading, the end of the tape must be trimmed. A tape crimper (IBM Part No. 2512063) can be used to trim the tape.

(11) Ensure that the unit is properly connected and, if the unit is being loaded for the first time, that the initial checkout procedure in Section II has been performed.

3.3 LOADING AND UNLOADING TAPE

The following paragraphs provide procedures for loading and unloading tape. These procedures assume that an industry standard tape reel (177.8, 215.9, or 266.7 mm [7, 8.5, or 10.5 inch]) is being used. The tape leader must be free of creases or folds (trim the leader using a tape crimper, IBM Part No. 2512063, as required).

3.3.1 AUTOLOAD PROCEDURE

(1) Toggle the POWER switch to the ON position.

(2) Lower the tape loading door in the front bezel of the drive.

(3) Position the tape reel on the supply hub in such a way that the tape will unwind if the reel is turned clockwise (write enable ring, if installed, should be down).

CAUTION

HANDLE TAPE REELS BY THE HUB WHENEVER POSSIBLE. IF TAPE REEL FLANGES ARE FORCED AGAINST THE TAPE, EDGE DAMAGE MAY RESULT.

(4) Close the tape loading door.

(5) Press the LOAD/ON LINE switch once.

The supply hub will automatically lock the tape reel in place. The reel will turn backwards a few turns and then turn forward (clockwise), ejecting the tape into the tape path. Figure 3-1 illustrates the tape routing. Tape is threaded through the tape path by the drive air system. The LD PT indicator will flash during the load operation, and remain illuminated to indicate successful completion (i.e., tape at load point). If the tape fails to load the first time, the supply reel backwinds all of the tape and tries to load a second and, if necessary, a third time. If the tape fails to load on the third attempt, the 7-segment displays flash the load fault code until RESET is depressed or POWER is switched to OFF. (Operator troubleshooting information, including a list of fault codes, is presented in Paragraph 3.10.)

3.3.2 MANUAL LOADING PROCEDURE

(1) Extend the drive out of the mounting frame on its slides.

(2) Open the top covers of the drive to gain access to the tape path.

(3) Lower the tape loading door in the front bezel of the drive.

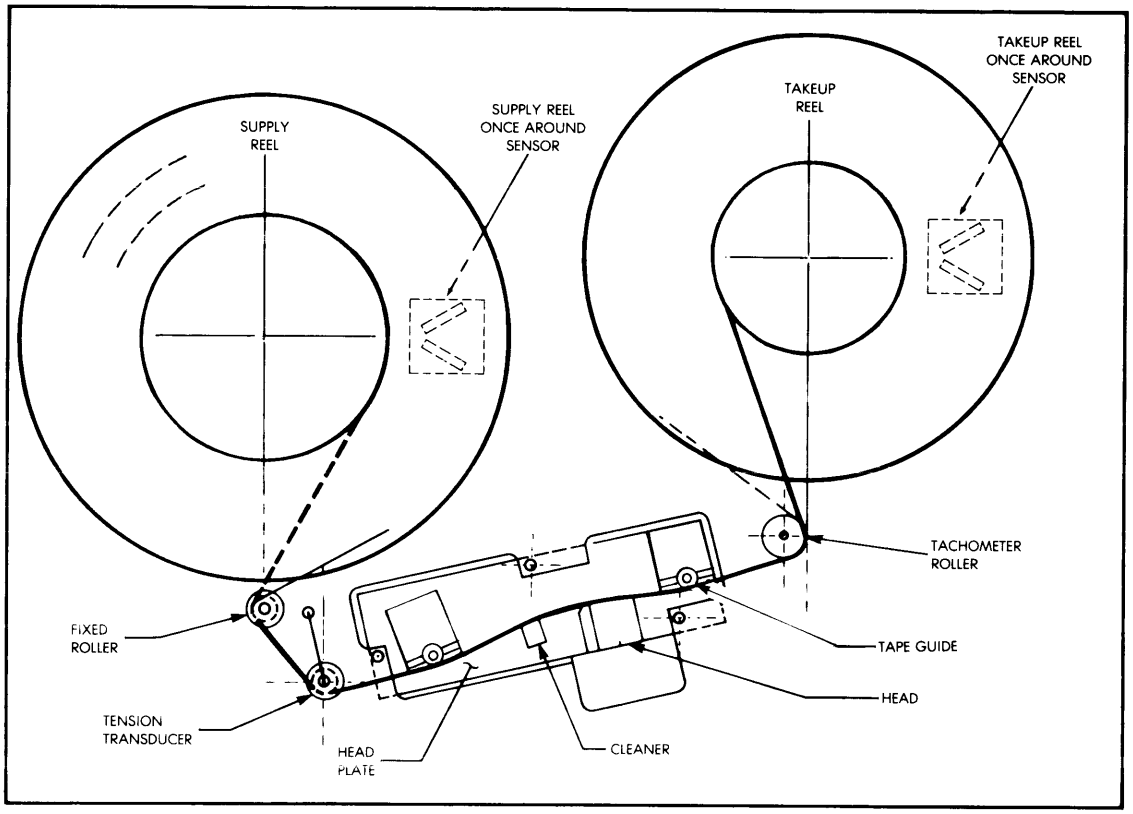

Figure 3-1. Tape Path

(4) Position the tape reel on the supply hub in such a way that the tape will unwind if the reel is turned clockwise (write enable ring, if installed, should be down).

CAUTION

HANDLE TAPE REELS BY THE HUB WHENEVER POSSIBLE. IF TAPE REEL FLANGES ARE FORCED AGAINST THE TAPE, EDGE DAMAGE MAY RESULT.

(5) Depress the Autoload Override button located at the lower left side of the tape loading door, press the tape reel hub down and turn it CCW to the lock position. Then release the Manual Override button.

(6) Toggle the POWER switch to the ON position.

(7) Manually thread the tape through the tape path (see Figure 3-1) by slowly winding both reels clockwise until at least four turns of tape have been wound onto the takeup reel.

(8) Close the top cover and the tape loading door on the drive and push the drive back into the mounting frame.

(9) Press the LOAD/ON LINE switch once to tension the tape and bring it to load point (LD PT indicator remains illuminated).

3.3.3 UNLOADING PROCEDURE

The following procedure assumes that tape is loaded and is at or beyond load point, and that the drive is off line.

(1) Press the REW/UNLOAD switch once. Tape will rewind to load point and stop.

(2) Press the REW/UNLOAD switch a second time. The tape will rewind onto the supply reel and the supply reel will automatically be released from the hub.

(3) Open the tape loading door in the front bezel and remove the supply reel.

CAUTION

HANDLE TAPE REELS BY THE HUB WHENEVER POSSIBLE. IF TAPE REEL FLANGES ARE FORCED AGAINST THE TAPE, EDGE DAMAGE MAY RESULT.

NOTE

If the supply reel hub does not automatically release, depress and hold the Autoload Override button located at the lower left side of the tape loading door and turn supply hub clockwise to release the supply reel.

3.4 CONTROLS AND INDICATORS

All controls and indicators, with the exception of the Autoload Override (hub lock) button, are located on the control panel of the drive. The following paragraphs describe the control and indicator functions. The control and indicator locations are shown in Figure 3-2.

3.4.1 POWER ON/OFF SWITCH

The POWER ON/OFF switch is a two-position rocker switch that controls the application of ac power to the drive. Powerup diagnostics are also initiated with the POWER ON/OFF switch.

3.4.2 POWER INDICATOR

This indicator is illuminated when secondary ac power is present.

3.4.3 LOAD/ON LINE SWITCH

If tape is not tensioned (loaded), depressing the switch once will begin the autoload cycle. After the tape reaches load point, depressing the switch a second time will place the drive on line (if code 31 is set). If code 31 is not set, depressing the switch twice upon start of load cycle will automatically place the drive on line when the tape reaches load point. In the on line mode, the unit will only respond to commands sent via the host interface (front panel switches, except LOAD/ON LINE will be ignored). All host interface command, data, and status lines are active in the on line mode. In the off line mode, all host interface command lines (except Load/On-Line) are disabled. Status lines are not disabled.

Subsequent depressions of the switch will cause the drive to toggle between the on line and off line states. The unit is never allowed on line prior to the tape reaching load point.

NOTE

If cache is enabled, the drive will not go off line until system dialogue with the cache has terminated. Continuing dialogue with the cache is indicated by the ON LINE indicator flashing for more than 2 seconds after the switch is depressed.

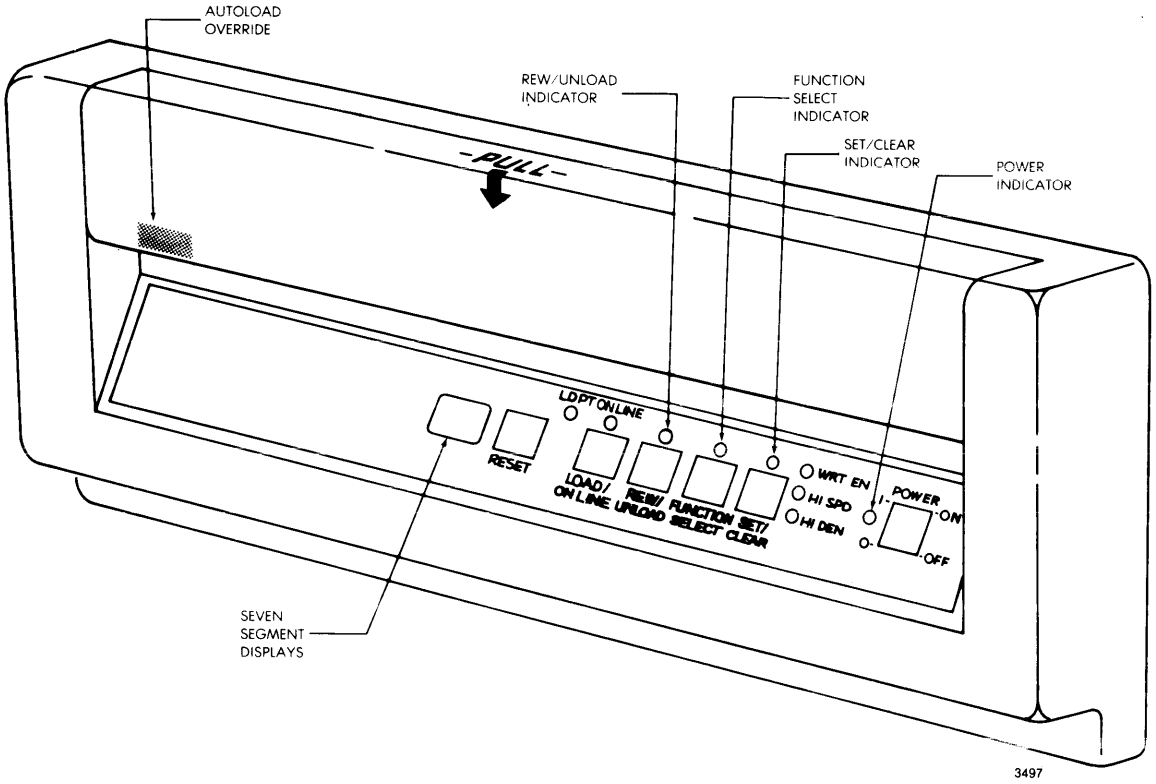

Figure 3-2. Control Switches and Indicators

3.4.4 LD PT (LOAD POINT) INDICATOR

This indicator flashes during a load operation and is steadily illuminated when the tape is at load point.

3.4.5 ON LINE INDICATOR

When the LOAD/ON LINE switch has been depressed twice and function code 31 (refer to Table 3-1) is not set, the indicator flashes during a load operation, and lights continuously when load point is reached. If function code 31 is set, the indicator remains off until load point is reached and the LOAD/ON LINE switch is depressed for the second time. The indicator then lights continuously. The indicator may flash for 2 seconds or more if the drive is taken off line with the cache enabled.

3.4.6 REW/UNLOAD SWITCH

When depressed once, with the unit off line and beyond load point, a rewind to load point operation is initiated. When load point is reached, the switch is depressed a second time to unload the tape. Two consecutive depressions of the switch with the unit off line and beyond load point, will result in the tape automatically being unloaded at the end of the rewind operation.

3.4.7 REW/UNLOAD INDICATOR

If the REW/UNLOAD switch is depressed twice while the unit is off line and loaded, the indicator will flash as tape is rewound and unloaded. If the REW/UNLOAD switch is depressed once, the indicator will illuminate during the rewind and go out when the tape stops at BOT. When the switch is depressed again, the indicator will flash as the tape is unloaded.

3.4.8 FUNCTION SELECT SWITCH

If the drive is off line, at load point, and code 10 is set, a momentary depression of the FUNCTION SELECT switch will cause a new density/speed selection. Each subsequent depression of the switch will step to the next available combination until the desired density/speed combination is reached.

When the FUNCTION SELECT switch is depressed and held for at least 3 seconds, with the drive off line and tape not in motion, the drive will switch to the Function Select mode. If the switch is held down, the 7-segment display will step through the function codes (listed in Table 3-1) at the rate of one per second. Rapid repeated depressions of the switch can be used to step through the function codes at a faster rate. The LOAD/ON LINE and REW/UNLOAD switches are disabled when function selection is in process. The RESET switch is used to exit the Function Select mode. An example of a function selection sequence to set the SCSI device ID is as follows:

(1) Depress and hold the FUNCTION SELECT switch for 3 seconds (7-segment display goes to – 0 and the FUNCTION SELECT indicator lights), then release the switch.

(2) Depress and release the FUNCTION SELECT switch three times to step display to – 3 (SCSI device ID to be set).

(3) Depress and release the SET/CLEAR switch, the SET/CLEAR indicator should light (SCSI device ID is set).

NOTE

Multiple drive configurations (more than one logical unit connected to the formatter at the tape drive interface) are not supported.

(4) If other function codes are to be selected, continue to depress and release the FUNCTION SELECT switch until the desired code is displayed; then depress and release the SET/CLEAR switch as appropriate (refer to Table 3-1).

(5) Depress and release the RESET switch, the FUNCTION SELECT indicator should go out and 7-segment display goes to – 3 (new SCSI device ID is enabled).

3.4.9 FUNCTION SELECT INDICATOR

This indicator is illuminated when the unit is in the Function Select mode. Depressing the RESET switch causes the indicator to go off.

3.4.10 SET/CLEAR SWITCH

Pressing this switch will cause the selected function to be set or cleared for a true/false function. For a multiple choice function, only one choice can be set, which will clear the previous choice in that group.

3.4.11 SET/CLEAR INDICATOR

This indicator is illuminated if the unit is in the Function Select mode, and the displayed function code is true (set) or if the unit is on line and cache is enabled.

Table 3-1
Function Selection Codes

Code	Operational Codes		Notes
	Code Set (SET/CLEAR LED On)	Code Cleared (SET/CLEAR LED Off)	
– 0	SCSI Device ID 0 selected	SCSI Device ID 0 deselected	
– 1	SCSI Device ID 1 selected	SCSI Device ID 1 deselected	
– 2	SCSI Device ID 2 selected	SCSI Device ID 2 deselected	
– 3	SCSI Device ID 3 selected	SCSI Device ID 3 deselected	
– 4	SCSI Device ID 4 selected	SCSI Device ID 4 deselected	
– 5	SCSI Device ID 5 selected	SCSI Device ID 5 deselected	
– 6	SCSI Device ID 6 selected	SCSI Device ID 6 deselected	
– 7	SCSI Device ID 7 selected	SCSI Device ID 7 deselected	
10	Local speed select. Determines how speed and density requests are supplied to formatter.	Speed and density selection accomplished according to function code 63, bytes 4 and 5.	1
11	Speed = 1.27 m/s (50 ips) Density = 32 c/mm (800 cpi) selected	Deselected	2
12	Speed = 2.54 m/s (100 ips) Density = 32 c/mm (800 cpi) selected	Deselected	
13	Speed = 1.27 m/s (50 ips) Density = 63 c/mm (1600 cpi) selected	Deselected	
14	Speed = 2.54 m/s (100 ips) Density = 63 c/mm (1600 cpi) selected	Deselected	
15	Speed = 1.27 m/s (50 ips) Density = 126 c/mm (3200 cpi) selected	Deselected	
16	Speed = 1.27 m/s (50 ips) Density = 246 c/mm (6250 cpi) selected	Deselected	
17	Speed = 2.54 m/s (100 ips) Density = 246 c/mm (6250 cpi) selected	Deselected	
30	Tape is automatically tensioned and brought to BOT, and (if unit was previously on line) unit is placed on line. If unit was not previously on line, tape is tensioned and brought to BOT, unit then idles. Occurs when tape is in path immediately after primary power is applied.	No autoload function; if tape is in path, it will sit idle.	3
31	Tape is loaded and brought to BOT with single depression of LOAD/ON LINE switch. Second switch depression after tape reaches BOT is required to place drive on line.	Tape is loaded and brought to BOT with single depression of LOAD/ON LINE switch. Second switch depression prior to tape reaching BOT causes drive to automatically go on line when tape reaches BOT.	

NOTES:

1. The factory default for this function code is set.
2. Only one code within this group can be set at a time. Setting a code clears the previously set code within the group. The individual codes within the group cannot be cleared independently.
3. Autoload function (code 30) must be set before tape is tensioned.
4. If RESET switch is pressed, unit will return to Function Select mode with code 50 displayed. To return to normal operation, set mode 50 and depress RESET.

Continued

Table 3-1
Function Selection Codes (Continued)

Code	Diagnostic Codes		Notes
	Code Set (SET/CLEAR LED On)	Code Cleared (SET/CLEAR LED Off)	
50	Normal operation selected.	Diagnostic routine selected	2
51	Manual control of tape motion functions is provided by front panel controls. Refer to Paragraph 3.13.1.	Diagnostic mode 51 deselected	4
52	Manual control of tape shuttle function is provided by front panel controls. Refer to Paragraph 3.13.2.	Diagnostic mode 52 deselected	4
53	Provides front panel monitoring of tension and velocity encoders and various sensors. Refer to Paragraph 3.13.3.	Diagnostic mode 53 deselected	4
54	Provides front panel control of self-adjustment diagnostics. Refer to Paragraph 3.13.4.	Diagnostic mode 54 deselected	4
55	Provides front panel examination and display of various data from the Control Write PCBA. Refer to Paragraph 3.13.5.	Diagnostic mode 55 deselected	4
56	Auto write current adjust and NRZI write deskew adjust	Diagnostic Mode 56 deselected	
57	Auto read gain adjust selected	Diagnostic Mode 57 deselected	
58	Spare		
59	Auto write current and read gain override (allows manual adjustment)	Diagnostic Mode 59 deselected	
60	Provides manual override of various safety interlocks. Refer to Paragraph 3.13.10. ***WARNING*** ***THIS CODE IS INTENDED FOR USE DURING SERVICING BY QUALIFIED TECHNICIANS ONLY. IMPROPER USE CAN RESULT IN INJURY TO PERSONNEL AND EQUIPMENT DAMAGE.***	Diagnostic mode 60 deselected	4
61	Provides manual override of various motion control corrections. Refer to Paragraph 3.13.11. *CAUTION* *THIS CODE IS INTENDED FOR USE DURING SERVICING BY QUALIFIED TECHNICIANS ONLY. IMPROPER USE CAN RESULT IN EQUIPMENT DAMAGE.*	Diagnostic mode 61 deselected	4
62	Spare		
63	Provides manual selection of operating configuration.	Deselected	

NOTES:
1. The factory default for this function code is set.
2. Only one code within this group can be set at a time. Setting a code clears the previously set code within the group. The individual codes within the group cannot be cleared independently.
3. Autoload function (code 30) must be set before tape is tensioned.
4. If RESET switch is pressed, unit will return to Function Select mode with code 50 displayed. To return to normal operation, set code 50 and depress RESET.

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3.4.12 RESET SWITCH

Depressing the RESET switch with the unit off line, terminates the last command in process, clears a load fault and terminates the function selection operation. Depressing the switch again has no effect.

3.4.13 WRT EN INDICATOR

Indicates that a reel of tape with a write enable ring is loaded on the supply hub.

3.4.14 HI SPD INDICATOR

Indicates that the drive's higher operating speed 2.54 m/s (100 ips) has been selected.

3.4.15 HI DEN INDICATOR

Indicates that the highest recording density has been selected.

3.4.16 SEVEN SEGMENT DISPLAYS

Two 7-segment displays are located on the front panel (see Figure 3-2). These displays indicate the selected density, drive's SCSI device ID, function select codes when in the function select mode, fault codes (located in Table 3-10, later in this section) and diagnostic codes (refer to Table 3-1).

Two digits are continuously displayed during on-line operations. The first of these digits indicates the selected density and the second indicates the SCSI device ID. Density is indicated by the following representation:

= NRZI = PE = DDPE = GCR

When off line, a dash in the first digit position indicates that function select code 10 is cleared. If function select code 10 is set, the density selected by the FUNCTION SELECT switch or codes 11—17 will be indicated as shown in the preceding representation.

A continuously illuminated code when off line indicates that diagnostic checks are in process. If a fault is identified, the displays flash the fault code until power is switched off or RESET is depressed.

3.4.17 AUTOLOAD OVERRIDE

The Autoload Override is a mechanical linkage accessible with the tape loading door opened. Depressing this switch unlatches the supply reel hub locking mechanism when the hub is turned CW, and latches the locking mechanism when the hub is turned CCW.

3.4.18 FORMATTER OPTION SWITCHES

The formatter option DIP switches, shown in Figure 3-3, provide a means of selecting certain optional features. Switch 1, when closed, enables a 30 second diagnostic test on unit powerup. The remaining switches are not currently used.

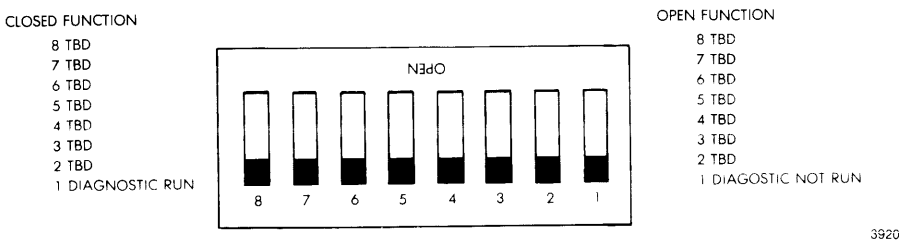

Figure 3-3. Formatter Option Switches

3.5 LOGICAL INTERFACE

The SCSI/Formatter implements the logical characteristics described in Section 5 of ANSI Specification X3.131—1986 with the options and exceptions specified in the following paragraphs.

3.5.1 BUS PHASES

The SCSI/Formatter supports all SCSI bus phases including ARBITRATION and RESELECTION.

3.5.2 SELECTION TIMEOUT OPTION

The SCSI/Formatter implements the Selection Timeout Option defined in ANSI Specification X3.131-1986, Paragraph 5.1.3.5, Option 2.

3.5.3 RESELECTION TIMEOUT OPTION

The SCSI/Formatter implements the Reselection Timeout procedure defined in ANSI Specification X3.131-1986, Paragraph 5.1.4.5. Option 2.

3.5.4 PHASE INTERRUPTIONS

The SCSI/Formatter can send a DISCONNECT message during either the COMMAND or DATA phases. The following conditions will also interrupt these phases.

RESET Condition: The RESET condition occurs when the SCSI RESET signal (– RST) is asserted or when a POWER FAIL/POWER OFF condition is detected. The SCSI/Formatter terminates the phase in progress and also the connection established during SELECTION/RESELECTION by releasing the BSY signal.

DATA (IN or OUT) PARITY ERROR Condition.

3.5.5 SYNCHRONOUS DATA TRANSFER REQ/ACK OFFSET

The REQ/ACK offset is programmable from 1 to 12 by using extended messages.

3.5.6 RESET OPTION

The SCSI/Formatter implements the Hard reset option. When a RESET condition is detected, the interface will:

(1) Immediately clear all uncompleted or pending operations.

(2) Release all SCSI device reservations.

(3) Return any SCSI device operating modes (e.g., MODE SELECT) to the default condition.

(4) Perform a limited set of self test diagnostics.

3.5.7 MESSAGES

The SCSI/Formatter supports the message protocol described in Section 5 of ANSI specification X3.131-1986, and implements the messages listed in Table 3-2.

3.5.8 EXTENDED MESSAGES

A value of one in the first byte of a message indicates the beginning of a multiple-byte extended message. The 3 bytes following the extended message code of 01 must comply with ANSI Standard X3.131-1986. Table 3-3 provides the extended message codes supported by the SCSI/Formatter.

If the SCSI/Formatter receives any of the non-supported extended message codes, it will respond with a MESSAGE-REJECT message code, 07H.

3.5.8.1 SYNCHRONOUS DATA TRANSFER REQUEST Message

The SCSI/Formatter must comply with the SYNCHRONOUS DATA TRANSFER REQUEST Extended Message as described in ANSI Standard X3.131-1986 for the Target Response when in the Target mode, and for the Initiator Response when in the Initiator mode (for the Copy command).

Table 3-4 describes the contents of the Synchronous Data Transfer Request message. The value of m in byte 3 gives the minimum transfer period for the initiator and the value of x in byte 4 gives the maximum REQ/ACK offset. The drive will return a Synchronous Data Transfer Request message to the initiator. The values for m and x in bytes 3 and 4, respectively, will be replaced with the drives minimum transfer rate and maximum REQ/ACK offset value closest to those indicated by the initiator.

Tables 3-5a and 3-5b list synchronous transfer rates for various values of m. Table 3-5a lists transfer rates to a maximum of 5.0 Mbytes/sec at a CMC/SBIC chip clock frequency of 30 MHz. Table 3-5b lists transfer rates to a maximum of 4.0 Mbytes/sec at a CMC/SBIC chip clock frequency of 24 MHz. The first column contains the value of m that represents the upper limit for a specified transfer period. (e.g., If the value of m in the received message is 5F hex, the drive will return a value of 5E hex (Table 3-5b) for a transfer rate of 2.7 Mbytes/sec). Ideally, the initiator will send values of m that match those in Table 3-5, thus matching initiator and drive transfer rates.

Table 3-6 lists the REQ/ACK offsets resulting from various values of x in byte 4 of the Synchronous Data Transfer Request message. If the value of x is 1 to 12, the drive will return the same value. If the value of x from the initiator is greater than 12, the drive will return a value of 12. If the value of x from the initiator is 0, a synchronous transfer is assumed.

Table 3-2
Currently Supported Messages

Message Code (Hex)	Definition
00	Command Complete
01	Extended Messages
02	Save Data Pointer
03	Restore Pointers
04	Disconnect
05	Initiator Detected Error
06	Abort
07	Message Reject
08	No Operation
09	Message Parity Error
0A*	Linked Command Complete
0B*	Linked Command Complete (with Flag)
0C	Bus Device Reset
XX	Identify
*Not supported.	

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Table 3-3
Extended Message Codes

Code	Description	Supported
00h	Modify Data Pointer	No
01h	Synchronous Data Transfer	Yes
02h	Extended Identify	No
03h-7Fh	Reserved	No
80h-FFh	Vendor Unique	No

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Table 3-4
Synchronous Data Transfer Request Message

Byte	Value	Description
0	01h	Extended message
1	03h	Extended message length
2	01h	SYNCHRONOUS DATA TRANSFER REQUEST code
3	m	Transfer period (m times 4 nanoseconds)
4	x	REQ/ACK offset

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Table 3-5a
Synchronous Transfer Periods/Rates (30 MHz Clock)

Value of m (hex)	Transfer Period (nsec)	Transfer Rate (MB/sec)
less than 32	200	5.0
32	200	5.0
4B	300	3.3
64	400	2.5
7D	500	2.0
96	600	1.7
greater than 96	600	1.7

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Table 3-5b
Synchronous Transfer Periods/Rates (24 MHz Clock)

Value of m (hex)	Transfer Period (nsec)	Transfer Rate (MB/sec)
less than 3F	250	4.0
3F	250	4.0
5E	375	2.7
7D	500	2.0
9D	625	1.7
BC	750	1.3
greater than BC	750	1.3

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Table 3-6
Synchronous Data Transfer Offset

Value of x	Action Taken
0	Asynchronous transfer
1-12	Synchronous transfer with offset 1-12
greater than 12	Synchronous transfer with offset 12

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3.6 SCSI BUS PARITY ERRORS

The following paragraphs describe the results of parity errors detected during different operational phases.

3.6.1 PARITY ERRORS DETECTED BY THE FORMATTER

3.6.1.1 Parity Error During SELECTION Phase

The Initiator creates the SELECTION phase to select a particular target. The SCSI/ Formatter confirms the selection by asserting BSY. However, if the SCSI/Formatter detects a parity error during the SELECTION phase, it will not assert BSY. After a selection abort timeout delay, the Initiator then asserts RST, or releases SEL and goes to the BUS FREE state.

3.6.1.2 Parity Error During MESSAGE OUT Phase

The SCSI/Formatter normally creates the MESSAGE OUT phase in response to an Attention condition created by the Initiator. It then transfers a message consisting of one or more bytes out from the Initiator. If the SCSI/Formatter detects a parity error on one or more of these bytes, it will switch to the MESSAGE IN phase and send a RESTORE DATA POINTER message. This causes the Initiator to move its message pointer back to the beginning of the message, insuring that when the SCSI/Formatter switches back to the MESSAGE IN phase, it will receive all the bytes in the message. The SCSI/Formatter then switches to the MESSAGE OUT phase and attempts to receive the entire message again.

If the Initiator detects a parity error during a RESTORE DATA POINTER message, it will assert ATN to tell the SCSI/Formatter it has a message. The SCSI/Formatter will then switch to the MESSAGE OUT phase and receive the message.

(1) If the message is ABORT, BUS RESET, or NO OPERATION, the SCSI/Formatter will return to the BUS FREE phase.

(2) If the message is MESSAGE REJECT or MESSAGE PARITY ERROR, the SCSI/Formatter will repeat the MESSAGE IN phase, send a RESTORE DATA POINTER message, switch to the MESSAGE OUT phase, and attempt to receive the message again.

3.6.1.3 Parity Error During COMMAND Phase

The recovery action performed by the SCSI/Formatter for a parity error detected during a COMMAND phase is similar to the action performed for errors detected during the MESSAGE OUT phase. If the SCSI/Formatter detects a parity error during the COMMAND phase, it will switch to the MESSAGE IN phase and send a RESTORE DATA POINTER message. It will then switch to the COMMAND phase and attempt to receive the entire 6-byte Command Descriptor Block again. From that point, the sequence of events is the same as for a parity error during the MESSAGE OUT phase.

3.6.1.4 Parity Error During DATA OUT Phase

If the SCSI/Formatter detects a parity error during the DATA OUT phase of a Write command, it will switch to the MESSAGE IN phase and send a RESTORE DATA POINTER message. It will then backspace the tape to the first data block transferred, switch back to the DATA OUT phase, and restart the data transfer from the first data block.

The Initiator saves data pointers at the start of each bus phase. In the case of a fixed block Write command, many hundreds (or thousands) of blocks could have been written before the parity error occurred, and the time involved to reposition the tape and rewrite the data from the first block could be significant.

An alternative to this is to set bit 2 of Configuration Code 6 in Function Code 63. This tells the SCSI/Formatter to send a SAVE DATA POINTER message after each block has been recorded on the tape during a fixed block transfer. Then if the SCSI/Formatter detects a SCSI bus parity error, it will send a RESTORE DATA POINTER message and only has to backspace the tape one block, rather than the number of blocks specified in the Write command.

Because the SCSI/Formatter sends a SAVE DATA POINTER message after each block, the Initiator must be fast enough to respond to the message, save the data pointers and respond to the following DATA OUT phase within the tape drive reinstruct time. If the Initiator is not fast enough, the tape will not stream.

3.6.2 PARITY ERRORS DETECTED BY THE INITIATOR

3.6.2.1 Parity Error During MESSAGE IN or STATUS Phase

If the Initiator detects a parity error during the MESSAGE IN or STATUS phase, the expected response would be to inform the SCSI/Formatter by asserting ATN. After the current bus phase is complete, the SCSI/Formatter then switches to the MESSAGE OUT phase to receive the message.

(1) If the message is INITIATOR DETECTED ERROR, the SCSI/Formatter will switch to the MESSAGE IN phase, send a RESTORE DATA POINTER message, and then try to resend the status or message bytes that resulted in the parity error.

(2) If the Initiator detects a parity error during the RESTORE POINTERS message, it will again assert ATN. The SCSI/Formatter will switch to the MESSAGE OUT phase to receive the next Initiator message.

If the message is ABORT, NO OPERATION, or BUS RESET, and if there was no parity error associated with the message, the SCSI/Formatter will go to the BUS FREE state.

If the message is MESSAGE REJECT or MESSAGE PARITY ERROR, the SCSI/Formatter will repeat the MESSAGE IN phase and resend the RESTORE DATA POINTER message.

(3) If the message is ABORT, NO OPERATION, or BUS RESET, and if there was no parity error associated with the message, the SCSI/Formatter will go to the BUS FREE state.

3.6.2.2 Parity Error during DATA IN Phase

Parity errors detected during the DATA IN phase of a Read (or Read Reverse) command are handled the same way as those detected during the MESSAGE IN or STATUS phases. The Initiator sends an INITIATOR DETECTED ERROR message and the SCSI/Formatter replies with a RESTORE DATA POINTER message. However, instead of resending a message or status byte, the SCSI/Formatter resends the data from the cache. If the data are not present in the cache, the SCSI/Formatter will reload the cache from the tape.

After the SCSI/Formatter sends the RESTORE DATA POINTER message, it will resend the data beginning with the first block of the command. In the fixed block mode, this could result in a considerable time delay depending upon the number of blocks specified by the command. (In the variable block mode, the delay is insignificant because the command only specifies 1 block).

An alternative is to set bit 2 of Configuration Code 6 in Function Code 63. This causes the SCSI/Formatter to send a SAVE DATA POINTER message after each block is sent to the Initiator. If and when a SCSI bus parity error is detected, the SCSI/Formatter will resend the data beginning with the block that caused the error, rather than with the first block specified by the Read command.

For variable block Read and Write commands, as well as Inquiry, Mode Sense, and Read Block Limits command, the SCSI/Formatter will always resend the entire data block.

3.7 SCSI COMMAND AND STATUS STRUCTURE

The SCSI/Formatter supports the 6-byte command descriptor block (CDB) structure as defined in ANSI X3.131—1986 with the following options or exceptions.

- Because the SCSI/Formatter only supports one logical unit, the value of the LUN field must be 0.
- If the SCSI/Formatter has accepted an IDENTIFY message, it will ignore the LUN value in the CDB. Otherwise, the SCSI/Formatter will check the LUN value and if it is not 0, will reject the command and return an ILLEGAL REQUEST sense key.
- Reserved bits, bytes, fields, and code values are set aside for future standardization. These are represented by zeros in the CDB and are not checked for non-zero conditions.
- The Flag and Link fields in Byte 5 of the CDB are not currently implemented.

3.8 COMPLETION STATUS BYTE

The SCSI/Formatter sends a Completion Status Byte to the initiator during the STATUS phase at the end of each command, unless the command is cleared by an ABORT or BUS DEVICE RESET message, or by a Hard reset condition. The content of the Completion Status Byte is shown in Figure 3-4 and described in the following paragraphs. Successful completion of a command (GOOD status) is indicated by zeros in all bits of the Completion Status Byte.

3.8.1 CHECK CONDITION STATUS

The CHECK CONDITION status (a 1 in bit 1) indicates that the command terminated with an error, exception, or abnormal condition, and that the condition should be checked. Additional information is available in the Extended Sense data.

3.8.2 BUSY STATUS

The SCSI/Formatter returns BUSY status (a 1 in bit 3) whenever it is unable to accept a command from an initiator.

3.8.3 INTERMEDIATE/GOOD STATUS (NOT SUPPORTED)

3.9 INTERNAL UNIT ATTENTION CONDITION

The SCSI/Formatter generates a Unit Attention condition when one of the following events occurs:

- The interface receives a BUS DEVICE RESET message
- The tape drive is first powered up
- The tape drive is switched from off line to on line
- The load command is given from the SCSI bus or front panel

Bit	7	6	5	4	3	2	1	0
	0	0	0	Inter/Good	Busy	0	Chk Cond	0

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Figure 3-4. Completion Status Byte Bit Map

Possible Initiator responses to the preceding events are:

- Case 1 — A Request Sense command
- Case 2 — An Inquiry command
- Case 3 — Any other command

The following paragraphs describe the responses to these commands when a Unit Attention condition exists.

3.9.1 CASE 1 —REQUEST SENSE

If a Unit Attention condition exists and a Request Sense command is received, the SCSI/Formatter will return UNIT ATTENTION sense key during the DATA IN phase, a GOOD status, and will then clear the Unit Attention condition for that initiator. Subsequent commands will return an appropriate status and sense key.

3.9.2 CASE 2 — INQUIRY

If the SCSI/Formatter receives an Inquiry command, it will return a GOOD status, but will not clear the Unit Attention condition. This will repeat as long as Inquiry commands are received from the initiator.

If, after the Inquiry command, the SCSI/Formatter receives a Request Sense command, it will return a UNIT ATTENTION sense key during the DATA IN phase, a GOOD status, and will clear the Unit Attention condition for that initiator. Subsequent commands will return an appropriate status and sense key.

If, after the Inquiry command, the SCSI/Formatter receives any command other than a Request Sense or an Inquiry command, it will not be performed. The SCSI/Formatter will return a CHECK CONDITION status, clear the Unit Attention condition for the initiator, and perform as follows:

(1) If the next command is a Request Sense command, the SCSI/Formatter will return a UNIT ATTENTION sense key and a GOOD status for that initiator. Subsequent commands will return an appropriate status and sense key.

(2) If the next command is not a Request Sense command, the SCSI/Formatter will return a NO SENSE sense key and a GOOD status. In this case, the Unit Attention condition will never have been reported to the initiator and will be lost.

3.9.3 CASE 3 — ANY OTHER COMMAND

If the SCSI/Formatter receives any command other than Request Sense or Inquiry, it will not perform the command. The SCSI/Formatter will return a CHECK CONDITION status and clear the Unit Attention condition for that initiator.

If the next command is a Request Sense command, the SCSI/Formatter will return a UNIT ATTENTION sense key and a GOOD status for that initiator. Subsequent commands will return an appropriate status and sense key.

If the next command is not a Request Sense command, the SCSI/Formatter will return a NO SENSE sense key and a GOOD status. In this case, the Unit Attention condition will not be reported to the initiator and will be lost.

3.10 SCSI COMMAND SET IMPLEMENTATION

The SCSI/Formatter normally functions as a target, but during the Copy command, it can also function as an initiator. The host sends a command to the SCSI/Formatter in the form of a command descriptor block (CDB). Certain fields in the CDB are examined and errors, if any, are reported to the host. If the command is valid, it is then executed.

When a Copy command is received, the SCSI/Formatter switches to the initiator mode, transmits the appropriate commands to another peripheral, transmits and receives data and status, then switches back to the target mode, and finally reports the results of the Copy command back to the host.

3.11 SUMMARY OF COMMANDS SUPPORTED

Table 3-7 lists the commands supported by the SCSI/Formatter. If an error or exception condition exists when the command is received, the SCSI/Formatter will return a CHECK CONDITON status. Further information may be available in the Extended Sense Data.

3.12 COMMAND RESTRICTIONS

The SCSI/Formatter will return an ILLEGAL REQUEST sense key with a Command Sequence Error in the Extended Sense data, if it receives any of the following commands immediately after a Write, Write Filemark, or Erase command.

- Read (Forward)
- Verify
- Copy (Restore)
- Space (Forward)

Note

Linked commands are not currently implemented. All fields designated 0 must be set to 0.

Table 3-7
Commands Supported

Command Code	Command Name	Command Code	Command Name
00	Test Unit Ready	14	Recover Buffered Data
01	Rewind	15	Mode Select
03	Request Sense	16	Reserve Unit
05	Read Block Limits	17	Release Unit
08	Read	18*	Copy
0A	Write	19	Erase
0F	Read Reverse	1A	Mode Sense
10	Write Filemark	1B	Load/Unload
11	Space	1C*	Receive Diagnostics Results
12	Inquiry	1D	Send Diagnostics
13*	Verify		

* Not yet implemented

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3.13 TEST UNIT READY COMMAND (00_H)

3.13.1 COMMAND DESCRIPTION

The Test Unit Ready command returns the current status of the tape drive to the host. The command format is shown in Figure 3-5.

3.13.2 ERROR CONDITIONS

If the tape drive is on line and not rewinding, the SCSI/Formatter will return a GOOD status byte. For all other conditions, a CHECK CONDITION status along with a NOT READY sense key will be returned.

3.14 REWIND COMMAND (01_H)

3.14.1 COMMAND DESCRIPTION

The Rewind command causes the tape to be positioned at BOT (Load Point). If disconnection has been allowed by the selection process, the SCSI/Formatter disconnects from the SCSI bus and checks the level of data in the cache. If the cache contains unrecorded data from a previous Write command, the data are written to tape before rewinding. If the cache contains data from a previous Read command, the cache is cleared. The command format is shown in Figure 3-6.

3.14.2 IMMEDIATE BIT

The value of the Immediate bit determines when the SCSI/Formatter returns status to the host. If this bit is 0, the host is reselected and GOOD status is returned at the end of the rewind operation. If the bit is set to 1, the host is reselected and GOOD status is returned immediately after sending a rewind signal to the tape drive.

3.14.3 ERROR CONDITIONS

If the Immediate bit is set to 1 and a write error occurs after the SCSI/Formatter has reported a GOOD status for the Rewind command, the process will halt and the tape will not be rewound. The host can send a Request Sense command and determine the unrecorded cache data count by examining the Extended Sense data. The host can then retrieve the unrecorded cache data by sending a Recover Buffered Data command.

	BIT							
BYTE	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0
1	Logical Unit Number			0	0			
2	00							
3	00							
4	00							
5	0				0	0	Flag	Link

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Figure 3-5. Test Unit Ready CDB

BYTE	BIT							
	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	1
1	Logical Unit Number			0	0	0	0	Immediate
2	00							
3	00							
4	00							
5	0				0	0	Flag	Link

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Figure 3-6. Rewind CDB

3.15 REQUEST SENSE COMMAND (03_H)

3.15.1 COMMAND DESCRIPTION

On receipt of a Request Sense command, the SCSI/Formatter sends several bytes of information that the host can use to obtain additional information about the last command after receiving a CHECK CONDITION status. The command format is shown in Figure 3-7. The sense data is valid for a CHECK CONDITION status returned on the previous command. The sense data is saved until: 1) The host that received the CHECK CONDITION status issues a Request Sense command, or 2) The host that received the CHECK CONDITION status issues another command to the same tape drive.

BYTE	BIT							
	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	1	1
1	Logical Unit Number			0	0			
2	00							
3	00							
4	Allocation Length (18_H)							
5	0				0	0	Flag	Link

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Figure 3-7. Request Sense CDB

3.15.2 ALLOCATION LENGTH

The Allocation Length specifies the number of bytes the initiator has allocated for returned Sense Data. The SCSI/Formatter supports both the Non-Extended and the Extended Sense Data formats. An allocation length value of zero causes the Non-Extended Sense Data format shown in Figure 3-8 to be sent. A value greater than zero will cause the Extended Sense Data format shown in Figure 3-9 to be sent. If the allocation length is greater than the number of bytes available for transfer, the SCSI/Formatter will terminate the DATA IN phase when it has transferred all the bytes it has. If the allocation length is less than the number of bytes available for transfer, the SCSI/Formatter will terminate the DATA IN phase after transferring the number of bytes specified in the Allocation Length field of the CDB.

3.15.3 ERROR CONDITIONS

If a fatal error occurs while a Request Sense command is being processed, the SCSI/ Formatter will return a CHECK CONDITON status. Following a fatal error on a Request Sense command, the sense data may not be valid. Examples of fatal errors are:

- A nonzero reserved bit is detected in the CDB.
- An unrecoverable parity error occurs on the data bus.
- A SCSI/Formatter malfunction prevents the return of sense data.

If a nonfatal error occurs during the execution of the Request Sense command, the SCSI/ Formatter will return the sense data with GOOD status.

3.15.4 VALID BIT

A 1 in bit 7 byte 0 of the Extended Sense Data indicates that the Information Bytes (bytes 3—6) contain valid data. If bit 7 is set to 0, the Information Bytes do not contain valid data.

3.15.5 SEGMENT NUMBER

This byte is used only during the Copy command. It contains the number of the segment descriptor being processed at the time an error is detected during a Copy, Compare, or Copy And Verify command.

3.15.6 FMK (FILEMARK BIT)

This bit is set to 1 if a filemark was read or spaced over.

	BIT							
BYTE	7	6	5	4	3	2	1	0
0	Valid	1	1	0	0	0	0	0
1	0	0	0	Logical Block Address (MSB)				
3	Logical Block Address							
4	Logical Block Address (LSB)							

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Figure 3-8. Non-Extended Sense Data CDB

BYTE	BIT							
	7	6	5	4	3	2	1	0
0	Valid	1	1	1	1	1	1	1
1	Segment Number (Copy command only, all others = 00)							
2	FMK	EOM	ILI	0	Sense Key			
3	Information Byte (MSB)							
4	Information Byte							
5	Information Byte							
6	Information Byte (LSB)							
7	Extended Sense Data Length (10_H)							
8	DVRDY	TNL	0	WPT	EOT	HER	BNF	EOF
9	0	0	BTE	0	BOT	SBPE	0	0
10	00							
11	Total Retries Performed							
12	00							
13	Unrecorded Cache Data							
14—16	00							
17	Sub-Code							
18	00							

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Figure 3-9. Extended Sense Data CDB

3.15.7 EOM (END OF MEDIA BIT)

When set to 1, this bit indicates that if the tape was moving forward, it is at or past Early EOT. If the tape was moving in the reverse direction, it indicates that BOT was detected while the command was being processed.

3.15.8 ILI (INCORRECT LENGTH INDICATOR BIT)

This bit is set to 1 if the requested block length did not match the block size on the tape.

3.15.9 SENSE KEYS

Following is a list of the sense keys used by the SCSI/Formatter.

0 NO SENSE. There is no specific sense key information currently stored for the designated unit. This would be the case for a successful command or a command that received a CHECK CONDITION status because one or more of the filemark, EOM, or ILI sense bits is set to 1.

1 RECOVERABLE ERROR. The last I/O was completed successfully with some recovery action. Details can be determined by examining the residue count and the Extended Sense Data bytes.

2 NOT READY. The addressed tape drive cannot be accessed. Operator intervention may be required to correct this condition.

3 MEDIA ERROR. Indicates that the command was completed with a non-recoverable error condition that was probably caused by defective tape.

4 HARDWARE ERROR. Indicates that a non-recoverable hardware error was detected while attempting to perform the command or the power up diagnostics.

5 ILLEGAL REQUEST. Indicates that there was an illegal parameter in the command descriptor block or in the additional parameters supplied as data for some commands (Mode Select).

6 UNIT ATTENTION. Indicates that the tape may have been changed, that the tape drive has been recently placed on line, or that the SCSI interface has received a BUS DEVICE RESET message or a hard RESET condition. May be the result of a power-up condition or a reset from the SCSI bus.

7 DATA PROTECT. Indicates that Write was attempted on a tape drive that is file-protected. The write operation is not performed and the tape is not moved.

8 BLANK CHECK. Indicates that blank tape has been detected. The current position of the tape will be about 25 feet beyond the last data block or filemark.

B ABORTED COMMAND. The SCSI/Formatter aborted the command. The operating system may be able to recover by trying the command again.

D VOLUME OVERFLOW. Occurs when the tape reaches physical EOT with unrecorded data still in the cache. A Recover Buffered Data command can be issued to read the data remaining in the cache.

3.15.10 INFORMATION BYTES

The Information Bytes are undefined if the Valid bit is 0. If the Valid bit is 1, their value depends upon the outcome of the previous command.

3.15.10.1 Read Information Bytes

The following conditions apply to a variable length read:

- If the data was read correctly from the tape and sent to the initiator, the Information Bytes will be set to 0.

- If a hard error occurred while reading data from the tape, the Information Bytes will be set to the requested block length.
- If the data was read correctly but the block read was larger or smaller than the requested block length, the Information Bytes will be set to a residue count that equals the requested block length minus the actual block length. Negative residue counts are expressed in 2's complement notation.

The following conditions apply to a fixed length read:

- If the data was read correctly from the tape and sent to the initiator, the Information Bytes will be set to 0.
- If a hard error occurred while reading data from the tape, the SCSI/Formatter will set the Information Bytes to a residue count that equals the requested number of blocks minus the actual number of blocks read, excluding a filemark, if that was the cause of the error.
- If the SCSI/Formatter read the data correctly but the block read was larger or smaller than the requested block length, the Information Bytes will be set to a residue count that equals the requested number of blocks minus the actual number of blocks transferred. The incorrect length block is transferred. If the length of the incorrect block exceeds the block size set in the last Mode Select command, only the number of bytes specified in the Mode Select command will be transferred.

One method of recovery from these conditions is to set the variable length mode, send a Read command in the opposite direction, examine the information bytes, and then reread the block with the correct block length in the CDB.

3.15.10.2 Write Information Bytes

The following conditions apply to a variable length write:

- If the SCSI/Formatter wrote the data correctly to the tape, it will set the Information Bytes to 0.
- If a hard error occurred while writing data to the tape, the Information Bytes will be set to a residue count that equals the block size of the last Write command.

The following conditions apply to a fixed length write:

- If the SCSI/Formatter wrote the data correctly to the tape, the Information Bytes will be set to 0.
- If a hard error occurred while writing data to the tape, the Information Bytes will be set to a residue count that equals the requested number of blocks minus the actual number of blocks recorded on the tape (including the bad block).

3.15.11 EXTENDED SENSE DATA LENGTH

This byte contains the number of Extended Sense Data bytes that follow.

Bytes 0—7 of the Standard Sense Data are followed immediately by the Extended Sense Data bytes as defined in the following paragraphs.

3.15.12 EXTENDED SENSE DATA BYTES

The format of the Extended Sense Data Bytes is shown in Figure 3-9. The various bit fields are described in the following paragraphs.

3.15.12.1 Total Retries Performed

This byte contains the total number of retries performed for a given command by both the SCSI/Formatter and the host.

3.15.12.2 Unrecorded Cache Data

In the variable block mode, the UCD byte will equal the number of unrecorded data blocks in the cache. Refer to the Write Command description in Paragraph 3.18 for further information.

3.15.12.3 Sub-Codes

When the SCSI/Formatter returns a UNIT ATTENTION sense key, it returns additional information in the Sub-Code byte. This additional information is defined in Table 3-8.

3.15.12.4 DVRDY (Drive Ready)

This bit is set to 1 when the tape drive is on line and the tape is tensioned.

3.15.12.5 TNL (Tape Not Loaded)

This bit is set to 1 when the tape is not tensioned.

3.15.12.6 WPT (Write Protected)

This bit is set to 1 when the tape is write protected.

3.15.12.7 EOT (End of Tape)

This bit is set to 1 when the tape is positioned at or beyond the physical EOT marker.

3.15.12.8 HER (Hard Error)

This bit is set to 1 when the previous command resulted in an unrecoverable data error.

Table 3-8
Sub Codes

Sub-Code (Hex)	Definition
00	**Reset without error.** A hard or soft reset occurred that was followed by an error free power on self test.
64	**Reset with error.** A hard or soft reset occurred that was followed by a power on self test that failed.
66	**Power Fail.** The tape drive sensed a power failure that was not long enough to force the drive into a complete power down, or cause it to do a power on self test.
84	**Media Change.** The tape has been changed since the last CDB.

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3.15.12.9 BNF (Block Not Found)

This bit is set to 1 when no block was found (same as Sense Key 8, BLANK CHECK).

3.15.12.10 EOF (End of File)

This bit is set to 1 if a filemark was detected during the previous Read or Space command.

3.15.12.11 BTE (Bad Tape Error)

This bit is set to 1 when a hard error occurred that is due to bad tape. In most cases, the Sense Key will be 03 (Media Error).

3.15.12.12 BOT (Beginning Of Tape)

This bit is set to 1 when the tape is positioned at load point.

3.15.12.13 SBPE (SCSI Bus Parity Error)

This bit is set to 1 when a SCSI bus parity error is detected.

3.16 READ BLOCK LIMITS COMMAND (05_H)

3.16.1 COMMAND DESCRIPTION

The Read Block Limits command returns the minimum and maximum data block lengths supported by the SCSI/Formatter. The command format is shown in Figure 3-10.

3.16.2 READ BLOCK LIMITS DATA

The SCSI/Formatter will return a value of 1 for the minimum block length (3 in the GCR mode) and a value of 64k for the maximum block length as shown in Figure 3-11.

	BIT							
BYTE	7	6	5	4	3	2	1	0
0	0	0	0	0	0	1	0	1
1	Logical Unit Number			0	0			
2	00							
3	00							
4	00							
5	0				0	0	Flag	Link

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Figure 3-10. Read Block Limits CDB

BYTE	BIT							
	7	6	5	4	3	2	1	0
0	00							
1	01 (Maximum Block Length MSB)							
2	00 (Maximum Block Length)							
3	00 (Maximum Block Length LSB)							
4	00 (Minimum Block Length MSB)							
5	01 or 03 (Minimum Block Length LSB)							

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Figure 3-11. Read Block Limits Data CDB

3.17 READ COMMAND (08_H)

3.17.1 COMMAND DESCRIPTION

The Read command transfers one or more blocks of data from the tape drive to the host, beginning with the next block on the tape. Data is copied from the tape into the cache and then transferred to the host.

The SCSI/Formatter supports both fixed and variable block size modes. The current mode of operation is determined by parameters sent during a previous Mode Select command. If no Mode Select command has been received since the last power up or Bus Reset, the default is variable block size and high speed buffered mode operation. Refer to the Mode Select and Mode Sense descriptions, Paragraph 3.25 and 3.30 respectively, for additional default conditions. The command format is shown in Figure 3-12.

BYTE	BIT							
	7	6	5	4	3	2	1	0
0	0	0	0	0	1	0	0	0
1	Logical Unit Number			0	0			Fixed
2	Transfer Length (MSB)							
3	Transfer Length							
4	Transfer Length (LSB)							
5	0				0	0	Flag	Link

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Figure 3-12. Read CDB

3.17.1.1 Reading From BOT

When a Read command is received with the tape at BOT, the tape drive will first determine the density by reading the ID burst (or lack of it). The tape drive will then configure itself accordingly, update the internal mode sense buffer, and read the tape until one of the following conditions occurs.

- The cache becomes full and no more read commands are received
- 255 blocks or filemarks have been read
- An error is encountered and the retry count is exhausted
- One filemark is detected beyond EOT
- The end of recorded media is detected (i.e., 2 consecutive filemarks)

When the number of blocks specified in the CDB have been successfully transferred to the host, the SCSI/Formatter will return a GOOD status and terminate the Read command.

3.17.1.2 Reading from Middle of Tape

Reading data from a position other than BOT is essentially the same as when reading from BOT, with the following differences.

- The density has already been determined.
- The requested data blocks may already be in the cache, in which case the tape may not move.

3.17.1.3 Read Look-Ahead

The SCSI/Formatter will try to anticipate the needs of the host by copying enough data from tape to keep the cache full. If the blocks to be read are already in the cache as a result of a previous read or write command, the tape may not move. The read look-ahead and other internal sync operations will occur at high speed and the HISPD indicator will be On.

If an unrecoverable error occurs during the read look-ahead operation, the SCSI/Formatter will terminate the look-ahead operation, but will not report the error until a subsequent Read command causes that block to be read.

3.17.2 FIXED BIT AND TRANSFER LENGTH

The state of the Fixed Bit in the CDB must match the current mode of the SCSI/Formatter. The power-up default is variable block size.

If the Fixed Bit is set to 0, the command is requesting a variable length transfer. If the SCSI/ Formatter is not in the variable block mode, it will return an ILLEGAL REQUEST sense key.

The Transfer Length specifies the size of each block to be read (in bytes). The largest block that can be transferred is 64 kilobytes. The smallest block that can be read is 1 byte in NRZI, PE, and DDPE; and 3 bytes in GCR. If the command Transfer Length is 0, the SCSI/Formatter will treat the command as a no-op command and return a GOOD status immediately. No data will be transferred and the tape will remain stationary.

In the variable length mode, the residue count in the Extended Sense data contains the requested block size minus the actual block size in bytes.

If the Fixed Bit is set to 1, the command is requesting a fixed length transfer. If the SCSI/ Formatter is not in the fixed block mode, it will return an ILLEGAL REQUEST sense key. The operating mode may be changed to *fixed* with a Mode Select command. The Transfer Length specifies the number of blocks to be read, while the Mode Select command specifies the block size.

In the fixed length mode, the residue count in the Extended Sense data contains the number of blocks remaining to be read.

3.17.3 SPECIAL CONDITIONS

3.17.3.1 Reading a Filemark

Although filemarks do not occupy space in the cache, their positions are noted. If a filemark is detected, the Read command will be terminated, the SCSI/Formatter will report a CHECK CONDITION status and a FMK sense key.

Although the read operation will continue until the cache is full, the tape will be logically positioned just beyond the filemark. The SCSI/Formatter will transmit the blocks up to the filemark. If the Fixed bit is 1, the Valid bit will be set and the Information Bytes will define a residue count equal to the requested transfer length minus the actual number of blocks read (not including the filemark).

3.17.3.2 Reading Across the EOT Marker

If the tape drive reports EOT during a Read command, the SCSI/Formatter will stop the tape in the first IBG following the EOT marker strip. It will return a CHECK CONDITION status and a MEDIA ERROR sense key with the EOM bit set. If the Fixed bit is 1, the Valid bit will be set and the Information Bytes define a residue count equal to the requested transfer length minus the actual number of blocks read.

3.17.3.3 Reading Into Blank Tape

When blank tape is detected, the tape will be stopped about 25 feet beyond the last block read. The SCSI/Formatter will return a CHECK CONDITION status, a BLANK CHECK sense key with the Incorrect Length Indicator (ILI) set, and a residue count equal to the number of blocks requested minus the number of blocks actually read.

3.17.3.4 Block Size Differences

The cache is capable of handling variable length blocks. In the fixed length block mode, if the actual block length differs from the specified block length, the block will be copied into the cache just like any other block, and the SCSI/Formatter will continue to copy blocks into the cache as described earlier.

In the fixed block mode, the SCSI/Formatter will only send the host those blocks that were the correct length. It will then return a CHECK CONDITION status, an INCORRECT LENGTH INDICATOR sense key, and a residue count equal to the number of blocks requested minus the number of blocks actually sent to the host.

If a difference exists between the requested block length and the actual block length while in the variable block length mode, the SCSI/Formatter will only transmit the requested number of bytes. The tape will be logically positioned in front of the first incorrect length block. The SCSI/Formatter will then return a CHECK CONDITION status and an INCORRECT LENGTH INDICATOR sense key. The Valid bit will be set and the Information Bytes will define a residue count equal to the number of bytes requested minus the actual number of bytes in the block.

If the requested block length is greater than the actual block length, the residue count will be positive. If the requested block length is less than the actual block length, the residue count will be negative, and will be expressed in 2's complement notation.

3.17.4 ERROR CONDITIONS

3.17.4.1 Correctible Read Errors

Read errors cause the SCSI/Formatter to initiate error recovery procedures. Unless the error correction option is disabled, the SCSI/Formatter will invoke an error correction algorithm and transfer the corrected data.

3.17.4.2 Recoverable Read Errors

If the error is not correctable and if the retry option is enabled, the SCSI Interface will perform a number of retry operations. This number is programmable from 1 to 15 using the front panel or the Mode Select command. The SCSI/Formatter considers blocks recovered via retries to be good blocks, and will return a GOOD status.

3.17.4.3 Unrecoverable Read Errors

If the data block cannot be read by the time the retry count is exhausted, the SCSI/Formatter will terminate the Read command and return a CHECK CONDITION status with a MEDIA ERROR sense key. The BTE (Bad Tape Error) bit in the Extended Sense data will be set to 1, and the retry count will equal the number of retries that took place during the command. The tape will be positioned after the last block transferred.

The Extended Sense Information Bytes define a residue count equal to the number of blocks (or bytes, if in the variable length block mode) that were not read.

3.17.4.4 Fixed/Variable Length Errors

If the state of the Fixed Bit does not match the current mode of the SCSI/Formatter, it will reject the Read command and return an ILLEGAL REQUEST sense key.

3.17.4.5 Other Errors

If an error occurs which prevents the successful transfer of command data, the SCSI/ Formatter will return an ABORTED COMMAND sense key.

If the block length exceeds the maximum or minimum allowable block length limits, the Read command will be rejected with an ILLEGAL REQUEST sense key.

3.18 WRITE COMMAND ($0A_H$)

3.18.1 COMMAND DESCRIPTION

The Write command is used to transfer blocks of data from the host to the tape drive beginning at the current tape position. The command format is shown in Figure 3-13.

	BIT							
BYTE	7	6	5	4	3	2	1	0
0	0	0	0	0	1	0	1	0
1	Logical Unit Number			0	0			Fixed
2	Transfer Length (MSB)							
3	Transfer Length							
4	Transfer Length (LSB)							
5	0				0	0	Flag	Link

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Figure 3-13. Write CDB

The SCSI/Formatter supports both the fixed and variable block size modes. The current mode of operation is determined by parameters sent during a previous Mode Select command. If no Mode Select command has been received since the last power up or Bus Reset, the default is to variable block size, high speed buffered mode, and 1600 cpi operation. Refer to Paragraphs 3.25 and 3.30 for further information.

If the first block of data is greater than the current partition size (as set in Configuration Code 63), the SCSI/Formatter will disconnect from the SCSI bus before the DATA OUT phase while it automatically resizes the cache partition size. After it has established the correct partition size, the SCSI/Formatter will reselect the initiator and start the DATA OUT phase.

When the data block has been transferred into the cache, the recording process will begin and will stop only for the following conditions:

- All the data in the cache has been recorded and no other write commands have been received.
- The retry count has been reached and the block has not been successfully recorded on the tape.
- EOT is sensed.
- A BUS RESET message is received.

3.18.2 EARLYEOT

To insure that the contents of the cache, plus an additional 64K byte block, plus a standard ANSI volume closing label, plus filemarks can be recorded before running out of tape, the tape drive sends the SCSI/Formatter an EarlyEOT signal. This signal occurs during the write mode between 25 and 150 feet ahead of the EOT marker depending upon recording density and cache capacity.

If the SCSI/Formatter detects EarlyEOT while processing a Write command, it will temporarily suspend the data transfer from the host while it performs an internal write sync command. This causes all remaining blocks in the cache to be recorded on the tape. At the end of the internal write sync command, the SCSI/Formatter switches to the unbuffered mode and resumes transferring data from the host, one block at a time.

The SCSI/Formatter will return a Check Condition when EarlyEOT is detected for write commands only. It will not return a Check Condition when EarlyEOT is detected for other SCSI commands.

3.18.3 PSEUDOEOT

An alternative to the associated delays caused by repositioning at each block is to select the PseudoEOT option. If this option is selected (i.e., Function Code 63, Configuration Code 6, bits 1 and 4 on), the IBGs will be automatically extended, allowing the tape to stream. The length of the extended gaps is determined by the SCSI/Formatter and depends upon the tape speed and recording density. The maximum gap is 72 inches.

3.18.4 VARIABLE BLOCK WRITE

The state of the Fixed Bit in the CDB must match the current mode of the SCSI/Formatter. The power-up default is variable block size.

If the Fixed Bit is set to 0, the Write command is requesting a variable length transfer. If the SCSI/Formatter is not in the variable block mode, it will return an ILLEGAL REQUEST sense key.

The Transfer Length specifies the size of each block to be read (in bytes). The largest block that can be transferred is 64 kilobytes. The smallest block that can be read is 1 byte in NRZI, PE, and DDPE, and 3 bytes in GCR. If the Transfer Length is 0, no data will be transferred and the tape position will not change.

3.18.4.1 Variable Block Write EOT

When EarlyEOT is detected during a variable block Write command, the SCSI/Formatter will finish recording the current block, stop the tape, return a CHECK CONDITION status, a NO SENSE sense key, and set the EOM and EOT bits in the Extended Sense data. The residue count will be zero. The SCSI/Formatter will continue to accept Write commands, but they will be performed in an unbuffered mode.

3.18.4.2 Unrecorded Cache Data, Variable Block Mode

In the variable block mode, in addition to the residue count the Extended Sense data will also contain a vendor-unique byte called Unrecorded Cache Data (UCD). If the initiator immediately follows the CHECK CONDITION status with a Request Sense command, the UCD byte will equal the number of unrecorded data blocks in the cache.

3.18.5 FIXED BLOCK WRITE

If the Fixed Bit is set to 1, the command is requesting a fixed length transfer. If the SCSI/Formatter is not in the fixed block mode, it will return an ILLEGAL REQUEST sense key. The operating mode can be changed to *fixed* with a Mode Select command. The Transfer Length specifies the number of blocks to be read, while the Mode Select command specifies the block size.

If the command Transfer Length is 0, the SCSI/Formatter will treat the command as a no-op command and return a GOOD status immediately. No data will be transferred and the tape will remain stationary.

3.18.5.1 Fixed Block Write At EOT

If EarlyEOT is detected during a fixed block Write command, the SCSI/Formatter will finish recording the current block, stop the tape, return a CHECK CONDITION status with a NO SENSE sense key, and set the EOM bit in the Extended Sense data. The residue count will equal the number of blocks requested minus the number of blocks actually recorded. If operating in the variable block mode, the residue count will equal the block size.

3.18.6 COMMAND ERROR CONDITIONS

If the fixed bit is 0 and the block length in the last Mode Select Parameter List is not 0, the SCSI/Formatter will reject the Write command and return an ILLEGAL REQUEST sense key.

If the fixed bit is 1 and the block length in the last Mode Select Parameter List is 0, the SCSI/Formatter will reject the Write command and return an ILLEGAL REQUEST sense key.

The largest block that can be recorded (or read) is 64 kilobytes. If the block length exceeds 64k (10000 hex), the Write command will be rejected with an ILLEGAL REQUEST sense key.

If an error occurs that prevents the successful transfer of command data, the SCSI/Formatter will return an ABORTED COMMAND sense key.

3.18.7 DATA ERRORS

If the SCSI/Formatter detects an error while recording data on the tape, it will perform a number of retry operations. This number is programmable from 1 to 15 using the front panel or the Mode Select command.

Each automatic write retry operation consists of backspacing the tape across the bad block, erasing a length equal to the block length of the bad block plus 4 inches, and a rewrite of the block.

If the block can be successfully recorded within the allotted retry count, the error is defined as *recoverable*; the SCSI/Formatter will return a GOOD status for that block and continue writing.

If the data cannot be successfully recorded by the time the retry count is exhausted, the error is defined as *unrecoverable*. In this case, the SCSI/ Formatter will stop recording blocks, terminate the command and return CHECK CONDITION status with a MEDIA ERROR sense key. The retry count in the Extended Sense data indicates the total number of retries performed for the last command.

3.18.7.1 Unrecorded Cache Data (Fixed Block Mode Only)

In the event of a unrecoverable write error in the fixed block mode, the SCSI/Formatter will position the recording head just beyond the bad block, and will position the logical pointer just before the bad block. The Information Bytes will contain a residue count equal to the requested number of blocks minus the number of blocks actually recorded on the tape, including the bad block.

The normal recovery from this condition is for the initiator to issue a Recover Buffered Data command with the fixed bit set to 1 and the transfer length set to the value of the UCD byte in the Extended Sense. This will read out the unrecorded data blocks in the cache, and move the logical tape pointer to just after the last block recorded on the tape.

3.19 READ REVERSE COMMAND ($0F_H$)

3.19.1 COMMAND DESCRIPTION

The Read Reverse command is the same as the Read command except that the direction of tape motion is towards BOT. The blocks, and the bytes within the blocks are transferred into and out of the cache in reverse order. The command format is shown in Figure 3-14.

If BOT is sensed before the specified number of blocks were transferred, the SCSI/ Formatter will return a MEDIA ERROR sense key with the EOM bit set. The residue count contains the number of blocks or bytes which were not read.

BYTE	BITS							
	7	6	5	4	3	2	1	0
0	0	0	0	0	1	1	1	1
1	Logical Unit Number			0	0			Fixed
2	Transfer Length (MSB)							
3	Transfer Length							
4	Transfer Length (LSB)							
5	0				0	0	Flag	Link

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Figure 3-14. Read Reverse CDB

3.20 WRITE FILEMARK COMMAND (10_H)

3.20.1 COMMAND DESCRIPTION

The Write Filemark command is used to write filemarks on the tape beginning at the current tape position. The command format is shown in Figure 3-15.

If there is any unrecorded data in the cache when the Write Filemark command is received, the SCSI/Formatter will first record that data on the tape, and then record the filemark(s).

3.20.2 IMMEDIATE BIT

If the Immediate bit is set to 1, the SCSI/Formatter will return status when the command is received and disconnect from the SCSI bus. If the Immediate bit is set to 0, the SCSI/Formatter will return status after the command is completed.

3.20.3 WRITING MULTIPLE FILEMARKS

The value in the number of filemarks bytes determines the number of consecutive filemarks to be recorded. If the value is zero, the SCSI/Formatter will *flush* the cache by writing all unrecorded data on the tape. It will then return a GOOD status to the host, but it will not send a Write Filemark command to the tape drive.

After receiving a Write Filemark command with one or more filemarks specified, the SCSI/Formatter will disconnect from the SCSI bus. If the cache contains data from a previous read command, an internal Read Sync operation is performed to clear the cache and reposition the tape.

The SCSI/Formatter will send Write Filemark commands, one at a time, to the tape drive until the specified number of filemarks have been recorded.It will then reselect the host and report a GOOD status.

3.20.4 WRITING FILEMARKS ACROSS EOT

If EarlyEOT is encountered while the cache is being flushed, the SCSI/Formatter will finish recording all the data in the cache and will then return an EOM sense key. No filemarks will be recorded, and the residue count will equal the number of filemarks requested.

BYTE	BIT							
	7	6	5	4	3	2	1	0
0	0	0	0	1	0	0	0	0
1	Logical Unit Number			0	0			Immediate
2	Number of Filemarks (MSB)							
3	Number of Filemarks							
4	Number of Filemarks (LSB)							
5	0				0	0	Flag	Link

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Figure 3-15. Write Filemark CDB

If EOT is encountered while recording a filemark, the SCSI/Formatter will terminate the command after writing the filemark. The SCSI/Formatter will return a CHECK CONDITION status with the EOM bit set and the sense key set to volume overflow. Additional filemarks can be recorded, but only one per command. The residue count will equal the number of remaining filemarks to be recorded.

3.20.5 ERROR CONDITIONS

If any of the blocks since BOT or since the previous filemark (whichever was last) had to be rewritten, the SCSI/Formatter will report a RECOVERABLE ERROR sense key along with the tape drive status. The Extended Sense data includes the number of blocks that were rewritten.

3.21 SPACE COMMAND (11_H)

3.21.1 COMMAND DESCRIPTION

The Space command allows the tape to be moved or *spaced* in either direction without transferring data. Spacing can be by block or by filemark as defined in the Code bits. When the SCSI/Formatter receives a Space command, it causes the data to be read from the tape into the cache, but does not send that data to the SCSI bus. The command format is shown in Figure 3-16.

3.21.2 CODE DEFINITION

The value of the Code bits specifies whether the spacing is in reference to data blocks or to filemarks. The SCSI/Formatter supports the spacing functions listed in Table 3-9.

	BIT							
BYTE	7	6	5	4	3	2	1	0
0	0	0	0	1	0	0	0	1
1	Logical Unit Number			0	0		Code	
2	Count (MSB)							
3	Count							
4	Count (LSB)							
5	0				0	0	Flag	Link

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Figure 3-16. Space CDB

Table 3-9
Space Command Code Bit Definition

Code Bits Value	Definition
0	Space Blocks
1	Space Filemarks
2	Space Sequential Filemarks
3	Physical End of Data

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3.21.2.1 Space Blocks

A Space Block code instructs the SCSI/Formatter to read tape until the number of blocks specified in the Count fields have been spaced over, or until the cache is full, whichever occurs last. During the space block operation, data from the tape is copied into the cache, but not sent to the SCSI/Formatter. If the blocks to be spaced over are already in the cache, there may not be any tape movement. The Space command will space over the *logical* tape and move the tape physically only when required. If the command caused a read look-ahead operation to be performed, the tape may be positioned beyond the last block requested.

If a filemark is detected during a Space Blocks command, the tape will be stopped and the SCSI/Formatter will report a CHECK CONDITION status and a FILEMARK sense key.

3.21.2.2 Space Filemarks

A Space Filemark code causes the drive to space blocks until the number of filemarks specified in the Count field has been detected. No data is transferrred to the SCSI bus. If the filemarks are already in the cache, the tape may not move, and the logical position of the tape will be just beyond the last filemark detected. If the command caused a read look-ahead operation to be performed, the tape may be physically positioned beyond the last filemark.

3.21.2.3 Space Sequential Filemarks

A Space Sequential Filemark code causes the drive to space blocks until a specified number of sequential (i.e., adjacent) filemarks has been detected. The number of sequential filemarks to be spaced over is determined by the value of the Count bytes. The Space Sequential Filemark code instructs the SCSI/Formatter to send the following sequence of commands to detect the requested number of filemarks.

- Space blocks until filemark is detected.
- Space another block.
- If a filemark is not detected, then sequential filemarks do not exist, and the search for the next filemark is repeated.
- If a filemark is detected, then Space additional blocks until the sequential filemark count is satisfied.

3.21.2.4 Space to Physical End of Data

When the SCSI/Formatter receives a command to space to the physical end of data, it spaces until it detects blank tape, a filemark, or EOT. At the end of the operation, the tape will be positioned after the last block or filemark.

3.21.3 COUNT BYTES

The value of the Count bytes specifies how many blocks or filemarks to space over, and in which direction. A positive value will space the tape in the forward direction, ending on the EOT side of the last block or filemark.

A count value of zero is acceptable and causes the SCSI/Formatter to return a GOOD status immediately.

A negative value will space the tape in the reverse direction ending on the BOT side of the last block or filemark. Negative values are expressed in 2's complement notation.

3.21.4 SPACING OVER EOT

If EOT is sensed during a space forward command, the SCSI/Formatter will stop the tape in the next IBG and return a MEDIA ERROR sense key with the EOM bit set to 1. The EOT bit in the Extended Sense data will also be set to 1, and the residue count will equal the number of blocks or filemarks in the command that were not spaced over.

3.21.5 SPACING OVER BOT

If the BOT marker is detected while performing a Space Reverse command, the SCSI/Formatter will return an EOM sense key. The BOT bit in the Extended Sense data will also be set to 1, and the residue count will equal the number of blocks or filemarks in the command that were not spaced over.

3.21.6 SPACING OVER BLANK TAPE

If blank tape is detected during a Space command other than a Space to End of Data command, the SCSI/Formatter will return a CHECK CONDITION and a BLANK CHECK sense key. The tape will be positioned about 25 feet beyond the last block spaced over.

3.21.7 SPACING OVER A BAD BLOCK

If a bad block is spaced over, the SCSI/Formatter will attempt to recover by performing error correction or retries. If this is not successful, the data block in the cache will be identified as bad and the Space operation will continue. The error will only be reported if the block in question is later encountered in the cache during a Read command.

3.22 INQUIRY COMMAND (12_H)

3.22.1 COMMAND DESCRIPTION

The Inquiry command instructs the SCSI/Formatter to send to the host a data file containing the parameters of the Formatter and the attached tape drive. The command format is shown in Figure 3-17.

If for some reason the SCSI/Formatter cannot return the requested data file, it will return a CHECK CONDITION status.

If a UNIT ATTENTION condition exists when the SCSI/Formatter receives the Inquiry command, it will perform the Inquiry command, return a GOOD status and will **not** clear the UNIT ATTENTION condition for that initiator.

	BIT							
BYTE	7	6	5	4	3	2	1	0
0	0	0	0	1	0	0	1	0
1	Logical Unit Number			0	0			EVPD
2	Page Code							
3	00							
4	Allocation Length ($1E_H$)							
5	0				0	0	Flag	Link

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Figure 3-17. Inquiry CDB

3.22.2 EVPD

If the EVPD bit is set to 0, the SCSI/Formatter will return the data format shown in Figure 3-18. If the EVPD bit is set to 1, the SCSI/Formatter will return a CHECK CONDITION status and an ILLEGAL REQUEST sense key.

3.22.3 PAGE CODE

If the Page Code byte is not 0, the SCSI/Formatter will return a CHECK CONDITION status and an ILLEGAL REQUEST sense key.

3.22.4 ALLOCATION LENGTH

The Allocation Length specifies the maximum number of bytes that the initiator has allocated for the returned Inquiry Data File. An allocation length of 0 is not considered an error, and indicates that no Inquiry Data File shall be transferred. The length of the returned Inquiry Data file is 30 bytes.

The SCSI/Formatter will terminate the DATA IN phase when the number of bytes specified in the Allocation Length has been transferred, or when all available data has been transferred, whichever is less.

BYTE	BIT							
	7	6	5	4	3	2	1	0
0	01_H (Sequential Access Device)							
1	$C5_H$ (Removable 9-Track Tape)							
2	ISO Compliance		ECMA Compliance			ANSI Compliance (01_H)		
3	02_H (Response Data Format)							
4	Additional Length (20_H)							
5	00							
6	00							
7	10_H (Sync Bit)							
8—15	"DDC PERTEC" ASCII Characters + 2 ASCII Space Characters							
16—31	"FS2001-2" ASCII Characters + 8 ASCII Space Characters							
	"0002" ASCII Characters							

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Figure 3-18. Standard Inquiry Data File

3.22.5 STANDARD INQUIRY DATA FILE

The SCSI/Formatter will return a Standard Inquiry Data File of 36 bytes during the DATA IN phase with a data format as shown in Figure 3-18.

3.22.5.1 Peripheral Device Type

The value of this byte will either by $0I_H$, indicating a sequential-access device, or $7F_H$, if the logical unit is not present.

3.22.5.2 ISO/ECMA Compliance

The usage of non-zero values in the ISO and ECMA Compliance fields is defined by the International Standards Organization and the European Computer Manufacturers Association. Because the SCSI/Formatter does not claim compliance with the ISO version of SCSI (ISO DP 9316), or with the ECMA version (ECMA-111), the value of these fields will be 0.

3.22.5.3 ANSI Compliance

The value in this field will be 1 to indicate that this device complies with ANSI Standard X3.131-1986.

3.22.5.4 Response Data Format

The value in this field will be 00 to indicate an INQUIRY data format as specified in SCSI-1 or 02_H to indicate a format as specified in SCSI-2.

3.22.5.5 Additional Length

The Additional Length byte specifies how many more bytes will follow in the Inquiry Data file; the SCSI/Formatter will return a value of 20_H. If the Allocation Length in the Inquiry CDB is less than the number of bytes in the Inquiry Data File, the SCSI/Formatter will truncate the Inquiry Data file and will not adjust the Additional Length value to reflect this truncation.

3.22.5.6 Sync Bit

The value in this field will be 00 to indicate that synchronous transfer is not supported and 10_H to indicate that synchronous transfer is supported.

3.22.5.7 Vendor Indentification

Bytes 8 through 15 contain the vendor identification in ASCII code. Unused bytes contain ASCII spaces.

3.22.5.8 Product Identification

Bytes 16 through 31 contain the product identification in ASCII code. Unused bytes contain ASCII spaces.

3.22.5.9 Product Revision Level

Bytes 32 through 35 contain the product revision level in ASCII code.

3.23 VERIFY COMMAND (13_H)

3.23.1 COMMAND DESCRIPTION

The Verify command verifies one or more blocks beginning with the next block recorded on the tape. In essence, the Verify command is identical to the Read command except that no data is transferred to the host. Data is read from the tape and transferred into the cache. The following conditions will terminate the Verify command.

- The verification length has been satisfied
- A filemark is detected
- EOT is reached

Upon completion of the Verify command, the tape will be positioned after the last block from which data was verified, after the filemark if one was detected, or in the first IBG following the EOT marker strip if EOT was sensed. The command format is shown in Figure 3-19.

3.23.2 BYTE COMPARE BIT

The SCSI/Formatter does not support the byte compare mode, and this bit will always be set to 0. The SCSI/Formatter will report errors such as CRC, ECC, etc.

3.23.3 FIXED BIT

The Fixed bit acts the same as it does in a Read command. If the value specified by the Fixed bit does not match the current mode, the SCSI/Formatter will reject the command with an ILLEGAL REQUEST sense key.

3.23.4 VERIFICATION LENGTH

The Verification Length fields specify the number of bytes (or blocks, depending upon the mode) that will be transferred from the tape into the cache. A Verification Length of zero is not considered an error. No data will be verified and the tape will not move.

3.23.5 ERROR CONDITIONS

If no data errors were detected during the verification, the SCSI/Formatter will return a GOOD status. Otherwise, the unit will return a CHECK CONDITION status with a MEDIA ERROR sense key.

BYTE	BIT							
	7	6	5	4	3	2	1	0
0	0	0	0	1	0	0	1	1
1	Logical Unit Number			0	0	0	ByteComp	Fixed
2	Verification Length (MSB)							
3	Verification Length							
4	Verification Length (LSB)							
5	0				0	0	Flag	Link

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Figure 3-19. Verify CDB

3.24 RECOVER BUFFERED DATA COMMAND (14_H)

3.24.1 COMMAND DESCRIPTION

The Recover Buffered Data command is similar to the Read command. It is used to read data that the host has transferred to the cache but which, due to an error or exception condition, could not be recorded on the tape. The blocks are transferred in the same order as if they had been transferred to the tape. One or more Recover Buffered Data commands may be used to read the unrecorded, buffered data.

Each time a Recover Buffered Data command is completed, the SCSI/Formatter will update the UCD (unrecorded cache data) byte in the Extended Sense Data.

If a Recover Buffered Data command is followed by a tape motion command (i.e., Rewind, Read, Write, etc.), any remaining unrecovered blocks in the cache will be erased. The command format is shown in Figure 3-20.

3.24.2 FIXED BIT

If the state of the Fixed bit does not match the current mode of the SCSI/Formatter , the command will be rejected with an ILLEGAL REQUEST sense key. When the Fixed bit is 0, the command is requesting a variable block transfer; when the Fixed bit is 1, the command is requesting a fixed block transfer.

3.24.3 TRANSFER LENGTH

The amount of data to recover is specified in bytes 2 through 4 of the CDB. In the fixed block mode, the transfer length specifies the number of blocks to be recovered; in the variable block mode, it specifies the length of the next block to be recovered.

A transfer length of zero is treated as a no-op command and the SCSI/Formatter will return a GOOD status immediately. No data are transferred.

3.24.4 ERROR CONDITIONS

If there is no unrecorded, buffered data in the cache, the SCSI/Formatter will return a CHECK CONDITION status, set the sense key to NO SENSE, set the EOM bit, and calculate a residue count.

	BIT							
BYTE	7	6	5	4	3	2	1	0
0	0	0	0	1	0	1	0	0
1	Logical Unit Number			0	0			
2	Transfer Length (MSB)							
3	Transfer Length							
4	Transfer Length (LSB)							
5	0				0	0	Flag	Link

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Figure 3-20. Recover Buffered Data CDB

If the actual block size differs from the specified block size, the SCSI/Formatter will send a CHECK CONDITION status, set the sense key to NO SENSE and the Incorrect Length bit to 1, and transfer only the number of bytes equal to the smaller size. In the variable mode, the residue count will equal the requested block size minus the actual block size. In the fixed mode, the residue count will equal the number of blocks requested minus the number of blocks transferred.

If the requested byte or block count is greater than the available data in the cache, the available data will be transferred to the host along with an EOM sense key and a residue count equal to the number of bytes (variable block mode) or blocks (fixed block mode) not transferred.

3.24.5 FILEMARK STATUS

If a filemark is recovered from the cache, the SCSI/Formatter will return a NO SENSE sense key with the Filemark bit set to 1. The logical tape position will be toward the EOT side of the filemark, and the residue count will equal the number of bytes (variable block mode) or blocks (fixed block mode) not transferred.

3.25 MODE SELECT COMMAND (15_H)

3.25.1 COMMAND DESCRIPTION

The Mode Select command allows the initiator to specify various operating parameters, such as tape speed and recording density, via the SCSI/Formatter. These parameters are transferred in a Parameter list during the DATA OUT phase. The command format is shown in Figure 3-21.

The SCSI/Formatter maintains an internal mode select data buffer whose contents are preset to the default values at power up and after a BUS RESET message. If Function Code 10 (Local Speed and Density Selection) is cleared, the contents can only be changed by a Mode Select command; if Function Code 10 is set, the contents can only be changed by the operator using the front panel. This is illustrated in Figure 3-22.

BYTE	BIT							
	7	6	5	4	3	2	1	0
0	0	0	0	1	0	1	0	1
1	Logical Unit Number			0	0			
2	00							
3	00							
4	Parameter List Length (10_H)							
5	0				0	0	Flag	Link

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Figure 3-21. Mode Select CDB

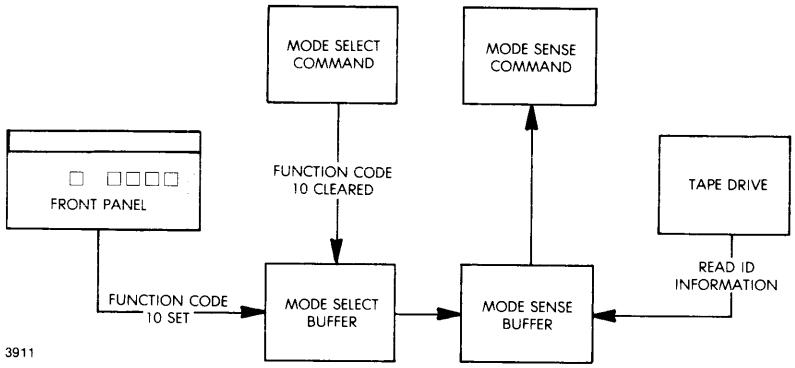

Figure 3-22. Internal Mode Select and Mode Sense Buffers

3.25.2 PARAMETER LIST LENGTH

The Parameter List Length specifies the number of bytes that will be transmitted during the DATA OUT phase. The SCSI/Formatter supports a maximum of 10_H Mode Select Parameter bytes; a value of 0 specifies that no data is to be transmitted.

3.25.3 PARAMETER LIST

In addition to tape speed and recording density, the Parameter List allows the host to select the number of blocks to transfer, the block length, and other parameters. The Mode Select parameter definition is shown in Figure 3-23.

3.25.3.1 Default Values

Following a power up and following each BUS RESET message, the SCSI/Formatter defaults to the following states: Buffered mode; default speed where *default* is high speed; 1600 cpi; 0 block count; soft error report enabled; and block length equal to 0 (variable length block size). The default retry count is obtained from Function Code 63, Configuration Code 9, and is set by the operator.

3.25.3.2 Buffered Mode

When this bit is 1, the SCSI/Formatter is in the buffered write mode and will return a GOOD status on write commands as soon as all the blocks have been transferred into the cache. One or more blocks of data may be buffered before the data is actually recorded on the tape (see Write command). In the unbuffered write mode, the SCSI/Formatter does not return status until all data specified by the command has been recorded on the tape.

3.25.3.3 Tape Speed

If the value of the Tape Speed field is 1, the tape will run at low speed; if the value is 0 (default) or 2, the tape will run at the speed selected via the front panel. The default speed value is high speed. The SCSI/Formatter will reject any other value with an ILLEGAL REQUEST sense key.

Low speed on the FS2000 is 50 ips; high speed is 100 or 125 ips.

BYTE	BIT							
	7	6	5	4	3	2	1	0
0	00							
1	00							
2	0	0	0	Buffered Mode	Tape Speed (0 = Default, 1 = Low, 2 = High)			
3	Block Descriptor Length (00 or 08_H)							
4	Recording Density (00 = No change, 01 = 800, 02 = 1600, 03 = 6250, 06 = 3200)							
5	00							
6	00							
7	00							
8	00							
9	Block Length (MSB)							
10	Block Length							
11	Block Length (LSB)							
	VENDOR-UNIQUE PARAMETERS							
12	0	0	0	0	0	0	Gap	SER
13	00							
14	00							
15	Maximum Number of Retries (Not Used)							

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Figure 3-23. Mode Select Parameter List

3.25.3.4 Block Descriptor Length

The Block Descriptor Length specifies the total number of bytes in all of the following block descriptors. Because the SCSI/Formatter supports only 1 block descriptor, its value must be 0 or 8 (vendor-unique parameters are not included in this value). A value of 0 indicates that no block descriptors are included in the parameter list.

3.25.3.5 Recording Density

The value in this field specifies the density at which data will be recorded on the tape. The FS2000 supports all the following densities:

Byte Value (Hex)	Recording Density
00	Default density from front panel
01	800 cpi, NRZI
02	1600 cpi, PE
03	6250 cpi, GCR
06	3200 cpi, PE

The default density is 1600 cpi.

If the tape is not at logical BOT and an attempt is made to change the Density field, the SCSI/Formatter will reject the Mode Select command and return an ILLEGAL REQUEST sense key.

If the tape is at BOT and the next command is a Read command, the drive will read the tape ID burst and configure itself accordingly.

For a recording density change to become effective, it must be followed by a Write or Write Filemark command. If a recording density change is followed by a Read command, subsequent Write commands will be performed at the density of the last tape read.

3.25.3.6 Block Length

The value of the Block Length field determines the length of the blocks recorded on the tape. Setting the block length to 00 00 00 places the SCSI/Formatter in the variable length mode. In this case, all following Write commands must have their Fixed Bit set to 0. The Transfer Length field in the Write CDB will then specify the number of bytes per block.

Setting the block length to other than 00 00 00 specifies the fixed length mode. The value placed in the block size then becomes the block size to be recorded on tape. In this case, all following Write commands must have their Fixed Bit set to 1. The Transfer Length field in the Write CDB will then specify the number of blocks to transfer.

The minimum block size in the GCR mode is 3 bytes. The SCSI/Formatter will return an Illegal Request sense key if the Host attempts to set the block size to less than 3 bytes in the GCR mode.

If the Fixed Bit in the Write CDB does not match the current state of the SCSI/Formatter, the Write command will be rejected and an ILLEGAL REQUEST sense key will be returned. Refer to Paragraph 3.18 for additional information.

3.25.3.7 Gap

If this bit is 0, standard interblock gaps (IBGs) for the selected format will be written on the tape. If this bit is 1, extended IBGs will be used. The size of the extended IBGs can be selected via the front panel in Function Code 63.

3.25.3.8 SER (Soft Error Reporting)

If this bit is 0, the SCSI/Formatter will not report soft (correctible) errors to the host (Sense Key 01). If this bit is 1, correctible errors will be reported to the host. The power-up default for this bit is 1.

A correctible error is defined as data recovered by performing one or more retries, using error correction algorithms (i.e., a single-track dropout in PE and DPE, and a single- or two-track dropout in GCR).

3.25.3.9 Maximum Number of Retries

The maximum number of retries is set via the front panel in Function Code 63, Configuration 9. Any value in this field is ignored.

3.26 RESERVE UNIT COMMAND (16_H)

3.26.1 COMMAND DESCRIPTION

The Reserve Unit command reserves the specified logical unit for the exclusive use of the requesting host, and blocks any other host from using the unit until it is released. The command format is shown in Figure 3-24.

The logical unit remains reserved until:

- The initiator that reserved the unit issues another Reserve Unit command.
- The initiator that reserved the unit sends a Release Unit command.
- The SCSI/Formatter receives a BUS DEVICE RESET message.
- A hard RESET condition occurs.

BYTE	BIT							
	7	6	5	4	3	2	1	0
0	0	0	0	1	0	1	1	0
1	Logical Unit Number			0	0			
2	00							
3	00							
4	00							
5	0				0	0	Flag	Link

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Figure 3-24. Reserve Unit CDB

If an initiator sends a Reserve Unit command to a logical unit already reserved by that initiator, the SCSI/Formattter will return a GOOD status.

The user is responsible for releasing the reserved unit when there is no longer a need for exclusive use. The Reserve Unit command should not be issued to the disk drive being copied to or from the tape drive. The user must coordinate tape and disk usage to prevent backup of inconsistent data and ensure that multiple hosts are not using the tape drive illegally.

The SCSI/Formatter does not support the third-party reservation option.

3.26.2 ERROR CONDITIONS

If an attempt is made to reserve a tape drive that is already reserved by another initiator, 2he SCSI/Formatter will return a RESERVATION CONFLICT status.

If the third-party bit is set when the Reserve Unit command is received, the SCSI/Formatter will reject it and return a CHECK CONDITION status with ILLEGAL REQUEST sense key.

3.27 RELEASE UNIT COMMAND (17_H)

3.27.1 COMMAND DESCRIPTION

The Release Unit command will release a logical unit if it is currently reserved by the requesting initiator; it is the reverse function of the Reserve Unit command. The command format is shown in Figure 3-25.

If a logical unit is already reserved and another initiator attempts to release it, the command will be ignored. A Release Unit command issued to a logical unit that is not reserved will return a GOOD status.

The user must release the logical unit on completion of the function for which it was reserved to enable other hosts to access it.

The SCSI/Formatter does not support the third party release option.

BYTE	BITS							
	7	6	5	4	3	2	1	0
0	0	0	0	1	0	1	1	1
1	Logical Unit Number			0	0			
2	00							
3	00							
4	00							
5	0				0	0	Flag	Link

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Figure 3-25. Release Unit CDB

3.28 COPY COMMAND (18_H)

3.28.1 COMMAND DESCRIPTION

The Copy command allows the host to copy data from one SCSI device to another with minimum host involvement. The SCSI/Formatter supports the following copy functions.

- Sequential-access to direct-access device (tape to disk)
- Direct-access to sequential-access device (disk to tape)
- Sequential-access to sequential-access device (tape to tape)

The process begins when the host sends the SCSI/Formatter a Copy command. If another Copy command is in progress, or if any tape motion function is currently active, the SCSI/Formatter returns a BUSY status to the host. The Copy command format is shown in Figure 3-26.

The host sends a Copy Parameter List to the SCSI/Formatter, identifying the devices and logical units that will take part in the copy process, the size and number of the blocks to be copied, which logical blocks will be copied, and the destination of the blocks to be copied.

The Copy Parameter List is transferred during the DATA OUT phase and consists of a 4-byte header, followed by one or more *segment descriptors*. The header determines the type and priority of the copy function to be performed; the segment descriptors identify the logical units involved and the size, number and address of the blocks to be copied. The copy parameters list format is shown in Figure 3-27.

The Copy command can contain more than one segment descriptor, providing the ability to transfer data to and from different locations without host intervention. The SCSI/Formatter supports up to 20 segment descriptors per Copy command. If the Copy Parameter list contains more than 20 segments, the SCSI/Formatter will reject the Copy command with an ILLEGAL REQUEST sense key.

	BIT							
BYTE	7	6	5	4	3	2	1	0
0	0	0	0	1	1	0	0	0
1	Logical Unit Number			0	0			
2	Parameter List Length (MSB)							
3	Parameter List Length							
4	Parameter List Length (LSB)							
5	0				0	0	Flag	Link

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Figure 3-26. Copy CDB

BYTE	BIT							
	7	6	5	4	3	2	1	0
	COPY PARAMETER LIST HEADER							
0	Copy Function Code					Priority		
1	Vendor Unique (00)							
2	00							
3	00							
	SEGMENT DESCRIPTORS							
4—15	First Segment Descriptor							
16—27	Next Segment Descriptor							
etc.	etc.							

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Figure 3-27. Copy Parameter List

After the SCSI/Formatter receives the Copy Parameter list, it disconnects from the host and switches to an initiator role to begin the data transfer. Using the header information from the Copy Parameter List, it determines the type of copy procedure to use, and using the information from the first segment descriptor, selects the logical unit (LUN) that is to be the source of the copied data and issues it a SCSI Read command.

Once the SCSI/Formatter reads the logical blocks from the source LUN, it selects the destination LUN, issues a Write command, and transfers the data. If there are more segment descriptors, the SCSI/Formatter will repeat the process for each segment descriptor.

As long as there are no errors, each SCSI Read and Write command will return a GOOD status. If errors occur during the data transfers, a CHECK CONDITION status is returned to the SCSI/Formatter. The SCSI/Formatter then issues a Request Sense command to determine the exact nature of the failure and to take appropriate action.

After all segment descriptors have been processed, the SCSI/Formatter switches from the initiator mode back to the target mode and reselects the host. At that time, the host can poll the SCSI/Formatter and determine the success or failure of the Copy command.

3.28.2 PARAMETER LIST LENGTH

The value in the Parameter List Length field specifies how many bytes there are in the following Copy Parameters List. A value of 0 is not an error, and indicates that no parameter list will be tranferred.

3.28.3 COPY PARAMETER LIST

The Copy Parameter List (shown in Figure 3-27) is sent to the SCSI/Formatter during the DATA OUT phase. The list begins with a 4-byte header and is followed by up to twenty 12-byte *Segment Descriptors*.

3.28.3.1 Copy Function Codes

The SCSI/Formatter supports the following Copy Function Codes.

- 00 (Disk to Tape)
- 01 (Tape to Disk)
- 03 (Tape to Tape)

3.28.3.2 Priority

The Priority field of the Copy Parameter list sets the relative priority of this copy command with respect to other commands being executed by the same target. All other commands are assumed to have a priority of 1. Priority 0 is the highest priority with increasing values indicating lower priorities.

3.28.4 SEGMENT DESCRIPTOR LIST, FUNCTION CODES 00 AND 01

The segment descriptor list format for Function Codes 00 and 01 is shown in Figure 3-28.

3.28.4.1 Source Address and LUN

The Source Address and Source LUN fields specify the SCSI Device address and the logical unit number attached to the device that contains the data to be copied for this segment.

3.28.4.2 Destination Address and LUN

The Destination Address and Source LUN fields specify the SCSI Device address and the logical unit number attached to the device that will copy the data for this segment.

3.28.4.3 Tape Drive Block Length

The Tape Drive Block Length fields specify the size of the blocks to be recorded on or read from the tape during this segment.

3.28.4.4 Disk drive Number of Blocks

The Disk Drive Number of Blocks fields specify the number of blocks to be transferred during this segment. A value of zero indicates that no blocks are to be transferred in this segment.

3.28.4.5 Disk drive LBA

The Disk Drive LBA specifies the address of the first byte to be transferred during this segment.

BYTE	BIT							
	7	6	5	4	3	2	1	0
4	Source Address			0	0	Source LUN		
5	Destination Address			0	0	Destination LUN		
6	Tape Drive Block Length (MSB)							
7	Tape Drive Block Length (LSB)							
8	Disk Drive Number of Blocks (MSB)							
9	Disk Drive Number of Blocks							
10	Disk Drive Number of Blocks							
11	Disk Drive Number of Blocks (LSB)							
12	Disk Drive Starting Logical Block Address (MSB)							
13	Disk Drive Starting Logical Block Address							
14	Disk Drive Starting Logical Block Address							
15	Disk Drive Starting Logical Block Address (LSB)							

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Figure 3-28. Segment Descriptor List for Function Codes 00, 01

3.28.5 SEGMENT DESCRIPTOR LIST, FUNCTION CODE 03

The segment descriptor list format for Function Code 00 is shown in Figure 3-29.

3.28.5.1 Source Address and LUN

The Source Address and Source LUN fields specify the SCSI Device address and the logical unit number attached to the device that contains the data to be copied for this segment.

3.28.5.2 Destination Address and LUN

The Destination Address and Source LUN fields specify the SCSI Device address and the logical unit number attached to the device that will copy the data for this segment.

BYTE	BIT							
	7	6	5	4	3	2	1	0
4	Source Address			0	0	Source LUN		
5	Destination Address			0	0	Destination LUN		
6	00							
7	00							
8	Source Block Length (MSB)							
9	Source Block Length (LSB)							
10	Destination Block Length (MSB)							
11	Destination Block Length (LSB)							
12	Source Number of Blocks (MSB)							
13	Source Number of Blocks							
14	Source Number of Blocks							
15	Source Number of Blocks (LSB)							

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Figure 3-29. Segment Descriptor List for Function Codes 03

3.28.5.3 Source Block Length

This field specifies the block length of the source device for this segment. A value of zero indicates variable block length. For non-zero values, this field must match the LUN's actual block length. If the SCSI/Formatter detects block length mismatches, it will terminate the Copy command with a CHECK CONDITION status and set the sense key to ILLEGAL REQUEST. If the SCSI/Formatter detects block length mismatches during the read operation, it will terminate the command and set the sense key to COPY ABORTED.

3.28.5.4 Destination Block Length

This field specifies the block length of the destination device for this segment. A value of zero indicates variable block length. Block length mismatches are handled in the same manner as source block length mismatches.

3.28.5.5 Source Number of Blocks

This field specifies the number of blocks to be transferred from the source device during this segment. A value of zero indicates that no blocks will be transferred.

3.28.6 ERRORS DETECTED BY THE SCSI/FORMATTER

During the copy process, errors can occur and be detected by the SCSI/Formatter. These errors include:

- Parity errors while transferring the Copy command and/or Status byte
- Invalid parameters in the Copy command
- Invalid segment descriptors
- General failure of the SCSI/Formatter or tape drive

In these cases, the SCSI/Formatter will terminate the Copy command with a CHECK CONDITION status and return sense data in the Extended Sense format. The Valid bit will be set to 1, and the Segment Number will contain the number of the segment descriptor being processed at the time the error condition was detected. The sense key will contain the appropriate code for the error condition, and the information bytes will equal the number of blocks requested in the segment descriptor minus the number of blocks successfully copied.

If the SCSI/Formatter detects an error in the Copy command or the Copy Parameter list, it will terminate the command and return an ILLEGAL REQUEST sense key.

The SCSI/Formatter does not support copy operations in which it is neither the source nor the destination LUN (i.e., third party copy operation), and will terminate such attempts with a CHECK CONDITION status and an ILLEGAL REQUEST sense key.

If the block length is known by the SCSI/Formatter to be unsupported, it will terminate the command with a CHECK CONDITION status and will set the sense key to COPY ABORTED.

3.28.7 ERRORS DETECTED BY THE COPY TARGET

In addition to the preceding errors, the Copy Target can also detect errors. These errors include:

- Parity errors detected while transferring the Copy read or write commands
- Invalid parameters in the Copy read or write commands
- Data errors detected while reading or writing the copy data
- General failure of the Copy Target

The SCSI/Formatter is notified of these errors when it receives a CHECK CONDITION status from the Copy Target. After recovering the sense data associated with the error condition, the SCSI/Formatter then terminates the Copy command with a CHECK CONDITION status and return sense data to the host in the Extended Sense format.

The Valid bit will be set to 1, and the Segment Number will contain the number of the segment descriptor being processed at the time the error condition was detected. The sense key will be set to COPY ABORTED, and the information bytes will equal the number of blocks requested in the segment descriptor minus the number of blocks successfully copied. The additional sense length will specify the number of Additional Sense bytes returned to the host.

3.28.8 ADDITIONAL SENSE BYTES

The additional sense bytes in the case of a COPY ABORTED sense key are shown in Figure 3-30 and described in the following paragraphs.

BYTE	BIT							
	7	6	5	4	3	2	1	0
8	Relative Byte Offset to Source Device's Status and Sense Data							
9	Relative Byte Offset to Destination Device's Status and Sense Data							
NOTE: Bytes 10 through N contain sense data received from the source or destination device which detected the error.								
10	COMPLETION Status Byte							
11	RCV	1	1	1	0	0	0	0
12	Not used, always 00							
13	FMK	EOM	ILI	0	Sense Key			
14—17	Residue Count							
18	Number of Additional Sense Bytes from 19 through "N" below							
19—N	Additional Sense Data Bytes							

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Figure 3-30. Additional Sense Data Bytes for Copy Command Aborted Sense Key

3.28.8.1 Byte 8

This byte specifies the byte number, relative to the first byte of sense data of the beginning of the source LUN's status byte and sense data. A value of zero indicates that no status byte or sense data is being returned for the source LUN. The first byte of the area pointed to by the first Additional Sense byte will contain the status byte from the source LUN. The subsequent bytes will contain, unchanged, the sense data recovered from the source LUN.

3.28.8.2 Byte 9

The second Additional Sense byte specifies the byte number, relative to the first byte of sense data of the beginning of the destination LUN's status byte and sense data. A zero value indicates that no status byte or sense data is being returned for the destination LUN. The first byte of the area pointed to by the second additional sense byte will contain the status byte from the destination LUN. The subsequent bytes will contain, unchanged, the sense data recovered from the destination LUN.

3.28.8.3 Completion Status Byte

This byte is the same as described in Paragraph 3.8, Completion Status Byte.

3.28.8.4 Residue Count Valid (RCV)

A "1" in this field indicates the value in the following Residue Count fields are valid.

3.28.8.5 Sense Key

The sense key in this field is the same as described in the Request Sense paragraphs.

3.28.8.6 Residue Count

The value of the Residue Count contains the value of the Number of Blocks fields in the segment descriptor being processes at the time of the failure minus the number of blocks successfully copied.

3.28.8.7 Number of Additional Sense Bytes

(TBD)

3.29 ERASE COMMAND (19_H)

3.29.1 COMMAND DESCRIPTION

The Erase function is normally used during error recovery procedures to erase a portion of the tape. The Erase command itself can be used either to erase a fixed length of tape or erase the remaining tape, starting at the current tape position. A variable length erase function can be simulated by issuing multiple Erase commands. The command format is shown in Figure 3-31.

When the SCSI/Formatter receives the Erase command, it disconnects from the SCSI bus and checks the level of data in the cache. If the cache contains unrecorded data from a previous write command, the unit will attempt to record the remaining data before performing the erase operation.

If the cache contains data from a previous Read command, the unit will clear the cache, perform an internal Read Sync operation, and then perform the erase operation.

	BIT							
BYTE	7	6	5	4	3	2	1	0
0	0	0	0	1	1	0	0	1
1	Logical Unit Number			0	0	0	Immediate	Long
2	00							
3	00							
4	00							
5	0				0	0	Flag	Link

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Figure 3-31. Erase CDB

3.29.2 LONG BIT

If the Long bit is 0, the SCSI/Formatter sends a Fixed Length Erase command to the tape drive, erasing approximately 4 inches of tape. If EOT is sensed, the SCSI/Formatter returns an EOM sense key.

If the Long bit is 1, the unit finishes recording any unrecorded data in the cache, then erases the remainder of the tape to a point past the EOT marker, and finally rewinds the tape. If the SCSI/Formatter receives commands during this time, it will return a BUSY status. This *data security erase* is performed at the high tape speed.

When the erase operation is complete, the SCSI/Formatter reselects the host and returns a GOOD status.

3.29.3 IMMEDIATE BIT

If the Immediate bit is 0, the SCSI/Formatter will return a GOOD status when the requested operation is complete. If the Immediate bit is 1, GOOD status will be returned immediately after initiating the erase sequence.

3.29.4 EOT OPERATIONS

If the tape drive detected EOTwhile the data in cache were being recorded prior to the erase, subsequent action depends upon the state of the Long bit.

If the Long bit is 0, the unit will attempt to record all data remaining in cache on the tape and return an EOM sense key. The unit will not perform the Erase operation, and will so indicate by setting the residue count to 1.

If the Long bit is 1, the unit will continue to erase a length of tape before rewinding it. The SCSI/Formatter will report a GOOD status at the end of the rewind, when the tape is stopped at BOT.

3.30 MODE SENSE COMMAND ($1A_H$)

3.30.1 COMMAND DESCRIPTION

The Mode Sense command allows the SCSI/Formatter to report various media, unit and device parameters to the host. The Mode Sense command is a complement to the Mode Select command. The command format is shown in Figure 3-32. The format of the data returned by the Mode Sense command is shown in Figure 3-33.

The SCSI/Formatter has an internal mode sense buffer that provides information during the DATA OUT phase of the Mode Sense command. The buffer contains essentially the same data as the mode select buffer. As new Mode Select data is accepted, both buffers are updated. See Figure 3-22 for more information.

When the tape is at load point and a Read command is received, the tape drive will determine the tape density by reading the ID burst (or lack of it), and configure itself accordingly. The internal mode sense buffer density information will then be updated. Refer to Paragraph 3.25 for additional information.

3.30.2 ALLOCATION LENGTH

The Allocation Length specifies the number of bytes the initiator has allocated for returned Mode Sense Data. If the allocation length is zero, the SCSI/Formatter will not transfer any Mode Sense Data. The SCSI/Formatter currently supports 16 (10_H) bytes.

If the allocation length is greater than the number of bytes to be transferred, the SCSI/Formatter will terminate the DATA IN phase when the transfer is complete.

If the allocation is less than the number of bytes to be transferred, the SCSI/Formatter will terminate the DATA IN phase after the specified number of bytes have been transferred.

	BIT							
BYTE	7	6	5	4	3	2	1	0
0	0	0	0	1	1	0	1	0
1	Logical Unit Number			0	0			
2	00							
3	00							
4	Allocation Length (10_H)							
5	0				0	0	Flag	Link

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Figure 3-32. Mode Sense Command CDB

BYTE	BIT							
	7	6	5	4	3	2	1	0
0	Sense Data Length ($0F_H$)							
1	00							
2	WPT	0	0	Buffered Mode	Tape Speed (0 = Default, 1 = Low, 2 = High)			
3	Block Descriptor Length (08_H)							
	BLOCK DESCRIPTOR							
4	Density Code (00 = Default Density, 01 = NRZI, 02 = PE, 03 = GCR, 06 = DPE)							
5	00							
6	00							
7	00							
8	00							
9	Block Length (MSB)							
10	Block Length							
11	Block Length (LSB)							
	VENDOR-UNIQUE PARAMETERS							
12	0	0	0	0	0	0	Gap	SER
13	00							
14	00							
15	Maximum Number of Retries							

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Figure 3-33. Mode Sense Data CDB

3.30.3 MODE SENSE DATA

3.30.3.1 Sense Data Length

The Sense Data Length byte specifies the length of the Mode Sense Data and does not include itself. Its value is $0F_H$.

3.30.3.2 Write Protect Bit

If the value of the Write Protect (WPT) bit is 0, the tape is write enabled. If the value is 1, the tape is write protected, and the SCSI/Formatter will reject Write and Erase commands, returning a CHECK CONDITION status and a FILE PROTECT sense key.

The value of the WPT bit is determined by the presence or absence of a write protect ring in the tape reel.

3.30.3.3 Maximum Number of Retries

For information regarding Buffered Mode, Speed, Density Code, Number of blocks, Block Length, Gap, SER, and Maximum Number of Retries, refer to Paragraph 3.25.

3.31 LOAD/UNLOAD COMMAND ($1B_H$)

3.31.1 COMMAND DESCRIPTION

The Load/Unload command is used to initiate an automatic load sequence (i.e., tension the tape, position it at load point and place the tape drive on line) or to rewind and unload the tape. It cannot be used to initiate an automatic load sequence if the seven segment display is flashing an error code. The command format is shown in Figure 3-34.

After the command is received, the SCSI/Formatter will disconnect from the SCSI bus, process any data remaining in the cache from a previous Write command, and continue with the Load/Unload command. On completion, the SCSI/Formatter will reselect the host and return the appropriate status.

BYTE	BIT							
	7	6	5	4	3	2	1	0
0	0	0	0	1	1	0	1	1
1	Logical Unit Number			0	0	0	0	Immediate
2	00							
3	00							
4	0	0	0	0	0	0	Retension	Load
5	0				0	0	Flag	Link

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Figure 3-34. Load/Unload CDB

3.31.2 IMMEDIATE BIT

If the Immediate bit is 0, the SCSI/Formatter will return a GOOD status when the requested operation is complete. If the Immediate bit is 1, GOOD status will be returned immediately after initiating the load or unload sequence.

3.31.3 RETENSION AND LOAD BITS

If both the Load and the Retension bits are 0, the SCSI/Formatter will initiate an unload operation that will rewind the tape to BOT, place the tape drive off line, unload the tape, and unlock the supply hub.

If the Load and/or the Retension bit is 1, the SCSI/Formatter will tension the tape, position it at BOT, and place the tape drive on line. If the unit is already on line and the tape is at BOT, sending this command with the Load and/or Retension bit set to 1 will have no effect.

3.32 RECEIVE DIAGNOSTIC RESULTS ($1C_H$)

The SCSI/Formatter will reject the Receive Diagnostic Results command and return CHECK CONDITION status with an ILLEGAL REQUEST sense key.

3.33 SEND DIAGNOSTIC COMMAND ($1D_H$)

3.33.1 COMMAND DESCRIPTION

The Send Diagnostic command requests the SCSI/Formatter to perform a set of diagnostic tests. The SCSI/Formatter stores the results of the diagnostic tests for later retrieval by the host using the Receive Diagnostic Results command.

3.33.2 SELF TEST BIT

The SCSI/Formatter currently supports the self-test option. When the Self Test bit is 1, the SCSI/Formatter performs a limited set of diagnostics lasting about 30 seconds. No data is transferred to the tape. Upon successful completion, the SCSI/Formatter returns a GOOD status. Otherwise, it will return CHECK CONDITION status with a HARDWARE ERROR sense key.

3.33.3 DEVICE OFF LINE BIT

The SCSI/Formatter does not support this bit, and will return an ILLEGAL REQUEST sense key if this bit is 1.

3.33.4 UNIT OFF LINE BIT

The SCSI/Formatter does not support this bit, and will return an ILLEGAL REQUEST sense key if this bit is 1.

3.34 OPERATOR TROUBLESHOOTING

If the drive will not load tape or otherwise fails to function properly, perform the following operator checks prior to notifying maintenance personnel.

(1) If the unit is totally inoperative, check the line fuse located under the sliding plastic cover on the rear of the unit, next to the power cord receptacle.

(2) Note any error code on the 7-segment displays and, if the problem requires calling maintenance personnel, report the fault code observed. Refer to Table 3-10 for a list of the error codes and the detected fault conditions that they represent.

Table 3-10
Fault Conditions Detected

Error Code	Fault Condition	Error Indication Source
01	Hub unlock error — Excessive supply reel movement after hub lock solenoid has been energized*	Supply once around sensor (SUOA)
02	Slack tape error — Slack tape not removed before timeout*	Tension encoder
03	Load off EOT error — Loss of tape in path during tape slack removal*	Tape path sensor (TIPA)
04	Motion error — Inadequate forward tape motion after take-up reel hookup*	Velocity encoder
05	Forward amplifier error — Incorrect voltage at amplifier output during amplifier nulling process*	Reel amplifier forward sense circuit
06	Sense hardware error — Forward and reverse signals present concurrently during amplifier nulling process*	Reel amplifier forward and reverse sense circuits
07	Reverse out of range error — Incorrect voltage at amplifier output during amplifier nulling process*	Reel amplifier reverse sense circuit
08	Forward out of range error — Incorrect voltage at amplifier output during amplifier nulling process*	Reel amplifier forward sense circuit
09	Tension flag error — High tension indication at start of loading process*	Mid tension sensor of tension encoder
10	Tape-in-path error — Loss of tape in path before loading process*	Tape path sensor (TIPA)
11	Hub lock error — Insufficient supply reel rotation before timeout*	SUOA
12	Upside down supply reel error — Both tape-in-path signals detected together during hublock or backwrap portion of loading process*	TIPA and TIPB
13	Load speed adjust error — Supply reel speed indication incorrect after speed adjustment portion of backwrap cycle*	SUOA
14	Static on tape error — Tape not in path after spinning supply reel in reverse direction*	TIPA
15	Anti-static spin error — Supply reel activity not sensed at beginning of reverse spin*	SUOA
16	Timeout before TIPB error — Tape-in-path not sensed before timeout or excesive supply once around changes before tape-in-path is sensed*	TIPB and SUOA
17	TIPA lost error — Loss of tape-in-path signal during threading*	TIPA
18	Hookup to takeup reel error — Tape motion not sensed after TIPB sensed during threading*	Velocity encoder
19	TIPB lost error — Loss of tape-in-path signal after takeup reel motion starts during hookup*	TIPB
20	Hookup timeout error — Tape motion not sensed during hookup portion of autoload*	Velocity encoder
21	Tension timeout error — Mid tension flag not detected before timeout during tension up*	Mid tension flag

*Tape load process
**Tape unload process

Continued

Table 3-10
Fault Conditions Detected (Continued)

Error Code	Fault Condition	Error Indication Source
22	Mid tension range error — Mid tension flag not detected within proper encoder count from loose position during tension up*	Mid tension flag and tension encoder
23	TIPA or TIPB lost error — Tape-in-path sense signal lost after hookup and before tension up*	TIPA and TIPB
24	Supply stuck error — Supply reel speed indication incorrect**	SUOA
25	Over tension error — Excessive tape tension**	Tension encoder and mid tension flag
26	Unload timeout error — Tape-in-path indication after fault timer timeout**	TIPA
27	Takeup once around (TUOA) timeout error — Timeout while waiting for SUOA activity during load, after hook-up and forward motion detected	TUOA
28	Circumference calculation timeout error — Timeout during once around circumference calculation during load	SUOA and TUOA
29	Velocity tachometer timeout — Tachometer pulses not detected during EOT backup	Velocity encoder
30	Over travel loose error — Tension arm out of operating range in loose direction after tension up	Tension encoder
31	Over travel tight error — Tension arm out of operating range in tight direction after tension up	Tension encoder
60	Voltage fault error — One or more supply voltages out of operating range	Power supply outputs
61	Over temperature error — Loss of cooling air	Thermal switch
62	Cover open error — Cover open indication during tape motion	Cover interlock switch
63	Door open error — Door open indication during tape motion	Door interlock switch
E2	Write status error — Detected incorrect SUOA duty cycle during write enable check*	SUOA
C0	WMC Error	WMC
C1	WMC Timeout	WMC
C2	DMA Parity Error	DMA Controller
C3	EMC Error	WMC or EMC
C4	RMC Error	WMC or RMC
C5	RMC Gap Failure	WMC or RMC
C6	RMC Timeout	WMC or RMC
C7	DMA Overflow	DMA A Controller
C8	DMA Underflow	DMA A Controller
C9	Cache Parity Error	Cache memory
CA	Cache Data Error	Cache memory
CB	Cache Last Word Error	Cache Memory
CC	DMA Did Not Start	DMA A Controller
CD	DMA Runaway	DMA A Controller
CE	Timer A Failure	Programmable Timer A
CF	Timer B Failure	Programmable Timer B

*Tape load process
**Tape unload process

Continued

Table 3-10
Fault Conditions Detected (Continued)

Error Code	Fault Condition	Error Indication Source
D0	RAM Complement Failure	RAM or RAM Controller
D1	RAM Rotating Ones Failure	RAM or RAM Controller
D2	RAM Sequence Failure	RAM or RAM Controller
D3	DBY Failure	Formatter
D4	FBY Failure	Formatter
D5	WMC DMA Byte Count Error	WMC or DMA A
D6	RMC DMA Byte Count Error	RMC or DMA A
D7	Timer A Interrupt Failure	Timer A
D8	RMC Interrupt Failure	RMC
D9	WMC Interrupt Failure	WMC
DA	Bad EMC Data	RMC or EMC or WMC
DB	Bad Cache Data From RMC	RMC or WMC
DC	Bad Parity/Last Word From RMC	RMC or WMC
DD	No Last Word From DMA	DMA A
DE	Non-Cache Loop Failure	WMC or RMC
DF	RAM Failure	RAM or RAM Controller
E0	Dead Track Error	WMC or RMC

*Tape load process
**Tape unload process

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(3) Ensure that the supply reel is positioned such that tape will unwind if the reel is turned clockwise (as viewed from above).

(4) If the tape reels turned, but tape did not thread, check the tape leader for damage. Trim the leader using a tape crimper (IBM Part No. 2512063, or equivalent) as required.

(5) If the tape reels do not turn, check that the tape loading door and the top doors of the unit are securely closed. The doors are interlocked to prevent tape motion when open.

3.35 OPERATOR MAINTENANCE

Operator maintenance of the FS2000 Formatted Tape Drive is limited to daily cleaning of the tape path components as specified in Paragraph 3.2. Also clean the exterior of the unit as necessary using a soft cloth slightly moistened with water. Notify maintenance personnel to perform regular preventive maintenance every 6 months.

CAUTION

ENSURE THAT CLEANING CLOTH IS ONLY DAMP, NOT WET. EXCESS MOISTURE CAN HAVE AN ADVERSE EFFECT ON UNIT PERFORMANCE. DO NOT USE SOLVENTS ON FRONT PANEL LETTERING.

3.36 DIAGNOSTIC OPERATING PROCEDURE

A sample procedure for operating the drive while using the diagnostic mode is given in Table 3-11. The procedure assumes a starting point of a fully connected unit with power off and tape reel in place, but tape not threaded. A further assumption is that it will be necessary to operate with the doors open. This condition requires that the interlocks be disabled. The diagnostic mode to be utilized is code 52, the shuttle mode. Note that, in general, the operating sequence consists of function code selection (FUNCTION SELECT switch), function code setting (SET/RESET switch), and function enable (RESET switch).

Table 3-11
Diagnostic Operating Procedure

Step No.	Action	Display	Comments
1	Toggle POWER switch to ON	Power indicator lights. 7-segment displays show default unit no. – 0	Powerup diagnostics indicated by lamp display. Refer to Paragraph 2.5.2.
2	Depress FUNCTION SELECT switch and hold for 3 seconds	Function select indicator lights	
3	Hold FUNCTION SELECT switch depressed or use multiple depressions to step thru function codes	Diagnostic code 60 on 7-segment display	Incrementing
4	Depress SET/CLEAR switch	Set/Clear indicator lights	Code 60 set
5	Depress RESET switch	Code 60 remains on display. All other indicators go out	Code 60 enabled; see Figure 3-16 for control/ indicator functions
6	Depress REW/UNLOAD COVER OPEN FAULT OVERRIDE) switch	Indicator flashes	
7	Depress FUNCTION SELECT (DOOR OPEN FAULT OVERRIDE) switch	Indicator flashes	
8	Depress RESET switch	Code 50 displayed. FUNCTION SELECT indicator lights	Exit mode 60 and reenter function select mode
9	Depress SET/CLEAR switch	Set/Clear indicator lights	Code 50 set
10	Depress RESET switch	Default unit no. – 0 displayed	Normal operating mode enabled
11	Depress LOAD/ON LINE switch	LD PT indicator flashes as tape loads, lights steadily when tape reaches load point	
12	Depress FUNCTION SELECT switch and hold for 3 seconds	Function select indicator lights	
13	Hold FUNCTION SELECT switch depressed or use multiple depressions to step thru function codes	Diagnostic code 52 on 7-segment display	
14	Depress SET/CLEAR switch	Set/Clear indicator lights	Code 52 set
15	Depress RESET switch	Code 52 remains on display. All other indicators go out	Code 52 enabled; see Figure 3-10 for control/ indicator functions
16	Depress and hold SET/ CLEAR (FWD LENGTH DISPLAY) switch	Forward shuttle length displayed on 7-segment display	Display is hexadecimal tach lines after rampup, most significant digit first
17	While holding SET/CLEAR switch, depress and hold REW/UNLOAD (INCREMENT LENGTH) switch until desired shuttle length is obtained. Release switches	900_{16} displayed on 7-segment display. Most significant digit first	Display decrementing starts slowly and increases to a blur, with a momentary pause and display of the MSB each time the LSB decrements to 00
18	Depress and hold FUNCTION SELECT (REV LENGTH DISPLAY) switch	Reverse shuttle length displayed on 7-segment display	Display is in hexadecimal tach lines after rampup, most significant digit first
19	While holding FUNCTION SELECT switch, depress and hold LOAD/ON LINE (DECREMENT LENGTH) switch until desired shuttle length is obtained. Release switches	300_{16} displayed on 7-segment display. Most significant digit first	Display decrementing starts slowly and increases to a blur, with a momentary pause and display of the MSB each time the LSB decrements to 00
20	Depress REW/UNLOAD (SHUTTLE/STOP) switch	Tape will shuttle forward 900_{16} tach lines and reverse 300_{16} tach lines	Cover and door can be opened to observe operation

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3.37 DIAGNOSTIC CODES

Various diagnostic codes (Table 3-1) can be selected via the FUNCTION SELECT switch on the drive front panel. Each of these codes, when enabled, changes the functions of the front panel controls and indicators. The codes and the resultant switch and indicator functions are defined in the subsequent paragraphs.

In general, the switch sequence to enable any diagnostic is

(1) Use FUNCTION SELECT switch to enter Function Select mode and step through codes to desired diagnostic.

(2) Use SET/CLEAR switch to set desired diagnostic.

(3) Use RESET switch to exit Function Select mode and enable diagnostic.

(4) Use RESET switch again to exit diagnostic back to Function Select mode at Code 50.

A detailed example of an operating sequence using several diagnostic codes, is given in Paragraph 3.36.

3.37.1 CODE 51

When code 51 is set, the functions of the front panel controls and indicators are changed to provide manual control of tape motion. Functions available are Load/EOT/BOT cycle, Forward, Reverse, and Stop/Rewind. Tape motion will be at the speed preselected by the operator using Function Select codes 11—17. Functions of the front panel controls and indicators with code 51 set, are shown in Figure 3-35.

With a tape reel in place on the supply hub but tape not loaded, depressing the Load/Cycle switch will initiate a tape load cycle. The Forward, Reverse, and Stop functions are self-explanatory. The EOT/BOT Cycle function interacts with Forward and Reverse. With EOT/BOT Cycle off, the drive will move tape in the selected direction and stop when either the EOT or BOT marker is detected.

With EOT/BOT Cycle on, tape motion will automatically reverse when either marker is detected, and tape will cycle continuously until stopped by the operator. When the STOP/REWIND switch is pressed and released, tape motion will stop. If the switch is pressed and held for more than 1 second, a rewind operation will be initiated. Depressing the RESET switch will cause the drive to exit code 51 and revert to Function Select mode with code 50 displayed.

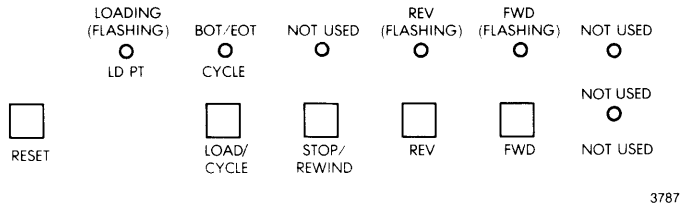

Figure 3-35. Code 51 Control/Indicator Functions

3.37.2 CODE 52

Selection of code 52, with tape loaded, provides a shuttle function at the speed preselected by the operator using Function Select codes 11—17. Functions of the front panel controls and indicators, with code 52 set, are shown in Figure 3-36.

The switches, as indicated in the figure, are dual purpose. The forward or reverse shuttle length is displayed by pressing the appropriate switch. Depressing the Load/ Decrement Length switch with a tape reel in place on the supply hub but tape not threaded will initiate a tape load cycle. To change the shuttle length, press and hold the Forward or Reverse Length display switch, and simultaneously press and hold the Increment Length or Decrement Length switch until the desired shuttle length is displayed. To set the length display to 0, press and hold the Forward or Reverse Length display switch and simultaneously press the RESET switch. Length is displayed in hexadecimal tach lines after ramp-up, most significant byte first (for 1 second), then the least significant byte. When incrementing or decrementing, each time the LSB goes to 0, the MSB will be displayed for 1 second. Shuttling is started and stopped by depressing the Shuttle/Stop switch. If EOT is detected during forward motion, the tape will rewind to BOT and shuttling will restart. Depressing the RESET switch will cause the drive to exit code 52 and revert to Function Select mode with code 50 displayed.

3.37.3 CODE 53

Selection of code 53 provides front panel monitoring of the tension or velocity encoder. The front panel indicators allow monitoring of the drive sensors. Functions of the front panel controls and indicators, with code 53 set, are shown in Figure 3-37.

The indicators are all dual purpose as shown in the figure. When Tension Look is depressed, the tension encoder count is shown on the 7-segment display, and the sensor functions shown over the indicators (Figure 3-37) are displayed on the indicators. When (Velocity Look) is depressed, the velocity encoder count is shown on the 7-segment display, and the sensor functions shown under the indicators (in parentheses) are displayed on the indicators. Depressing the RESET switch will cause the drive to exit code 53 and revert to Function Select mode with code 50 displayed.

3.37.4 CODE 54

Selection of code 54 provides front panel access to four adjustment diagnostic routines; the SU/TU DAC MID Self Adjustment, SU/TU Load Speed Self Adjustment, SU Load Pulse Self Adjustment, and Motor Torque Factor Self Adjustment. Performance of the SU Load Pulse Self Adjustment and the SU/TU Load Speed Self Adjustment requires a 10.5-inch reel of tape to be locked on the supply hub with the end of the tape leader secured to the tape pack. The Motor Self Adjust requires the use of a 10.5-inch reel of tape with the tape leader free to thread. Functions of the front panel controls and indicators, with code 54 set, are shown in Figure 3-38. Depressing the RESET switch will cause the drive to exit code 54 and revert to Function Select mode with code 50 displayed.

3.37.5 CODE 55

Selection of code 55 provides front panel access to and display of data stored in memory that may be required during maintenance operations. Functions of the front panel controls and indicators with code 55 set are shown in Figure 3-39.

When the Prom Version Examine/Display switch is depressed, the associated indicator will flash and the PROMs part number and version will be shown on the 7-segment displays. This number will be shown as four sequential bytes.

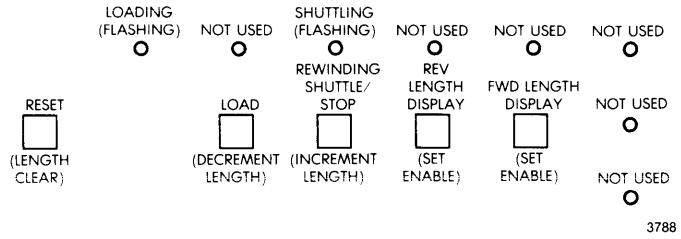

Figure 3-36. Code 52 Control/Indicator Functions

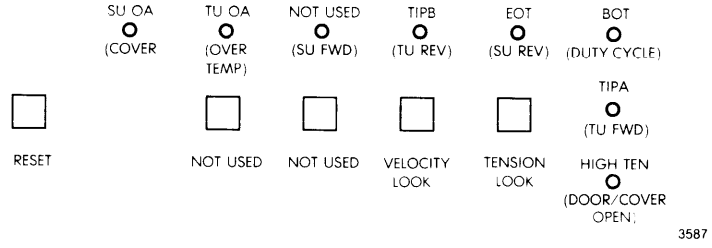

Figure 3-37. Code 53 Control/Indicator Functions

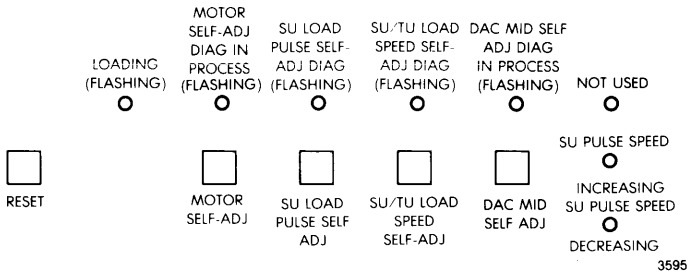

Figure 3.38. Code 54 Control/Indicator Functions

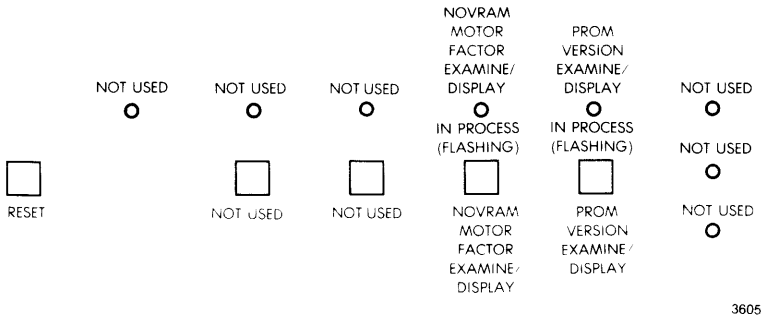

Figure 3-39. Code 55 Control/Indicator Functions

Depressing the NOVRAM Motor Factor Examine/Display causes the associated indicator to flash while the contents of the NOVRAM motor factor table are shown on the 7-segment display. The table consists of 20 bytes which are presented sequentially. The factors displayed and their byte numbers are given in the following list. Takeup reel tension (TU TENSION), bytes 1 and 2; takeup motor drag (TU MDRAG), bytes 3 and 4; takeup motor acceleration (TU ACCEL), bytes 5 and 6; head drag (HDRAG), bytes 7 and 8; supply reel tension (SU TENSION), bytes 9 and 10; supply motor drag (SU MDRAG), bytes 11 and 12; supply motor acceleration (SU ACCEL), bytes 13 and 14; takeup reel load speed (TU LD SPD), byte 15; supply reel load speed (SU LD SPD), byte 16; supply reel load pulse, reverse (SU LD PULSE REV), byte 17; supply reel load pulse, forward (SU LD PULSE FWD), byte 18; byte 19 not used; takeup/supply digital analog converter mid value (TU/SU DACMID), byte 20. The most significant (left) nibble when added to $1F8_{16}$ will equal the TU DACMID. The least significant (right) nibble when added to $1F8_{16}$ will equal the SU DACMID. Depressing the RESET switch will cause the drive to exit code 55 and revert to Function Select mode with code 50 displayed.

3.37.6 CODE 56

Selection of code 56 enables automatic adjustment of write currents and automatically performs the write deskew adjustment for NRZI density. A data tape, with write enable ring installed, must be loaded prior to starting the adjustment. Functions of the front panel controls and indicators with code 56 set are shown in Figure 3-40.

With code 56 set and the tape loaded, depress each of the switches in turn starting with NRZI Auto Write Deskew. As the unit performs each adjustment, the indicator associated with that adjustment will flash. On completion of the adjustment, the associated indicator will light steadily and remain lighted during performance of the subsequent adjustments.

3.37.7 CODE 57

Selection of code 57 enables the automatic adjustment of read amplifier gain. A master output tape must be loaded prior to starting the adjustment. Functions of the front panel controls and indicators with code 57 set are shown in Figure 3-41.

With code 57 set and the tape loaded, depress each of the switches in turn starting with Auto Gain Adj NRZI. As the unit performs each adjustment, the indicator associated with that adjustment will flash. On successful completion of the adjustment, the associated indicator will light steadily and remain lighted during performance of the subsequent adjustments. If the adjustment cannot be successfully performed, the associated indicator will continue to flash and the number of the track or tracks that failed will be displayed on the 7-segment displays. Tracks that failed at 50 ips will be shown on the left display and tracks that failed at 100 ips will be shown on the right display.

3.37.8 CODE 58

Spare

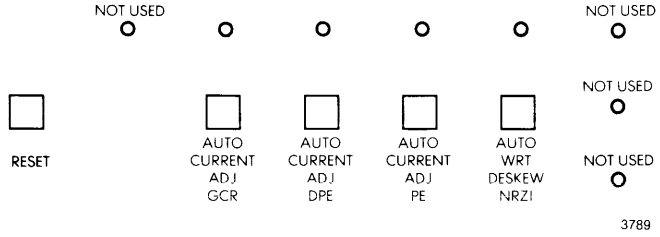

Figure 3-40. Code 56 Control/Indicator Functions

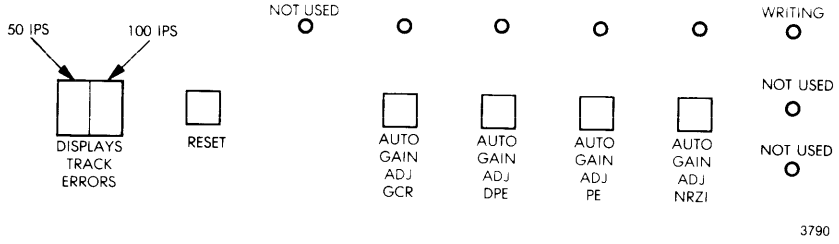

Figure 3-41. Code 57 Control/Indicator Functions

3.37.9 CODE 59

Selection of code 59 allows service personnel to manually adjust the tape drive write currents and read gains. A data tape or master output tape, depending on the adjustment being performed, must be loaded prior to starting the adjustment.

The following provides detailed descriptions of the multiple switch functions; for ease of reference, the same information is recapped in Table 3-12.

- Description 1. Switch functions after mode 59 is entered and before (S2) has been pressed.

  (S1) — Disables/Enables tape motion until mode 59 is reset. The LD PT indicator illuminates to show that tape motion is disabled.

  (S2) — When depressed, causes the currently selected density and speed to be displayed on the 7-segment displays; when released, the selected track number is displayed.

  (S3) — When depressed, (S3) indicator will light; when held for 1 second, will initiate rewind to load point.

  (S4) — If tape is not tensioned, pressing (S4) will cause tape to be loaded and or tensioned. If tape is already tensioned, pressing (S4) once will enable write current, pressing a second time will enable step/write, and pressing a third time will disable write current. The WRT EN indicator shows status as follows: Off = write current off; On = write current on; Flashing = step/write on.

  (S5) — Unit returns to function select mode with code 50 displayed, code 59 remains set. (Current and gain values are stored into nonvolatile memory at this time.) A second depression of (S5) returns unit to mode 59. to exit the function select mode; with code 50 displayed, press (S1) to set mode 50, then press (S5).

Table 3-12
Diagnostic Mode 59 Switch Definition

Present Operation	Reset (S5)	Load/Online (S4)	Rewind/Unload (S3)	Function Select (S2)	Set Clear (S1)
Mode 59 entered. (S2) not yet pressed. (Paragraph 3.13.9 Description 1)	Returns to Function Select Mode	Load/Select Write/Step Write/Write Off	Rewind if held for 1 second	Density display and select enable/track select enable after release	Tape motion disable/enable toggle
(S2) pressed and (S2) indicator is on. (Paragraph 3.13.9 Description 2)	No use	Steps to next lower density/ speed selection	Steps to next higher density/ speed selection	Depressed	No use
After (S2) has been pressed and released and (S2) indicator is on. (Paragraph 3.13.9 Description 3)	Returns to Function Select Mode	Steps to next lower track	Steps to next higher track	Displays selected speed/density	Starts tape motion if motion is enabled & displays write current value
(S1) pressed and (S1) indicator is on. (Paragraph 3.13.9 Description 4)	No use	Decreases write current for selected density	Increases write current for selected density	No use	Depressed
(S1) released and (S1) indicator is on. (Paragraph 3.13.9 Description 5)	Returns to Function Select Mode	Decreases read gain value for selected track	Increases read gain value for selected track	Stops tape motion and displays selected density/ speed	Stops tape motion and displays 59
(S1) released with both (S1) and (S2) indicators off. (Paragraph 3.13.9 Description 6)	Returns to Function Select Mode	No use	Rewind if held for 1 second	Displays selected density/speed	Starts tape motion and displays write current value

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- Description 2. Switch functions with (S2) pressed and held.

  (S1) — Has no effect.

  (S2) — Depressed and held.

  (S3) — Causes unit to step to the next higher Density/Speed selection as shown in the following listing. Symbol for the selected Density/Speed combination is shown on the 7-segment displays.

Density	Speed	Symbol
NRZI	50 ips	n5
NRZI	100 ips	n1
PE	50 ips	P5
PE	100 ips	P1
DDPE	50 ips	d5
GCR	50 ips	G5
GCR	100 ips	G1

  (S4) — Causes unit to step to the next lower Density/Speed selection as shown in the preceding listing. Symbol for the selected Density/Speed combination is shown on the 7-segment displays.

  (S5) — Has no effect (refer to Description 1 [S5]).

- Description 3. Switch functions after (S2) has been released, (S2) indicator illuminated

  (S1) — Causes (S1) indicator to light. Starts tape motion if it has not been disabled (refer to description 1 [S1]). While (S1) is depressed, the write current value for the selected density is shown on the 7-segment displays in hexadecimal format and switches (S3) and (S4) are enabled for write current adjustments. When (S1) is released, the read gain value, for the currently selected track, will be shown on the 7-segment displays and switches (S3) and (S4) are enabled for read gain adjustments.

  (S2) — While (S2) is depressed, the currently selected Density/Speed combination is shown on the 7-segment display. When (S2) is released, the selected track number is shown on the display.

  (S3) — Causes unit to step to the next higher track of the selected Density/Speed combination. When track 9 is displayed and (S3) is depressed, causes unit to step to track 1 of the next higher Density/Speed combination and display the Density/Speed symbol until the switch is released. Stepping stops when the unit reaches track 9 of GCR 100 ips.

  (S4) — Causes unit to step to the next lower track of the selected Density/Speed combination. When track 1 is displayed and (S4) is depressed, causes unit to step to track 9 of the next lower Density/Speed combination and display the Density/Speed symbol until the switch is released. Stepping stops when the unit reaches track 1 of NRZI 50 ips.

  (S5) — Causes unit to exit mode 59 (refer to Description 1 [S5]).

- Description 4. Switch functions while (S1) is held depressed and the (S1) indicator is illuminated.

  (S1) — Depressed and held, (S1) indicator is illuminated.

  (S2) — Has no effect.

  (S3) — Increases the write current for the selected density.

  (S4) — Decreases the write current for the selected density.

  (S5) — Has no effect.

- Description 5. Switch functions after (S1) is released and the (S1) indicator is illuminated

  (S1) — Stops tape motion, if tape is moving, and returns display to mode 59. Causes (S1) indicator to go off.

  (S2) — Stops tape motion, if tape is moving, and causes selected Density/Speed symbol to be displayed. (Refer to Description 2.)

  (S3) — Increases the read gain for the selected track.

  (S4) — Decreases the read gain for the selected track.

  (S5) — Stops tape motion, if tape is moving, and causes unit to exit mode 59 (refer to Description 1 [S5]).

- Description 6. Switch functions after (S1) is released and both (S1) and (S2) indicators are off.

  (S1) — Causes (S1) indicator to light and starts tape motion if tape motion has not been disabled (refer to Description 1 (S1)). While the switch is depressed, the write current value for the selected density is shown on the 7-segment display in hexadecimal format. When the switch is released, the read gain value for the selected track is displayed. (Refer to Description 5.)

  (S2) — Causes (S2) indicator to light and the currently selected Density/Speed symbol to be displayed. (Refer to Description 2.)

  (S3) — Causes (S3) indicator to light and if held for 1 second or more, initiates a tape rewind to load point.

  (S4) — Has no effect.

  (S5) — Causes unit to exit mode 59 (refer to Description 1 [S5]).

3.37.10 CODE 60

Selection of code 60 provides manual override, via the front panel controls, of two safety interlocks designed into the drive. The front panel indicators flash to provide a display of the interlock features that have been defeated. Functions of the front panel controls and indicators, with code 60 set, are shown in Figure 3-42.

WARNING

CODE 60 OVERRIDES SAFETY FEATURES BUILT INTO THE DRIVE TO PROTECT THE OPERATOR FROM INJURY AND THE EQUIPMENT FROM BEING DAMAGED. IT IS INTENDED FOR USE ONLY BY QUALIFIED SERVICE TECHNICIANS.

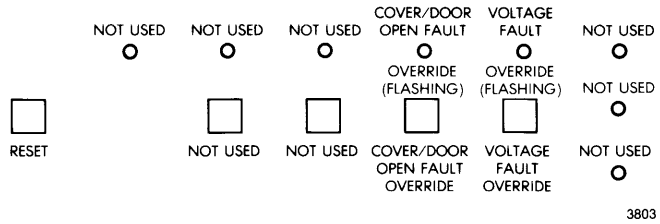

Figure 3-42. Code 60 Control/Indicator Functions

3.37.11 CODE 61

Selection of code 61 provides manual override, via the front panel controls, of four motion control correction functions designed into the drive. The front panel indicators flash to provide a display of the correction functions that have been defeated. Functions of the front panel controls and indicators with code 61 set, are shown in Figure 3-43.

CAUTION

CODE 61 DISABLES CRITICAL CORRECTION FEATURES BUILT INTO THE DRIVE THAT ARE REQUIRED FOR NORMAL, SAFE, OPERATION. IF MISUSED, DAMAGE TO THE EQUIPMENT CAN OCCUR. CODE 61 IS INTENDED FOR USE ONLY BY QUALIFIED SERVICE TECHNICIANS.

3.37.12 CODE 62

Spare

3.37.13 CODE 63

Selection of code 63 provides manual control of various features of the units operating configuration. The 16 configuration codes that can be accessed via code 63 (not all of which are currently used) are described in the following paragraphs. The 7-segment display shows the configuration currently accessed (00 thru 15 for configurations codes 0 thru 15).

Following normal entry of code 63 (code 63 displayed, SET/CLEAR switch pressed, RESET switch pressed) the RESET switch (S5) must be pressed again and held for 3 seconds to enable mode 63. If the switch is held for less than 3 seconds and released, the unit will exit mode 63 and return to the function select mode. Functions of the front panel controls and indicators, with code 63 set and enabled are shown in Figure 3-44. Settings for the configuration codes are presented in terms of the indicators associated with the switches being either ON, OFF, or X (don't care).

3.37.13.1 Configuration Code 0

Configuration Code 0 is designated by 00 on the 7-segment display. This configuration code contains status bits controlled by the tape drive firmware and should not be altered by the operator.

3.37.13.2 Configuration Code 1

Configuration Code 1 is designated by 01 on the 7-segment display. This configuration code is used to select master drive status and configure the drive for operation with or without external parity checking during a write operation. Switch settings for this Configuration Code 1 are given in Table 3-13.

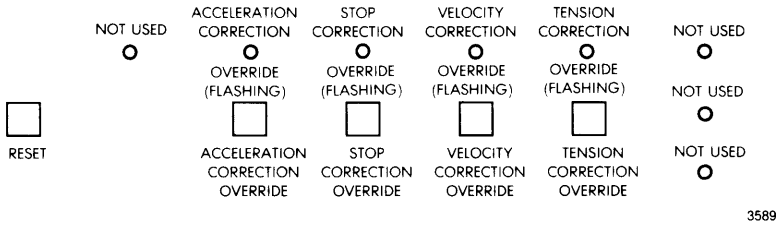

Figure 3-43. Code 61 Control/Indicator Functions

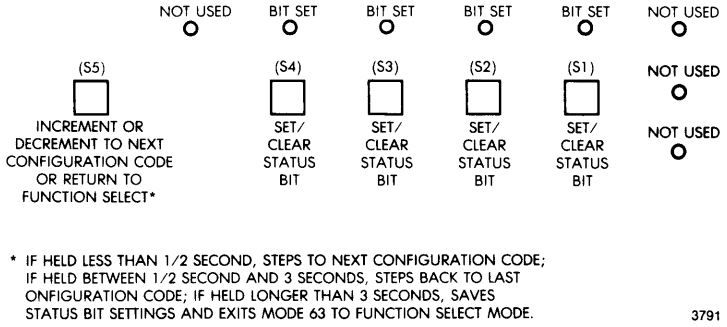

Figure 3-44. Code 63 Control/Indicator Functions

Table 3-13
Configuration Code 1 Switch Settings

	S4	S3	S2	S1
Master drive	X	X	X	ON
Host write data parity checking disabled	X	X	ON	X

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3.37.13.3 Configuration Code 2

Configuration Code 2 is designated by 02 on the 7-segment display. This configuration code allows the operator to disable the automatic error correction, select the extended gap feature (gap length is set using Configuration Code 3), disable the ID burst generation and checking during 126 c/mm (3200 cpi) operation, and disallow single track write errors. Switch settings for Configuration Code 2 are given in Table 3-14.

NOTE

During read operations, when the 3200 cpi ID Burst has been disabled, the drive will not read NRZI tapes from BOT unless the NRZI Density mode is selected. For example, if Function Code 10 is set and the left display is showing an "n", the drive will try to read the tape in NRZI if no density ID burst is detected during a read-from-BOT operation. Once the tape is positioned away from BOT, the drive will retain the density selection detected when the tape left BOT.

NOTE

Use of the extended gap feature can be overridden using the MODE SELECT command.

3.37.13.4 Configuration Code 3

Configuration Code 3 is designated by 03 on the 7-segment display. This configuration code allows the operator to select an extended gap length (extended gap feature in Configuration Code 2 must be set) that matches the operational requirements of the system. Default gap lengths (extended gap not selected) are: GCR = 0.3 inch, all other densities = 0.6 inch. Gap length extensions and switch settings are given in Table 3-15

NOTE

Exercise caution when using the maximum (72-inch) extended gap. If automatic retries are disabled (Code 9) and the host initiates retries, the ANSI maximum IBG specification can be exceeded in certain circumstances.

3.37.13.5 Configuration Code 4

Configuration Code 4 is designated by 04 on the 7-segment display and is configured to select the method the system will use in choosing speed and density combinations over the interface. Configuration Code 4 can be used only if Code 10 in the normal Function Codes is reset, permitting remote selection of speed and density. Since the factory default for Code 10 is set, this configuration code is inactive when the unit is shipped. Switch settings for the available options are given in Table 16.

3.37.13.6 Configuration Code 5

Configuration Code 5 is designated by 05 on the 7-segment display. This function is not used in the SCSI configuration.

3.37.13.7 Configuration Code 6

Configuration Code 6 is designated by 06 on the 7-segment display and is used to select the Pseudo EOT mode and to enable saving data pointers. Switch settings to set Configuration Code 6 are defined in Table 3-17.

Table 3-14
Configuration Code 2 Switch Settings

	S4	S3	S2	S1
Factory default setting	OFF	OFF	OFF	OFF
Error correction disabled	X	X	X	ON
Extended gap selected	X	X	ON	X
3200 ID burst disabled	X	ON	X	X
Single track write errors disallowed	ON	X	X	X

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Table 3-15
Extended Gap Switch Settings

Amount Added to Standard Gap	S4	S3	S2	S1
Up to 0.15 inch*	OFF	OFF	OFF	OFF
Up to 0.3 inch	OFF	OFF	OFF	ON
Up to 0.6 inch	OFF	OFF	ON	OFF
Up to 0.9 inch	OFF	OFF	ON	ON
Up to 1.2 inch	OFF	ON	OFF	OFF
Up to 1.5 inch	OFF	ON	OFF	ON
Up to 1.8 inch	OFF	ON	ON	OFF
Up to 2.1 inch	OFF	ON	ON	ON
Up to 2.4 inch	ON	OFF	OFF	OFF
Up to 2.7 inch	ON	OFF	OFF	ON
Up to 3.0 inch	ON	OFF	ON	OFF
Up to 3.3 inch	ON	OFF	ON	ON
Up to 3.6 inch	ON	ON	OFF	OFF
Up to 3.9 inch	ON	ON	OFF	ON
Up to 4.2 inch	ON	ON	ON	OFF
Up to 72 inches	ON	ON	ON	ON

* Factory default setting

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Table 3-16
Configuration Code 4 Switch Settings

Functional Result	S4	S3	S2	S1
Density selected via SCSI Interface	OFF	OFF	X	X
Speed selected via SCSI Interface	X	X	OFF	OFF
Speed selected via front panel (Low Speed)	X	X	OFF	ON
Speed selected via front panel (High Speed)	X	X	ON	ON
Factory Default Density = IRTH2, Speed = IDEN	OFF	OFF	OFF	OFF

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Table 3-17
Configuration Code 6 Switch Settings

Cache Mode	S4	S3	S2	S1
Cache Enabled	X	X	X	ON
Save Data Pointers	X	X	ON	ON
Pseudo EOT Mode	ON	X	X	X
Factory Default Settings	OFF	OFF	OFF	ON

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3.37.13.8 Configuration Code 7 Cache Partition

Configuration Code 7 is designated by 07 on the 7-segment display. This function enables the user to partition the cache memory into data block sizes that range from 256 1-kilobyte data blocks to 16 64-kilobyte data blocks. Switch settings for Configuration Code 7 and the resulting data block sizes are given in Table 3-18.

3.37.13.9 Configuration Code 8

Configuration Code 8 is designated by 08 on the 7-segment display. This function provides for operating the drive in a start/stop emulation mode. Various *Psuedo Ramps* from 0 to 15 milliseconds, can be input to the cache using the switch settings given in Table 3-19.

3.37.13.10 Configuration Code 9

Configuration Code 9 is designated by 09 on the 7-segment display and allows the user to select the number of automatic retrys for use during cache operations. Switch settings for this function are given Table 3-20.

3.37.13.11 Configuration Code 10

Configuration Code 10 is designated by 10 on the 7-segment display. This function is not used in the SCSI configuration.

3.37.13.12 Configuration Code 11

Configuration Code 11 is designated by 11 on the 7-segment display and is a diagnostic function for use by trained service personnel only. Switch settings to implement Configuration Code 11 are: (TBD)

Table 3-18
Configuration Code 7 Switch Settings

Maximum Block Size	S4	S3	S2	S1
64 Kilobytes (65,535)	OFF	OFF	OFF	OFF
32 Kilobytes	OFF	OFF	OFF	ON
21 Kilobytes	OFF	OFF	ON	OFF
16 Kilobytes	OFF	OFF	ON	ON
12 Kilobytes	OFF	ON	OFF	OFF
10 Kilobytes	OFF	ON	OFF	ON
8 Kilobytes*	OFF	ON	ON	OFF
6 Kilobytes	OFF	ON	ON	ON
4 Kilobytes	ON	OFF	OFF	OFF
2 Kilobytes	ON	OFF	OFF	ON
1 Kilobyte	ON	OFF	ON	OFF
48 Kilobytes	ON	OFF	ON	ON
Undefined Range	ON	ON	OFF	OFF
	ON	ON	ON	ON

* Factory Default

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Table 3-19
Configuration Code 8 Switch Setting

Pseudo Ramp	S4	S3	S2	S1
*0 milliseconds	OFF	OFF	OFF	OFF
1 millisecond	OFF	OFF	OFF	ON
2 milliseconds	OFF	OFF	ON	OFF
3 milliseconds	OFF	OFF	ON	ON
4 milliseconds	OFF	ON	OFF	OFF
5 milliseconds	OFF	ON	OFF	ON
6 milliseconds	OFF	ON	ON	OFF
7 milliseconds	OFF	ON	ON	ON
8 milliseconds	ON	OFF	OFF	OFF
9 milliseconds	ON	OFF	OFF	ON
10 milliseconds	ON	OFF	ON	OFF
11 milliseconds	ON	OFF	ON	ON
12 milliseconds	ON	ON	OFF	OFF
13 milliseconds	ON	ON	OFF	ON
14 milliseconds	ON	ON	ON	OFF
15 milliseconds	ON	ON	ON	ON

*Factory Default Setting

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Table 3-20
Configuration Code 9 Switch Settings

Retry Count	S4	S3	S2	S1
No Retries	OFF	OFF	OFF	OFF
1 Retry	OFF	OFF	OFF	ON
2 Retries	OFF	OFF	ON	OFF
3 Retries	OFF	OFF	ON	ON
4 Retries*	OFF	ON	OFF	OFF
5 Retries	OFF	ON	OFF	ON
6 Retries	OFF	ON	ON	OFF
7 Retries	OFF	ON	ON	ON
8 Retries	ON	OFF	OFF	OFF
9 Retries	ON	OFF	OFF	ON
10 Retries	ON	OFF	ON	OFF
11 Retries	ON	OFF	ON	ON
12 Retries	ON	ON	OFF	OFF
13 Retries	ON	ON	OFF	ON
14 Retries	ON	ON	ON	OFF
15 Retries	ON	ON	ON	ON

* Factory default setting

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3.37.13.13 Configuration Code 12

Configuration Code 12 is designated by 12 on the 7-segment display and is reserved for a diagnostic function that is not implemented at this time.

3.37.13.14 Configuration Code 13

Configuration Code 13 is designated by 13 on the 7-segment display and is reserved for a diagnostic function that is not implemented at this time.

3.37.13.15 Configuration Code 14

Configuration Code 14 is designated by 14 on the 7-segment display and is reserved for a diagnostic function that is not implemented at this time.

3.37.13.16 Configuration Code 15

Configuration Code 15 is designated by 15 on the 7-segment display and is reserved for a diagnostic function that is not implemented at this time.

3.38 REFERENCE DOCUMENTS

An Operating and Service Manual (DDC Pertec No. 114068) containing detailed description, theory of operations, and maintenance information is available at extra cost. Contact the DDC Pertec Order Entry Department, 20400 Plummer Street, Chatsworth, California 91311.

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