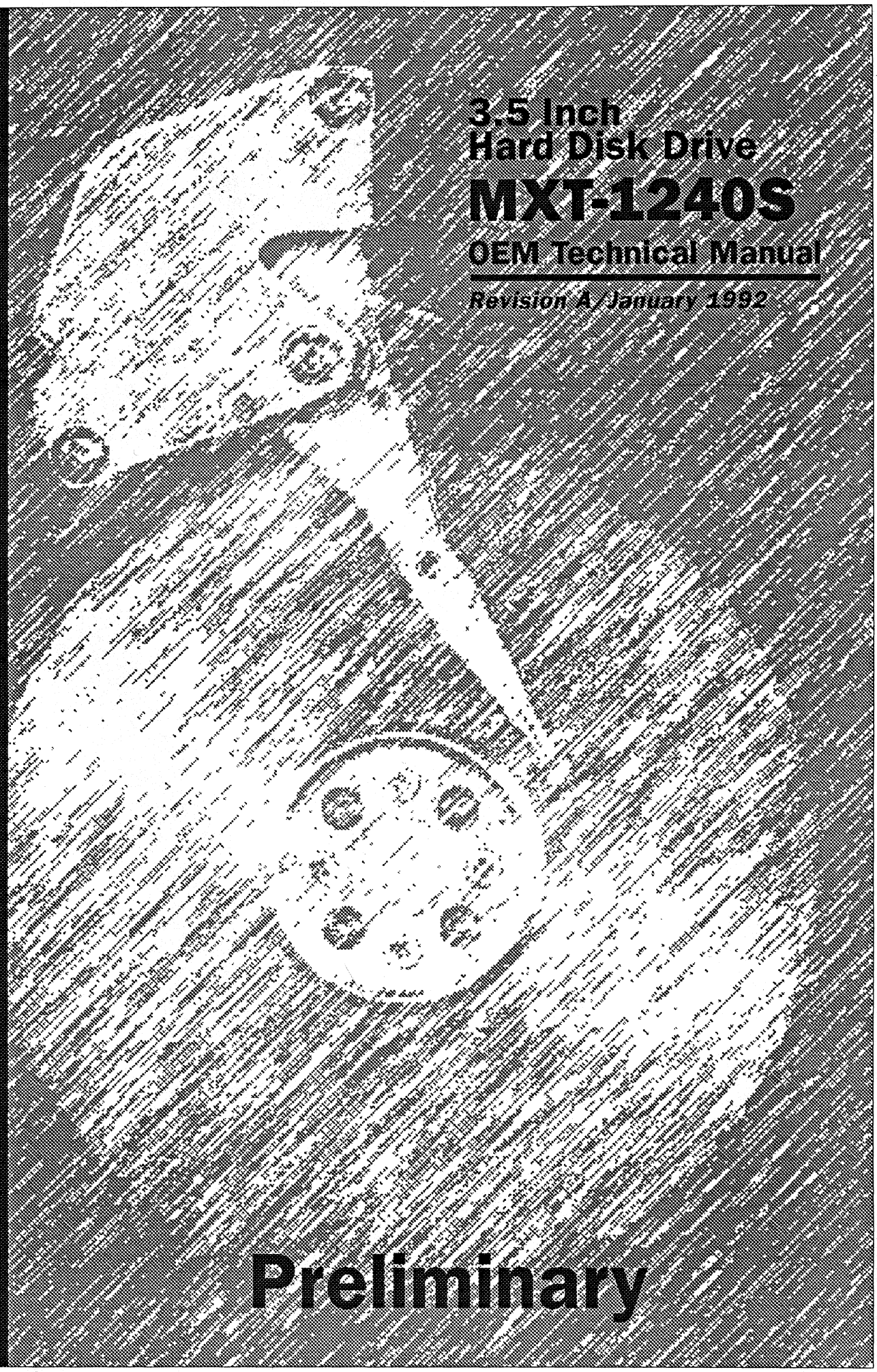
Maxtor Total Customer Satisfaction



3.5 Inch Hard Disk Drive

MXT-1240S

OEM Technical Manual

Revision A/January 1992

Preliminary

NOTICE TO MXT-1240S OEM MANUAL USERS 1-10-92

The features below are listed in the MXT-1240S OEM manual, but are not supported at this time. Unless otherwise indicated, they will be supported in mid February, 1992.

SECTOR SIZE

The MXT-1240S currently only supports a 512-byte sector size.

SPINDLE SYNCHRONIZATION

The MXT-1240S does not currently support spindle synchronization.

ERROR CORRECTION

Firmware or "off-line" error correction is not currently supported.

BITS AND FIELDS NOT CURRENTLY SUPPORTED

The MXT-1240S disk drive does not currently support the bits and fields listed below:

• Disable Certification (DCRT) Bit	Section 7.2.2, Page 76
• Rotational Position Locking (RPL) Field	Section 7.4.6, Page 109
• Report Log Exception (RLEC) Bit	Section 7.4.9, Page 114
• Enabled Extended Contingent Allegiance (EECA) Bit	Section 7.4.9, Page 114
• Ready AEN Permission (RAENP) Bit	Section 7.4.9, Page 114
• UNIT ATTENTION AEN Permission (UAAENP) Bit	Section 7.4.9, Page 114
• Error AEN Permission (EAENP) Bit	Section 7.4.9, Page 114

MXT–1240S

Product Specification and
OEM Technical Manual

Document 1028044
Revision A
January 10, 1992

REVISION RECORD

Revision	Date Published	Revised Contents
A	January 10, 1992	Preliminary Release

Document Number: 1028044

REGULATORY APPROVALS

TUV	File Number:	Application Submitted
	Issuance Number:	Application Submitted
CSA	File Number:	Application Submitted
UL	File Number:	Application Submitted

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PREFACE

The purpose of this manual is to provide all of the technical information you need to install and use Maxtor MXT SCSI disk drives. It is intended for evaluation and integration engineers who are building or assembling a total computer system. This manual does not include the information needed to repair these disk drives. For this information contact the Maxtor Service Center in San Jose, CA.

Chapter 1 is a description of the disk drives, including specifications. Chapter 2 provides the information you need to prepare drives for installation. Chapter 3 covers installation. Chapter 4 provides information on disk drive operation. Chapter 5 provides information on various configurations and on the electrical interface. Chapter 6 continues the discussion on the interface with information on the SCSI phases. Chapter 7 concludes the interface discussion with information on the SCSI commands supported by the drives.

Maxtor publishes descriptive brochures and data sheets, this original equipment manufacturer (OEM) technical manual, and a quick reference guide for each product line. Changes that affect the content of any manual are covered by addenda or revisions to the affected manual.

Maxtor reserves the right to make changes and/or improvements to its products without incurring any obligation to incorporate such changes or improvements in units previously sold or shipped.

REFERENCE NUMBERS

For information concerning drive set-up and operation, contact Maxtor Technical Support at (800) 2-MAXTOR. Outside of the U.S., Maxtor Technical Support can be reached at (303) 678-2700.

To receive Maxtor product literature via facsimile machine, call the MaxFax hot line at (303) 678-2618. For various information on distributors, drive parameters, installation tips, and application notes as well as Maxtor product literature, the Maxtor Bulletin Board may be accessed via modem at (303) 678-2222. Your modem should be set for 2400 baud with eight bits and one stop bit.

For information regarding PC AT/XT™, PS-2™, and Macintosh® applications, contact Storage Dimensions Inc. (SDI) Technical Support at (408) 879-0300.

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1.0 DISK DRIVE DESCRIPTION

The MXT-1240 SCSI (Small Computer System Interface) disk drives are high capacity, high performance, random access storage devices which use nonremovable 3.5-inch disks as storage media. Each disk surface employs one moveable head to access the data tracks. See Figure 1•1.

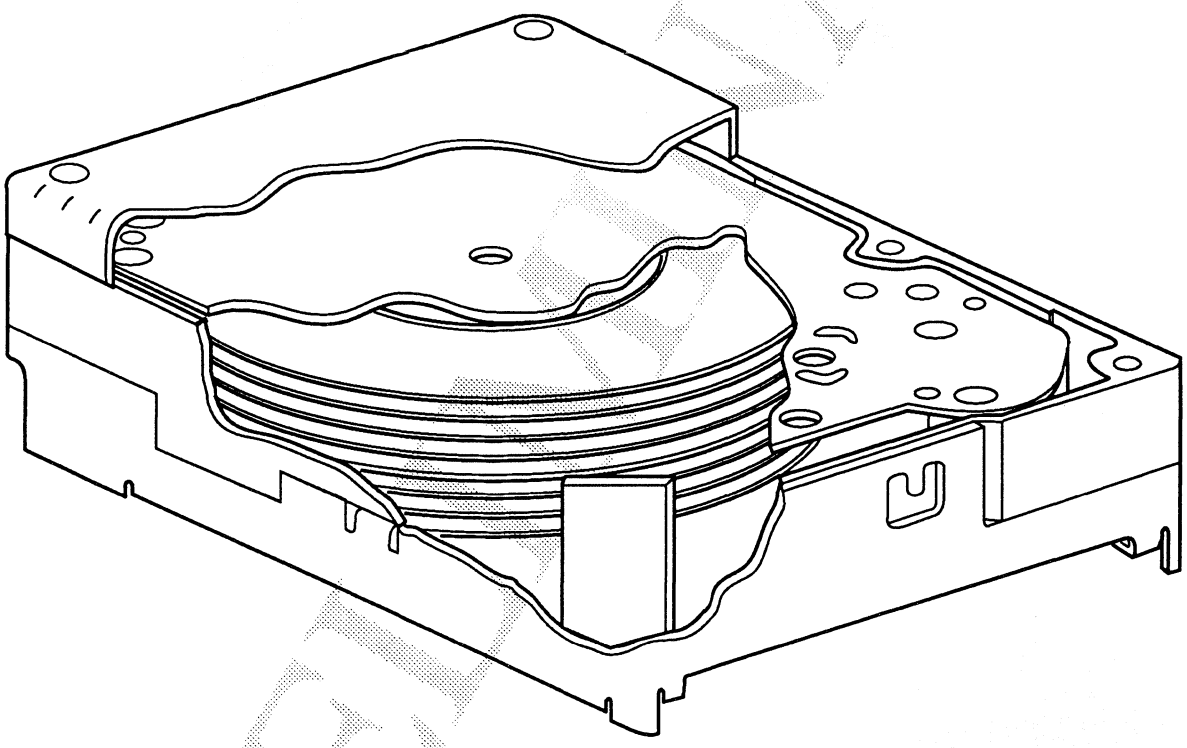


Figure 1•1
MXT-1240S Disk Drive

These disk drives include a controller embedded in the drive electronics. Some of the resulting benefits of having an integrated controller include the elimination of a separate controller printed circuit board (PCB), reduction in the number of associated cables, and elimination of the controller-specific power supply.

High performance is achieved through the use of a rotary voice coil actuator and a closed loop hybrid servo system using a dedicated servo surface and embedded servo information on each data surface. The innovative MAXTORQ™ rotary voice coil actuator provides performance usually achieved only with larger, higher powered linear actuators. The

closed loop hybrid servo system with dedicated and embedded servo surfaces allow state-of-the-art recording densities in a 3.5-inch package.

High capacity is achieved by a balanced combination of high areal recording density, run-length limited (RLL) data encoding techniques, and high density packaging techniques. A multi-zone implementation of 1,7 code is used. Maxtor's advanced MAXPAK™ electronic packaging techniques use miniature surface-mounted devices to allow all electronic circuitry to fit on one PCB. Advanced flexures and heads allow closer spacing of disks, and therefore allow a higher number of disks in a 3.5-inch package. Maxtor's integrated drive motor/spindle design allows a deeper head disk assembly (HDA) casting than conventional designs, permitting the use of up to eight disks.

The drive's electrical interface is compatible with the ANSI SCSI–2 standard, plus the Common Command Set (CCS) requirements. The drive's size and mounting conform to the industry standard 3.5-inch form factor for disk drives, and uses the same direct current (DC) voltages and connectors. For details on this connector see section 5.2.2, Power Connector.

The commands supported by the drive are listed and discussed later in this manual in Chapter 7.0, SCSI Command Descriptions. For more information on Group 0 and Group 1 commands for direct-access devices, see the reference documents below:

- ANSI X3.131-1986, SCSI, American National Standards Institute, Inc., June 23, 1986.
- X3T9.2/86-109 Rev 4.B CCS of the SCSI, American National Standards Institute, Inc., June 23, 1986.

1.1 PRODUCT SPECIFICATIONS

This section includes specifications for performance, function, environmental limits, physical dimensions, reliability, error rates, and DC power requirements. At the end of this section, there is a list of the standards and regulations that apply to this family of disk drives.

1.1.1 Performance Specifications

	MXT-1240S
CAPACITY UNFORMATTED	
PER DRIVE (Mbytes)	1,524
PER SURFACE (Mbytes)	101.6
CAPACITY FORMATTED*	
PER DRIVE (Bytes)	1,240,809,984
PER SURFACE (Bytes)	82,724,000
AVERAGE LATENCY (msec)	4.76
SEEK TIME (msec) MAXIMUM	
SINGLE TRACK READ	<1.5
SINGLE TRACK WRITE	2.0
AVERAGE SEEK	8.5
AVERAGE SEEK TO READ	8.5
AVERAGE SEEK TO WRITE	9.0
FULL STROKE	20.0
SCSI OVERHEAD (µsec)	<300
SCSI TRANSFER RATE	
BUFFER TO HOST (Mbyte/sec)	
ASYNCHRONOUS	5.0
SYNCHRONOUS	10.0
BUFFER SIZE (K)	256

*Actual capacity available depends on user-defined parameters selected in the format operation. The formatted capacity above was calculated using a 512 byte sector.

Table 1-1
Performance Specifications

1.1.1.1 PERFORMANCE SPECIFICATIONS BY ZONE

ZONE	UNFORMATTED DISK DATA RATES (MBits/Second)	FORMATTED DISK DATA RATES 512 Bytes/Sector (MBits/Second)	CYLINDERS PER ZONE	TRACKS PER ZONE	SECTORS PER TRACK BY ZONE	RECORDING DENSITY (bpi)	FLUX DENSITY (fci)
1	22.49	18.92	315	4,725	44	42,630	31,973
2	25.46	21.50	314	4,710	50	41,930	31,447
3	28.81	24.08	314	4,710	56	41,940	31,455
4	32.53	27.09	314	4,710	63	42,430	31,822
5	35.69	29.68	314	4,710	69	42,170	31,628
6	38.29	31.83	314	4,710	74	41,350	31,013
7	41.63	34.41	314	4,710	80	41,400	31,050
8	44.42	36.56	314	4,710	85	40,930	30,698

Table 1-2
Performance Specifications by Zone

1.1.2 Functional Specifications

	MXT-1240S
ROTATIONAL SPEED (rpm)	6,300 ± .5%
RECORDING METHOD	1,7 RLL
TRACK DENSITY(tpi)	2,600
DATA HEADS	15
SERVO HEADS	1
DISKS	8
ACTUATOR TYPE	Rotary Voice Coil
SERVO TYPE	Dedicated/Hybrid

Table 1-3
Functional Specifications

1.1.3 Environmental Specifications

	EQUIPMENT OPERATING	EQUIPMENT NONOPERATING
AMBIENT TEMPERATURE	41° to 131° F (5° to 55° C)	–40° to 149° F (–40° to 65° C)
MAXIMUM TEMPERATURE GRADIENT	2° C/5 min. (3.6° F/5 min.) Below Condensation	2° C/5 min. (3.6° F/5 min.) Below Condensation
RELATIVE HUMIDITY	5 to 95% Non-condensing with Maximum Gradient of 20%/hr	5 to 95% Non-condensing with Maximum Gradient of 20%/hr
ELEVATION	–1,000 ft to 10,000 ft	–1,000 ft to 10,000 ft
VIBRATION, ALL AXES (Inputs to Frame of Drive, 1-2K Hz)	.5 G Peak	1 G Peak
SHOCK, ALL AXES (Inputs to Frame of Drive) (11 msec Pulsewidth, Half Sine Wave)	3 G (No Errors) and 10 G (Recoverable Errors)	50 G
AUDIBLE NOISE (Random Seek, 100ms Delay)	30 dBA (Sound Power at 1 Meter)	Not Applicable

Table 1-4
Environmental Limits

1.1.4 Physical Specifications

HEIGHT	1.625 in. (41.3 mm)
WIDTH	4.000 in. (101.6 mm)
DEPTH	5.750 in. (146 mm)
WEIGHT	2.2 lbs.

Table 1-5
Physical Dimensions (Without Bezel)

1.1.4.1 TRANSLATED INTEGRATION VALUES

	MXT-1240S
HEADS	15
CYLINDERS	2,513
SECTORS PER TRACK	44-85

Table 1-6
Translated Integration Values

1.1.5 Reliability Specifications

MTBF	300,000 POH, Typical Usage
PM	Not Required
MTTR	30 Minutes
COMPONENT DESIGN LIFE	5 Years

Table 1-7
Reliability Specifications

1.1.6 Error Rates

RECOVERABLE ERRORS *	Less Than 10 per 10^{13} Bits Read
UNRECOVERABLE ERRORS	Less Than 10 per 10^{17} Bits Read
SEEK ERRORS	Less Than 10 per 10^{7} Seeks
PROBABILITY OF MISCORRECTED DATA	Less Than 10 per 10^{24} Bits Read

* Requires Off-Line Firmware Error Correction Code (ECC).

Table 1-8
Error Rates

1.1.7 DC Power Requirements

VOLTAGE (Nominal)	+12V DC	+5V DC
REGULATION	+5% -10%	±5%
CURRENT (Average)	.70A	.83A
CURRENT (Maximum)	2.5A*	1.20A
POWER (Average)	8.4W	4.1W
RIPPLE (Maximum, P-P)	120mV	50mV

* During Drive Start Up

Table 1-9
DC Power Requirements
for Drive with Single Ended Outputs

VOLTAGE (Nominal)	+12V DC	+5V DC
REGULATION	+5% -10%	±5%
CURRENT (Average)	.70A	1.20A
CURRENT (Maximum)	2.5A*	1.83A
POWER (Average)	8.4W	6.0W
RIPPLE (Maximum, P-P)	120mV	50mV

*During Drive Start Up

Table 1-10
DC Power Requirements
for Drive with Differential Outputs
(Tailgate PCB Attached to Drive)

1.1.8 SCSI Implementation

OPERATION CODE	COMMAND NAME	OPERATION CODE	COMMAND NAME
00h	TEST UNIT READY	1Ch	RECEIVE DIAGNOSTIC RESULTS
01h	REZERO UNIT	1Dh	SEND DIAGNOSTIC
03h	REQUEST SENSE	25h	READ CAPACITY
04h	FORMAT UNIT	28h	READ (EXTENDED)
07h	REASSIGN BLOCK	2Ah	WRITE (EXTENDED)
08h	READ	2Bh	SEEK (EXTENDED)
0Ah	WRITE	2Eh	WRITE AND VERIFY
0Bh	SEEK	2Fh	VERIFY
12h	INQUIRY	37h	READ DEFECT LIST
15h	MODE SELECT	3Bh	WRITE BUFFER
16h	RESERVE UNIT	3Ch	READ BUFFER
17h	RELEASE UNIT	3Eh	READ LONG
1Ah	MODE SENSE	3Fh	WRITE LONG
1Bh	START/STOP UNIT		

Table 1-11
SCSI Implementation

1.1.9 Standards and Regulations

The Maxtor MXT-1240S disk drive satisfies the following standards and regulations:

UNDERWRITERS LABORATORIES (UL) is United States safety; UL 478, Standard for Safety, Electronic Processing Units and Systems.

CANADIAN STANDARDS ASSOCIATION (CSA) is Canadian safety; CSA C22.2 No. 220, 1986, Information Processing and Business Equipment (Consumer and Commercial Products).

TECHNISCHER ÜBERWACHUNGS-VEREIN RHEINLAND e. V. (TUV) is Technical Supervisory Association of Germany.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC) is International Safety Commission; IEC 950 (formerly 380), Safety of Information Technology Equipment.

CAUTION: *This equipment generates and uses radio frequency energy, and may cause interference to radio and television reception if not installed and used in strict accordance with the instructions in this manual.*

You may find the FCC booklet *How to Identify and Resolve Radio TV Interference Problems* helpful. This booklet is available from the United States Government Printing Office, Washington, D.C., 20402, stock number 004-000-00345-4.

Maxtor is not responsible for any radio or television interference caused by unauthorized modifications to the drive. It is the responsibility of the user to correct such interference.

For the file numbers for these standards see page iii at the front of this manual.

1.2 HEAD/DISK ASSEMBLY MAJOR PARTS

The major elements of the Head/Disk Assembly (HDA) are the air filter, the head amplifier, the positioning motor, the actuator latch, the read/write head assembly, and the spindle motor. See Figure 1•1, earlier in this manual. A brief discussion of some of these parts follows.

1.2.1 Air Filtration System

The disks and read/write heads are assembled in a Class 100 environment and then sealed within the HDA. The HDA contains an absolute filter, mounted inside the casing, to provide constant internal air filtration. See Figure 1•2, below.

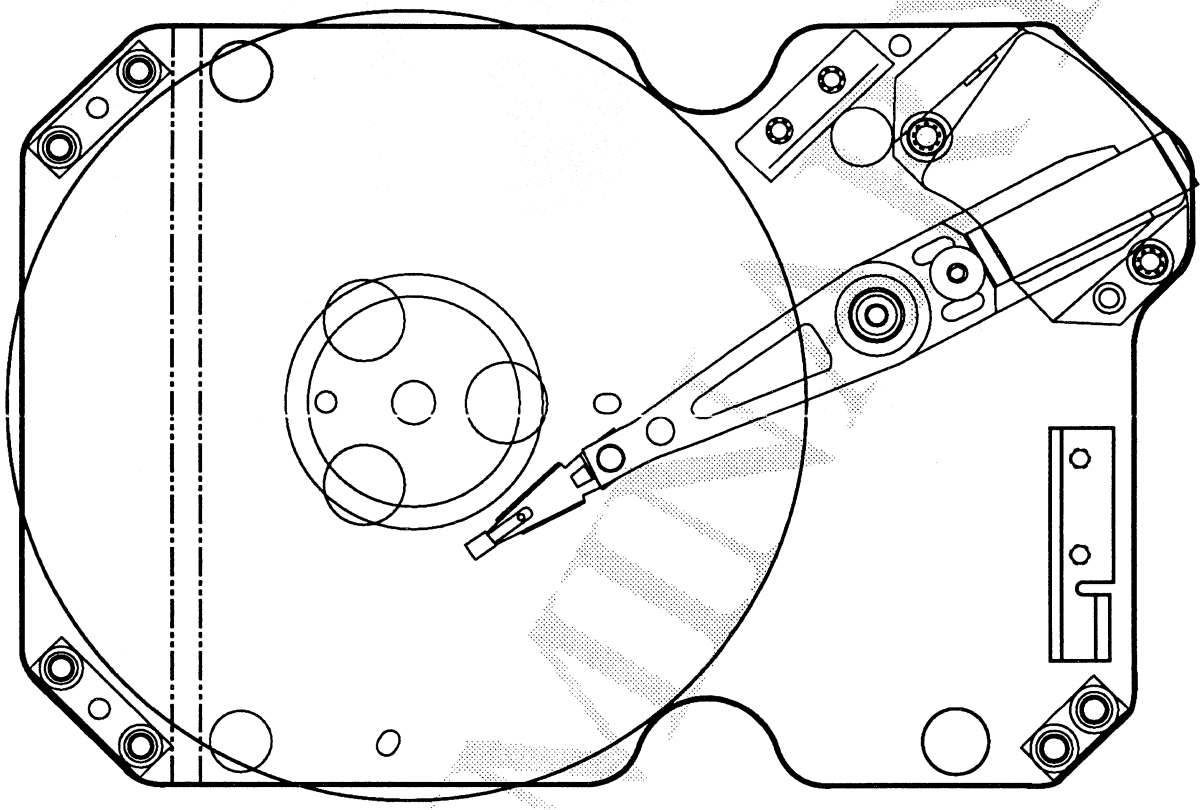


Figure 1•2
Air Filtration System

1.2.2 Drive Mechanism

The HDA is a sealed subassembly containing the mechanical portion of the disk drive. A brushless DC motor contained within the spindle hub rotates the spindle and is controlled by a dedicated microprocessor. Shock mounting is provided internally in the HDA and externally at vibration isolators to minimize transmission of vibration through the frame. The frame is the mechanical assembly holding the HDA and PCB.

1.2.3 Head Positioning Mechanism

The read/write heads are mounted on a head/arm assembly, which is then mounted on a ball bearing supported shaft. See Figure 1•3. The voice coil, an integral part of the head/arm assembly, lies inside the magnet housing when installed in the drive. Current from the power amplifier, controlled by the servo system, induces a magnetic field in the voice coil which either aids or opposes the field around the permanent magnets. This reaction causes the voice coil to move within the magnetic field. Because the head/arm as-

semblies are connected to the voice coil, the voice coil movement is transferred, through the pivot point, directly to the heads, to position them in the desired cylinder over the desired track.

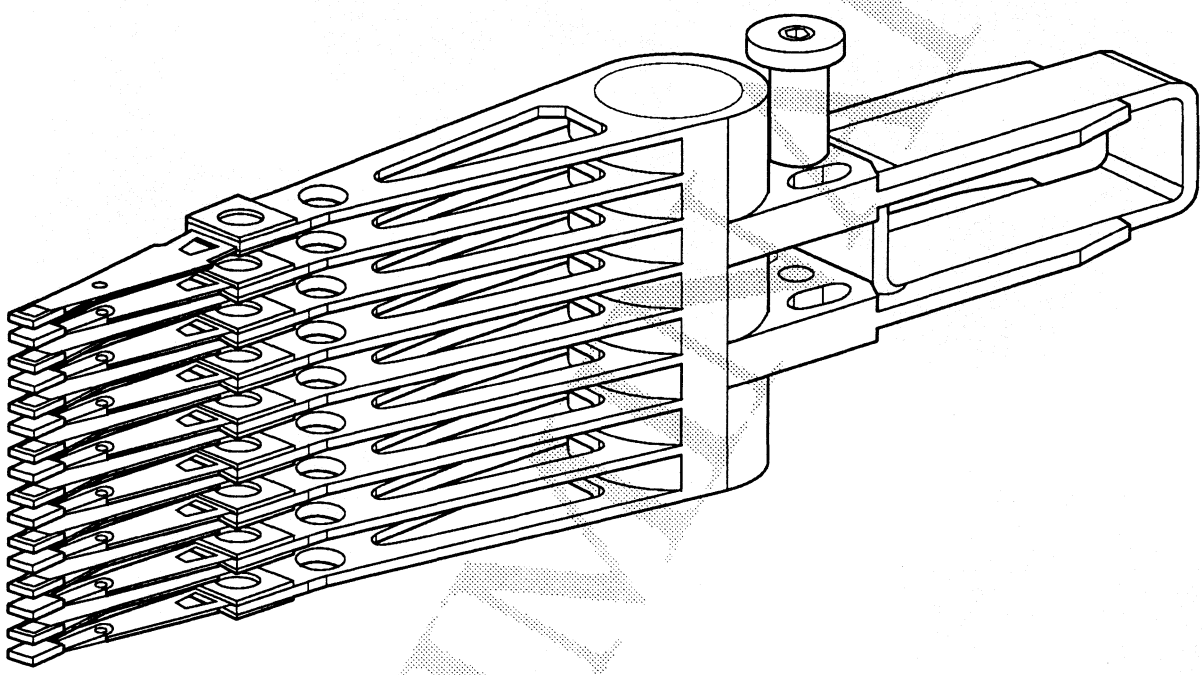


Figure 1•3
Head Positioning Mechanism

Actuator movement is controlled by the servo feedback signal from the servo head. The servo information is prewritten at the factory and is used for the following functions: as a control signal for the actuator to provide track crossing signals during a seek operation, for track following signals during in-cylinder operations, and for timing information such as index and servo clocks. Servo information also provides the timing to divide a track into sectors used for data storage. The servo control system has a dedicated microprocessor for fast, optimized performance.

1.2.4 Read/Write Heads and Disks

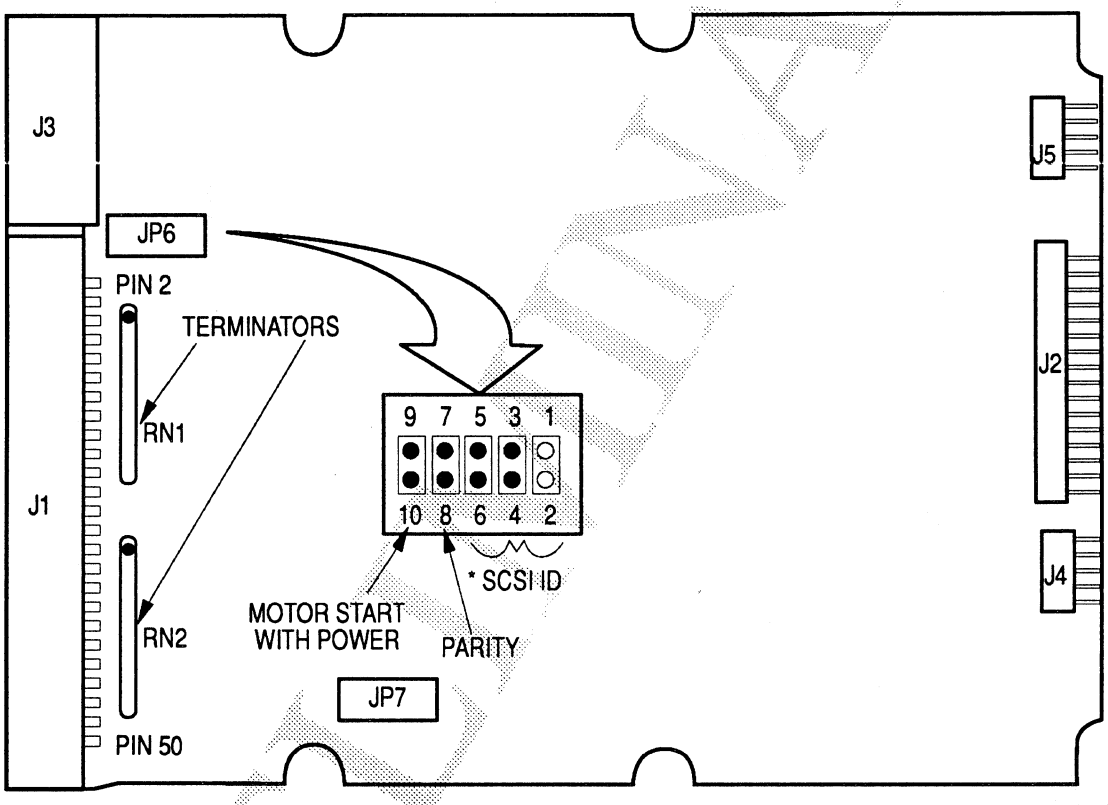
The disk drive employs state of the art sliders and flexures. The configuration of the sliders and flexures provides improved aerodynamic stability, superior head/disk compliance, and a higher signal-to-noise ratio.

The disk media uses a nickel-cobalt metallic film that yields high amplitude signals, and very high resolution performance, compared to conventional oxide coated media. It also provides an abrasion and impact resistant surface, decreasing the potential for damage caused by shock and vibration during shipping.

Data on each of the data surfaces is read or written by one read/write head. There is one surface dedicated to servo information in each disk drive.

2.0 DISK DRIVE SETUP

Jumper locations are identified in Figure 2•1.



** The disk drive is shipped as SCSI ID 6 as shown in this figure. All solid dots indicate that the drive is shipped with those jumpers installed.*

Figure 2•1
PCB Layout

2.1 SCSI ID SELECTION

SCSI ID jumpers (pins one through six on JP6) are provided to configure each disk drive with a SCSI device ID for use in multiple SCSI device configurations.

Table 2•1, is a reference table for the SCSI ID jumper configuration, the ID, and the priority on the SCSI bus. An ID of seven is the highest priority in a multiple device configuration, and is usually used by the initiator.

SCSI ID	PRIORITY	PINS 5 & 6 (MSB)	PINS 3 & 4	PINS 1 & 2 (LSB)
0	Lowest	Out	Out	Out
1		Out	Out	In
2		Out	In	Out
3		Out	In	In
4		In	Out	Out
5		In	Out	In
6		In	In	Out
7	Highest	In	In	In

In = Installed, Shorted
Out = Not Installed, Open

Table 2•1
SCSI ID Jumpers

The disk drive is shipped from the factory with an ID of six. This ensures that sufficient jumpers are available for any address except seven, which is usually reserved for the host system.

2.2 DRIVE SPIN-UP OPTIONS

MODE	J6 PINS 9 & 10 (spin with power)
Wait for START Command	Jumper Removed
Start When Power Applied	Jumper Installed

Table 2•2
Summary of Power-Up Options

Wait for START Command: With no jumper on pins nine and ten of J6, the disk drive does not spin up until the initiator issues a START/STOP UNIT (1Bh) command with the start bit set to one.

Start When Power Is Applied: When pins nine and ten of J6 are jumpered, the motor starts as soon as power is applied. The disk drive is shipped in this configuration.

2.3 TERMINATOR POWER SELECTION

Power to the terminators may come internally from the disk drive, or externally from the SCSI bus.

The drive electronics are capable of sensing if the host is providing power to the terminators. If the host is not providing power, the disk drive automatically provides power to the terminators via a regulated (active) power source. By removing the jumper from JP7, the drive is prevented from supplying termination power to the SCSI bus.

2.4 PARITY

Parity can be disabled by removing the jumper from pins seven and eight of JP6. Odd parity detection is incorporated by the disk drive.

The disk drive is shipped with parity detection enabled.

2.5 SECTOR SIZE

The disk drive is shipped from the factory formatted with a default sector size of 512 bytes. Various other sector sizes are also supported.

2.6 INTERFACE TERMINATION

SCSI devices require proper interface termination. The first physical device and the last physical device on a SCSI bus daisy chain must be terminated. See Figure 5•1 in chapter 5 of this manual. Remove the terminators from any devices in between. For instance, if a disk drive is in the middle of a SCSI bus daisy chain, remove its terminators. The location of the drive terminators is shown in Figure 2•1.

The terminator resistor pack's pin one is marked with a dot on the terminator as shown in Figure 2•1. The orientation of the terminator on the PCB is also shown. Note that the PCB's hole/solder pad for pin one has a square outline, whereas all the other holes/pads

have a round outline. Also, note that pin one is always the closest pin to the power connector, J3.

***NOTE**: Both terminator packs (RN1 and RN2) must be oriented with the dot (pin one) toward J3 for the disk drive to work properly.*

As shipped, the interface signal lines are terminated with two removable 220/330 ohm resistor network packs. Resistor tolerances in the terminator network should be ±5% or less.

The devices driving the disk drive inputs should be open collector devices capable of sinking at least 48 milliamps at a voltage level of less than 0.5 volts DC (7438 or equivalent).

Devices receiving the disk drive outputs should be of a SCHMITT trigger type to improve noise immunity (74LS14, 74LS240, or equivalent). The initiator should not load the bus with more than one standard low power Schottky transistor-transistor logic (LSTTL) load per input line, and should terminate all input signals with 220/330 ohm terminators.

2.7 SERVICE CONNECTOR

Connector J4, whose location is shown in Figure 2•2, is a 10-pin service connector provided for serial input, the synchronous spindle, and LED source current. Its mating connector is a Berg 6976410 part. Pin assignments are shown in Table 2•3.

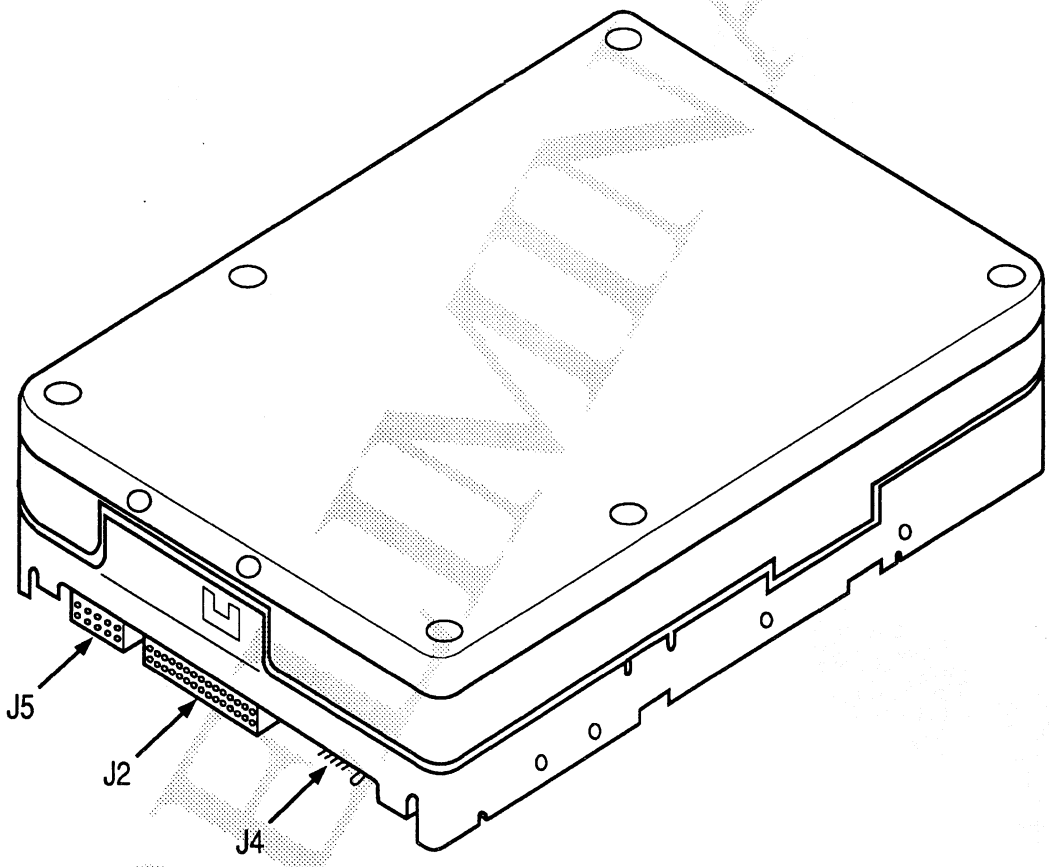


Figure 2•2
Connector Locations, Front View of Drive

PIN 2 CNMI	**PIN 4** DTR	**PIN 6** Gnd	**PIN 8** SPDL Pulse Ref	**PIN 10** - LED DRV
PIN 1 Gnd	**PIN 3** DTX	**PIN 5** Gnd	**PIN 7** N/C	**PIN 9** +5V

Table 2-3
J4 Service Connector Pin Assignments

When an LED is connected to pins nine and ten, it functions in the same manner as the LED which is mounted on the disk drive's faceplate. This is typically used in cases when the drive is mounted in a position where the LED is not visible or the faceplate is removed.

Pins three (transmit data, DTX) and four (receive data, DTR) are the main communication lines. Pin two is for factory use only. Pins five and six are signal ground lines. Pin eight is used to synchronize the spindles in multiple drive applications.

2.8 SPINDLE SYNCHRONIZATION

The MXT-1240S disk drives are able to synchronize their spindles together for use in disk drive arrays. This is accomplished by having all drives in the array synchronized to a common pulsed index signal. This synchronous signal can be provided by either an external source or the master drive and can be transceived on the service connector (J4 pin 8). See Figure 2-3 on the next page for a diagram of a disk drive array.

If the sync pulses are to be supplied by a drive, only one drive in an array may transmit it. All other drives will receive the sync pulses and synchronize their index pulses to it.

The configuration for the synchronization-spindle bus is a twisted pair cable, daisy-chained from the master to each slave drive. This twisted pair cable is connected to the Service Connector (J4) on each drive. The mating connector is a Dupont part number 69764-010 or Berg part number 6976410.

The number of drives that can be attached to the array depends on the length of the bus connecting each drive to the source of the sync. signal and the amount of current supplied by the terminating resistor. If the MXT-1240S drive is the signal source, it can sink 15 mA. The maximum cable length is 3 meters.

The source of the reference pulse must be at the far end of the transmission line, opposite the 2K ohm terminating resistor, which is between the signal and +5V.

NOTE: *The terminating resistor must be supplied by the user as part of the cable*

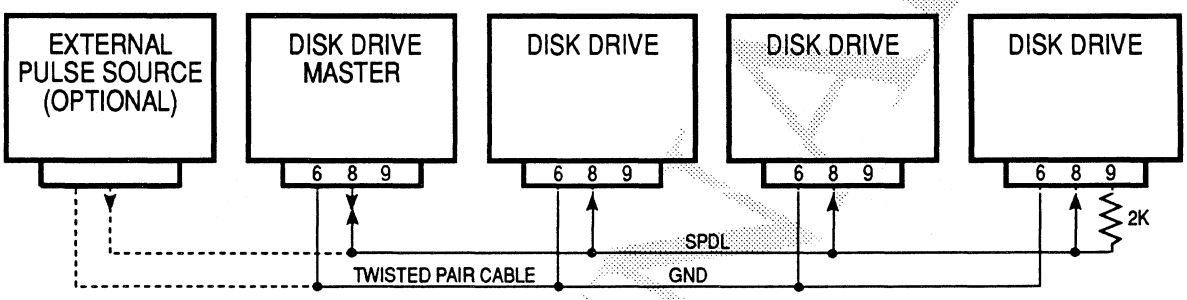


Figure 2•3
System Cabling With One Drive in Master Mode

After power is reset, the drive will be in an independent spindle mode, not configured for either a MASTER or SLAVE mode. Each drive must be configured for the appropriate mode of operation. This configuration is accomplished via a MODE SELECT command with Page 04h setting the RPL bits in byte 17, bits 0 and 1. The master drive will generate the spindle-synchronization sync pulses with the slave drives to receive the sync pulses. The connection between drives for the sync reference pulses, is a bi-directional line. The master can be either the host, a drive, or an external signal source which generates the sync reference pulses. Again, refer to Figure 2•3.

If the index pulses are to be generated by an external source, they should be a negative going TTL pulse with a minimum width of 2 µsec and a frequency of 105Hz ±0.5%. See Figure 2•4 for a diagram of this signal.

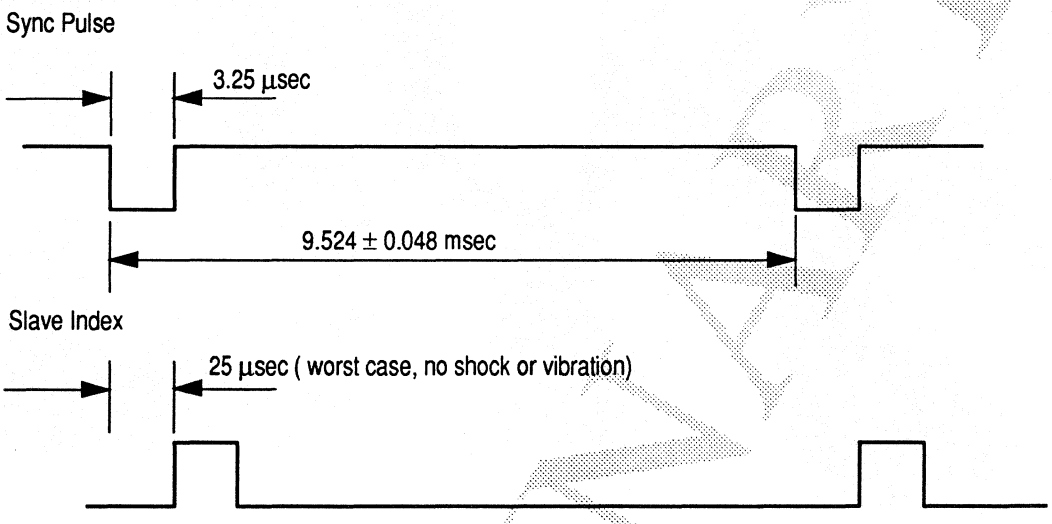


Figure 2•4
Synchronization Reference Pulse

The RPL and Rotational offset fields in MODE SELECT/MODE SENSE Page 04h are used to control the spindle synchronization.

RPL	Mode
00b	Indicates that spindle synchronization is disabled
01b	The drive operates as a synchronized-spindle slave
10b	The drive operates as a synchronized-spindle master
11b	Not Supported - Master Controller

Table 2•4
Rotational Position Locking

The rotational offset indicates the amount of rotational skew that the drive will use when synchronized. This is the numerator of a fractional multiplier that has 256 as its denominator (e.g. a value of 128 indicates a one-half revolution).

2.8.1 Error Conditions

When the drive fails to achieve synchronization, a UNIT ATTENTION condition with an Additional Sense Code (ASC) of 06h with an Additional Sense Code Qualifier (ASCQ) of 5Ch (RPL status change) will be posted. Additionally, if subsequent to achieving synchronization, the drive detects a loss of synchronization and no I/O operation is being executed, a check condition of UNIT ATTENTION with RPL status change will be posted.

If an I/O operation is being executed, and no other error condition exists, the drive will return a CHECK CONDITION status. The Sense Key will be Recovered Error if the drive is able to recover. If it is not able to recover, then the Sense Key will be Hardware Error, with an additional sense code of RPL status change.

NOTE: *The number of slave drives that can be directly attached to the master drive is dependent on the cable length and output capability of the open collector driver.*

A fault tolerant method would be dual 105 Hz (+/–.01%) crystal oscillators as the master synchronized-spindle with a buffer output to each slave drive.

On the J4 connector on the front of the drive, pin 9 is +5 volts, the maximum current rating is 100 milliamps. A preferred power option would be an external power source.

If the requirement is for an LED to be displayed on the drive, some allowance in current calculations must be made, due to the fact that a common connector is used for both the LED and synchronized-spindle. The LED is connected from pin 10 (–LED Drv) to pin 9 (+5 volts).

3.0 DISK DRIVE INSTALLATION

This chapter includes the information you need to install the MXT-1240S disk drive into a PC chassis, specifically regarding mounting and shipping considerations.

3.1 MOUNTING

The drives may be mounted on any axis. Certain switching power supplies may emanate electrical noise, which can degrade the specified read error rate. For best results, orient the drives so that the PCB assemblies are not adjacent to these noise sources.

Twelve mounting holes, four on the bottom and four on each side, are provided for mounting each disk drive into an enclosure. The size and location of these holes, shown in Figure 3•1, are identical to industry standards. Overall height, width, and depth, along with other key dimensions, are shown in Figure 3•1.

CAUTION: *Mounting screw lengths must be chosen so that no more than 0.125 inch of the screw is available to enter the frame mounting hole. The PCB must have clearance. The torque applied to the mounting screws should be between 4 and 6 inch-pounds.*

3.2 AIR FLOW REQUIREMENTS

It is recommended that air flow over the PCB have a minimum velocity of 3.6 feet (1.1 meters) per second.

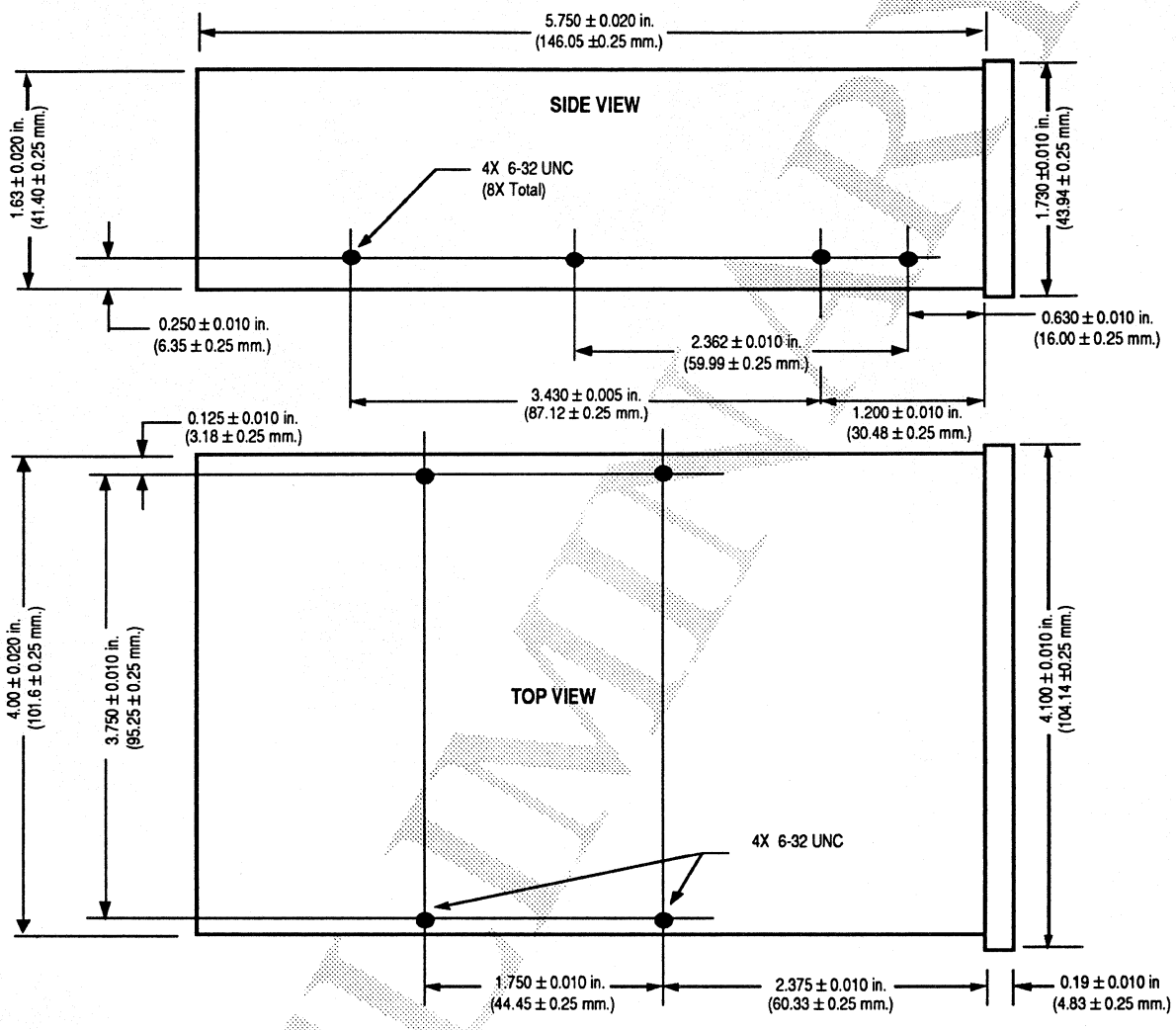


Figure 3-1
Mechanical Outline, Top and Side Views

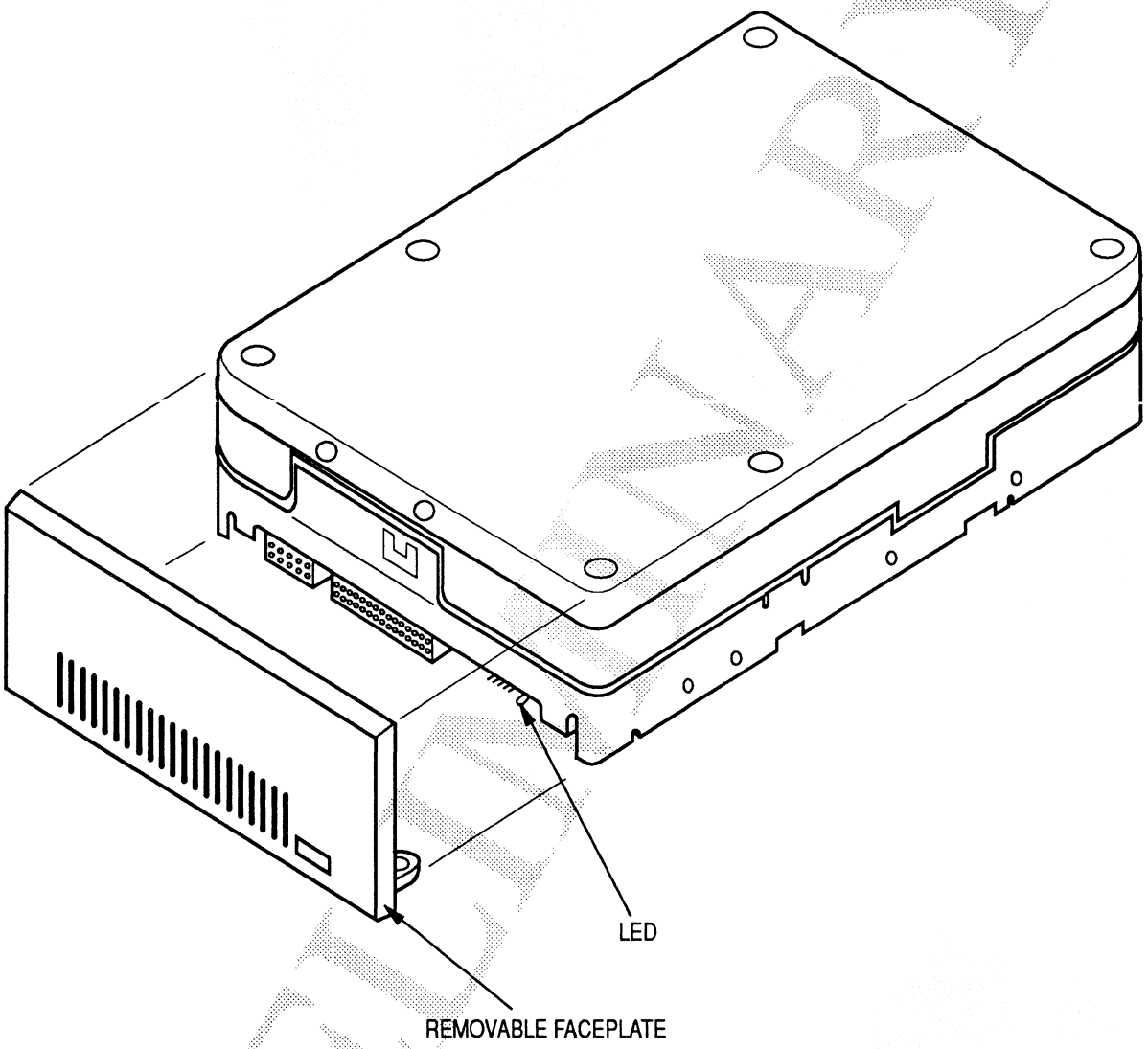


Figure 3•2
Removable Faceplate

3.3 POWER-UP TESTING

This section describes the sequence of events during the drive self-test and initialization sequences. The self-test sequence is performed upon power up, and is followed by the initialization sequence. When the drive is reset, either by the SCSI bus –RST signal or by the BUS DEVICE RESET message, only the initialization sequence is performed.

3.3.1 Self-Test Sequence

The self-test sequence is executed upon disk drive power up. The self-test sequence verifies the integrity of the hardware. This test is not an exhaustive hardware diagnostic, but simply a check of the major components for full functionality. The drive does not respond to a SELECTION phase on the SCSI bus for about the first 250 milliseconds of the self-test.

The self-test sequence consists of the following events:

- Hardware Reset Test - This routine tests the microprocessor, program ROM checksum/buffer controller, external program RAM/disk formatter, and the SCSI reset latch for the proper power up condition. If any of these tests fail, the disk drive can only be reset by a POWER UP condition.

- Microprocessor Test - This routine tests the microprocessor's internal memory, timers, and register bank switching for proper operation.

- Program ROM Checksum/Buffer Controller Test - This routine tests the buffer controller for proper operation. All the registers are tested and the buffer controller is engaged to access random-access memory (RAM).

- External Program RAM Test - This routine tests the external RAM by writing and reading four test patterns to each location.

If any portion of the self-test fails, except the hardware reset test, the disk drive can be reset by a SCSI bus RESET condition or a power on RESET condition. The failure of the hardware reset test is considered a catastrophic failure and the controller can only be reset from such a failure by a power on RESET condition.

3.3.2 Initialization Sequence

The initialization sequence is executed for any one of the following three reasons:

- a POWER ON condition occurs
- the SCSI bus –RST signal is asserted
- a BUS DEVICE RESET message (on the SCSI bus) is received.

After a successful initialization, the first command from each initiator is terminated with a CHECK CONDITION and POWER ON/RESET additional sense code (ASC) of 29h.

Until the disk drive has been spun up, commands sent by an initiator which require a ready drive for GOOD completion status, are terminated with a CHECK status and DRIVE

NOT READY sense key. Commands that may complete with GOOD status prior to the drive being ready are REQUEST SENSE, INQUIRY, START/STOP UNIT, READ BUFFER, and WRITE BUFFER.

After the disk drive has spun up, the drive uploads the MODE SENSE parameters and drive configuration. An initiator should not request any MODE SENSE parameters until the drive is ready.

3.3.3 Self-Configuration

When the disk drive powers up or is reset, it configures itself from the MODE SENSE parameters saved from the previous format operation or the MODE SELECT command with the save parameters bit set (byte one, bit zero). This includes the drive's exact model number returned in the INQUIRY command and the MODE SELECT page parameters. Refer to section 7.4, MODE SELECT, and section 7.6, MODE SENSE later in this manual, which describe the parameters in the MODE SELECT pages.

3.3.4 UNIT ATTENTION Condition

A UNIT ATTENTION condition is created for each initiator whenever the disk drive has been reset (by a BUS DEVICE RESET message or a RESET condition) or when the MODE SELECT parameters have been changed by other initiators. The UNIT ATTENTION condition (sense key 06h) is returned in the sense data by the drive in association with the CHECK CONDITION (02h) status byte. The UNIT ATTENTION condition persists for each initiator until that initiator issues any command other than INQUIRY.

If an INQUIRY command is received from an initiator with a pending UNIT ATTENTION condition (before the disk drive reports CHECK CONDITION status) then the drive reports any pending sense data and preserves the UNIT ATTENTION condition.

If a REQUEST SENSE command is received from an initiator with a pending UNIT ATTENTION condition (before the disk drive reports CHECK CONDITION status) then the drive reports any pending sense data and preserves the UNIT ATTENTION condition in the sense data. However, the CHECK CONDITION is cleared, and thus GOOD status is returned on a subsequent command, which then clears the UNIT ATTENTION from the sense data.

3.4 SHIPPING

At power down, the heads are automatically positioned over the nondata, dedicated landing zone on each disk surface. The automatic shipping lock solenoid is also en-

gaged at this time. Maxtor ships the disk drive in single or multipack shipping containers. Users can ship the drive installed if the nonoperating shock and vibration limits are not exceeded.

NOTE: *Warranty requires use of the original packing materials when shipping the drive alone.*

4.0 DISK DRIVE OPERATION

The MXT-1240S drive consists of read/write, control, and interface electronics, read/write heads, a servo head, a head positioning actuator, a disk drive motor/spindle, media, and an air filtration system. The components perform the following functions:

- interpret and generate control signals
- position the heads over the desired track
- read and write data
- provide automatic error correction to the data
- provide a contamination-free environment
- provide a controller to interact with the initiator
- maintain precise spindle rotation speed.

4.1 READ/WRITE CONTROL AND SCSI CONTROLLER ELECTRONICS

All of the disk drive and controller electronics are packaged on a single printed circuit board (PCB). This PCB, which includes two microprocessors, performs the following disk drive functions:

- data separation
- reading/writing of data
- index detection
- head positioning
- head selection
- disk drive selection
- fault detection
- recalibration on power up
- track position counter
- power and speed control for spindle disk drive motor
- disk drive up-to-speed indication
- monitoring for WRITE FAULT conditions
- control of all internal timing.

The PCB performs the following controller functions:

- error detection and correction
- SCSI bus disconnect/reconnect functions
- SCSI bus arbitration
- defect handling
- data transfer
- automatic retries
- data buffering
- command linking
- sector formatting.

4.2 TRACK AND SECTOR FORMAT

The standard track format is organized into numbered data segments, or sectors. See Figure 4•1, Sector Format. The sectors are addressed via the logical block address (LBA) in the SCSI commands. The method of encoding is 1,7 code.

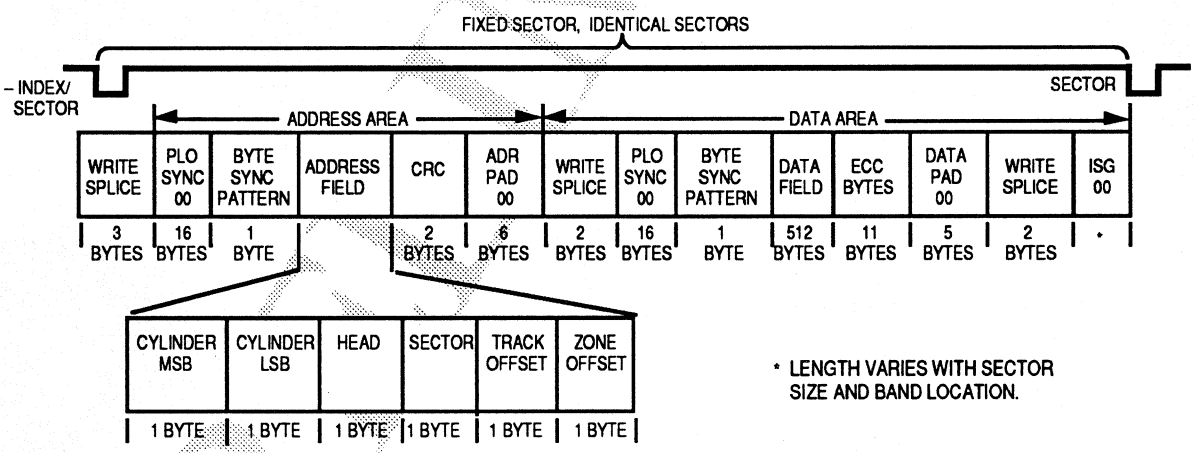


Figure 4•1
Sector Format

4.3 ERROR CORRECTION

The MXT-1240S disk drive contains an 88-bit Reed-Solomon error correction code which is non-interleaved and capable of correcting four 10-bit symbols. Different than the previous Maxtor ECC implementations, this error correction code resides in the hardware within the Cirrus SH-450 SCSI controller IC. This allows for "in-line" or "on the fly" correc-

tion of single burst errors up to 11 bits in length without any mechanical delays or interruption of data. Additional error correction capability for double burst or greater than 11-bit errors resides in the firmware or "off-line" and is invoked as part of the error recovery algorithm.

The 88-bit ECC, both hardware and firmware correction codes, provides increased error correction capability, thus allowing a significant improvement in both the recovered and unrecovered error rates along with a very low miscorrection probability.

For additional information on error correction, see Table 1-8 and section 7.4.3.4.

5.0 INTERFACE

This is the first of three chapters on the SCSI interface. This chapter includes information on the logical interface and the electrical power interface.

5.1 SCSI INTERFACE

This section includes information on initiator-target configurations, signal definitions, pin assignments, and the connector.

5.1.1 Initiator-Target Configurations

The SCSI interface offers a number of unique advantages which facilitate the interconnection of the disk drive with one (or more) computer systems. Unlike traditional microcomputer disk interfaces, such as ST506 or ESDI, SCSI supports multiple peripherals and different peripheral types, all operating on the same bus structure. Figure 5•1 shows examples of typical configurations.

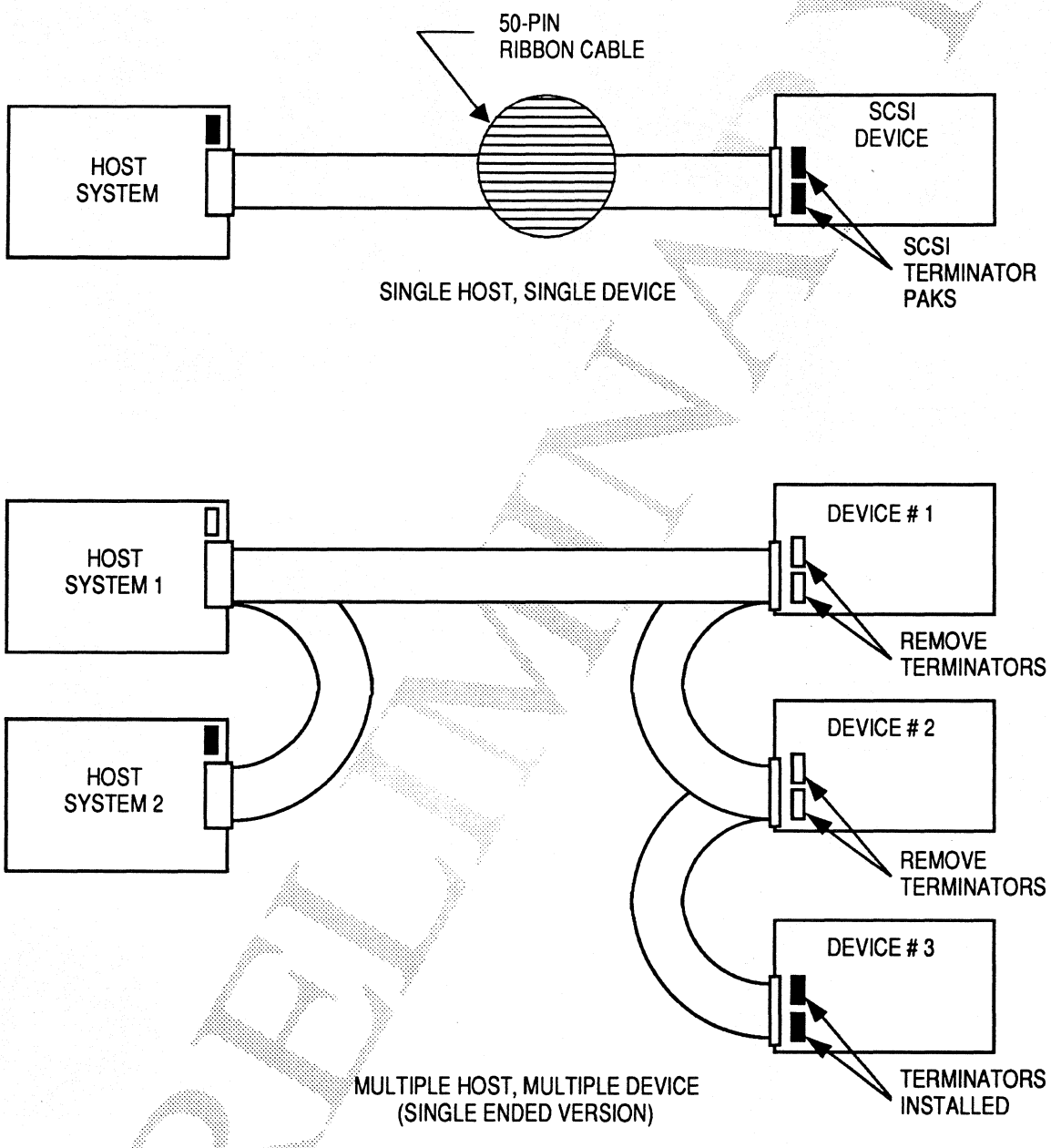


Figure 5•1
Typical SCSI Configurations

The MXT–1240S also supports multiple initiator configurations consistent with the established arbitration cycle outlined in the SCSI standards. Configuration changes are made by SCSI address jumpers, which are set when the drive is installed in the system (jumper settings are discussed in Chapter 2.0, Disk Drive Setup, earlier in this manual).

The SCSI implementation used in the disk drive is intended to facilitate high-speed data transfers between the initiator and the drive. Interconnection between the initiator system(s) and the drive is via a fifty-pin ribbon cable. The drive may be configured as either single ended or differential.

5.1.2 Logical/Electrical Signal Definitions

The SCSI bus uses eighteen signals. Nine signals are for the 8-bit data bus, with one data parity bit; the other nine signals are for the SCSI control lines, which coordinate bus activity for transfers of commands, data, status, and messages. The interface signals are listed below; refer to the SCSI standard for further details. Pin assignments of the connector are provided in sections 5.1.3 and 5.1.4, later in this chapter.

Across the SCSI bus all signals are low-true. The signals are asserted, or active, at 0 to 0.8 volts DC, and negated, or inactive, at 2.5 to 5.25 volts DC. This low-true logic is indicated by the negative sign which precedes the signal name.

–RST
The –RST (reset) signal is an or-tied signal asserted by the initiator, causing the disk drive to do a RESET, self configure and return to the IDLE condition. This signal is normally used during a power-up sequence. The –RST pulse should be at least 25 microseconds wide.

–SEL
The –SEL (select) signal, accompanied by the disk drive's SCSI ID bit (zero through seven) is asserted by the initiator and causes the disk drive to be selected. The –SEL line must be negated by the initiator after the disk drive asserts the –BSY line in response to a proper selection. The signal can be asserted by the arbiter (initiator or drive) in the ARBITRATION phase. The signal is also asserted by the disk drive during the RESELECTION phase.

–BSY
The –BSY (busy) signal is an or-tied signal asserted by the disk drive, indicating that the bus is being used. It is also asserted by the arbiter during the ARBITRATION phase and by the initiator and the drive during the RESELECTION phase.

–C/D
Assertion of the –C/D (control/data) signal by the disk drive indicates that command, status, or message information is to be transferred on the data bus. Negation of this line indicates that data is to be transferred on the data bus.

–I/O

When the –I/O (input/output) signal is asserted by the disk drive it indicates that information is transferred to the initiator from the drive. Negation of the signal indicates that information is transferred to the drive from the initiator. Note that input means toward the initiator, and output means toward the drive.

–REQ

When asserted by the disk drive, the –REQ (request) signal indicates that a byte is to be transferred on the data bus. –REQ is negated following assertion of the –ACK line by the initiator.

–ACK

The –ACK (acknowledge) signal is asserted by the initiator, following assertion of the –REQ line, to indicate data has been accepted by the initiator, or that data is ready to be transferred from the initiator to the disk drive. –ACK is negated following negation of the –REQ line.

–ATN

The –ATN (attention) signal is asserted by the initiator to indicate the ATTENTION condition, which is a request by the initiator for the disk drive to enter the MESSAGE OUT phase.

–MSG

The –MSG (message) signal is asserted by the disk drive during one of the message phases. Messages may be either IN or OUT, depending on the state of the –I/O signal.

–DB (7-0, P)

The eight bidirectional data bus lines (DB 7-0) and parity line (DBP) are used to transfer eight bits of parallel data and a parity bit to or from the initiator. Bit seven is the most significant bit. Bits zero through seven are also used as SCSI ID bits during the ARBITRATION, SELECTION and RESELECTION phases. Data bus parity (DBP) is odd.

5.1.3 Pin Assignments and Connector (Single Ended)

The MXT-1240S communicates with an initiator system via a fifty-pin connector, J1. The logical/electrical configuration of the SCSI connector is given in Tables 5•1 and 5•2. Pin one is located on the end of J1 closest to the DC power connector, J3. See Figure 5•3, Connector Locations, Rear View of Drive.

PIN NUMBER	SIGNAL NAME	DESCRIPTION	DRIVEN BY
2	– DB0	Data Bit 0	Host or Drive
4	– DB1	Data Bit 1	Host or Drive
6	– DB2	Data Bit 2	Host or Drive
8	– DB3	Data Bit 3	Host or Drive
10	– DB4	Data Bit 4	Host or Drive
12	– DB5	Data Bit 5	Host or Drive
14	– DB6	Data Bit 6	Host or Drive
16	– DB7	Data Bit 7	Host or Drive
18	– DBP	Data Parity (Odd)	Host or Drive
20	Gnd	Reserved	
22	Gnd	Reserved	
24	Gnd	Reserved	
26	TERMPWR	Termination Power (+5 V DC)	Host or Drive
28	Gnd	Reserved	
30	Gnd	Reserved	
32	– ATN	Attention	Host
34	Gnd	Reserved	
36	– BSY	Busy	Host or Drive
38	– ACK	Acknowledge	Host
40	– RST	Reset	Host
42	– MSG	Message	Drive
44	– SEL	Select	Host or Drive
46	– C/D	Control/Data	Drive
48	– REQ	Request	Drive
50	– I/O	Input/Output	Drive
ALL ODD PINS (Except Pin 25)	Gnd	Ground	
PIN 25		Open (No Signal)	

Table 5-1
Connector Pin Assignments (For Single Ended SCSI Bus)

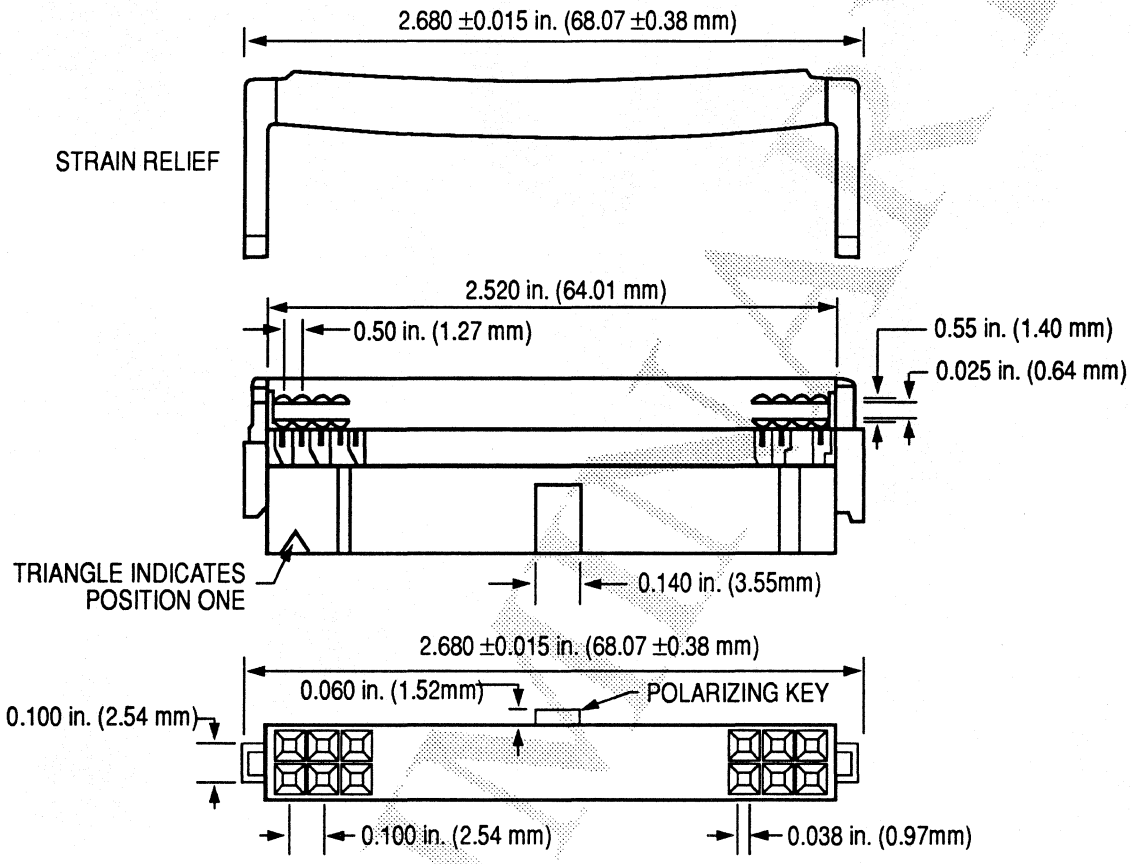


Figure 5-2
SCSI Cable Connector

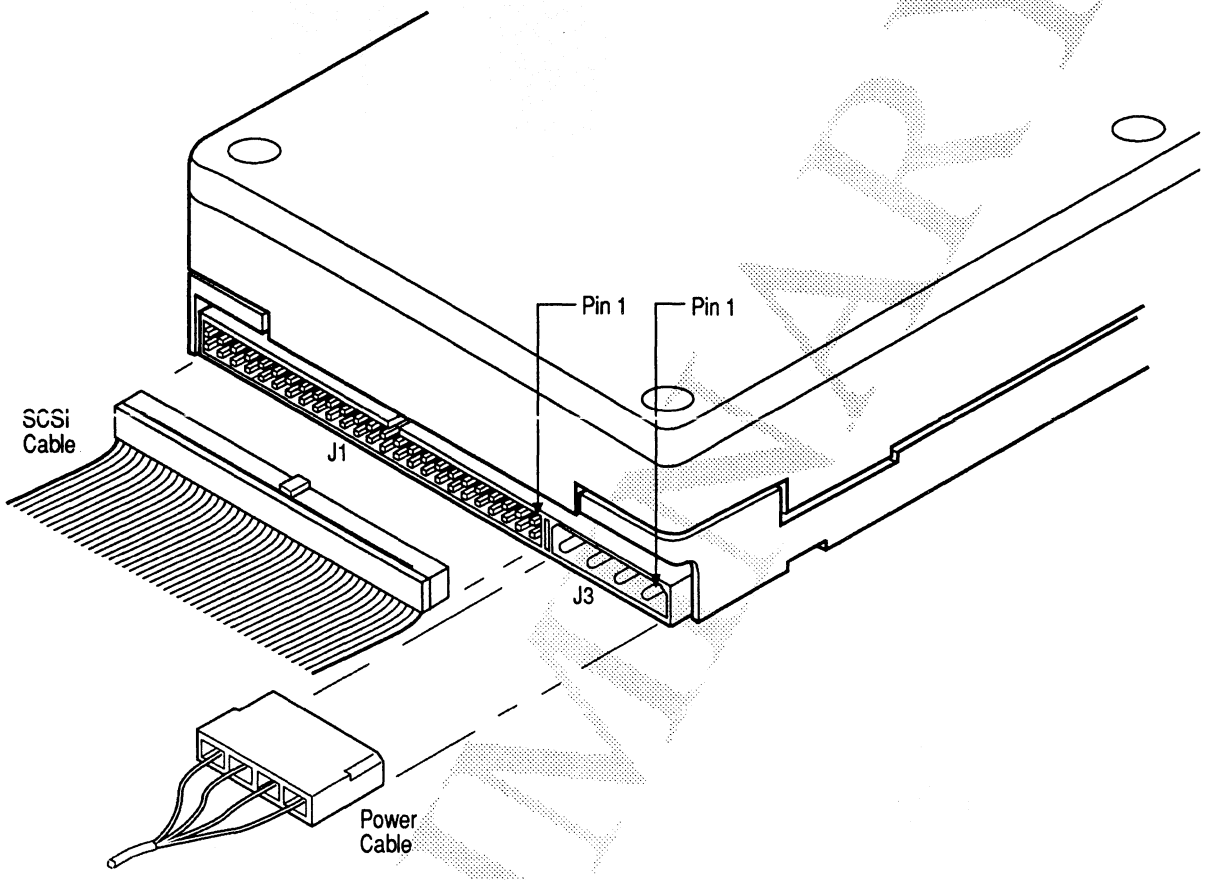


Figure 5•3
Connector Locations, Rear View of Drive

5.2 ELECTRICAL POWER INTERFACE

This section describes the power-up sequence for the MXT–1240S, and the two connectors associated with the electrical power interface. These connectors are the power connector, J3 and the frame ground connector, J4.

5.2.1 Power-Up Sequence

DC power (+5 volts and +12 volts) may be supplied in any order. Both power supplies must be present and within the tolerances of the power sensing circuit, before the motor will spin up. Typical current draw during power up is shown in Figures 5•4 and 5•6. When the spindle reaches full speed, the actuator lock automatically disengages. The disk drive performs automatic SEEK calibration during start up for optimum SEEK performance. The drive spins up and becomes ready in 13 to 15 seconds. The drive executes

its recalibration sequence whenever power is applied or the SCSI START/STOP command is invoked via the SCSI bus.

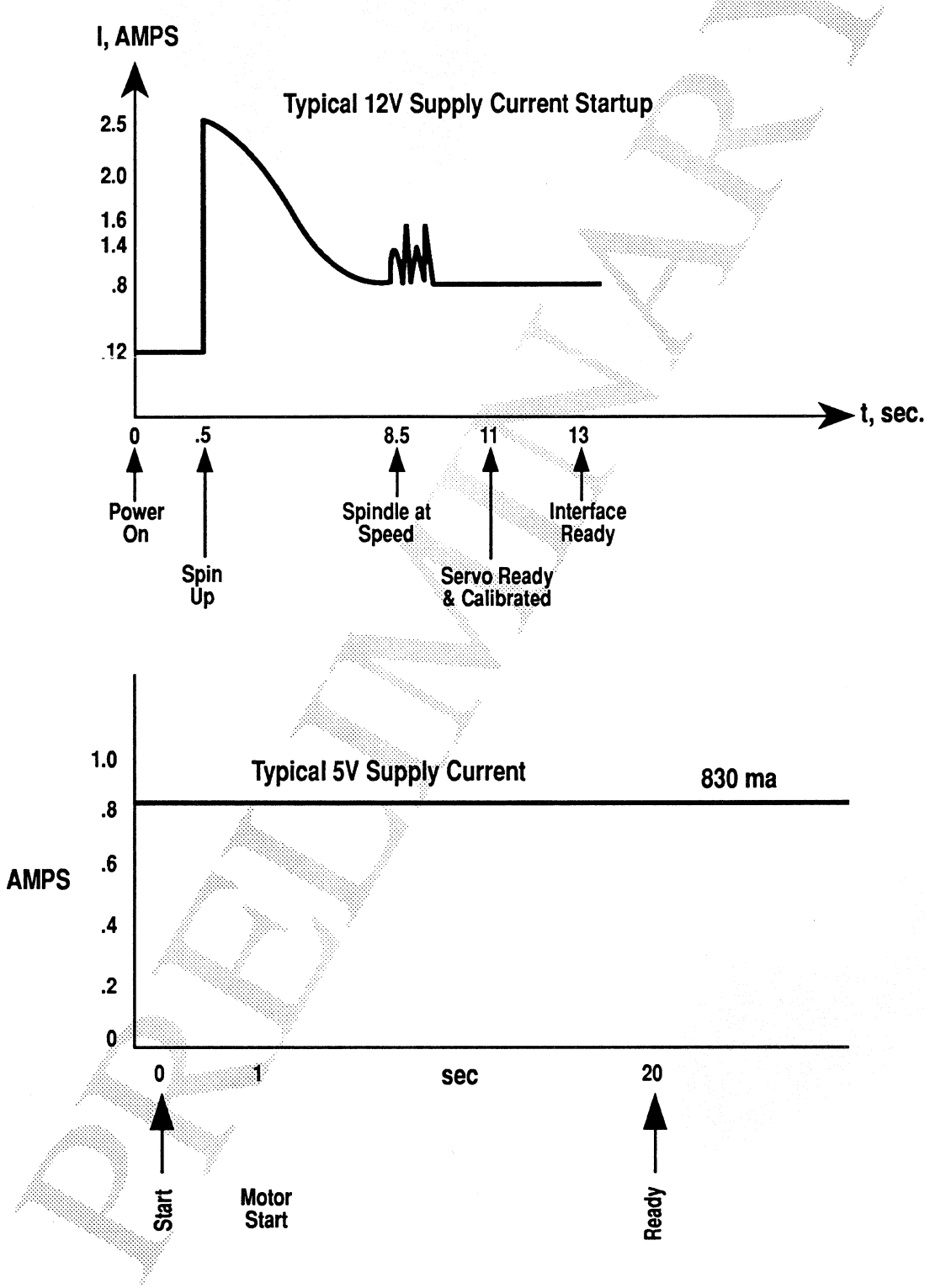


Figure 5•4
Typical Power Supply Currents During Start Up (In Seconds)
(Single Ended Version)

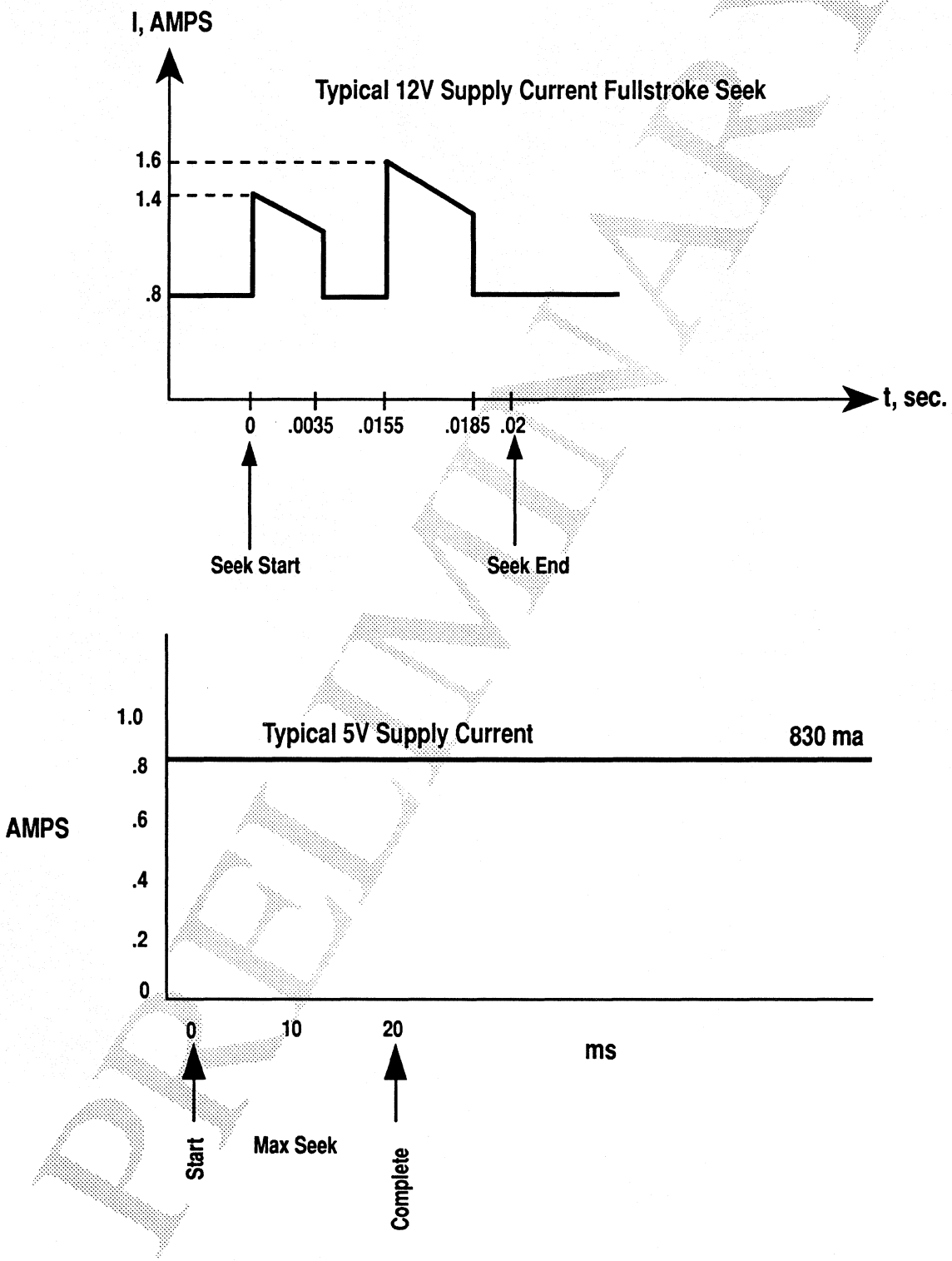
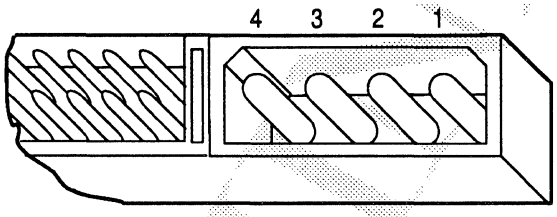


Figure 5-5
Typical Power Supply Currents in SEEK Mode (In Milliseconds)
(Single Ended Version)

5.2.2 Power Connector

The four-pin DC power connector J3, is similar to AMP's MATE-N-LOCK connector part number 350543-1. J3 however, is surface mounted to the PCB rather than free-hanging as the AMP part is. The recommended socket housing that is compatible with connector J3 is AMP part number 1-480424-0. The recommended female sockets that are compatible with connector J3 are AMP socket part numbers 350078-4 (strip) or 61173-4 (loose piece). J3 pins are numbered and assigned as shown in Figure 5•6 below. Figure 5•3 shows the location of J3.



Pin 1 = +12 V DC
Pin 2 = +12 V Ground Return
Pin 3 = +5 V Ground Return
Pin 4 = +5 V DC

Figure 5•6
J3 Power Connector

6.0 SCSI PHASES

The condition on the SCSI bus can be divided into eight distinct phases:

BUS FREE phase
ARBITRATION phase
SELECTION phase
RESELECTION phase
COMMAND phase \
DATA phase \ These phases are collectively termed the
STATUS phase / Information Transfer phases.
MESSAGE phase /

The various phases are defined by the state of the SCSI bus signals –SEL, –BSY, –MSG, –C/D, –I/O, –REQ, and –ACK. The SCSI bus can never be in more than one phase at a time. Figure 6•1 shows the signal sequence of the eight phases. The figure has been provided for your reference while reading the following sections.

NOTE: *A new phase does not begin until the –REQ signal is asserted for the first byte of the new phase.*

-SEL	-BSY	-MSG	-C/D	-I/O	BUS	PHASE
HI	HI	X	X	X	X	BUS FREE
HI	LO	X	X	X	ID	ARBITRATION
I	I&T	X	X	X	IDs	SELECTION
T	I&T	X	X	X	ID	RESELECTION
HI	LO	HI	HI	HI	Bytes	DATA OUT
HI	LO	HI	HI	LO	Bytes	DATA IN
HI	LO	HI	LO	HI	Bytes	COMMAND
HI	LO	HI	LO	LO	Byte	STATUS
HI	LO	LO	LO	HI	Byte	MESSAGE OUT
HI	LO	LO	LO	LO	Byte	MESSAGE IN

I = Initiator Asserts
T = Target Asserts

HI = False/negated
LO = True/asserted
X = HI or LO

Table 6•1
Signal States and Bus Phases

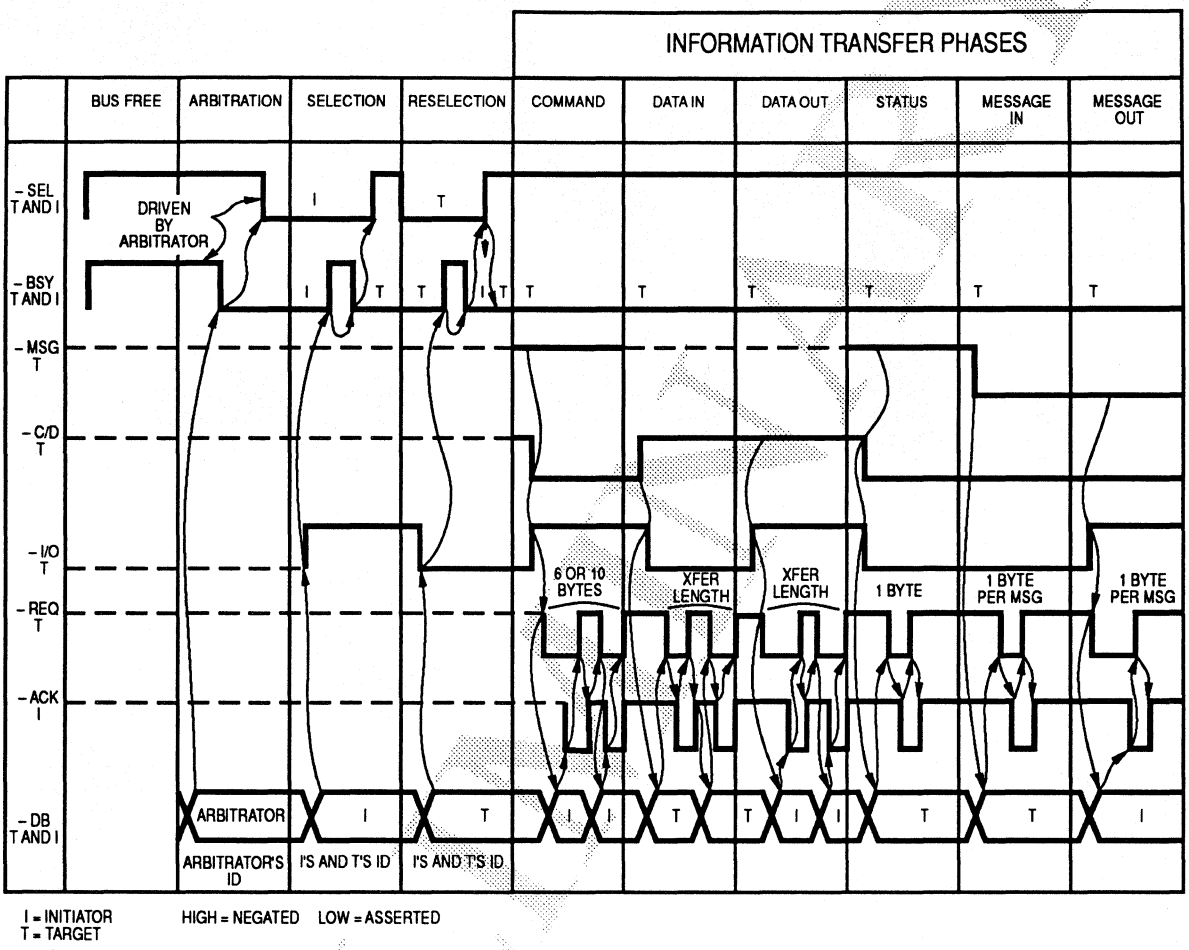


Figure 6-1
Signal Sequence Chart for SCSI Phases

6.1 BUS FREE PHASE

The BUS FREE phase is used to indicate that no SCSI device is actively using the SCSI bus, and that it is available for subsequent users. BUS FREE occurs when the drive releases –BSY following a RESET condition, or certain message phases (that is, COMMAND COMPLETE and DISCONNECT).

6.2 ARBITRATION PHASE

The ARBITRATION phase allows one SCSI device to gain control of the SCSI bus so that it can assume the role of an initiator or target. The arbitrating device waits for the BUS FREE phase to occur. It then asserts its own SCSI ID bit and –BSY. The arbitrating de-

vice then examines the data bus. If a higher priority SCSI ID bit exists on the data bus, the arbitrating device loses arbitration and releases –BSY and the data bus. Otherwise, the arbitrating device wins arbitration, asserts –SEL and becomes the initiator.

NOTE: *Implementation of the ARBITRATION phase is a system option. The ARBITRATION phase is required for systems that use the disconnect/reconnect feature.*

6.3 SELECTION PHASE

If the initiator wins arbitration, it enters the SELECTION phase by continuing to assert its own initiator SCSI ID bit and asserting the target's SCSI ID bit. The initiator then negates –BSY (–SEL remains asserted by the initiator). If the initiator supports disconnect/reconnect, the initiator must assert the –ATN line prior to the negation of –BSY.

If the initiator does not support arbitration, then the SELECTION phase is entered from the BUS FREE phase. The initiator asserts only the drive's SCSI ID bit and asserts –SEL.

During the SELECTION phase, the drive maintains a negated –I/O line so that the SELECTION phase may be distinguished from the RESELECTION phase.

The drive determines that it has been selected by detecting its SCSI ID bit asserted on the bus (as determined by the ID jumpers—see section 2.1, SCSI ID Selection, earlier in this manual).

If more than two IDs are asserted on the data bus, or parity is enabled and bad parity is detected, the drive does not respond to SELECTION.

The drive asserts –BSY after detecting that it has been selected. At this point, the initiator must negate –SEL and may remove the IDs from the data bus.

6.4 RESELECTION PHASE

After disconnecting to free the bus for other activity, the drive reconnects when it is ready to transfer data or status across the bus. The drive arbitrates for the bus and, if it wins, reselects the initiator. RESELECTION is very similar to SELECTION, except that the –I/O signal line is asserted. The drive asserts its own SCSI ID bit and the SCSI ID bit of the initiator which is being reselected. The drive releases –BSY (–BSY was already asserted during arbitration) and continues to assert –SEL. The initiator detects that it has been selected and responds by asserting –BSY. The drive detects that the –BSY signal is now true and responds by also asserting –BSY (at this point, both the initiator and the drive are holding the –BSY signal low). The drive then releases –SEL and the initiator re-

sponds by releasing –BSY (–BSY is still being asserted by the drive). See Figure 6•1, Signal Sequence Chart for SCSI Phases.

After reselecting the initiator, the drive sends an IDENTIFY message to identify itself to the initiator. See section 6.5.6.14 later in this chapter for a description of IDENTIFY.

If the initiator does not respond to the reselection within a selection time-out delay, the drive releases the bus and then rearbitrates for the bus, trying to reselect the initiator. It does this up to 255 times, or until the initiator responds or the drive is reset. See Tables 6•2 and 6•3.

NOTE: *The drive does not disconnect if, during the SELECTION phase, the initiator does not set its initiator SCSI device ID on the bus and if the initiator does not send an IDENTIFY message out (with bit six asserted) to the drive.*

6.5 INFORMATION TRANSFER PHASES

The –C/D, –I/O, and –MSG signals are used to distinguish between the different information transfer phases (COMMAND, DATA, STATUS, and MESSAGE). The drive controls these three signals and therefore, controls all changes from one phase to another. The initiator can request a MESSAGE OUT phase by asserting –ATN, and the drive can cause a BUS FREE phase by deasserting –SEL and –BSY (and all other SCSI bus signals).

The information transfer phases use one or more –REQ/–ACK handshakes to control the information transfer. Each –REQ/–ACK handshake allows the transfer of 1 byte of information. During the information transfer phases, –BSY remains true and –SEL remains false. Additionally, during the information transfer phases, the drive continuously envelopes the –REQ/–ACK handshake(s) with –C/D, –I/O, and –MSG in such a manner that these control signals are valid for a bus settle delay (see Tables 6•2 and 6•3) before the assertion of –REQ of the first handshake, and remain valid until the negation of -ACK at the end of the last handshake.

NAME	DELAY TIME
ARBITRATION DELAY	2.2 µsec
ASSERTION PERIOD	90 nsec
BUS CLEAR DELAY	800 nsec
BUS FREE DELAY	800 nsec
BUS SET DELAY	1.8 µsec
BUS SETTLE DELAY	400 nsec
CABLE SKEW DELAY	10 nsec
DATA RELEASE DELAY	400 nsec
DESKEW DELAY	45 nsec
HOLD TIME	45 nsec
NEGATION PERIOD	90 nsec
RESET HOLD TIME	25 µsec
SELECTION ABORT TIME	200 µsec
SELECTION TIMEOUT DELAY	250 msec (Recommended)
TRANSFER PERIOD	(Set During MESSAGE Phase)

Table 6-2
SCSI Bus Timing (SCSI-I)

NAME	DELAY TIME
ARBITRATION DELAY	TBD
ASSERTION PERIOD	TBD
BUS CLEAR DELAY	TBD
BUS FREE DELAY	TBD
BUS SET DELAY	TBD
BUS SETTLE DELAY	TBD
CABLE SKEW DELAY	TBD
DATA RELEASE DELAY	TBD
DESKEW DELAY	TBD
HOLD TIME	TBD
NEGATION PERIOD	TBD
RESET HOLD TIME	TBD
SELECTION ABORT TIME	TBD
SELECTION TIMEOUT DELAY	TBD
TRANSFER PERIOD	TBD

Table 6-3
SCSI Bus Timing (SCSI-2, "Fast")

6.5.1 Asynchronous Information Transfer

The drive controls the direction of information transfer by means of the –I/O signal. When –I/O is true, information is transferred from the drive to the initiator. When –I/O is false, information is transferred from the initiator to the drive.

If –I/O is true (transfer to the initiator), the drive first asserts –DB (7-0, P) to their desired values, delays at least one deskew delay, plus a cable skew delay (see Tables 6•2 and 6•3) and then asserts –REQ. –DB (7-0, P) remains valid until –ACK is true at the drive. The initiator reads –DB (7-0, P) after –REQ is true, then signals its acceptance of the data by asserting –ACK. When –ACK becomes true at the drive, the drive may change or release –DB (7-0, P). It then negates –REQ. After –REQ is false, the initiator then negates –ACK. After –ACK is false, the drive may continue the transfer by continuing to drive –DB (7-0, P) and asserting –REQ as described above.

If –I/O is false (transfer to the drive), the drive requests information by asserting –REQ. The initiator asserts –DB (7-0, P) to their desired values, delays at least one deskew delay, plus a cable skew delay and asserts –ACK. Again see Tables 6•2 and 6•3. The initiator continues to assert –DB (7-0, P) until –REQ is false. When –ACK becomes true at the drive, the drive reads –DB (7-0, P) and then negates –REQ. When –REQ becomes false at the initiator, the initiator may change or release –DB (7-0, P) and negates –ACK. The drive may continue the transfer by asserting –REQ as described above.

6.5.2 Synchronous Data Transfer

During the MESSAGE phase, the initiator and the drive establish a –REQ/–ACK offset and a transfer period. The synchronous mode, once established, remains in effect for all DATA phases until a RESET condition or power cycle occurs.

The –REQ/–ACK offset specifies the maximum number of –REQ pulses that can be sent by the target in advance of the number of –ACK pulses received from the initiator, thereby establishing a pacing mechanism. If the number of –REQ pulses exceeds the number of –ACK pulses by the –REQ/–ACK offset, the drive does not assert –REQ until the next –ACK pulse is received. A requirement for successful completion of the DATA phase is that the number of –ACK and –REQ pulses be equal.

The drive asserts the –REQ signal for a minimum of one assertion period. The drive waits at least one transfer period from the last transition of –REQ to true, or the minimum of a negation period from the last transition of –REQ to false before the drive asserts the –REQ signal.

The initiator sends one pulse of the –ACK signal for each –REQ pulse received. The initiator asserts the –ACK signal for a minimum of one assertion period. The initiator waits at

least one transfer period from the last transition of –ACK to true, or for a minimum of a negation period from the last transition of –ACK to false, before the initiator asserts the –ACK signal.

If –I/O is true (transfer to the initiator) the drive first asserts –DB (7-0, P) to their desired values, waits at least one deskew delay, plus one cable skew delay (see Tables 6•2 and 6•3), and then asserts –REQ. –DB (7-0, P) are held valid for a minimum of one deskew delay, plus one cable skew delay, plus one hold time after the assertion of –REQ. The drive asserts –REQ for a minimum of one assertion period. The drive may then negate –REQ and change or release –DB (7-0, P). The initiator reads the value on –DB (7-0, P) within one hold time of the transition of –REQ to true. The initiator then responds with an –ACK pulse.

If –I/O is false (transfer to the drive) the initiator transfers 1 byte for each –REQ pulse received. After receiving a –REQ pulse, the initiator first asserts –DB (7-0, P) to the desired values, delays at least one deskew delay, plus one cable skew delay (see Tables 6•2 and 6•3) and then asserts –ACK. The initiator holds –DB (7-0, P) valid for at least one deskew delay, plus one cable skew delay, plus one hold time (see Tables 6•2 and 6•3) after the assertion of –ACK. The initiator asserts –ACK for a minimum of one assertion period. The initiator may then negate –ACK and may change or release –DB (7-0, P). The drive reads the value of –DB (7-0, P) within one hold time of the transition of –ACK to true.

6.5.3 COMMAND Phase

After the drive is selected and has received the IDENTIFY message, if any, the drive normally switches to the COMMAND phase. The 6, 10 or 12 bytes of command information (command descriptor block, or CDB) are transferred from the initiator to the drive.

If enabled, parity is checked on each command byte. If bad parity is detected, the command is aborted. The drive switches to the STATUS phase, returns a CHECK CONDITION status, and sets the sense data to ABORTED COMMAND/PARITY ERROR for that initiator. The drive then switches to the MESSAGE phase, returns a COMMAND COMPLETE message, and goes to the BUS FREE phase.

After each command byte transfer, the –ATN bit is checked; if set, the drive switches to the MESSAGE OUT phase, and receives and then acts on the message.

6.5.4 DATA IN and DATA OUT Phases

In commands that require a DATA phase (e.g. READ, WRITE, MODE SELECT), the drive enters a DATA phase. During the DATA IN phase, data is transferred from the drive to the initiator. During the DATA OUT phase, data is transferred from the initiator to the drive.

If bus parity is enabled and bad parity is detected, the command is aborted. The controller switches to the STATUS phase, returns a CHECK CONDITION status, and sets the sense data to ABORTED COMMAND/PARITY ERROR for that initiator. The drive then switches to the MESSAGE phase, returns a COMMAND COMPLETE message, and goes to the BUS FREE phase.

After each block, or group of blocks is transferred, the –ATN bit is checked; if set, the drive switches to the MESSAGE phase to receive, and then act on, the message.

6.5.5 STATUS Phase

After completing any command (successfully or unsuccessfully, as indicated by the status byte), the drive switches to the STATUS phase and returns the status byte to the initiator as specified in Table 6•4. The drive also switches to the STATUS phase for reporting a BUSY, INTERMEDIATE/GOOD, or RESERVATION CONFLICT status. The drive does not go to the STATUS phase if it is cleared by a BUS DEVICE RESET or ABORT message, or by a "hard" RESET condition. Following the STATUS phase, the drive enters the MESSAGE phase.

The format of the status byte containing the command completion information is defined in Table 6•4 below.

BIT							
7	6	5	4	3	2	1	0
Reserved		Status Code					Reserved

Table 6•4
Status Byte

The reserved bits are set aside for future standardization and are always set to zero.

The status code bits are used to specify the status of the completed command. Table 6•5, Status Codes, gives the bit values for the status codes returned by the drive.

STATUS CODE BYTE						HEX VALUE	STATUS
5	4	3	2	1	0		
0	0	0	0	0	0	00	GOOD
0	0	0	0	1	0	02	CHECK CONDITION
0	0	1	0	0	0	08	BUSY
0	1	0	0	0	0	10	INTERMEDIATE/GOOD
0	1	1	0	0	0	18	RESERVATION CONFLICT
1	0	1	0	0	0	28	QUEUE FULL
1	0	0	0	1	0	22	COMMAND TERMINATED

Table 6-5
Status Codes

Descriptions of the status codes are given below:

GOOD - This status byte indicates that the operation completed as expected.

CHECK CONDITION - Any error, exception, or abnormal condition that causes sense data to be set causes a CHECK CONDITION status. The REQUEST SENSE command should be issued following a CHECK CONDITION status, to determine the condition.

NOTE: *If any command other than REQUEST SENSE or INQUIRY is issued following a CHECK CONDITION, the sense data is lost.*

BUSY - The drive returns this status whenever it is unable to accept a command. The drive returns this status when it is busy doing self-tests and self configuration, during power up or reset, or if it is busy executing a previously received command.

INTERMEDIATE/GOOD - This status is returned for every command in a series of linked commands (except the last command), unless an error, exception, or abnormal condition causes a CHECK CONDITION status or a RESERVATION CONFLICT status to be set. If the INTERMEDIATE/GOOD status is not returned, the chain of linked commands is broken; no further commands in the series are executed.

RESERVATION CONFLICT - This status is returned whenever an initiator attempts to access a drive that is reserved by another initiator.

COMMAND TERMINATED - This status is returned whenever the drive terminates the current I/O process after receiving a TERMINATE I/O message. This status also indicates that a contingent allegiance condition has occurred.

QUEUE FULL - This status is returned when a SIMPLE QUEUE TAG, ORDERED QUEUE TAG, or HEAD OF QUEUE TAG message is received and the command queue is full. The I/O process is not placed in the command queue.

6.5.6 MESSAGE Phase

The MESSAGE phase is used to transfer information about exception conditions between the initiator and the drive. The MESSAGE IN and MESSAGE OUT phases are discussed below, followed by descriptions of the SCSI messages. Message codes supported by the drive are shown in Table 6•6.

CODE	DESCRIPTION	DIRECTION
00h	COMMAND COMPLETE	Drive to Initiator
01h	EXTENDED MESSAGE (Synchronous Data Transfer Request)	Both Ways
02h	SAVE DATA POINTERS	Drive to Initiator
03h	RESTORE POINTERS	Drive to Initiator
04h	DISCONNECT	Drive to Initiator
05h	INITIATOR DETECTED ERROR	Initiator to Drive
06h	ABORT	Initiator to Drive
07h	MESSAGE REJECT	Both Ways
08h	NO OPERATION	Initiator to Drive
09h	MESSAGE PARITY ERROR	Initiator to Drive
0Ah	LINKED COMMAND COMPLETE	Drive to Initiator
0Bh	LINKED COMMAND COMPLETE WITH FLAG	Drive to Initiator
0Ch	BUS DEVICE RESET	Initiator to Drive
0Dh	ABORT TAG	Drive to Initiator
0Eh	CLEAR QUEUE	Initiator to Drive
11h	TERMINATE I/O PROCESS	Initiator to Drive
20h	SIMPLE QUEUE TAG	Both Ways
21h	HEAD OF QUEUE TAG	Initiator to Drive
22h	ORDER QUEUE TAG	Initiator to Drive
C0h/80h	IDENTIFY	Both Ways

Table 6•6
Message Codes

Message In Phase

During the MESSAGE IN phase, a message is transferred from the drive to the initiator. The drive may enter this phase at any time.

Message Out Phase

During the MESSAGE OUT phase, a message is transferred from the initiator to the drive.

The initiator requests that the drive enter the MESSAGE OUT phase by asserting the -ATN line. The drive monitors the –ATN line and enters the MESSAGE OUT phase in response to the initiator's assertion of –ATN.

After being selected, the drive checks if –ATN was inserted with the selection. If the initiator has –ATN asserted, the drive requests a message from the initiator by asserting -REQ. The first message is expected to be an IDENTIFY message. If any other message is received, the drive goes to the BUS FREE phase with a CHECK CONDITION status and the sense data set to ABORTED COMMAND/INAPPROPRIATE/ILLEGAL MESSAGE (0Bh/49h).

If, during the selection, the initiator does not assert its ID on the bus, or –ATN is not asserted, the drive assumes the initiator cannot support DISCONNECT/RECONNECT.

NOTE: *If the initiator expects the drive to disconnect/reconnect, a MESSAGE OUT phase (IDENTIFY with bit six true) must occur immediately following a SELECTION phase which had both the initiator's and the drive's SCSI device ID asserted on the bus.*

6.5.6.1 COMMAND COMPLETE (00h)

This message is sent from the drive to the initiator to indicate that the execution of a command (or a series of linked commands) has terminated, and that valid status has been sent to the initiator. After sending this message successfully, the drive goes to the BUS FREE phase by releasing –BSY unless the initiator sets the –ATN line.

NOTE: *The command may or may not have been executed successfully, as indicated in the status.*

If the initiator rejects this message with a MESSAGE REJECT, the drive goes to the BUS FREE phase and does not consider this an error.

6.5.6.2 SYNCHRONOUS DATA TRANSFER REQUEST MESSAGE (01h)

The drive can optionally perform synchronous data transfers, as discussed in section 6.5.2, Synchronous Data Transfer. A pair of SYNCHRONOUS DATA TRANSFER REQUEST messages (see Table 6•7) are exchanged between an initiator and the drive under the following conditions:

- A SCSI device that supports synchronous data transfer recognizes it has not communicated with the other SCSI device since receiving the last "hard" RESET.

- A SCSI device that supports synchronous data transfer recognizes it has not communicated with the other SCSI device since receiving a BUS DEVICE RESET message.

SCSI devices may also exchange messages to establish synchronous data transfer when requested to do so. The messages exchanged establish the transfer period and the -REQ/–ACK offset.

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	00–0Fh	REQ/ACK offset

Table 6-7
SYNCHRONOUS DATA TRANSFER REQUEST Byte Values

The transfer period is defined as the minimum time between the leading edge of a –REQ pulse and of its corresponding –ACK pulse. The –REQ/–ACK offset is defined as the maximum number of –REQ pulses that may be outstanding before the corresponding -ACK pulse is received at the drive. A –REQ/–ACK offset value of zero indicates asynchronous mode; a value of 0Fh yields the maximum number of outstanding –REQ pulses supported (15).

If the initiator recognizes that negotiation is required it asserts –ATN and if the drive implements message transfers, sends a SYNCHRONOUS DATA TRANSFER REQUEST message specifying the –REQ/–ACK offset and minimum transfer period. The -REQ/-ACK offset is chosen to meet the data handling requirements of the drive, while the minimum transfer period is chosen to meet the data handling requirements of the initiator. The drive responds in any of the following ways:

Drive Response	Implied Agreement
–REQ/–ACK offset less than or equal to the requested value.	–REQ/–ACK offset equal to drive value.
Minimum transfer period equal to or greater than requested period.	Minimum transfer period equal to the drive value.
–REQ/–ACK offset equal to zero.	Asynchronous transfer.
MESSAGE REJECT.	Asynchronous transfer.

The implied agreement remains in effect until a BUS DEVICE RESET message is received, a "hard" RESET condition occurs, or until one of the two SCSI devices elects to modify the agreement. Renegotiation at every selection is not recommended since a significant performance impact is likely. The default mode of data transfer is asynchronous. The default mode is entered at power on, after a BUS DEVICE RESET message, or after a "hard" RESET condition. The SYNCHRONOUS DATA TRANSFER REQUEST message exchange can only take place following a SELECTION phase that includes the SCSI IDs for both the initiator and the target. Violation of this rule may make data transfer impossible owing to disagreements among SCSI devices about the data transfer mode.

6.5.6.3 SAVE DATA POINTER (02h)

This message is sent from a target to direct the initiator to copy the active data pointer to the saved data pointers for the current I/O process. If the initiator rejects this message with a MESSAGE REJECT, the drive does not disconnect.

6.5.6.4 RESTORE POINTERS (03h)

This message is sent from the drive to the initiator. The message acts to restore to the active state the most recently saved pointers for the currently attached logical unit. Pointers to the command, data, and status locations for the logical unit are restored to the active pointers. Command and status pointers are restored to the beginning of the present command and status areas. The data pointer is restored to the value at the beginning of the data area, or to the value at the point at which the last SAVE DATA POINTERS message occurred for that logical unit.

If the initiator rejects this message with a MESSAGE REJECT, the drive immediately terminates the present command with a CHECK CONDITION status and sets the sense

key/error code to ABORTED COMMAND/Message Reject Error (0Bh, 43h) for that initiator.

When the drive reselects the initiator, the IDENTIFY message implies that the initiator should restore its pointers. Therefore, this message is not normally used in reselection.

6.5.6.5 DISCONNECT (04h)

This message is sent from the drive to inform the initiator that the present physical path is about to be broken (the drive plans to disconnect by releasing –BSY) but that a later reconnect is required in order to complete the current operation. This message does not cause the initiator to save the data pointer. If the initiator rejects this message with a MESSAGE REJECT, the drive does not disconnect.

6.5.6.6 INITIATOR DETECTED ERROR (05h)

This message is issued by an initiator to inform the drive that an error has occurred during an operation. This message should be sent by the initiator when a parity error is detected. The disk drive aborts the current command with a CHECK CONDITION status and sets the sense data to ABORTED COMMAND/INITIATOR DETECT ERROR (0Bh/48h).

6.5.6.7 ABORT (06h)

This message is sent from the initiator to the drive to clear the present operation. All pending data and status for the issuing initiator is cleared from the drive, and the drive goes to the BUS FREE phase. Pending data and status for other initiators is not cleared. No status or ending message is sent for the operation. It is not an error to issue this message to a logical unit that is not currently performing an operation for the initiator.

If an ABORT message is received in either tagged or untagged queuing, all processes for that host are cleared. The controller goes BUS FREE after successfully receiving this message. Any pending status and data are cleared.

6.5.6.8 MESSAGE REJECT (07h)

This message is sent from either the initiator or the drive to indicate that the last message received was inappropriate or has not been implemented.

In order to indicate its intentions in sending this message, the initiator asserts –ATN prior to its release of –ACK for the handshake of the message to be rejected. When the drive

sends this message, it changes to MESSAGE IN phase and sends this message prior to requesting additional message bytes from the initiator. This provides an interlock so that the initiator can determine which message is rejected.

If the initiator responds to this message with a MESSAGE REJECT message, the drive immediately terminates the present command with a CHECK CONDITION status and sets the sense data to ABORTED COMMAND/MESSAGE REJECT ERROR (0Bh, 43h) for that initiator.

6.5.6.9 NO OPERATION (08h)

The initiator sends this message when it has no valid message for the drive request. The drive receives and ignores this message.

6.5.6.10 MESSAGE PARITY ERROR (09h)

The initiator sends this message to indicate a parity error on one or more bytes of the last message sent from the drive. The initiator asserts –ATN prior to releasing –ACK for the last byte of the message in error, so that the drive knows which message is in error. If the drive returns to the MESSAGE IN phase, it will resend to the last message.

6.5.6.11 LINKED COMMAND COMPLETE (0Ah)

This message is sent to the initiator to indicate that the execution of a linked command has completed and the status has been sent.

If the initiator responds with a MESSAGE REJECT message, the drive goes to the BUS FREE phase and does not execute the next command in the chain. The sense data is set to ABORTED COMMAND/MESSAGE REJECT ERROR (0Bh, 43h) for that initiator.

6.5.6.12 LINKED COMMAND COMPLETE (WITH FLAG) (0Bh)

This message is sent to the initiator to indicate that the execution of a linked command (with the flag bit set to one) has completed and that the status has been sent.

If the initiator responds with a MESSAGE REJECT message, the drive goes to the BUS FREE phase and does not execute the next command in the chain. The sense data is set to ABORTED COMMAND/MESSAGE REJECT ERROR (0Bh, 43h).

6.5.6.13 BUS DEVICE RESET (0Ch)

An initiator may send this message to the drive to clear all current commands on that SCSI device. The drive clears all commands, goes through its initial power up, checks its self configuration, and goes to the BUS FREE state ("hard" RESET).

6.5.6.14 ABORT TAG (0Dh)

If an ABORT TAG message is received upon initial selection in tagged queueing mode, the message sequence is: IDENTIFY, SIMPLE QUEUE TAG, TAG VALUE, ABORT TAG. The controller goes BUS FREE and clears the I/O process specified. Any status or data is cleared and no ending status or message is sent to the host.

If an ABORT TAG message is received upon initial selection in untagged mode, the message sequence is: IDENTIFY, SIMPLE QUEUE TAG, ABORT TAG or IDENTIFY, ABORT TAG. Both sequences leave all I/O processes unchanged. The current I/O process is aborted by virtue of the controller going BUS FREE.

If an ABORT TAG message is received upon reselection for the I/O process specified in the ABORT TAG, then it is aborted, otherwise, the controller goes BUS FREE and nothing is aborted.

6.5.6.15 CLEAR QUEUE (0Eh)

If a CLEAR QUEUE message is received in either tagged or untagged queueing, all I/O processes from all initiators are cleared. The controller goes BUS FREE after successfully receiving this message. Any pending status and data are cleared. A UNIT ATTENTION condition with an additional sense code of COMMANDS CLEARED BY ANOTHER INITIATOR is generated for each other host that had an I/O process cleared.

6.5.6.16 TERMINATE I/O PROCESS (11h)

This message is sent from the initiator to terminate the current I/O process. The drive will terminate the current I/O process and return COMMAND TERMINATED status. The sense data is set to NO SENSE:I/O PROCESS TERMINATED.

If the current I/O process is also an active I/O process the termination will be done in a manner that does not corrupt the medium.

If the current I/O process involves a data phase, the valid bit is set in the sense data and the information field reports the following:

1. If the command descriptor block specifies an allocation length or parameter list length, the information field is set to the difference (residue) between the number of bytes successfully transferred and the requested length.

2. If the command descriptor block specifies a transfer length field, the information field is set to the unsigned logical block address associated with the sense key.

If an error is detected for the associated I/O process the drive ignores the TERMINATE I/O PROCESS message.

If the operation requested for the associated I/O process has been completed but status has not been returned, the drive ignores the TERMINATE I/O PROCESS message.

The effect of a TERMINATE I/O PROCESS message on the command queue depends on the queue error recovery option specified in the control mode page and on whether or not a contingent allegiance condition is generated.

6.5.6.17 SIMPLE QUEUE TAG (20h)

I/O processes with the SIMPLE QUEUE TAG message can undergo restricted or unrestricted reordering (enabled via the Queue Algorithm Modifier). Limits set by the I/O processes with the ORDERED QUEUE TAG messages and by hosts disabling reordering are observed. Currently, the reordering algorithm for restricted and unrestricted reordering is a restricted reordering algorithm.

6.5.6.18 HEAD OF QUEUE TAG (21h)

A command (I/O process) with the HEAD OF QUEUE TAG message is placed at the head of the queue (I/O processes previously activated are not considered in the queue). The I/O process with the HEAD OF QUEUE TAG message is executed after the active I/O process, if any, is complete.

6.5.6.19 ORDERED QUEUE TAG (22h)

An I/O process received with an ORDERED QUEUE TAG message must be executed in the order received (no reordering allowed). I/O processes received prior to the ordered I/O process must be executed before the ordered I/O processes can be activated, and I/O processes received subsequent to an ordered I/O process are executed after the ordered I/O process. The only exception is an I/O process received with the HEAD OF QUEUE TAG message.

6.5.6.20 IDENTIFY (C0h/80h)

This message is sent by an initiator after it selects a drive. It is sent by the drive as the first message after a reconnect. In addition, this message specifies that the sender supports some or all of the optional messages. The bits in Table 6•8, IDENTIFY Message Codes, show that the only truly changeable bit is bit six; therefore, the command can have only two values: C0h if disconnect/reconnect is supported and 80h if disconnect/reconnect is not supported.

BITS	IDENTIFY MESSAGE FUNCTION
7	Always Set
6	Set Indicates Ability to Disconnect and Reconnect
3 - 5	Reserved
2 - 0	Specify Logical Unit Number (Always Zero Value)

Table 6•8
IDENTIFY Message Codes

If the initiator responds to this message with a MESSAGE REJECT, the drive goes to the BUS FREE phase and sets the sense data to ABORTED COMMAND/MESSAGE REJECT ERROR (0Bh, 43h) for that initiator.

NOTE: *The drive does not disconnect if, during the SELECTION phase the initiator does not set its initiator SCSI device ID on the bus, and if the initiator does not send an IDENTIFY message out (with bit six set) to the drive.*

6.6 ERROR CONDITIONS

Under several error conditions, the drive changes the phase to BUS FREE without correctly terminating the command (that is, no DISCONNECT or COMMAND COMPLETE message is sent). The drive clears all information regarding the command, except sense data (if any) and does not attempt to reconnect or in any other way terminate the command. The initiator must assume this is a catastrophic failure and return the error to the system software.

Sense data may or may not be valid when this condition occurs. If the initiator issues a REQUEST SENSE command and the returned sense key/error code is anything other than 00h/00h, the sense data is valid.

6.6.1 MESSAGE OUT Phase Parity Error

If the drive detects one or more parity error(s) on the message byte(s) received, it may indicate its desire to retry the message(s) by asserting the REQ signal after detecting the ATN signal has gone false and prior to changing to any other phase. The initiator, upon detecting this condition, will resend all of the previous message byte(s) in the same order as previously sent during this phase. When resending more than one message byte, the initiator will assert the ATN signal at least two deskew delays prior to asserting the ACK signal on the first byte and will maintain the ATN signal asserted until the last byte is sent.

6.6.2 COMMAND Phase Parity Error

When the drive detects a parity error during the COMMAND phase, the drive aborts the command using the following sequence:

- The disk drive terminates the command with a CHECK CONDITION status and sets the sense data to ABORTED COMMAND/PARITY ERROR (0Bh/47h). This error does not prevent the initiator from trying the command again.

6.6.3 DATA OUT Phase Parity Error

If the drive detects a parity error during the DATA OUT phase, it terminates the command with a CHECK CONDITION status, and sets the sense data to ABORTED COMMAND/PARITY ERROR (0Bh/47h). This error does not prevent the initiator from trying the command again.

6.6.4 Initiator Detected Error

If the drive receives an initiator detected error message at any time during the command, except during the STATUS phase or COMMAND COMPLETE message, it terminates the current command with a CHECK CONDITION status and sets the sense data to ABORTED COMMAND/INITIATOR DETECTED ERROR (0Bh/48h). This error does not prevent the initiator from trying the command again.

If the initiator sends an initiator detected error message immediately after the STATUS phase, the drive immediately goes to the BUS FREE phase. The sense data is set to ABORTED COMMAND/INITIATOR DETECTED ERROR (0Bh/48h). This error does not prevent the initiator from trying the command again.

If the initiator sends an initiator detected error message immediately after the COMMAND COMPLETE message is sent, the drive immediately goes to the BUS FREE phase. The

sense data is set to ABORTED COMMAND/INITIATOR DETECTED ERROR (0Bh/48h). This error does not prevent the initiator from trying the command again.

6.6.5 REJECTED Message

When the drive receives a MESSAGE REJECT message from the initiator, the drive takes one of the following actions, based on which message was rejected:

- COMMAND COMPLETE - The drive goes to the BUS FREE phase and does not consider this an error.

- DISCONNECT - The drive does not disconnect from the initiator and continues the current command. This condition does not preclude the drive from attempting to disconnect at a later time.

  NOTE: *The drive does not send a DISCONNECT message to an initiator which does not support the disconnect/reconnect option.*

- IDENTIFY (Reconnect) - The drive immediately goes to the BUS FREE phase and aborts the current SCSI command. No further reconnection is attempted, and no STATUS or COMMAND COMPLETE message is sent for the command. The sense data is set to ABORTED COMMAND/MESSAGE REJECT ERROR (0Bh, 43h).

- LINKED COMMAND COMPLETE - The drive immediately goes to the BUS FREE phase and does not read the next command in the linked list. The sense data is set to ABORTED COMMAND/MESSAGE REJECT ERROR (0Bh, 43h).

- MESSAGE REJECT - The drive immediately terminates the present command with a CHECK CONDITION status and sets the sense data to ABORTED COMMAND/MESSAGE REJECT ERROR (0Bh, 43h).

- RESTORE POINTERS - Because the RESTORE POINTERS message is only used in an error recovery or retry situation, the drive aborts the recovery or retry attempt, assumes the error is unrecoverable, and completes the command according to the error condition.

- SAVE DATA POINTER - The drive assumes the initiator does not support this message and does not attempt to disconnect from the bus during this command.

6.6.6 MESSAGE IN PARITY ERROR

When the drive receives a MESSAGE PARITY ERROR message from the initiator, the drive will indicate that it is going to resend the message by returning the MESSAGE IN phase.

6.6.7 RESELECTION Time-Out

When the drive attempts to reselect the initiator and the initiator does not respond within a selection time-out delay (as defined in the SCSI standard), the drive will retry reselection continuously every 250 milliseconds until the initiator responds to the reselection attempts or a hard reset occurs.

NOTE: *The initiator must have an overall command time-out delay to detect this error.*

6.6.8 Internal Controller Errors

If an error occurs within the embedded controller that is related to the SCSI hardware or firmware, the drive terminates the present command with a CHECK CONDITION status and sets the sense data to HARDWARE ERROR/SCSI HARDWARE ERROR (04h/44h). This error does not prevent the initiator from trying the command again.

7.0 SCSI COMMAND DESCRIPTIONS

This chapter describes the SCSI commands implemented by Maxtor's MXT-1240S disk drive. The commands are listed alphabetically. Each command is presented with a section that defines the parameters sent to the drive, and what response the initiator should expect.

7.1 SCSI COMMAND OVERVIEW

Common to every command is a Command Descriptor Block (CDB). The CDB is 6, 10 or 12 bytes long and contains the basic parameters for each command. This section explains the fields that are common to all CDBs. The six-byte CDB is shown in Table 7•1. The ten-byte CDB is shown in Table 7•2.

For information about the parameters of a specific command, see the section which defines that command.

BIT / BYTE	7	6	5	4	3	2	1	0
0	Operation Code							
1	LUN			Logical Block Address (MSB) (If Required)				
2	Logical Block Address (If Required)							
3	Logical Block Address (LSB) (If Required)							
4	Transfer Length (If Required)							
5	Control Byte							

Table 7•1
Typical CDB for 6-Byte Commands

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code							
1	LUN			Reserved (Zeros)				RelAdr
2	Logical Block Address (MSB) (If Required)							
3	Logical Block Address (If Required)							
4	Logical Block Address (If Required)							
5	Logical Block Address (LSB) (If Required)							
6	Reserved (Zeros)							
7	Transfer Length (MSB) (If Required)							
8	Transfer Length (LSB) (If Required)							
9	Control Byte							

Table 7•2
Typical CDB for 10-Byte Commands

Operation Code

The Operation Code declares which operation is being requested. It is made up of the Group Code and the Command Code as shown in Table 7•3.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Group Code			Command Code				

Table 7•3
CDB Operation Code Format

The group code specifies one of the following groups:

Group 0 = 6-byte commands (see Table 7•1).
Groups 1 & 7 =10-byte commands (see Table 7•2).

The Command Code specifies which command is selected. The supported Operation Codes are shown in Table 7•4.

OPERATION CODE	COMMAND NAME	OPERATION CODE	COMMAND NAME
00h	TEST UNIT READY	1Ch	RECEIVE DIAGNOSTIC RESULTS
01h	REZERO UNIT	1Dh	SEND DIAGNOSTIC
03h	REQUEST SENSE	25h	READ CAPACITY
04h	FORMAT UNIT	28h	READ (EXTENDED)
07h	REASSIGN BLOCK	2Ah	WRITE (EXTENDED)
08h	READ	2Bh	SEEK (EXTENDED)
0Ah	WRITE	2Eh	WRITE AND VERIFY
0Bh	SEEK	2Fh	VERIFY
12h	INQUIRY	37h	READ DEFECT LIST
15h	MODE SELECT	3Bh	WRITE BUFFER
16h	RESERVE UNIT	3Ch	READ BUFFER
17h	RELEASE UNIT	3Eh	READ LONG
1Ah	MODE SENSE	3Fh	WRITE LONG
1Bh	START/STOP UNIT		

Table 7•4
Supported CDB Operation Codes

LUN

The Logical Unit Number (LUN) field contains the number of the device being addressed. This field should always be set to zero.

The LUN field is used for targets that do not implement the IDENTIFY message. (A LUN specified in the IDENTIFY message overrides any LUN specified in the CDB).

If an invalid LUN value is specified, the drive will return a CHECK CONDITION status and the sense data will be set to ILLEGAL REQUEST/INVALID LUN, except following an INQUIRY command. An INQUIRY command will respond to an invalid LUN with 011b in the peripheral qualifier and a 7Fh in byte 0.

NOTE: *The Maxtor MXT–1240S does not check reserved bits on every command.*

RelAdr

The Relative Address (RelAdr) field is set to one to indicate that the LBA portion of the CDB is a twos complement displacement. This negative or positive displacement is added to the LBA last accessed on the logical unit to form the LBA for this command.

This feature is used when linking commands, and it requires that a previous command in the linked group has accessed a block of data on the logical unit.

For detailed information on the logical block address (LBA) see the command sections. The LBA field begins with block zero and is contiguous up to the last logical block. The maximum LBA is variable, depending on the parameters selected for the number of bytes per sector and number of alternate sectors.

NOTE: *The maximum LBA allowable is returned to a READ CAPACITY command with a partial media indicator (PMI) bit equal to zero.*

Group 0 commands contain 21-bit LBAs.

Group 1 and 7 commands contain 32-bit LBAs.

Control

The control byte is the last byte in every CDB. The control byte is separated into three fields, as shown in Table 7•5, Control Byte.

BIT	7	6	5	4	3	2	1	0
	Reserved (Zeros)						Flag	Link

Table 7•5
Control Byte

Bits seven through two are reserved. The Maxtor MXT–1240S does not check reserved bits.

Flag

The flag bit is only checked when the link bit is set to one. The flag bit should be set to zero if the link bit is set to zero.

When the flag bit is set to zero, the drive sends a LINKED COMMAND COMPLETE message after the command successfully completes.

When the flag bit is set to one, the drive sends a LINKED COMMAND COMPLETE (WITH FLAG) message after the command successfully completes.

Link

When the current command completes successfully and the link bit is set to one, the

drive returns an INTERMEDIATE status, followed by one of the two messages defined by the flag bit as described above. The drive then automatically links to the next command. If a linked command is not completed successfully, the drive returns a CHECK CONDITION status, and does not link to the next command.

7.2 FORMAT UNIT - 04h

The FORMAT UNIT command formats the media so that all data blocks can be accessed. It rewrites all sector IDs and relocates defective sectors. Additionally, it causes all data to be overwritten with E5h and the first four bytes of every sector with the logical block address (LBA). Reserved areas are not affected.

The FORMAT UNIT command uses the drive geometry and format information (read from a reserved area on the disk during power up) to format the disk drive. These parameters may be changed by using the MODE SELECT command just prior to issuing the FORMAT UNIT command. If the information contained in the reserved area is invalid or cannot be read, the drive rejects the command.

The FORMAT UNIT command uses three internal and one external defect list. The first internal list is the Plist (primary list). It contains defects known to exist at the time of manufacture. The Plist is permanent and never changes. The second internal defect list is the Glist (grown list). The Glist keeps track of all defects found after the Plist was created. The third internal list is the Clist (certification list). The Clist is created during certification and is added to the Glist. The Initiator can erase the Glist or add to it. The REASSIGN BLOCK command also adds entries to the Glist. The only external defect list is the Dlist (initiator defect list). The Dlist consists of entries transferred from the initiator during the FORMAT UNIT command. When a Dlist is used, its contents are added to the Glist.

The FORMAT mode is determined by the settings in the FORMAT UNIT command descriptor block and if needed the defect list header.

7.2.1 Command Parameters

BIT / BYTE	7	6	5	4	3	2	1	0
0	Command Code (04h)							
1	LUN (Zeros)			FmtData	CmpLst	Defect List Format		
2	Reserved (Zeros)							
3	Interleave Factor (MSB)							
4	Interleave Factor (LSB)							
5	Control Byte							

Table 7-6
FORMAT UNIT CDB

FmtData
A format data (FmtData) bit of zero indicates that no DATA OUT phase follows.

A FmtData bit of one indicates that a DATA OUT phase follows. The DATA OUT phase consists of a four byte defect list header followed by zero or more defect descriptors (Dlist).

CmpLst
A complete list (CmpLst) bit of zero indicates that the Dlist is to be used in conjunction with the Plist and Glist.

A CmpLst bit of one indicates that formatting is done using the Plist and Dlist only. The current Glist is erased and a new one is created using the Dlist and any other new defects that are found.

NOTE: *The FmtData bit must be set to one for the CmpLst bit and defect list format bits to be recognized.*

Defect List Format
The Defect List Format field declares the type of Dlist the initiator should send. The table below shows the possible settings.

DEFECT LIST FORMAT BITS			DESCRIPTION
2	1	0	
1	0	0	Format with bytes from index format. The Dlist, if any, is in bytes from index format.
1	1	0	Format with the default format. The Dlist, if any, is in the MXT-1240S default format.
1	1	1	Reserved.
0	0	0	Format block mode, zero defect list only. (Not currently supported)

Table 7-7
Dlist formats

Interleave Factor
The interleave factor field supports an interleave factor of one only.

NOTE: *An interleave factor of zero or one requests that the drive use its default interleave (1:1 sequential).*

7.2.2 Defect List Header

If the FmtData bit (in the FORMAT UNIT command) is set to one, the initiator transfers the defect list header to the drive during the DATA OUT phase of the FORMAT UNIT command.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Reserved (Zeros)							
1	FOV	DPRY	DCRT	Rsrv	IP	DSP	IMMED	Rsrv
2	Defect List Length (MSB)							
3	Defect List Length (LSB)							

Table 7-8
FORMAT UNIT Defect List Header

FOV

A format options valid (FOV) bit of one indicates that bits two through six of byte one are valid.

A FOV bit of zero instructs the drive to use its default settings and ignore bits two through six. The default settings will cause the drive to format with the Plist and Glist.

DPRY

A disable primary (DPRY) bit of one instructs the drive to format without the Plist.

A DPRY bit of zero instructs the drive to use the Plist.

DCRT

A disable certification (DCRT) bit of one disables the certification options.

A DCRT bit of zero enables drive certification. Certification includes writing and reading of various bit patterns on the medium. These extra write and read cycles increase format time. Defects found during certification will be reallocated and their location put into a Clist (certification list). The Clist is added to the Glist.

IP

The initialization pattern option allows the initiator to initialize the initiator accessible areas of the media to a specified pattern. The pattern is specified in the initialization pattern descriptor output during the DATA OUT phase.

The initialization pattern is not intended for media analysis or certification. It is used to initialize the data in the initiator accessible area of the media to the specified pattern.

An initialization pattern (IP) bit of one indicates that an initialization pattern descriptor is supplied during the DATA OUT phase, immediately following the defect list header. An IP bit of zero indicates that no initialization pattern descriptor will be sent during the DATA OUT phase. If the IP bit is zero, the drive will format the disk using its default initialization pattern of four bytes for the LBA address followed by an E5h pattern. See Table 7•10 for Initialization Pattern Descriptor.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	IP Modifier		Reserved					
1	Pattern Type							
2	(MSB) Initialization Pattern Length							
3								(LSB)
n	Initialization Pattern (if any)							

Table 7•10
Initialization Pattern Descriptor

IP Modifier
The IP modifier field specifies the type and location of a header that modifies the initialization pattern. The IP modifier is defined in Table 7•11.

Pattern Type
The initialization pattern type field indicates the type of pattern the drive will use to initialize each logical block within the initiator accessible portion of the media. The initialization pattern type is defined in Table 7•12. All bytes within a logical block are written with the initialization pattern. The initialization pattern may be modified by the IP modifier field as described in Table 7•11.

IP	MODIFIER	DESCRIPTION
0	0	No header. The drive does not modify the initialization pattern.
0	1	Not currently supported
1	0	The drive overlays the initialization pattern with the current logical block address at the start of each physical sector contained within the logical block. Four bytes of logical block address are written with the most significant byte first.
1	1	Not currently supported

Table 7•11
Initialization Pattern Modifier

PATTERN TYPE	NOTE	DESCRIPTION
00h	(1)	Use default pattern.
01h	(2)	Repeat the initialization pattern as required to fill the logical block.

NOTES:

(1) If the initialization pattern length is not zero, the drive returns CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN PARAMETER LIST.

(2) If the initialization pattern length is zero, the drive returns CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN PARAMETER LIST.

Table 7•12
Initialization Pattern Type

Initialization Pattern Length

The initialization pattern length field indicates the number of bytes contained in the initialization pattern. If the length exceeds the current logical block size, the drive returns CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN PARAMETER LIST. The pattern may be modified by the IP modifier field.

DSP

The disable saving parameters (DSP) bit is not supported by the drive and must be set to zero.

Immed

An immediate (Immed) bit of zero specifies that the drive return status after the format operation has completed. An Immed bit of one specifies that the drive return status as soon as the command descriptor block has been validated, and the entire defect list has been transferred. If the Immed bit is one during the format operation, the drive will return BUSY status in response to all commands. The LED will stay on during formatting if the Immed bit is set, otherwise it will go off.

Defect List Length

The defect list length field specifies the total number of bytes (not the number of defect descriptors) in the Dlist. It doesn't include the four bytes in the header. A defect list length of zero indicates that no Dlist is provided and is not considered an error by the drive.

FMT	CMP	DPRY	DCRT	FORMAT MODE
0	X	X	X	P, G
0	1	X	X	P
1	0	0	1	P, G, D
1	1	0	1	P, D
1	0	1	1	D, G
1	1	1	1	D
1	0	0	0	P, G, C, D
1	1	0	0	P, C, D
1	0	1	0	G, C, D
1	1	1	0	D, C

X = 1 or 0
P = Plist
G = Glist
C = Clist
D = Dlist

Table 7-9
Drive Format Modes

7.2.3 DList (Initiator Defect List)

The Dlist is sent by the initiator when the FmtData bit is set to one; the defect list format is set to either bytes from Index or MXT-1240S format, and the defect list length field must be a non-zero value.

NOTE: *The initiator should use the drive's internal defect maps, rather than sending a Dlist to the drive. Maxtor performs extensive testing of all drives and adds all areas of defective or marginal performance to the defect lists. If the initiator disables the internal lists using the disable primary (DPRY) bit, marginal sectors might cause future loss of data.*

7.2.3.1 DLIST - BYTES FROM INDEX FORMAT

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Cylinder Number of Defect (MSB)							
1	Cylinder Number of Defect							
2	Cylinder Number of Defect (LSB)							
3	Head Number of Defect							
4	Defect Bytes from Index (MSB)							
5	Defect Bytes from Index							
6	Defect Bytes from Index							
7	Defect Bytes from Index (LSB)							

Table 7-13
Defect Descriptor - Bytes from Index Format

The defect descriptor provides the information necessary to locate a defective byte.

Cylinder Number of Defect
The cylinder number of defect field specifies the cylinder containing the defect.

Head Number of Defect
The head number of defect field specifies the head containing the defect.

Defect Bytes from Index
The defect bytes from index field specifies the number of bytes between the index and the defect.

The defect descriptors must be in ascending order. For determining ascending order, the cylinder number of defect field is considered the most significant part of the address, and the defect bytes from index field is considered the least significant part of the address.

7.2.4 Error Conditions

If the FORMAT mode is invalid, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN CDB (05h/24h), or ILLEGAL REQUEST/INVALID FIELD IN PARAMETER LIST (05h/26h), whichever is applicable.

If the drive has insufficient capacity to reassign all the defective blocks, it terminates the command with a CHECK CONDITION status. The sense data is set to MEDIUM ERROR/NO DEFECT SPARE LOCATION AVAILABLE (03h/32h).

7.3 INQUIRY - 12h

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	Logical Unit Number			Reserved				EVPD
2	Page Code							
3	Reserved							
4	Allocation Length							
5	Control							

Table 7-14
INQUIRY Command

The INQUIRY command (Table 7-14) requests that information regarding parameters of the drive and its attached peripheral device(s) be sent to the initiator. An option allows the initiator to request additional information about the drive or logical unit.

If an initiator has a pending unit attention condition the drive returns the INQUIRY data and does not clear the unit attention condition.

The drive returns CHECK CONDITION status in response to an INQUIRY command only if the requested INQUIRY data cannot be returned. The drive returns INQUIRY data even if the medium is not ready for access. The INQUIRY data that is on the medium is returned as zeros or ASCII spaces (20h) in those fields until the data is available. If the INQUIRY data changes, the drive generates a UNIT ATTENTION condition and sets the additional sense code to TARGET OPERATING CONDITIONS HAVE CHANGED.

EVPD
An enable vital product data (EVPD) bit of zero specifies that the drive return the standard INQUIRY data.

An EVPD bit of one specifies that the drive return the vital product data specified by the page code field.

If the EVPD bit is zero and the page code field is not zero, the drive will return CHECK CONDITION status with the sense data set to ILLEGAL REQUEST/INVALID FIELD IN CDB.

Page Code

The page code field specifies which page of vital product information the drive will return. These pages are described in section 7.3.2, Vital Product Data Parameters.

7.3.1 Vital Product Data

The initiator requests the vital product data information by setting the EVDP bit to one and specifying the page code of the desired vital product data. See Table 7•15. If the drive does not implement the requested page, it returns CHECK CONDITION status and the sense data is set to ILLEGAL REQUEST/INVALID FIELD IN CDB.

7.3.2 Vital Product Data Parameters

The vital product data codes supported by the MXT-1240S disk drive are; Supported Vital Product Data Pages (00h) and the Unit Control Number Page (80h). These are described in Table 7•15 and Table 7•16, respectively.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (00h)							
2	Reserved							
3	Page Length (n - 3)							
4	Supported Page List							
n								

Table 7•15
Supported Vital Product Data Pages

Peripheral Qualifier and Peripheral Device-Type
The peripheral qualifier and peripheral device-type fields identify the device currently connected to the logical unit.

If the logical unit number is zero, the drive sets this field to 00h (peripheral qualifier set to 000b and peripheral device type set to 00h). If the logical unit number is other than zero, the drive sets this field to 7Fh (peripheral qualifier set to 011b and peripheral device type set to 1Fh).

A peripheral qualifier of 000b does not imply that the device is ready for access by the initiator. A peripheral device type of 00h indicates that this is a direct-access device.

Page Code
The page code field is set to 00h.

Page Length
The page length field specifies the length of the supported page list. If the allocation length is too small to transfer all of the page, the page length is not adjusted to reflect the truncation.

Supported Page List
The supported page list field contains a list of all vital product data page codes implemented in ascending order, beginning with page code 00h (i.e. the drive returns 00h in byte 4 and 80h in byte 5 since only these two pages are supported).

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (80h)							
2	Reserved							
3	Page Length (08h)							
4	Unit Control Number							
11								

Table 7•16
Unit Control Number Page

Peripheral Qualifier and Peripheral Device-Type
The peripheral qualifier and peripheral device-type fields identify the device currently connected to the logical unit.

If the logical unit number is zero, the drive sets this field to 00h (peripheral qualifier set to 000b and peripheral device type set to 00h). If the logical unit number is other than zero, the drive sets this field to 7Fh (peripheral qualifier set to 011b and peripheral device type set to 1Fh).

A peripheral qualifier of 000b does not imply that the device is ready for access by the initiator. A peripheral device type of 00h indicates that this is a direct-access device.

Page Code
The page code field is set to 80h.

Page Length
The page length field specifies the length of the unit control number. If the allocation length is too small to transfer all of the page, the page length will not be adjusted to reflect the truncation.

Unit Control Number
The unit control number field contains eight bytes of ASCII data that is unique for each drive manufactured. The least significant ASCII character of the number is in byte 11. If the number is not available, the drive returns ASCII spaces (20h) in this field.

7.3.3 Standard INQUIRY Data

The standard INQUIRY data is 36 bytes long. The standard INQUIRY data format is shown in Table 7-17.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	RMB	Device-Type Modifier						
2	ISO Version		ECMA Version			ANSI-Approved Version		
3	Rsrv	TrmIOP	Reserved		Response Data Format			
4	Additional Length (n-4)							
5	Reserved							
6								
7	RelAdr	WBus32	WBus16	Sync	Linked	Reserved	CmdQue	SftRe
8	(MSB)							
9 - 14	Vendor Identification							
15								(LSB)
16	(MSB)							
17 - 30	Product Identification							
31								(LSB)
32	(MSB)							
33	Product Revision Level							
34								
35								(LSB)

Table 7-17
Standard INQUIRY Data Format

Peripheral Qualifier
The peripheral qualifier is returned as 000b if the logical unit number is zero. The field is returned as 011b for logical unit numbers one through seven.

Peripheral Device-Type
The peripheral device-type field is returned as 00h if the logical unit number is zero to indicate that it is a direct-access device. The field is returned as 1Fh for logical unit numbers one through seven.

RMB
The removable medium bit (RMB) is returned as zero to indicate that the medium is not removable.

Device-Type Modifier
The device-type modifier field is returned with a value of zero.

ISO version field
The ISO version field is returned as 00b.

ECMA version
The ECMA version field is returned as 000b.

ANSI-approved version
The ANSI-approved version field is returned as 001b to indicate that the drive complies to ANSI X3T9.2/86-109 (SCSI-2).

TrmIOP
The TERMINATE I/O PROCESS (TrmIOP) message is sent from the initiator to the drive to advise it to terminate the current I/O process without corrupting the medium. Upon successful receipt of this message the drive will terminate the current I/O process as soon as possible and return COMMAND TERMINATED status. The sense key will be set to NO SENSE and the additional sense code and qualifier will be set to I/O PROCESS TERMINATED. The TERMINATE I/O PROCESS message will not affect pending status, data and commands for other queued or executing I/O processes.

Response Data Format
The response data format is returned as 2h to indicate that the INQUIRY data format is as specified in SCSI-2.

Additional Length
The additional length field is returned as 1Fh to indicate the length in bytes of the parameters. If the allocation length of the command descriptor block is too small to transfer all of the parameters, the additional length is not adjusted to reflect the truncation.

RelAdr
The relative addressing (RelAdr) bit is returned as one. For a description of this bit, see section 7.1 earlier in this manual.

WBus32
The wide bus 32 (WBus32) bit is returned as zero to indicate that the drive does not support 32-bit wide data transfers.

WBus16
The wide bus 16 (WBus16) bit is returned as zero to indicate that the drive does not support 16-bit wide data transfers.

Sync
The synchronous transfer (Sync) bit is returned as one to indicate that the drive supports synchronous data transfer.

Linked
The linked command (Linked) bit is returned as one.

CmdQue
The command queuing (CmdQue) bit is returned as one to indicate that the drive supports tagged command queuing.

SftRe
The soft reset (SftRe) bit is returned as zero to indicate that the drive responds to the RESET condition with the hard RESET alternative.

The ASCII data fields contain only graphic codes (i.e., code values 20h through 7Eh). Left-aligned fields place any unused bytes at the end of the field (highest offset) and the unused bytes are filled with space characters (20h). Right-aligned fields place any unused bytes at the start of the field (lowest offset) and the unused bytes are filled with space characters (20h).

Vendor Identification
The vendor identification field contains eight bytes of ASCII data identifying Maxtor as the vendor of the product. The data is left aligned within this field.

Product Identification
The product identification field contains sixteen bytes of ASCII data. The data is left-aligned within this field.

Product Revision Level
The product revision level field contains four bytes of ASCII data. The data is left-aligned within this field.

7.4 MODE SELECT (6) - 15h

The MODE SELECT command provides a way for the initiator to send parameters to the drive. The parameters are separated into categories called pages. Parameters that are changed by the MODE SELECT command on pages 01h, 02h, 8h, 0A, 32h and 38h will take effect immediately after the command has terminated. Pages 3 and 4 are saved only after a successful format operation. MODE SELECT is complementary to MODE SENSE.

When the initiator wants to change a parameter, it may send only the page effected or all of the pages (in any order).

Prior to issuing a MODE SELECT command, the initiator should inspect (via MODE SENSE) the current values to see which pages are implemented; the page length and current values. It should also inspect the changeable values to determine which parameters can be altered. The MODE SELECT command should not attempt to change any bit or field which is not implemented or changeable.

If the initiator sends a MODE SELECT command that changes any parameters applying to other initiators, the drive will generate a UNIT ATTENTION condition for all initiators except the one that issued the MODE SELECT command. The drive sets the additional sense code to MODE PARAMETERS CHANGED.

The MODE SELECT command affects both the current and saved values. Current values are the MODE SELECT parameters used by the drive during normal operation. Saved values are all changeable MODE SELECT parameters that are saved by the drive on the medium during a FORMAT UNIT command.

7.4.1 SCSI Deviations

Only a single block descriptor may be sent to the drive.

The drive ignores the number of blocks field in the block descriptor.

7.4.2 Command Parameters

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (15h)							
1	LUN (Zeros)			PF	Reserved (Zeros)			SP
2	Reserved (Zeros)							
3	Reserved (Zeros)							
4	Parameter List Length							
5	Control Byte							

Table 7-18
Mode Select CDB

P F
The page format (PF) bit, when set to one, declares that the parameters which follow the MODE SELECT header and the block descriptors (if any) comply with the page format as defined in the CCS.

S P
A save parameters (SP) bit of one directs the drive to perform the specified MODE SELECT operation and save all pages on the disk. If an error occurs during the MODE SELECT command, the command is terminated without saving the parameters.

If the SP bit is zero, the drive will perform the specified MODE SELECT operation but will not save any pages.

Parameter List Length
The parameter list length field specifies the length (in bytes) of the parameters that are sent to the drive during the MODE SELECT command. A parameter list length field of 00h indicates that no data is transferred and is not considered an error.

7.4.3 Parameter List Format

The MODE SELECT parameter list is sent to the drive during the DATA OUT phase. This list consists of a parameter list header, zero or one block descriptor, and zero or more

page descriptors. The entire length of the parameter list is specified in the MODE SELECT CDB.

The parameter list header is made up of four bytes. It specifies the medium type and length of the block descriptor.

The block descriptor consists of eight bytes. It specifies the medium density; number of blocks and logical block length.

The page descriptors contain various parameters, separated into pages. These parameters specify various options and features which can be changed by the initiator. One or more pages may be sent during the MODE SELECT command.

7.4.3.1 PARAMETER LIST HEADER FORMAT

The MODE SELECT parameter list header is the first part of the parameter list. Appended to this header will be the parameter list block descriptor.

BIT / BYTE	7	6	5	4	3	2	1	0
0	Reserved (Zeros)							
1	Medium Type (Zeros)							
2	Reserved (Zeros)							
3	Block Descriptor Length (00h or 08h)							

Table 7•19
Parameter List Header

Medium Type
The medium type field must be set to 00h.

Block Descriptor Length
The block descriptor length field specifies number of bytes to follow after this field. The MXT–1240S does not support zero or one block descriptor per MODE SELECT command. Therefore, the only valid block descriptor lengths are 0 or 8 bytes.

7.4.3.2 PAGE HEADER FORMAT

The Page Header is the first two bytes of each page descriptor. It contains the page code (PC) and page length.

Page Code

The page code (PC) field identifies the page type. Table 7•20 lists the page codes and their corresponding page descriptions.

PAGE CODE	PAGE DESCRIPTION
00h	Vendor Unique
01h	Error Recovery Parameters
02h	Disconnect/Reconnect Control Parameters
03h	Direct Access Device Format Parameters
04h	Rigid Disk Drive Geometry Parameters
08h	Caching Parameters
0Ah	Control Mode Page
32h	Drive Control Page
38h	Read-Ahead Control Page
3Fh	Reserved for use in MODE SENSE Command

Table 7•20
MODE SELECT Page Codes

7.4.3.3 PARAMETER LIST BLOCK DESCRIPTOR FORMAT

The MODE SELECT parameter list block descriptor immediately follows the parameter list header.

The drive does not report an error if the block descriptor is not in the parameter list (block descriptor length equals zero).

MODE SELECT - 15h

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Density Code (00h)							
1	Number of Blocks (MSB) (00h)							
2	Number of Blocks (00h)							
3	Number of Blocks (LSB) (00h)							
4	Reserved (Zeros)							
5	Block Length (MSB)							
6	Block Length							
7	Block Length (LSB)							

Table 7-21
Mode Select Parameter List Block Descriptor Format

Density Code
The density code field must be set to 00h.

Number of Blocks
The number of blocks field is ignored by the drive.

Block Length
The block length field specifies the length of the logical block (in bytes). The block length must equal the physical sector size.

7.4.3.4 PAGE 1 - ERROR RECOVERY PARAMETERS

The read-write error recovery page, described in Table 7•22, specifies the error recovery parameters the drive uses during any command that performs a read or write operation to the medium.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	PS	Rsrv	Page Code (01h)					
1	Page Length (0Ah)							
2	AWRE	ARRE	TB	RC	EEC	PER	DTE	DCR
3	Read Retry Count							
4	Correction Span							
5	Head Offset Count							
6	Data Strobe Offset Count							
7	Reserved							
8	Write Retry Count							
9	Reserved							
10	(MSB) Recovery Time Limit							
11	Recovery Time Limit (LSB)							

Table 7•22
Read-Write Error Recovery Page

P S

The parameters savable (PS) bit is only used with the MODE SENSE command and will return a value of one to indicate that the drive is capable of saving the page. This bit is reserved with the MODE SELECT command. A copy of this page is saved for each initiator.

AWRE

An automatic write reallocation enabled (AWRE) bit of one indicates that the drive will enable automatic reallocation of defective data blocks detected during write operations. All error recovery actions required by the error recovery bits (EER, PER, DTE, and DCR) are executed. The automatic reallocation is performed only if the drive encounters a BLOCK NOT FOUND (03h/14h) during the write process. The defective sector is then relocated and the write data is then placed in the reallocated block. Error reporting as required by the error recovery bits is performed only after completion of the reallocation. The drive presents any failures that occur during the reallocation process. The automatic reallocation process follows the same error procedures as the REASSIGN BLOCKS command.

An AWRE bit of zero indicates that the drive does not perform automatic write reallocation of defective data blocks during write operations.

ARRE

An automatic read reallocation enabled (ARRE) bit of one indicates that the drive will enable automatic reallocation of defective data blocks during read operations. All error recovery actions required by the error recovery bits (TB, EER, PER, DTE, and DCR) are executed. The automatic reallocation is then performed only if the target successfully recovers the data. The recovered data is then placed in the reallocated block. Error reporting as required by the error recovery bits is performed only after completion of the reallocation. The drive presents any failures that occur during the reallocation process. The automatic reallocation process follows the same error procedures as the REASSIGN BLOCKS command.

An ARRE bit of zero indicates that the target shall not perform automatic read reallocation of defective data blocks during read operations. See Figure 7•1 for a flow chart of automatic read reallocation.

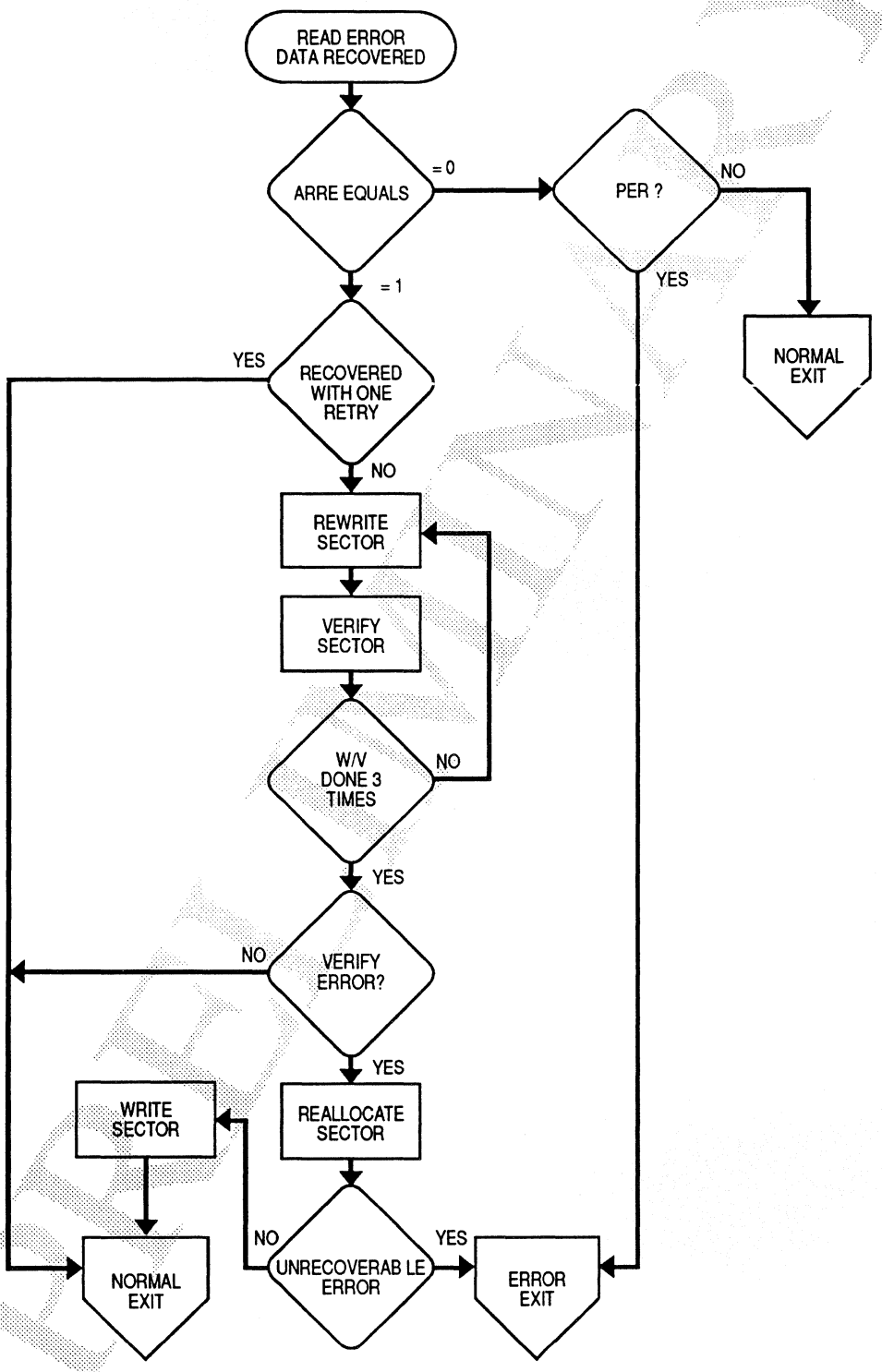


Figure 7-1
Flow Chart of Automatic Read Reallocation

TB

A transfer block (TB) bit of one indicates that the drive should transfer the block with the data error before terminating the command. This bit is only applicable when an unrecoverable error is encountered, or when the disable transfer on error (DTE) bit is set to one, and a recoverable error is encountered. If the TB bit is zero, the drive does not transfer the block with the data error. In both cases, the drive reports the address of the block with the error, rather than that of the preceding block, in the sense data. If the transfer terminates with other than a data error (i.e., block not found), the block is not transferred. If the initiator requested the changeable values, this bit will return a value of one.

RC

A read continuous (RC) bit of one overrides the enable early correction (EEC), disable transfer on error (DTE), post error (PER), and disable correction (DCR) bits, and disables all retries and data correction. The transfer block (TB) bit is not applicable. When the read continuous (RC) bit is set to one, the drive transfers the entire requested length of data without adding delays that are caused by its error recovery algorithms. The drive sends data which may be erroneous, or fabricated, to maintain a continuous flow of data and avoid delays. If the initiator requested the changeable values, this bit will return a value of one.

EEC

The enable early correction (EEC) bit indicates that the drive will attempt firmware ECC correction before entering the recovery algorithm. When this bit is set to one, the drive does not exhaust the retry count before attempting any firmware ECC correction. When this bit is set to zero, the drive exhausts the retry count, before it attempts any firmware ECC correction. If the initiator requested the changeable values, this bit will return a value of one.

PER

A post error (PER) bit of one instructs the drive to report any recoverable errors to the initiator. This error is either reported immediately, or at the normal completion of the command, depending on the state of the disable transfer on error (DTE) bit. The error reported to the initiator is the last error encountered during the data transfer. If multiple errors occur, the drive reports (in the sense information) the block address of either 1) the last block where the recovered error occurred; or 2) the block with the first unrecoverable error. If the initiator requested the changeable values, this bit will return a value of one.

DTE

A disable transfer on error (DTE) bit of one and a post error (PER) bit of one instruct the drive to terminate the command immediately when a recoverable error is encountered, and create the CHECK CONDITION status. The drive may or may not transfer the data contained in the block in error, depending on the setting of the transfer block (TB) bit. The initiator can only set the disable transfer on error (DTE) bit to one if it has set the post error (PER) bit to one. If the disable transfer on error (DTE) bit is set to zero, the drive

continues the data transfer when a recoverable error is encountered. If the initiator requested the changeable values, this bit will return a value of one.

DCR

A disable correction (DCR) bit of one disables firmware ECC correction when reading a sector from the drive. No correction is attempted, and if a correctable ECC error occurs, it is treated as a recoverable error. If the initiator requested the changeable values, this bit will return a value of one.

NOTE: *If an invalid mode for the error recovery combination is sent by the initiator the drive will return CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.*

Read and Write Retry Count

The read and write retry count fields specify the number of times that the drive attempts its recovery algorithm during read and write operations, respectively. These fields have a range of values of 0 to 255. The default value is 10 for read operations and 4 for write operations.

Correction Span

The correction span field specifies the size, in bits, of the largest data error burst for which data error correction may be attempted. A correction span of zero specifies that the drive use its default value. This field has a range of values of 11 to 20. The default value is 11.

Head Offset Count

The head offset count field specifies the total number of offset locations from the track center to which the heads are moved during the read error recovery. After four recovery attempts with the heads on track, the heads are moved in incremental, alternate offset positions for each read recovery attempt. A value of zero indicates that no head offset occurs during error recovery. A head offset value of 2 indicates one read retry at each of the following 2 offset positions: +1, –1, incremental positions from track center. If this value is greater than 2, the 2 offset positions are repeated for N number of times (where N = the head offset value divided by 2). The default value is 2.

Data Strobe Offset Count

The data strobe offset count field specifies the total number of times the data strobe is adjusted during the read error recovery. The range of values for this field is 0 to 2. A value of zero indicates that no data strobe offset is applied. A value of 2 indicates one read retry with each of the following data strobe offset: +1, –1 increment. The default value is 2.

Recovery Time Limit

The recovery time limit field specifies in increments of one millisecond the maximum time

duration that the drive uses for data error recovery procedures. A recovery time limit of zero specifies that the drive will use its default value. This field is currently not supported.

The recovery time limit field is always set to 00h. This feature is not supported.

Table 7•23 lists the possible error recovery modes which may occur using the above parameters. Those combinations that do not provide any useful function, that is, terminate on errors but do not report them, are marked as invalid mode and should not be selected by the initiator. Data transfers terminate immediately for any unrecoverable error.

ECC	PER	DTE	DCR	DESCRIPTION
0	0	0	0	Retries Then Correction. Rerties are exhausted, ECC correction is attempted and recovered errors are not reported.
0	0	0	1	No Correction. Retries are exhausted, no ECC correction is attempted and recovered errors are not reported.
0	0	1	0	Invalid Mode. The initiator should not use this mode.
0	0	1	1	Invalid Mode. The initiator should not use this mode.
0	1	0	0	Report Recovered Errors. Retries are exhausted, ECC is attempted and recovered errors are reported.
0	1	0	1	Report Errors, No Correction. Retries are exhausted, no ECC correction is attempted and recovered errors are reported.
0	1	1	0	Report Errors and Stop. Retries are exhausted, ECC correction is attempted and recovered errors are reported. The transfer terminates prematurely if any error occurrs.
0	1	1	1	Report Errors, No Correction, Stop. Retries are exhausted, no ECC correction is attempted and recovered errors are reported. The transfer terminates prematurely if any error occurs.
1	0	0	0	Early Correction. A minimum number of retries are attempted before ECC correction is applied. Any recovered errors are not reported.
1	0	0	1	Invalid Mode. The initiator should not use this mode.
1	0	1	0	Invalid Mode. The initiator should not use this mode.
1	0	1	1	Invalid Mode. The initiator should not use this mode.
1	1	0	0	Report Recovered Errors with Firmware ECC First. A minimum number of retries are attempted before firmware ECC correction is applied. Any recovered errors are reported.
1	1	0	1	Invalid Mode. The initiator should not use this mode.
1	1	1	0	Report Errors and Stop with Firmware ECC First. A minimum number of retries are attempted before firmware ECC correction is applied. Any recovered errors are reported. The transfer terminates prematurely if any error occurs.
1	1	1	1	Invalid Mode. The initiator should not use this mode.

Table 7•23
Error Recovery Modes

7.4.4 Page 2 - Disconnect/Reconnect Parameters

This section specifies the MODE SELECT disconnect/reconnect parameter options.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Reserved		Page Code (02h)					
1	Page Length (In Bytes) (0Ah)							
2	Buffer Full Ratio							
3	Buffer Empty Ratio							
4	Bus Inactivity Limit (MSB)							
5	Bus Inactivity Limit (LSB)							
6	Disconnect Time Limit (MSB)							
7	Disconnect Time Limit (LSB)							
8	Connect Time Limit (MSB)							
9	Connect Time Limit (LSB)							
10	Reserved							
11	Reserved							

Table 7-24
Page 2 - Disconnect/Reconnect Control Parameters

Page Code
This page has a page code of 02h, indicating that the following parameters pertain to error recovery.

Page Length
The page length field specifies the number of bytes to follow after this field. This is equal to the total page length minus two.

Buffer Full Ratio

The buffer full ratio field indicates to the target, on read operations, how full the buffer should be prior to attempting a reselection.

The buffer full ratio is a percentage of the buffer, or the transfer length, whichever is less. If the transfer length is less than the buffer, the buffer full ratio will be applied to the transfer length. If the transfer length is greater than the buffer, the buffer full ratio will be applied to the buffer size. The buffer full ratio is a numerator of a fractional multiplier that has 256 as its denominator. A value of 255 indicates that 100% of the data transfer is in the buffer or the buffer was filled with data before reselection. A value of zero indicates that the target will automatically calculate the proper buffer full ratio for each data zone across the disk surface. The algorithm for calculating the buffer full ratio is **(1-(DTR/STR)) x 256**.

STR = SCSI bus transfer rate = [10 Mbytes/sec] or [1/(4m)] which ever is less. (Where "m" is the value returned in the SDTR request in nanoseconds.)

DTR = disk transfer rate for each zone of "net user data" = (sectors/track x bytes/sector x 105 rounds per second).

The auto-calculated buffer full ratio is applied to each data zone and to each buffer segment and is used when the following conditions are met.

- Synchronous data transfers. (Asynchronous data transfers are normally close to the disk transfer rate and the target reconnects as soon as one sector of data is in the buffer.
- When the synchronous negotiations are complete and the value in the buffer full ratio is 00h, the auto-calculated value would be used for the buffer full ratio. If the buffer full ratio value is non-zero, the user programmed value will be used. This allows the user to override the automatically calculated value.

Buffer Empty Ratio

The buffer empty ratio field specifies the amount of data in the buffer on a WRITE command before the sector ID search is initiated. The default value for this is 40h.

The performance benefit from using buffer ratios is in a multi-target environment where SCSI bus utilization is critical. Proper use of the buffer ratios can ensure maximum utilization of the SCSI bus, by minimizing the time to transfer data. See appendix B for further information.

Bus Inactivity Limit

The bus inactivity limit field specifies the length of time (in 100 microsecond increments) that the drive is allowed to stay connected to the SCSI bus without any bus activity.

Disconnect Time Limit
The disconnect time limit field is always set to 0000h. This feature is not supported.

Connect Time Limit
The connect time limit field is always set to 0000h. This feature is not supported.

7.4.5 Page 3 - Direct Access Device Format Parameters

This section specifies the Direct Access Device Format Parameters page.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Reserved (Zeros)		Page Code (03h)					
1	Page Length (in Bytes) (16h)							
2	Tracks Per Zone (MSB)							
3	Tracks Per Zone (LSB)							
4	Alternate Sectors Per Zone (MSB)							
5	Alternate Sectors Per Zone (LSB)							
6	Alternate Tracks Per Zone (MSB)							
7	Alternate Tracks Per Zone (LSB)							
8	Alternate Tracks Per Volume (MSB)							
9	Alternate Tracks Per Volume (LSB)							
10	Sectors Per Track (MSB)							
11	Sectors Per Track (LSB)							
12	Data Bytes per Physical Sector (MSB)							
13	Data Bytes per Physical Sector (LSB)							
14	Interleave (MSB)							
15	Interleave (LSB)							
16	Track Skew (MSB)							
17	Track Skew (LSB)							
18	Cylinder Skew (MSB)							
19	Cylinder Skew (LSB)							
20	SSEC	HSEC	RMB	SURF	Reserved (Zeros)			
21	Reserved (Zeros)							
22	Reserved (Zeros)							
23	Reserved (Zeros)							

Table 7-25
Page 3 - Direct Access Device Format Parameters

Page Code
This page has a page code of 03h, indicating that the following parameters pertain to error recovery.

Page Length
The page length field specifies the number of bytes to follow after this field. This is equal to the total page length minus two.

Tracks Per Zone
The tracks per zone field specifies the number of tracks per zone. The drive supports 15 tracks per zone.

Alternate Sectors Per Zone
The alternate sectors per zone field specifies the number of alternate sectors per zone to allocate during formatting. The drive supports six alternate sectors per cylinder.

Alternate Tracks Per Zone
The alternate tracks per zone field is always set to 0000h. This feature is not supported.

Alternate Tracks Per Volume
The alternate tracks per volume field specifies the number of alternate tracks allocated for bad sectors. (A sector is mapped onto the alternate tracks by the FORMAT UNIT or REASSIGN BLOCK commands when reallocation occurs in a zone whose alternate sectors have been exhausted). The drive supports 15 alternate tracks per volume. This field is not changeable.

Sectors Per Track
The sectors per track field specifies the number of physical sectors per track and is zone dependent. Therefore, this field is not changeable.

Bytes Per Physical Sector
The bytes per physical sector field specifies the number of bytes per physical sector. The MXT–1240S is shipped from the factory formatted with a default sector size of 512 bytes. Various other sector sizes are also supported.

Interleave Value
The interleave value field returns the interleave value specified when the drive was formatted. It is always set to one (1:1 ratio) for best drive performance.

Track Skew
The track skew field specifies the number of physical sectors between the last logical block of one track and the first logical block of the next sequential track of the same cylinder. This field's value is changed for different data zones for best drive performance. This field is not changeable.

Cylinder Skew
The cylinder skew factor field specifies the number of physical sectors between the last logical block of one cylinder and the first logical block on the next sequential cylinder. This value is optimized for different data zones.

SSEC
The soft sector format (SSEC) bit is always set to zero. This feature is not supported.

HSEC
The hard sector format (HSEC) bit is set to one indicating that the drive uses hard sector formatting.

RMB
The removable media (RMB) bit is always set to zero. This feature is not supported.

SURF
The surface (SURF) bit is always set to zero. This feature is not supported.

7.4.6 Page 4 - Rigid Disk Drive Geometry Parameters

This section specifies the format of the Rigid Disk Drive Geometry page.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Resrvd (Zeros)		Page Code (04h)					
1	Page Length (In Bytes) (16h)							
2	(MSB) Maximum Number of Cylinders							
3								
4								(LSB)
5	Maximum Number of Heads							
6	(MSB) Starting Cylinder - Write Precompensation							
7								
8								(LSB)
9	(MSB) Starting Cylinder - Reduced Write Current							
10								
11								(LSB)
12	(MSB) Drive Step Rate							
13								(LSB)
14	(MSB) Landing Zone Cylinder							
15								
16								(LSB)
17	Reserved (Zeros)							RPL
18	Rotational Offset							
19	Reserved (Zeros)							
20	(MSB) Medium Rotation Rate							
21								(LSB)
22	Reserved (Zeros)							
23								

Table 7-26
Page 4 - Rigid Disk Drive Geometry Parameters

Page Code
This page has a page code of 04h indicating that the following parameters pertain to error recovery.

Page Length
The page length field specifies the number of bytes to follow after this field. This is equal to the total page length minus two.

Maximum Number of Cylinders
The maximum number of cylinders field specifies the maximum logical number of cylinders that are accessible by the user. This value already takes into account the reserved cylinders for the alternate tracks per volume; defect management and any other reserved tracks that the drive may be using. The most significant bytes (bytes two and three) must be set to 0000h.

Maximum Number of Heads
The maximum number of heads field must be set to the number of data heads found in the MXT-1240S (15).

Starting Cylinder - Write Precompensation
The starting cylinder - write precompensation field is always set to 000000h. This feature is not supported.

Starting Cylinder - Reduced Write Current
The starting cylinder - reduced write current field is always set to 000000h. This feature is not supported.

Drive Step Rate
The drive step rate field is always set to 0000h. This feature is not supported.

Landing Zone Cylinder
The landing zone cylinder field is always set to 000000h. This feature is not supported.

RPL
The rotational position locking (RPL) field is used for spindle synchronization. 00b disables synchronization. 01b indicates that the drive is a slave. 10b indicates that the drive is a master. 11b indicates that the drive is a master controller (not supported).

Rotational Offset
The rotational offset field indicates the amount of rotational skew the drive uses when synchronized. 00h indicates that rotational offset is not used.

Medium Rotation Rate

The medium rotation rate field indicates the speed at which the medium rotates. The unit of measure is rotations per minute (e.g., 6300 rpm).

7.4.7 Page 8 - Caching Parameters

This section describes the caching parameters page.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	PS	Resrvd	Page Code (08h)					
1	Page Length (0Ah)							
2	Reserved					WCE	MF	RCD
3	Demand Read Retention Priority				Write Retention Priority			
4	(MSB) Disable Pre-fetch Transfer Length							
5								(LSB)
6	(MSB) Minimum Prefetch							
7								(LSB)
8	(MSB) Maximum Prefetch							
9								(LSB)
10	(MSB) Maximum Prefetch Ceiling							
11								(LSB)

Table 7-27
Page 8 - Caching Parameters Parameters

Page Code
This page has a page code of 08h indicating that the following parameters pertain to caching.

Page Length
The page length field specifies the number of bytes to follow after this field. This is equal to the total page length minus two.

WCE

A write cache enable (WCE) bit of one will cause the drive to be in a write cache mode and return a GOOD status immediately following a WRITE command.

A WCE bit of zero will prevent the drive from entering the write cache mode and will return a GOOD status after all data is successfully written onto the medium.

While in the write cache mode, data received from the host will first be written to RAM and then copied from RAM to the disk. This enables the host to send many write commands to the drive without waiting for the previous commands to write their data to the disk.

The write cache will be aborted if: a WRITE command containing an LBA that's not in sequential order (with the previous command) is received; if the write buffer is empty; if the command is sent from a different initiator; if the command is not a WRITE command or; if an error occurs. When aborted, except the error condition, the data already in RAM will be written before another command is executed.

The write cache can be temporarily disabled by using the write extended (2Ah) command and setting the FUA bit to one.

MF

The multiplication factor (MF) bit is non-changeable and is set to zero.

RCD

A read cache disable (RCD) bit of zero instructs the drive to return data during a READ command, from either the cache or the media.

A RCD bit of one disables the cache and causes any READ command to return data from the media only.

Read Retention Priority

The read retention priority field enables or disables the anticipatory prefetching of data into the cache that has not been requested. A value of 0Fh enables prefetching. A value of 01h disables the prefetching.

Write Retention Priority

The write retention priority field is always set to 0001h. Data that is written into buffer memory will be retained until another WRITE, WRITE LONG or WRITE AND VERIFY command is sent.

Disable Prefetch Transfer Length

The disable prefetch transfer length field is always set to 0000h. After the requested data is written into the buffer, the drive will prefetch data until the buffer is full.

Minimum Prefetch
The minimum prefetch field is always set to 0000h. After the requested data is written into the buffer, the drive will prefetch data until the buffer is full.

Maximum Prefetch
The maximum prefetch field is always set to 0000h. After the requested data is written into the buffer, the drive will prefetch data until the buffer is full.

Maximum Prefetch Ceiling
The maximum prefetch ceiling field is always set to 0000h. After the requested data is written into the buffer, the drive will prefetch data until the buffer is full.

7.4.8 Error Conditions

If any field that is not used or supported by the drive is set to one, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN PARAMETER LIST (05h/26h).

If the medium type is not set to zero, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN PARAMETER LIST (05h/26h).

If a block descriptor length other than 00h or 08h is specified, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN PARAMETER LIST (05h/26h).

If the density code is set to 01h, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN PARAMETER LIST (05h/26h).

If the number of bytes per physical sector is less than 512 or greater than 1,024, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN PARAMETER LIST (05h/26h).

If the track skew parameter exceeds the sectors per track of the inner-most zone, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN PARAMETER LIST (05h/26h).

If the tracks per zone field is set to 0000h, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN PARAMETER LIST (05h/26h).

If the alternate sectors per zone field value is not within the supported range, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN PARAMETER LIST (05h/26h).

If the initiator specifies an invalid mode in the error recovery bits, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN PARAMETER LIST (05h/26h).

In the rigid disk drive geometry parameters page, if the drive receives a value in the maximum number of heads field that is greater than the actual maximum number of heads, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN PARAMETER LIST (05h/26h).

If the page length byte in each page header does not match the page length, as specified in this document and returned by the command, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN PARAMETER LIST (05h/26h).

7.4.9 Page 0Ah - Control Mode Page

BYTE \ BIT	7	6	5	4	3	2	1	0
0	PS	Rsrv	Page Code (0Ah)					
1	Page Length (06h)							
2	Reserved							RLEC
3	Queue Algorithm Modifier				Reserved		QErr	DQue
4	EECA	Reserved				RAENP	UAAENP	EAENP
5	Reserved							
6	Ready AEN Hold-Off Period							
7								

Table 7-28
Control Mode Page

The control mode page, Table 7•28, provides control over several SCSI-2 features which are applicable to all device types such as tagged queuing, extended contingent allegiance, asynchronous event notification, and error logging.

RLEC

The drive does not currently support the RLEC bit. This bit must be set to zero.

Queue Algorithm Modifier

The queue algorithm modifier field, Table 7•29, specifies restrictions on the algorithm used for re-ordering commands that are tagged with the SIMPLE QUEUE TAG message.

VALUE	DEFINITION
0h	Restricted Re-ordering
1h	Unrestricted Re-ordering Allowed
2h - 7h	Reserved
8h - Fh	Vendor Specific

Table 7•29
Queue Algorithms Modifier

A value of zero in the field specifies that the drive will order the actual execution sequence of the queued commands from each initiator such that data integrity is maintained for that initiator. This means that, if the transmission of new commands was halted at any time, the final value of all data available on the medium shall have exactly the same value as it would have if the commands had been executed in the same received sequence without tagged queuing. The restricted reordering value will be the default value.

A value of one in this field specifies that the target may re-order the actual execution sequence of the queued commands in any manner it selects. Any data integrity exposures related to command sequence order are explicitly handled by the initiator through the selection of appropriate commands and queue tag messages.

QErr

A queue error management (QErr) bit of zero specifies that those commands still queued after the drive has entered the contingent allegiance or extended contingent allegiance conditions will continue execution in a normal manner when that condition has terminated. A QErr bit of one specifies that those commands still queued after the drive has entered the contingent allegiance of extended contingent allegiance conditions will be

aborted when that condition has terminated. A UNIT ATTENTION condition will be generated for each initiator which had commands in the queue except the initiator that received the original INITIATE RECOVERY message. When reporting the UNIT ATTENTION condition, the drive will set the additional sense code to TAGGED COMMANDS CLEARED BY ANOTHER INITIATOR.

DQue

A disable queuing (DQue) bit of zero specifies that tagged queuing will be enabled if the drive supports tagged queuing. A DQue bit of one specifies that tagged queuing will be disabled. Any queued commands for the I_T_x nexus will be aborted. Any subsequent queue tag message received will be rejected with a MESSAGE REJECT message and the I/O process will be executed as an untagged command.

EECA

An enabled extended contingent allegiance (EECA) bit of one specifies that extended contingent allegiance is enabled. An EECA bit of zero specifies that extended contingent allegiance is disabled.

RAENP, UAAENP, and EAENP

The RAENP, UAAENP, and EAENP bits enable specific events to be reported via the asynchronous event notification protocol. When all three bits are zero, the drive will not create asynchronous event notifications.

A ready AEN permission (RAENP) bit of one specifies that the drive may issue an asynchronous event notification upon completing its initialization sequence instead of generating a UNIT ATTENTION condition. An RAENP bit of zero specifies that the drive will not issue an asynchronous event notification upon completing its initialization sequence.

NOTE: *If the drive's default value for the RAENP bit is one and it does not implement saved parameters or include a hardware switch, then it may not be possible to disable the initialization sequence asynchronous event notification.*

A UNIT ATTENTION AEN permission (UAAENP) bit of one specifies that the drive may issue an asynchronous event notification instead of creating a UNIT ATTENTION condition upon detecting an event which would cause a UNIT ATTENTION condition (other than upon completing an initialization sequence). A UAAENP bit of zero specifies that the drive will not issue an asynchronous event notification instead of creating a UNIT ATTENTION condition.

An error AEN permission (EAENP) bit of one specifies that the drive may issue an asynchronous vent notification upon detecting a DEFERRED ERROR condition instead of waiting to report the deferred error on the next command. An EAENP bit of zero specifies that the drive will not report DEFERRED ERROR conditions via an asynchronous event notification.

Ready AEN Hold-Off Period

The ready AEN holdoff period field specifies the minimum time in milliseconds after the drive starts its initialization sequence that it will delay before attempting to issue an asynchronous event notification. This value may be rounded up.

7.4.10 Drive Control Page

The drive control page, Table 7•30, defines the parameters that affect the firmware configuration and allows customization for specific functions.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	PS	Rsrv	Page Code (32h)					
1	Page Length (06h)							
2	Rsrv	CPE	DQ	ESDTR	FDPE	CR	DUA	START
3	Reserved		SSID	Reserved		SCSIADDR		
4	Reserved							
5	Reselection Attempts							
6	(MSB) Reserved							
7	Reserved (LSB)							

Table 7•30
Drive Control Page

PS

The parameters savable (PS) bit is only used with the MODE SENSE command. This bit is reserved with the MODE SELECT command. A PS bit of one indicates that the controller is capable of saving the page in a non-volatile vendor-specific location.

CPE

A continuous pre-fetch enable (CPE) bit of zero specifies that the controller will not replace data that has been transferred to the initiator with read-ahead data. A CPE bit of one specifies that the controller replace data that has been transferred to the initiator with read-ahead data.

DQ

A disable queueing (DQ) bit of zero specifies that the controller may queue I/O processes. A DQ bit of one specifies that the controller not queue I/O processes, either tagged or untagged. If the DQ bit is one, and an I/O process is in progress, the controller will respond to all other initiators with BUSY status.

ESDTR

An enable synchronous data transfer request (ESDTR) bit of zero specifies that the controller will comply with the SCSI-2 standard with regard to synchronous data transfer request messages. An ESDTR bit of one specifies that the controller will not initiate a synchronous data transfer request message following a POWER-ON or RESET condition.

FDPE

A format data pattern enable (FDPE) bit of zero specifies that the controller will comply with the SCSI-2 standard with regard to format data pattern field. A FDPE bit of one specifies that the controller will not use 00h as the format pattern.

CR

A contingent reservation (CR) bit of zero specifies that the controller will comply with the SCSI-2 standard with regard to contingent reservations. A CR bit of one specifies that the controller will generate a reservation for the initiator whenever CHECK CONDITION status is returned to it. The reservation is generated and cleared in the same manner as if a RESERVE command had been received.

DUA

A disable unit attention (DUA) bit of zero specifies that the controller will comply with the SCSI-2 standard with regard to UNIT ATTENTION conditions. A DUA bit of one specifies that the controller will not generate a UNIT ATTENTION condition following a POWER-ON or RESET condition.

Start

A start (START) bit of zero specifies that the controller will achieve READY condition in accordance with the hardware configuration switches and jumpers. A START bit of one specifies that the controller will ignore the hardware configuration and achieve the READY condition following power-on.

SSID

A software selectable SCSI ID (SSID) bit of zero specifies that the controller will use the SCSI ID in accordance with the hardware configuration switches or jumpers. An SSID bit of one specifies that the controller will use the value in the SCSIADDR field as its SCSI ID.

SCSIADDR

The SCSIADDR field specifies the SCSI ID that the controller will use if the SSID bit is set.

Reselection Attempts

The reselection attempts field specifies the number of attempts to reselect the initiator that the controller will perform. A value of zero indicates that reselection attempts will continue until a POWER-OFF or a RESET condition occurs. If the value is non-zero and reselection is not successful before the count is exhausted, the controller will abort the command and set the sense information to ABORTED COMMAND: RESELECT FAILURE.

7.4.11 Read-Ahead Control Page

The read-ahead control page, Table 7•31, defines the parameters that affect the use of the read-ahead buffer.

BIT / BYTE	7	6	5	4	3	2	1	0
0	PS	Rsrv	Page Code (38h)					
1	Page Length (0Eh)							
2	Reserved				CE	Number of Segments		
3	Pre-Fetch Threshold							
4	Maximum Pre-Fetch							
5	(MSB) Reserved							
6 - 15	Reserved (LSB)							

Table 7•31
Read-Ahead Control Page

PS

The parameters savable (PS) bit is only used with the MODE SENSE command. This bit is reserved with the MODE SELECT command. A PS bit of one indicates that the controller is capable of saving the page in a non-volatile vendor-specific location.

CE

A cache enable (CE) bit of zero specifies that the controller will not perform read-ahead operations. A CE bit of one specifies that the controller will perform read-ahead operations in accordance with the mode parameters governing these operations.

Number of Segments

The number of segments field specifies the number of segments that the data buffer be divided into. A value of zero indicates that the controller will use the entire buffer as a segment. A value of four specifies that the data buffer be divided into four segments.

NOTE: *Only a value of zero or four is supported in the number of segments field.*

Pre-Fetch Threshold

The pre-fetch threshold field specifies the largest transfer length for which a read-ahead operation will be performed.

7.5 MODE SELECT (10) - 55h

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (55h)							
1	Logical Unit Number			PF	Reserved			SP
2	Reserved							
3								
4								
5								
6								
7	(MSB) Parameter List Length							
8								(LSB)
9	Control							

Table 7•32
MODE SELECT (10) Command

The MODE SELECT (10) command (Table 7•32) provides a means for the initiator to specify the medium, logical unit, or peripheral device parameters to the target. See the MODE SELECT (6) command for a description of the fields in this command. Initiators should issue MODE SENSE prior to MODE SELECT to determine supported pages, page lengths, and other parameters.

7.6 MODE SENSE - 1Ah

The MODE SENSE command provides a way for the drive to report various parameters to an initiator. These parameters are separated into categories called pages. MODE SENSE is complementary to MODE SELECT.

BIT / BYTE	7	6	5	4	3	2	1	0
0	Operation Code (1Ah)							
1	LUN				Reserved (Zeros)			
2	Page Control Field		Page Code					
3	Reserved (Zeros)							
4	Allocation Length							
5	Control Byte							

Table 7-33
MODE SENSE CDB

Page Control
The Page Control field specifies which type of page data is to be returned to the initiator. The four types are listed below:

1) Default values are stored by the disk drive.

2) Saved values are parameters saved on the medium during a FORMAT UNIT or MODE SELECT command.

3) Current values are the parameters used by the drive during normal drive operation. When first powered up or reset, the current values are equal to the default values. Once the media can be accessed, the saved values are read and they become the current value. When the spinup procedure is complete, the MODE SELECT command can modify the current values. The current values are written to the saved values during a FORMAT UNIT command.

4) Changeable values are those parameters that can be changed by the MODE SELECT command.

BIT 7	BIT 6	PAGE CONTROL FIELD
0	0	Report Current Values. If the page code is 3Fh, the drive returns all the pages it implements, with the fields and bits set to their current values. If the page code is not 3Fh and the drive implements the page specified, the drive returns the page with the fields and bits set to their current values. The drive returns the length specified in the Page Length field for each page.
0	1	Report Changeable Values. If the page code is 3Fh, the drive returns all the pages it implements, with the fields and bits that can be changed set to one. Fields and bits that are not changeable are set to zero. If the page code is not 3Fh and the drive implements the page specified, the drive returns the page with the fields and bits that can be changed set to one. Fields and bits that are not changeable are set to zero. The drive returns the length specified in the page length field for each page.
1	0	Report Default Values. If the page code is 3Fh, the drive returns all the pages it implements with the fields and bits set to the drive's default values. If the page code is not 3Fh and the drive implements the page specified, the drive returns the page with the fields and bits set to the drive's default values. Any fields or bits not supported by the drive are set to zero. The drive returns the length specified in the page length field for each page.
1	1	Report Saved Values. If the page code is 3Fh, the drive returns all the pages it implements with the fields and bits set to their saved values. If the page code is not 3Fh and the drive implements the page specified, it returns the page with the fields and bits set to their saved values. Any fields or bits not supported by the drive are set to zero. The drive returns the length specified in the page length field for each page.

Table 7•34
Page Control Fields

Page Code

The page code field specifies the page(s) that will be returned to the initiator. Table 7•35 gives a brief description of these pages.

PAGE CODE	PAGE DESCRIPTION
00h	Vendor Unique
01h	Error Recovery Parameters
02h	Disconnect/Reconnect Control Parameters
03h	Direct Access Device Format Parameters
04h	Rigid Disk Drive Geometry Parameters
08h	Caching Parameters
0Ah	Control Mode Page
32h	Drive Control Page
38h	Read-Ahead Control Page
3Fh	Reserved for use in MODE SENSE Command

Table 7-35
MODE SENSE Page Codes

Allocation Length
The allocation length field specifies the number of bytes the initiator has allocated for the MODE SENSE data. If the allocation length is less than the amount available, then only a portion of parameters (up to the number indicated) will be sent. A value of 00h is not considered an error.

7.6.1 Parameter List Format

The MODE SENSE parameter list is sent to the initiator during the DATA IN phase. This list consists of a parameter list header, one block descriptor, and one to four page descriptors. The entire length of the parameter list is specified in the MODE SENSE CDB.

The parameter list header is four bytes long and specifies the medium type and the length of the block descriptor.

The block descriptor is eight bytes long and specifies the medium density, the number of blocks, and the block length.

The page descriptors contain various parameters separated into pages. These parameters specify various options and features which the initiator may change with the MODE SELECT command. The type of page data returned is specified with the page code and page control field (PCF) in the CDB.

7.6.2 Parameter List Header Format

The MODE SENSE parameter list header is the first part of the parameter list. Appended to this header will be the parameter list block descriptor.

BIT / BYTE	7	6	5	4	3	2	1	0
0	Sense Data Length							
1	Medium Type							
2	WP	Reserved (Zeros)						
3	Block Descriptor Length							

Table 7-36
Parameter List Header

Sense Data Length
The sense data length field specifies the length of the data to be returned in the DATA IN phase. It does not include the data length field itself.

Medium Type
The medium type field indicates the drive's medium type. The drive always returns a medium type of 00h.

WP
The write protect (WP) bit is not supported by the drive and must be set to zero.

Block Length
The block length field specifies the length of the block descriptor and is set to 08h.

7.6.3 Parameter List Block Descriptor Format

The MODE SENSE parameter list block descriptor immediately follows the parameter list header.

MODE SENSE - 1Ah

BIT / BYTE	7	6	5	4	3	2	1	0
0	Density Code (00h)							
1	Number of Blocks (MSB) (00h)							
2	Number of Blocks (00h)							
3	Number of Blocks (LSB) (00h)							
4	Reserved (Zeros)							
5	Block Length (MSB)							
6	Block Length							
7	Block Length (LSB)							

Table 7-37
Parameter List Block Descriptor Format

Density Code
The density code field is set to 00h, indicating that the default of only one density is supported.

Number of Blocks
The number of blocks field specifies the number of logical blocks on the medium to which the density code and block length fields apply. A value of 000000h indicates that all of the remaining logical blocks of the logical unit have the medium characteristics specified.

Block Length
The block length field specifies the number of bytes in each logical block.

7.6.4 Page 1 - Error Recovery Parameters

For a description of the MODE SENSE error recovery parameters, see section 7.4.3.4.

7.6.5 Page 2 - Disconnect/Reconnect Parameters

This section specifies the format of the disconnect/reconnect parameter page.

BIT / BYTE	7	6	5	4	3	2	1	0
0	PS	Rsrv	Page Code (02h)					
1	Page Length (In Bytes) (0Ah)							
2	Buffer Full Ratio							
3	Buffer Empty Ratio							
4	Bus Inactivity Limit (MSB)							
5	Bus Inactivity Limit (LSB)							
6	Disconnect Time Limit (MSB)							
7	Disconnect Time Limit (LSB)							
8	Connect Time Limit (MSB)							
9	Connect Time Limit (LSB)							
10	Reserved							
11	Reserved							

Table 7-38
Page 2 - Disconnect/Reconnect Control Parameters

PS
The parameter savable (PS) bit is always set to one. This feature is not supported.

Page Code
This page has a Page Code of 02h, indicating that the following parameters pertain to error recovery.

Page Length
The page length field specifies the number of bytes to follow after this field. This is equal to the total page length minus two.

Buffer Full Ratio and Buffer Empty Ratio
For a description of the buffer full ratio and buffer empty ratio fields, see section 7.4.4.

Bus Inactivity Limit
The bus inactivity limit field specifies the length of time (in 100 microsecond increments) that the drive is allowed to stay connected to the SCSI bus without any bus activity. If the initiator requests the changeable values, this field is set to 0000h.

Disconnect Time Limit
The disconnect time limit field is always set to 0000h. This feature is not supported.

Connect Time Limit
The connect time limit field is always set to 0000h. This feature is not supported.

7.6.6 Page 3 - Direct Access Device Format Parameters

The table below shows the bits, bytes, and fields in the direct access device format parameters page. For a description of these bits, bytes, and fields, see section 7.4.5.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	PS	Rsrv	Page Code (03h)					
1	Page Length (In Bytes) (16h)							
2	Tracks Per Zone (MSB)							
3	Tracks Per Zone (LSB)							
4	Alternate Sectors Per Zone (MSB)							
5	Alternate Sectors Per Zone (LSB)							
6	Alternate Tracks Per Zone (MSB)							
7	Alternate Tracks Per Zone (LSB)							
8	Alternate Tracks Per Volume (MSB)							
9	Alternate Tracks Per Volume (LSB)							
10	Sectors Per Track (MSB)							
11	Sectors Per Track (LSB)							
12	Data Bytes per Physical Sector (MSB)							
13	Data Bytes per Physical Sector (LSB)							
14	Interleave (MSB)							
15	Interleave (LSB)							
16	Track Skew (MSB)							
17	Track Skew (LSB)							
18	Cylinder Skew (MSB)							
19	Cylinder Skew (LSB)							
20	SSEC	HSEC	RMB	SURF	INS	Reserved (Zeros)		
21	Reserved (Zeros)							
22	Reserved (Zeros)							
23	Reserved (Zeros)							

Table 7-39
Page 3 - Direct-Access Device Format Parameters

7.6.7 Page 4 - Rigid Disk Drive Geometry Parameters

This section specifies the format of the rigid disk drive geometry page.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	PS	Resrvd	Page Code (04h)					
1	Page Length (In Bytes) (16h)							
2	(MSB) Maximum Number of Cylinders							
3								
4								(LSB)
5	Maximum Number of Heads							
6	(MSB) Starting Cylinder - Write Precompensation							
7								
8								(LSB)
9	(MSB) Starting Cylinder - Reduced Write Current							
10								
11								(LSB)
12	(MSB) Drive Step Rate							
13								(LSB)
14	(MSB) Landing Zone Cylinder							
15								
16								(LSB)
17	Reserved (Zeros)						RPL	
18	Rotational Offset							
19	Reserved (Zeros)							
20	(MSB) Medium Rotation Rate							
21								(LSB)
22	Reserved (Zeros)							
23								

Table 7-40
Page 4 - Rigid Disk Drive Geometry Parameters

P S
The parameter savable (PS) bit is always set to one indicating that the drive saves the parameters supported in this page.

Page Code
This page has a page code of 04h indicating that the following parameters pertain to error recovery.

Page Length
The page length field specifies the number of bytes to follow after this field. This is equal to the total page length minus two.

Maximum Number Of Cylinders
The maximum number of cylinders field specifies the maximum logical number of cylinders that are accessible by the user. This value already takes into account the reserved cylinders for the alternate tracks per volume, defect management and any other reserved tracks that the drive may be using. The most significant bytes (bytes two and three) must be set to 0000h.

Maximum Number Of Heads
The maximum number of heads field must be set to the number of data heads found in the MXT-1240S (15).

Starting Cylinder - Write Precompensation
The starting cylinder - write precompensation field is always set to 000000h. This feature is not supported.

Starting Cylinder - Reduced Write Current
The starting cylinder - reduced write current field is always set to 000000h. This feature is not supported.

Drive Step Rate
The drive step rate field is always set to 0000h. This feature is not supported.

Landing Zone Cylinder
The landing zone cylinder field is always set to 000000h. This feature is not supported.

RPL
The rotational position locking (RPL) field is used for spindle synchronization. 00b disables synchronization. 01b indicates that the drive is a slave. 10b indicates that the drive is a master and 11b indicates that the drive is a master controller (not supported). See section 2.8 earlier in this manual, for a description of spindle synchronization.

Rotational Offset

The rotational offset field indicates the amount of rotational skew the drive uses when synchronized. 00h indicates that rotational offset is not used.

Medium Rotation Rate

The medium rotation rate field indicates the speed at which the medium rotates. The unit of measure is rotations per minute (e.g., 6300 rpm).

7.6.8 Page 8 - Caching Parameters

This section describes the caching parameters page.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	PS	Rsrv	Page Code (08h)					
1	Page Length (0Ah)							
2	Reserved					WCE	MF	RCD
3	Read Retention Priority				Write Retention Priority			
4	(MSB) Disable Pre-fetch Transfer Length							
5	(LSB)							
6	(MSB) Minimum Prefetch							
7	(LSB)							
8	(MSB) Maximum Prefetch							
9	(LSB)							
10	(MSB) Maximum Prefetch Ceiling							
11	(LSB)							

Table 7-41
Page 8 - Caching Parameters

P S

The parameter savable (PS) bit is always set to one indicating that the drive saves the parameters supported in this page.

Page Code

This page has a Page Code of 08h indicating that the following parameters pertain to caching.

Page Length
The page length field specifies the number of bytes to follow after this field. This is equal to the total page length minus two.

WCE
A write cache enable (WCE) bit of one will cause the drive to be in a write cache mode and return a GOOD status immediately following a WRITE command.

A WCE bit of zero will prevent the drive from entering the write cache mode and will return a GOOD status after all data is successfully written onto the medium.

While in the write cache mode, data received from the host will first be written to RAM and then copied from RAM to the disk. This enables the host to send many write commands to the drive without waiting for the previous commands to write their data to the disk.

The write cache will be aborted if: a WRITE command containing an LBA that is not in sequential order (with the previous command) is received; if the write buffer is empty; if the command is sent from a different initiator;if the command is not a WRITE command or; if an error occurs. When aborted, except the error condition, the data already in RAM will be written before another command is executed.

The write cache can be temporarily disabled by using the write extended (2Ah) command and setting the FUA bit to one.

MF
The multiplication factor (MF) bit is non-changeable and set to zero.

RCD
A read cache disable (RCD) bit of one disables the cache and causes any READ command to return data from the media only.

An RCD bit of zero instructs the drive to return data during a READ command from either the cache or the media.

Read Retention Priority
The read retention priority field enables or disables the anticipatory prefetching of data into the cache that has not been requested. A value of 0Fh enables prefetching. A value of 01h disables prefetching.

Write Retention Priority
The write retention priority field is always set to 0001h. Data that is written into buffer memory will be retained until another WRITE, WRITE LONG or WRITE AND VERIFY command is sent.

Disable Prefetch Transfer Length
The disable prefetch transfer length field is always set to 0000h. After the requested data is written into the buffer, the drive will prefetch data until the buffer is full.

Minimum Prefetch
The minimum prefetch field is always set to 0000h. After the requested data is written into the buffer, the drive will prefetch data until the buffer is full.

Maximum Prefetch
The maximum prefetch field is always set to 0000h. After the requested data is written into the buffer, the drive will prefetch data until the buffer is full.

Maximum Prefetch Ceiling
The maximum prefetch ceiling field is always set to 0000h. After the requested data is written into the buffer, the drive will prefetch data until the buffer is full.

7.6.9 Error Conditions

If the page code is not valid, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN CDB (05h/24h).

If the drive cannot read the default information, it terminates the command with a CHECK CONDITION status. The sense data is set to NOT READY/ILLEGAL FUNCTION FOR DEVICE TYPE (02h/22h).

7.6.10 Drive Control Page

The drive control page, Table 7•42, defines the parameters that affect the firmware configuration and allows customization for specific functions.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	PS	Rsrv	Page Code (32h)					
1	Page Length (06h)							
2	Rsrv	CPE	DQ	ESDTR	FDPE	CR	DUA	START
3	Reserved		SSID	Reserved		SCSIADDR		
4	Reserved							
5	Reselection Attempts							
6	(MSB) Reserved							
7	Reserved (LSB)							

Table 7-42
Drive Control Page

PS

The parameters savable (PS) bit is only used with the MODE SENSE command. This bit is reserved with the MODE SELECT command. A PS bit of one indicates that the controller is capable of saving the page in a non-volatile vendor-specific location.

CPE

A continuous pre-fetch enable (CPE) bit of zero specifies that the controller will not replace data that has been transferred to the initiator with read-ahead data. A CPE bit of one specifies that the controller replace data that has been transferred to the initiator with read-ahead data.

DQ

A disable queueing (DQ) bit of zero specifies that the controller may queue I/O processes. A DQ bit of one specifies that the controller not queue I/O processes, either tagged or untagged. If the DQ bit is one, and an I/O process is in progress, the controller will respond to all other initiators with BUSY status.

ESDTR

An enable synchronous data transfer request (ESDTR) bit of zero specifies that the controller will comply with the SCSI-2 standard with regard to synchronous data transfer request messages. An ESDTR bit of one specifies that the controller will not initiate a synchronous data transfer request message following a POWER-ON or RESET condition.

FDPE

A format data pattern enable (FDPE) bit of zero specifies that the controller will comply with the SCSI-2 standard with regard to format data pattern field. A FDPE bit of one specifies that the controller will not use 00h as the format pattern.

CR

A contingent reservation (CR) bit of zero specifies that the controller will comply with the SCSI-2 standard with regard to contingent reservations. A CR bit of one specifies that the controller will generate a reservation for the initiator whenever CHECK CONDITION status is returned to it. The reservation is generated and cleared in the same manner as if a RESERVE command had been received.

DUA

A disable unit attention (DUA) bit of zero specifies that the controller will comply with the SCSI-2 standard with regard to UNIT ATTENTION conditions. A DUA bit of one specifies that the controller will not generate a UNIT ATTENTION condition following a POWER-ON or RESET condition.

Start

A start (START) bit of zero specifies that the controller will achieve READY condition in accordance with the hardware configuration switches and jumpers. A START bit of one specifies that the controller will ignore the hardware configuration and achieve the READY condition following power-on.

SSID

A software selectable SCSI ID (SSID) bit of zero specifies that the controller will use the SCSI ID in accordance with the hardware configuration switches or jumpers. An SSID bit of one specifies that the controller will use the value in the SCSIADDR field as its SCSI ID.

SCSIADDR

The SCSIADDR field specifies the SCSI ID that the controller will use if the SSID bit is set.

Reselection Attempts

The reselection attempts field specifies the number of attempts to reselect the initiator that the controller will perform. A value of zero indicates that reselection attempts will continue until a POWER-OFF or a RESET condition occurs. If the value is non-zero and reselection is not successful before the count is exhausted, the controller will abort the command and set the sense information to ABORTED COMMAND: RESELECT FAILURE.

7.6.11 Read-Ahead Control Page

The read-ahead control page, Table 7•43, defines the parameters that affect the use of the read-ahead buffer.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	PS	Rsrv	Page Code (38h)					
1	Page Length (0Eh)							
2	Reserved			CE	Number of Segments			
3	Pre-Fetch Threshold							
4	Maximum Pre-Fetch							
5	(MSB) Reserved							
6 - 15	Reserved (LSB)							

Table 7•43
Read-Ahead Control Page

PS
The parameters savable (PS) bit is only used with the MODE SENSE command. This bit is reserved with the MODE SELECT command. A PS bit of one indicates that the controller is capable of saving the page in a non-volatile vendor-specific location.

CE
A cache enable (CE) bit of zero specifies that the controller will not perform read-ahead operations. A CE bit of one specifies that the controller will perform read-ahead operations in accordance with the mode parameters governing these operations.

Number of Segments
The number of segments field specifies the number of segments that the data buffer be divided into. A value of zero indicates that the controller will use the entire buffer as a segment. A value of four specifies that the data buffer be divided into four segments.

NOTE: *Only a value of zero or four is supported in the number of segments field.*

Pre-Fetch Threshold

The pre-fetch threshold field specifies the largest transfer length for which a read-ahead operation will be performed.

7.7 MODE SENSE (10) - 5Ah

The MODE SENSE (10) command , Table 7•44 provides a means for the drive to report parameters to the initiator. It is a complementary command to the MODE SELECT (10) command. If the MODE SELECT (10) command is implemented, the MODE SENSE (10) command will be implemented. See the MODE SENSE (6) command for a description of the fields in this command.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (5Ah)							
1	Logical Unit Number			Rsrv	DBD	Reserved		
2	PC		Page Code					
3	Reserved							
4								
5								
6								
7	(MSB) Allocation Length							
8	(LSB)							
9	Control							

Table 7•44
MODE SENSE (10) Command

7.8 READ - 08h

The READ command requests that the drive transfer data from the logical unit to the initiator. It causes the drive to perform an implied SEEK to the cylinder, head, and sector, which corresponds to the specified LBA.

7.8.1 Command Parameters

The READ CDB is formatted as shown in Table 7•45.

BIT / BYTE	7	6	5	4	3	2	1	0
0	Operations Code (08h)							
1	LUN			Logical Block Address (MSB)				
2	Logical Block Address							
3	Logical Block Address (LSB)							
4	Transfer Length							
5	Control Byte							

Table 7•45
READ CDB

Logical Block Address
The logical block address (LBA) field specifies the logical block at which the read operation begins.

Transfer Length
The transfer length field specifies the number of contiguous logical blocks of data to be transferred. A transfer length of 00h indicates that 256 logical blocks will be transferred.

7.8.2 Error Conditions

If the LBA is invalid, and/or if the LBA plus the transfer length results in an invalid block address, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/ILLEGAL BLOCK ADDRESS (05h/21h). No data is transferred if this condition occurs.

***NOTE**: When using the 6 byte READ Command, the entire capacity of the MXT–1240S is not addressable at 512 bytes per sector. Extended READs and WRITEs are required.*

7.9 READ BUFFER - 3Ch

The READ BUFFER command is used in conjunction with the WRITE BUFFER command as a diagnostic function for testing the drive's data buffer memory and the SCSI bus integrity. The medium is not accessed by this command.

7.9.1 Command Parameters

The READ BUFFER CDB is formatted as shown in Table 7•46.

BIT / BYTE	7	6	5	4	3	2	1	0
0	Operation Code (3Ch)							
1	LUN (Zero)			Reserved (Zeros)		Mode		
2	Buffer ID							
3	Buffer Offset							
4	Buffer Offset							
5	Buffer Offset							
6	Allocation Length (MSB)							
7	Allocation Length							
8	Allocation Length (LSB)							
9	Control Byte							

Table 7•46
READ BUFFER CDB

Mode
The mode field may be set to either 000b, 010b or 011b. When this field is set to 000b the drive will respond by sending the four byte header and data. When it is set to 010b

the drive will only send data. When it is set to 011b the drive sends only the four byte header, regardless of the allocation length.

Buffer ID
The buffer ID field should be set to 00h. This feature is not supported.

Buffer Offset
The buffer offset field contains the byte offset within the specified buffers from which data will be transferred.

Allocation Length
The allocation length field specifies the number of bytes the initiator has allocated for the returned buffer data. Up to 65,535 bytes (including the 4-byte header) may be requested by the initiator. An allocation length of 000000h (not considered an error) causes no data to be sent.

If the number of bytes requested exceeds the drive's buffer size, the drive will transfer the entire buffer and terminate the command without an error. Under this condition, the initiator must check the value in the available length field in the READ BUFFER header to determine the number of bytes returned. See Table 7•47.

7.9.2 Command Usage

It is recommended that the initiator issue the RESERVE UNIT command before it issues the READ BUFFER command to ensure that no other initiator sends data to the drive's data buffer. After the drive has completed the READ BUFFER command, the initiator should then issue a RELEASE UNIT command.

To determine the maximum amount of data that can be transferred with the READ BUFFER and WRITE BUFFER commands, the initiator can issue a READ BUFFER command with the allocation length set to four. This causes the drive to return only the READ BUFFER header. Bytes one through three of the header contain the maximum buffer size.

7.9.3 Data Format

The data returned from the READ BUFFER command during the DATA IN phase consists of a 4-byte header, immediately followed by the data bytes from the drive's data buffer. This header is formatted as shown in Table 7•47.

BIT / BYTE	7	6	5	4	3	2	1	0
0	Reserved (Zeros)							
1	Available Length (MSB)							
2	Available Length							
3	Available Length (LSB)							

Table 7-47
READ BUFFER Header

Available Length
The available length field specifies the maximum amount of memory available in the drive's data buffer. (This may or may not be the number of bytes actually transferred, depending on the allocation length specified in the CDB).

7.9.4 Error Conditions

If the data in the buffer has been modified since the last WRITE BUFFER command was issued, or if no WRITE BUFFER command has been issued since the last RESET condition, the READ BUFFER command is terminated with a CHECK CONDITION status. The sense data is set to MISCOMPARE/COMPARE ERROR (0Eh/1Dh). If the allocation length is set to 000004h or less, the drive does not return this error.

7.10 READ CAPACITY - 25h

The READ CAPACITY command is used to inform the initiator of the last full logical block on the drive. The READ CAPACITY command also helps to determine the amount of contiguous memory available in a given cylinder.

7.10.1 Command Parameters

The READ CAPACITY CDB is formatted as shown in Table 7•48.

BIT / BYTE	7	6	5	4	3	2	1	0
0	Operation Code (25h)							
1	LUN			Reserved (Zeros)				
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved (Zeros)							
7	Reserved (Zeros)							
8	Reserved (Zeros)							PMI
9	Control Byte							

Table 7•48
READ CAPACITY CDB

Logical Block Address
The logical block address (LBA) field specifies the block address to use when computing the last block before a substantial delay is encountered. The LBA should be set to zero if the PMI bit is zero.

PMI

A partial medium indicator (PMI) bit of one indicates that the information returned is for the last full logical block (from the block specified in the LBA field) that can be transferred before a substantial delay is encountered (that is, a cylinder boundary).

A PMI bit of zero indicates that the information returned is for the last logical block of the drive.

7.10.2 Data Format

The READ CAPACITY data is sent to the initiator during the DATA IN phase and formatted as shown in Table 7•49.

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

Table 7•49
READ CAPACITY Data Format

Logical Block Address

The logical block address (LBA) field specifies the last logical block on the unit (if the PMI bit is zero), or the last full logical block before a substantial delay is encountered (if the PMI bit is one).

Block Length

The block length field specifies the size of the logical block in bytes.

7.10.3 Error Conditions

If the PMI bit is one, and the LBA is invalid, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/ILLEGAL BLOCK ADDRESS (05h/21h).

If the PMI bit is zero and the LBA bit is one, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN CDB (05h/24h).

7.11 READ DEFECT LIST - 37h

The READ DEFECT LIST command requests that the drive transfer one or more of the defect lists, maintained by the drive to the initiator. The initiator may request the original Plist and/or the Glist.

7.11.1 Command Parameters

The READ DEFECT LIST CDB is formatted as shown in Table 7•50.

BIT / BYTE	7	6	5	4	3	2	1	0
0	Operation Code (37h)							
1	LUN			Reserved (Zeros)				
2	Reserved (Zeros)			Plist	Glist	Defect List Format		
3	Reserved (Zeros)							
4	Reserved (Zeros)							
5	Reserved (Zeros)							
6	Reserved (Zeros)							
7	Alocation Length (MSB)							
8	Allocation Length (LSB)							
9	Control Byte							

Table 7•50
READ DEFECT LIST CDB

Plist
A Plist bit of one specifies that the Plist will be returned by the drive during the DATA IN phase.

Glist

A Glist bit of one specifies that the Glist will be returned by the drive during the DATA IN phase. If the drive's Glist is empty, the four byte header with the defect length set to zero will be returned.

When both the Plist and Glist bits are set to one, the drive returns both lists. The drive merges the lists and sends the lists in ascending order. When both the Plist and Glist bits are set to zero, the drive returns only the defect list header.

Defect List Format

The defect list format field specifies the format of the returned defect list. Table 7•51 lists the types of formats supported by the drive.

DEFECT LIST FORMAT BITS			DESCRIPTION
2	1	0	
1	0	0	Bytes from Index Format. The initiator requests that the defect list be returned in bytes from index format.
1	1	0	MXT-1240S Format. The initiator requests that the defect list be returned in MXT-1240S format.
1	1	1	Reserved

Table 7•51
READ DEFECT LIST Defect List Formats

NOTE: *The block format is not supported.*

Allocation Length

The allocation length field specifies the number of bytes the initiator has allocated for the returned defect list. The drive terminates the DATA IN phase when the number of bytes transferred reaches the allocation length field value or when the entire list has been transferred, whichever is less.

7.11.2 Read Defect List Header

The READ DEFECT LIST list, shown in Table 7•52, contains a four-byte header followed by zero or more defect descriptors.

BIT	7	6	5	4	3	2	1	0
Defect List Header								
Defect Descriptor(s) (If Any)								
Defect Descriptor 0								
Defect Descriptor n								

Table 7•52
READ DEFECT LIST List

The defect descriptors are in ascending order. For determining ascending order, the cylinder number of a defect is considered the most significant part of the address and the defect bytes from index/physical sector is considered the least significant part of the address.

7.11.3 Bytes from Index Format

When the bytes from index format is specified in the defect list format (Read Defect List Header), the defect list is formatted as shown in Table 7•53.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Cylinder Number of Defect (MSB)							
1	Cylinder Number of Defect							
2	Cylinder Number of Defect (LSB)							
3	Head Number of Defect							
4	Defect Bytes from Index (MSB)							
5	Defect Bytes from Index							
6	Defect Bytes from Index							
7	Defect Bytes from Index (LSB)							

Table 7-53
Defect Descriptor(s), Bytes from Index Format

Cylinder Number of Defect
The cylinder number of defect field specifies the physical cylinder number which contains the defect.

Head Number of Defect
The head number of defect field specifies the head number which contains the defect.

Defect Bytes from Index
The defect bytes from index field specifies the number of bytes between the index and the defect on the specified track.

7.11.4 Error Conditions

If the preferred defect list format does not specify bytes from index or MXT-1240S format, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN CDB (05h/24h).

7.12 READ (EXTENDED) - 28h

The READ (EXTENDED) command requests that the drive transfer data from the logical unit to the initiator. It causes the drive to perform an implied SEEK to the cylinder, head, and sector which correspond to the specified LBA.

7.12.1 Command Parameters

The READ (EXTENDED) CDB is formatted as shown in Table 7•54.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (28h)							
1	LUN			Reserved (Zeros)				Rel Adr
2	(MSB)							
3	Logical Block Address							
4								
5								(LSB)
6	Reserved (Zeros)							
7	(MSB)							
8	Transfer Length							(LSB)
9	Control Byte							

Table 7•54
READ (EXTENDED) CDB

Logical Block Address
The logical block address (LBA) field specifies the logical block at which the read operation begins.

Transfer Length

The transfer length field specifies the number of contiguous logical blocks of data to be transferred. A transfer length of 0000h indicates that no data is transferred, and is not considered an error by the drive.

7.12.2 Error Conditions

If the LBA is invalid, and/or if the LBA plus the transfer length results in an invalid block address, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/ILLEGAL BLOCK ADDRESS (05h/21h). No data is transferred if this condition occurs.

7.13 READ LONG - 3Eh

The READ LONG command requests the drive to perform a read operation of one data block and 11 bytes of ECC information. The data from the block and the ECC bytes are transferred to the initiator during the DATA IN phase.

NOTE: *The READ LONG command does not perform any ECC correction when reading the disk.*

7.13.1 SCSI Deviations

The drive recognizes 3Eh as being the READ LONG command.

One block of data is transferred rather than the amount normally specified by a Byte Transfer Length field.

7.13.2 Command Parameters

The READ LONG CDB is formatted as shown in Table 7•55.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (3Eh)							
1	LUN			Reserved (Zeros)			Correct	RelAdr
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved (Zeros)							
7	Byte Transfer Length (MSB)							
8	Byte Transfer Length (LSB)							
9	Control Byte							

Table 7•55
READ LONG CDB

Correct
The correct bit should be set to zero. This feature is not supported.

Logical Block Address
The logical block address (LBA) field specifies the block at which the read long operation begins.

Byte Transfer Length
The byte transfer length field specifies the number of bytes of data that are available for transfer. This is the sum of data sector size and ECC bytes. The ECC field is 11 bytes.

CAUTION: *The physical location of the READ LONG and WRITE LONG block address is always computed using the physical sector size instead of the logical block size.*

7.13.3 Error Conditions

If the block address is invalid, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/ILLEGAL BLOCK ADDRESS (05h/21h).

7.14 REASSIGN BLOCK - 07h

The REASSIGN BLOCK command requests that the drive reassign a logical block(s) to a spare location. The address of the defective logical block(s) is transferred to the drive during the DATA OUT phase. The location of the defective block(s) is added to the Glist.

The data contained in the blocks specified by the initiator may be altered, but the data in all other blocks is preserved.

7.14.1 Command Parameters

The REASSIGN BLOCK CDB is formatted as shown in Table 7•56.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (07h)							
1	LUN			Reserved (Zeros)				
2	Reserved (Zeros)							
3	Reserved (Zeros)							
4	Reserved (Zeros)							
5	Control Byte							

Table 7•56
REASSIGN BLOCK CDB

7.14.2 Defect List Format

The REASSIGN BLOCK parameter list consists of a header, followed by zero or more defect descriptors. See Tables 7•57 and 7•58. This information is transferred to the drive during the DATA OUT phase of the REASSIGN BLOCK command.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Reserved (Zeros)							
1	Reserved (Zeros)							
2	Defect List Length (MSB)							
3	Defect List Length (LSB)							

Table 7•57
REASSIGN BLOCK Defect List Header

Defect List Length
The defect list length field specifies the total length (in bytes) of the defect descriptors that follow. Because each defect descriptor is four bytes long, the defect list length will be equal to the number of defective blocks times four. A defect list length of 0000h is not considered an error by the drive.

The defect descriptor LBA specifies the location of the defect. See Table 7•58. The defect descriptors must be in ascending order.

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

Table 7•58
REASSIGN BLOCK Defect Descriptor(s)

Defect Logical Block Address
The defect logical block address specifies the location of a defective logical block.

7.14.3 Error Conditions

If the drive has insufficient capacity to reassign all the defective blocks, the drive terminates the command with a CHECK CONDITION status. The sense data is set to MEDIUM ERROR/NO DEFECT SPARE LOCATION AVAILABLE (03h/32h).

If the defect LBA is invalid, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/ILLEGAL BLOCK ADDRESS (05h/21h).

7.15 RECEIVE DIAGNOSTIC RESULTS - 1Ch

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (1Ch)							
1	Logical Unit Number			Reserved				
2	Reserved							
3	(MSB) Allocation Length							
4	(LSB)							
5	Control							

Table 7•59
RECEIVE DIAGNOSTIC RESULTS Command

The RECEIVE DIAGNOSTIC RESULTS command, shown in Table 7•59, requests analysis data be sent to the initiator after completion of a SEND DIAGNOSTIC command. If the drive supports the optional page format the page code field sent in the previous SEND DIAGNOSTIC command specifies the format of the returned data.

NOTES: *To ensure that the diagnostic command information is not destroyed by a command sent from another initiator, the SEND DIAGNOSTIC command should either be linked to the RECEIVE DIAGNOSTIC RESULTS command or the logical unit should be reserved.*

Although diagnostic software is generally device-specific, this command and the SEND DIAGNOSTIC command provide a means to isolate the operating system software from the device-specific diagnostic software. Hence the operating system can remain device-independent. This also allows diagnostic software to be more easily transferred to other operating systems.

7.15.1 Diagnostic Pages

This section describes the diagnostic page structure and the diagnostic pages that are applicable to direct-access devices.

A SEND DIAGNOSTIC command with a PF bit of one specifies that the SEND DIAGNOSTIC parameter list consists of zero or more diagnostic pages and that the data returned by the subsequent RECEIVE DIAGNOSTIC RESULTS command uses the diagnostic page format described in this standard. See Table 7•60.

Each diagnostic page defines a function or operation which the drive performs. The page contains a page header followed by the analysis data which is formatted according to the page code specified in the previous SEND DIAGNOSTIC command.

The drive accepts a single diagnostic page per command.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Page Code							
1	Reserved							
2	(MSB) Page Length (n-3)							
3	Page Length (n-3) (LSB)							
4 to n	Diagnostic Parameters							

Table 7•60
Diagnostic Page Format

Page Code
The page code field identifies which diagnostic page is being sent or returned. The page codes are defined in Table 7•61.

Page Length
The page length field specifies the length in bytes of the diagnostic parameters which follow this field. If the initiator sends a page length that results in the truncation of any parameter, the drive terminates the command with CHECK CONDITION status. The data is set to ILLEGAL REQUEST/INVALID FIELD IN PARAMETER LIST.

Diagnostic Parameters
The diagnostic parameters are defined for each page code. The diagnostic parameters within a page may be defined differently in a SEND DIAGNOSTIC command than in a RECEIVE DIAGNOSTIC RESULTS command.

The diagnostic page codes for direct-access devices are defined in Table 7•61.

PAGE CODE	DESCRIPTION
00h	Supported Diagnostic Pages Page
40h	Translate Address Page
01h - 3Fh	Reserved (For All Device Type Pages)
41h - 7Fh	Reserved
80h	Microwire Pass Through
81h - FFh	Not Used

Table 7•61
Diagnostic Page Codes

7.15.2 Supported Diagnostic Pages

The supported diagnostics page returns the list of diagnostic pages implemented by the drive. This page will be implemented if the drive implements the page format option of the SEND DIAGNOSTIC and RECEIVE DIAGNOSTIC RESULTS commands. See Table 7•62.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Page Code (00h)							
1	Reserved							
2	(MSB) Page Length (n-3)							
3	Page Length (n-3) (LSB)							
4 to n	Supported Page List							

Table 7•62
Supported Diagnostic Pages

The definition of this page for the SEND DIAGNOSTIC command includes only the first four bytes. If the page length field is not zero, the drive terminates the SEND DIAGNOSTIC command with CHECK CONDITION status. The sense key will be set to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN PARAMETER LIST. This page instructs the drive to make available the list of all supported diagnostic pages to be returned by a subsequent RECEIVE DIAGNOSTIC RESULTS command.

The definition of this page for the RECEIVE DIAGNOSTIC RESULTS command includes the list of diagnostic pages supported by the drive.

Page Length
The page length field specifies the length in bytes of the following supported page list.

Supported Page List
The supported page list field contains a list of all diagnostic page codes implemented by the drive in ascending order beginning with page code 00h.

7.15.3 Translate Address Page - RECEIVE DIAGNOSTIC

The translate address page allows the initiator to translate a logical block address, physical sector address, or physical bytes from index address into any one of the other formats. The address to be translated is passed to the drive with the SEND DIAGNOSTIC command and the results are returned to the initiator by the RECEIVE DIAGNOSTIC RESULTS command. The translated address is returned in the translate address page - RECEIVE DIAGNOSTIC. See Table 7•63.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Page Code (40h)							
1	Reserved							
2	(MSB) Page Length							
3	Page Length (LSB)							
4	Reserved					Supplied Format		
5	RAREA	ALTSEC	ALTTRK	Reserved		Translated Format		
6 to 13	Translated Address 1							
14 to 21	Translated Address 2 (If Required)							
n	Translated Address n (If Required)							

Table 7-63
Translate Address Page - RECEIVE DIAGNOSTIC

The translate address page contains a four byte page header which specifies the page code and length followed by two bytes which describe the translated address followed by zero or more translated address(es).

Page Length
The page length field contains the number of parameter bytes which follow.

Supplied Format
The supplied format field contains the value from the SEND DIAGNOSTIC command supplied format field. See section SEND DIAGNOSTIC command.

RAREA
The reserved area (RAREA) bit is not currently supported and must be set to zero.

ALTSEC
The alternate sector (ALTSEC) bit is not currently supported and must be set to zero.

ALTTRK
The alternate track (ALTTRK) bit is not currently supported and must be set to zero.

Translated Format

The translated format field contains the value from the SEND DIAGNOSTIC command translate format field. See section SEND DIAGNOSTIC command.

Translated Address

The translated address field contains the address(es) that the drive translated from the address supplied by the initiator in the SEND DIAGNOSTIC command. This field only supports a BFI (Bytes From Index) format.

If the returned data is in the logical block or physical sector format and the address to be translated covers more than one address after it has been translated (e.g. accounting for speed tolerance or multiple physical sectors within a single logical block or multiple logical blocks within a single physical sector) the drive will return all possible addresses which are contained in the area specified by the address to be translated.

The drive only accepts logical block address (LBA) format and will only return BFI format.

7.16 RELEASE UNIT - 17h

The RELEASE UNIT command causes the drive (previously reserved by the RESERVE UNIT command) to be released. Once the RELEASE UNIT command is issued, other initiators can access the drive.

It is not an error to release a drive which is not currently reserved.

7.16.1 SCSI Deviations

The drive does not support the extent release option.

7.16.2 Command Parameters

The RELEASE UNIT CDB is formatted as shown in Table 7•64.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (17h)							
1	LUN			3rdPty	Third Party Device ID			0
2	Reserved (Zeros)							
3	Reserved (Zeros)							
4	Reserved (Zeros)							
5	Control Byte							

Table 7•64
RELEASE UNIT CDB

3rdPty
If the third party reservation (3rdPty) bit is set to one, the drive is released if the following conditions are met:

- The unit was originally reserved using the third party option in the RESERVE UNIT command.
- The same initiator that issued the RESERVE UNIT command is requesting the release of the drive.
- The initiator specifies the same SCSI bus device ID in the third party ID field as was specified in that field by the initiator in the RESERVE UNIT command.

A 3rdPty bit of zero indicates that the drive is to be released if it was not reserved by a third party.

Third Party Device ID
The third party device ID field specifies the SCSI bus device ID for which the drive was reserved.

7.16.3 Error Conditions

If the extent reservation option is specified, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN CDB (05h/24h).

If the third party release option is specified, and the unit was not originally reserved with the third party option, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN CDB (05h/24h).

If the third party release option is specified, and the third party device ID is not the same as the one specified in the original RESERVE UNIT command, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN CDB (05h/24h).

If the third party release option is specified, and the initiator SCSI ID is not the same as that of the initiator which originally reserved the unit, the drive terminates the command with a RESERVATION CONFLICT status.

7.17 REQUEST SENSE - 03h

The REQUEST SENSE command provides a means for the initiator to obtain more detailed information after execution of a command. Typically, a REQUEST SENSE command is issued if the previous command has completed with a CHECK CONDITION status returned to the initiator.

An initiator should issue a REQUEST SENSE command as soon as it receives a CHECK CONDITION status to obtain the sense data saved by the drive. The sense block is cleared after the REQUEST SENSE command has completed.

Only the extended format should be used. The drive does not support the nonextended sense format.

7.17.1 Command Parameters

The REQUEST SENSE CDB is formatted as shown in Table 7•65.

BIT / BYTE	7	6	5	4	3	2	1	0
0	Operation Code (03h)							
1	LUN			Reserved (Zeros)				
2	Reserved (Zeros)							
3	Reserved (Zeros)							
4	Allocation Length							
5	Control Byte							

Table 7•65
REQUEST SENSE CDB

Allocation Length
The allocation length field specifies the number of bytes the initiator has allocated for the sense data.

7.17.2 Data Format

The format of the returned sense data depends on the number of bytes specified in the allocation length field of the CDB. Two sense data formats are supported:

- An allocation length of 00h results in a transfer of 4 bytes in the nonextended sense data format.
- An allocation length greater than 00h results in a transfer of up to the requested number of sense bytes, or until all the sense data has been transferred in the extended sense data format.

7.17.2.1 EXTENDED SENSE DATA FORMAT

The extended sense data format is returned when the allocation length is greater than 00h. See Table 7•66.

REQUEST SENSE - 03h

BIT / BYTE	7	6	5	4	3	2	1	0
0	Valid	1	1	1	Error Code 70h/71h			
1	Segment Number							
2	0	0	ILI	0	Sense Key			
3	Information Byte (MSB)							
4	Information Byte							
5	Information Byte							
6	Information Byte (LSB)							
7	Additional Sense Length (0Ah)							
8	Reserved for Copy/Compare Command (zeros)							
9	Reserved for Copy/Compare Command (zeros)							
10	Reserved (zeros)							
11	Reserved (zeros)							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Field Replaceable Unit							
15	FPV	C/D	Reserved (zeros)		BPV	Bit Pointer		
16	Field Pointer							
17	Field Pointer							

Table 7•66
Extended Sense Data Format

Valid
A valid bit of one indicates that the information byte field contains valid information related to the error condition.

A valid bit of zero indicates that the information byte field does not contain valid information.

Error Code
A valid bit of one indicates that the information byte field contains valid information related to the error condition.

ILI
An incorrect length indicator (ILI) bit of one indicates that the data available in the drive is

larger than the requested transfer size during a READ DATA BUFFER command. The ILI bit is set to zero for all other conditions.

Sense Key

The sense key field provides status information about deleted errors. The errors are listed and defined in Table 7•67.

REQUEST SENSE - 03h

CODE	SENSE KEYS
00	No Sense. There is no sense key information to be reported. This code occurs for a successfully completed command.
01	Recovered Error. The last command was completed successfully, but with some recovery action performed by the disk drive.
02	Not Ready. The disk drive cannot be accessed. Operator intervention may be required.
03	Medium Error. The command terminated with a nonrecoverable error condition which was probably caused by a flaw in the media or by an error in the recorded data.
04	Hardware Error. A nonrecoverable hardware error (e.g., disk drive failure, parity error, etc.) was detected while the disk drive was performing the command, or while the disk drive was performing a self-test operation.
05	Illegal Request. There was an illegal parameter in the command or in the additional required parameters supplied as data for some related commands. If the error is detected in the CDB, the disk drive does not alter the media.
06	Unit Attention. The disk drive has been reset. This error is reported the first time any command is issued after the condition is detected and the requested command is not performed. This condition is cleared when the next command that is not an INQUIRY command is issued by the same initiator. UNIT ATTENTION is reported to all SCSI devices that subsequently issue a command to the disk drive.
07	Data Protect. A write operation was attempted on a write protected device.
08	Reserved. This key is reserved.
09	Vendor Unique. A vendor unique error condition occurred. This code is currently not returned by the disk drive.
0A	Copy/Compare Aborted. A COPY or COMPARE command was aborted because an error condition was detected on the source and/or destination device. This code is not returned by the disk drive.
0B	Aborted Command. The disk drive aborted the command. The initiator may recover by trying to execute the command again.
0C	Reserved. This key is reserved.
0D	Volume Overflow.
0E	Miscompare. Used by the VERIFY and READ DATA BUFFER commands to indicate that the source data did not match the data read from the disk.
0F	Reserved. This key is reserved.

Table 7-67
REQUEST SENSE Sense Key Codes

Information Byte
The information byte field is valid only when the valid bit is set to one. For information on the data returned, see the description of the previously issued command.

Additional Sense Length
The additional sense length field specifies the number of additional sense bytes that follows. If the allocation length in the CDB is too small to transfer the additional sense data, the additional sense length field is not adjusted to reflect the truncation. The additional sense length byte is set to ten for all commands.

Bytes eight through eleven are reserved and always set to 00h.

Additional Sense Code
The additional sense code field contains additional information about the event that occurred. Refer to Table 7-70 for a complete listing of these sense codes. When this field is set to 00h, the drive does not have any additional sense information.

Additional Sense Code Qualifier
The additional sense code qualifier field contains detailed information related to the additional sense code.

FRU
The field replaceable unit (FRU) field contains vendor unique error code.

FPV
A field pointer valid (FPV) bit of one indicates that the information in the C/D and BPV bits, plus the field pointer bit is valid. Normally the field pointer is only valid when an ILLEGAL REQUEST sense key is returned. In this situation, the field pointer bit points to the byte which caused the error. When this bit is set to zero, the C/D, BPV and field pointer field are not valid.

C/D
A command/data (C/D) bit of one indicates that the field pointer field is pointing to a byte in the CDB. When this bit is zero, it indicates the field pointer field is pointing to a byte in the command parameters which were passed to the drive during the DATA OUT phase. This bit is only valid if the field pointer valid (FPV) bit is set to one.

BPV
A bit pointer valid (BPV) bit of one indicates that the information in the bit pointer field is valid. A BPV bit of zero indicates that the information in the bit pointer field is not valid. This bit is only valid if the field pointer valid (FPV) bit is set to one.

Field Pointer
The field pointer field specifies the byte position that is incorrect. This pointer points to

either the CDB, or the command parameters passed during the DATA OUT phase, depending on the value in the C/D bit. When a multiple byte field is in error, the pointer will point to the most significant bit of the field. This field is only valid when the field pointer valid (FPV) bit is set to one.

If the sense key is RECOVERED ERROR, HARDWARE ERROR or MEDIUM ERROR and if the SKSV bit is one, the sense-key specific field is defined as shown in Table 7•68.

BYTE \ BIT	7	6	5	4	3	2	1	0
15	SKSV	Reserved						
16	(MSB)	Actual Retry Count						
17								(LSB)

Table 7•68
Actual Retry Count Bytes

The actual retry count field returns implementation-specific information on the actual number of retries of the recovery algorithm used in attempting to recover an error or exception condition.

NOTE: *It is recommended that this field relate to the retry count fields within the error recovery page of the MODE SELECT command.*

7.17.2.2 SENSE CODES

Table 7•69 lists and describes the sense codes supported by the drive.

CODE	SENSE CODE DESCRIPTION
00	NO ADDITIONAL SENSE INFORMATION. The disk drive has no additional sense available for the previous command.
01	RESERVED. This code is reserved.
02	NO SEEK COMPLETE. The disk drive could not complete a SEEK operation.
03	PERIPHERAL DEVICE WRITE FAULT. The disk drive determined that a fault occured during a WRITE operation.
04	LOGICAL UNIT NOT READY. The disk drive is not ready.
05	LOGICAL UNIT DOES NOT RESPOND TO SELECTION.
06	NO REFERENCE POSITION FOUND. The disk drive could not rezero the positioner.
08	LUN COMMUNICATION ERROR.
10	ID CRC OR ECC ERROR. The sector ID field could not be read without a CRC error.
11	UNRECOVERED READ ERROR. A block could not be read after the number of retry attempts specified in the MODE SELECT command.
12	ADDRESS MARK NOT FOUND FOR ID FIELD. The disk drive could not locate the address mark for a sector header.
13	ADDRESS MARK NOT FOUND FOR DATA FIELD. The disk drive could not locate the address mark for the sector data area.
14	RECORDED ENTITY NOT FOUND. The block sequence is improper, a block is missing, or the block cannot be read.
15	RANDOM POSITIONING ERROR. A miscompare occurred between the cylinder address of the data header and the address specified in the CDB of the command.
16	DATA SYNC MARK ERROR.
17	RECOVERED DATA WITH NO ERROR CORRECTION APPLIED. The disk drive encountered an error which was recovered using retries, not including ECC, while reading the media.
18	RECOVERED DATA WITH ERROR CORRECTION APPLIED. The disk drive encountered an error which was recovered using ECC correction while reading the media.
19	DEFECT LIST ERROR. The disk drive encountered an error while accessing one of the defect lists.
1A	PARAMETER LIST LENGTH ERROR. The parameter list length specified in the CDB by the initiator is too large for the disk drive.
1B	SYNCHRONOUS DATA TRANSFER ERROR.

Table 7•69
REQUEST SENSE Sense Codes

CODE	SENSE CODE DESCRIPTION
1C	DEFECT LIST NOT FOUND. The disk drive could not locate the primary defect list (P list).
1D	MISCOMPARE DURING VERIFY OPERATION. One or more bytes did not compare when the VERIFY or the WRITE AND VERIFY command was issued.
1E-1F	RESERVED. These codes are reserved.
20	INVALID COMMAND OPERATION CODE. The initiator issued a command that cannot be executed or is not applicable.
21	LOGICAL BLOCK ADDRESS OUT OF RANGE. The addressed block is not valid.
22	ILLEGAL FUNCTION FOR DEVICE TYPE. The disk drive is unable to perform the requested function.
23	RESERVED. This code is reserved.
24	INVALID FIELD IN CDB. A field in the CDB is reserved and contains a value other than zero, or the value in the field is incorrect.
25	LOGICAL UNIT NOT SUPPORTED. The LUN specified in the CDB or the SCSI IDENTIFY message is not zero.
26	INVALID FIELD IN PARAMETER LIST. A field in the parameter list is reserved and contains a value other than zero, or the value in the field is incorrect.
27	WRITE PROTECTED. The disk is write protected. The outstanding WRITE command is aborted.
28	NOT READY TO READY TRANSITION. The disk drive has detected a NOT READY condition followed by a READY condition.
29	POWER ON, RESET, OR BUS DEVICE RESET OCCURRED. The disk drive has been reset by a SCSI BUS RESET, BUS DEVICE RESET message, or POWER ON/RESET condition.
2A	PARAMETERS CHANGED. The MODE SELECT parameters for this device have been changed by another initiator and may affect current operations.
2B-30	RESERVED. These codes are reserved.
31	MEDIUM FORMAT CORRUPTED. The FORMAT UNIT command failed to complete.
32	NO DEFECT SPARE LOCATION AVAILABLE . There are no remaining alternate tracks on the addressed disk drive. This error condition may occur during the processing of a FORMAT UNIT or REASSIGN BLOCK command.
33-3F	RESERVED. These codes are reserved.
40	DIAGNOSTIC FAILURE ON COMPONENT. The disk drive detected a RAM error during a SEND DIAGNOSTIC test operation.

Table 7-69 (cont'd)
REQUEST SENSE Sense Codes

CODE	SENSE CODE DESCRIPTION
41-42	RESERVED. These codes are reserved.
43	MESSAGE ERROR. The initiator responded with a MESSAGE REJECT message to a message sent by the disk drive.
44	INTERNAL TARGET FAILURE. The SCSI firmware detected an internal firmware or hardware error and was unable to complete the current command.
45	SELECT/RESELECT FAILURE. The SCSI firmware detected a time-out error while attempting a reselection.
46	RESERVED. This code is reserved.
47	SCSI PARITY ERROR. A parity error occurred on the SCSI bus and the disk drive was unable to recover the data.
48	INITIATOR DETECTED ERROR MESSAGE RECEIVED. The initiator sent an INITIATOR DETECTED ERROR message and the disk drive was unable to recover from the error.
49	INVALID MESSAGE ERROR. The initiator sent an inappropriate or illegal SCSI message to the disk drive.
4A-4F	RESERVED. These codes are reserved.
50-5F	RESERVED. These codes are reserved.
60-6F	RESERVED. These codes are reserved.
70-7F	RESERVED. These codes are reserved.
80-8F	RESERVED. These codes are reserved.

Table 7•69 (cont'd)
REQUEST SENSE Sense Codes

7.17.3 Error Conditions

If a CHECK CONDITION status is received on a REQUEST SENSE command, any sense data returned by the drive is invalid.

7.18 RESERVE UNIT - 16h

The RESERVE UNIT command is used to reserve the specified drive for exclusive use by the initiator or a designated third party.

The drive remains reserved until it receives a RELEASE UNIT command or SCSI reset or the issuing initiator is granted reservation of another target.

If a reserved drive receives any command from an initiator other than the one it's reserved for, a RESERVATION CONFLICT status will be returned.

7.18.1 SCSI Deviations

The drive does not support the extent reservation option.

The drive does not support reservation queuing. If a RESERVE UNIT command is received for a logical unit which is already reserved for a different initiator, the drive returns a RESERVATION CONFLICT status.

7.18.2 Command Parameters

The RESERVE UNIT CDB is formatted as shown in Table 7•70.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (16h)							
1	LUN			3rdPty	Third Party Device ID			Extent
2	Reservation Identification							
3	Extent List Length (MSB)							
4	Extent List Length (LSB)							
5	Control Byte							

Table 7•70
RESERVE UNIT CDB

3rdPty
The third party reservation (3rdPty) bit allows an initiator to reserve a drive for another device on the SCSI bus. If the 3rdPty bit is set to one, it indicates that the drive is being reserved for an initiator other than the one issuing the command. If the 3rdPty bit is set to zero, it indicates that the drive is being reserved for the same initiator that issued this command. Any device that uses the third party reservation option to reserve the drive must also use the third party reservation option to release the drive. This option is intended for use in multiple-initiator systems. See section 7.16, RELEASE UNIT.

Third Party Device ID
The third party device ID field specifies the SCSI bus ID of the device being reserved. The ID is valid only when the third party reservation bit is set to one.

Extent
The extent bit is not supported and must be set to zero.

Reservation Identification
The reservation identification field is not supported and must be set to 00h.

Extent List Length
The extent list length field is not supported and must be set to 0000h.

7.18.3 Error Conditions

If the extent, reservation identification, or extent list length fields are not set to 00h, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/INVALID FIELD IN CDB (05h/24h).

7.19 REZERO UNIT - 01h

The REZERO UNIT command requests that the drive set the logical unit to cylinder zero.

7.19.1 Command Parameters

The REZERO UNIT CDB is formatted as shown in Table 7•71.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (01h)							
1	LUN			Reserved (Zeros)				
2	Reserved (Zeros)							
3	Reserved (Zeros)							
4	Reserved (Zeros)							
5	Control Byte							

Table 7•71
REZERO UNIT CDB

7.20 SEEK - 0Bh

The SEEK command causes the drive to seek to the cylinder of the specified LBA. If the LBA specifies a block on a defective track, the seek to the alternate track is not performed until the drive receives and processes a command which accesses the medium.

7.20.1 Command Parameters

The SEEK CDB is formatted as shown in Table 7•72.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (0Bh)							
1	LUN			Logical Block Address (MSB)				
2	Logical Block Address							
3	Logical Block Address (LSB)							
4	Reserved (Zeros)							
5	Control Byte							

Table 7•72
SEEK CDB

Logical Block Address
The logical block address (LBA) field specifies the LBA in which to seek.

7.20.2 Error Conditions

If the LBA is invalid, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/ILLEGAL BLOCK ADDRESS (05h/21h).

If the LBA is greater than the value returned in the READ CAPACITY command the drive returns a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST.

7.21 SEEK (EXTENDED) - 2Bh

The SEEK (EXTENDED) command causes the drive to seek to the cylinder that contains the specified LBA. If the LBA specifies a block on a defective track, the SEEK to the alternate track is not performed until the drive receives and processes a command which accesses the medium.

7.21.1 Command Parameters

The SEEK (EXTENDED) CDB is formatted as shown in Table 7•73.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (2Bh)							
1	LUN			Reserved (Zeros)				Rel Adr
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved (Zeros)							
7	Reserved (Zeros)							
8	Reserved (Zeros)							
9	Control Byte							

Table 7•73
SEEK (EXTENDED) CDB

Logical Block Address
The logical block address (LBA) field specifies the block address in which to seek.

7.21.2 Error Conditions

If the LBA is invalid, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/ILLEGAL BLOCK ADDRESS (05h/21h).

If the LBA is greater than the value returned in the READ CAPACITY command, the drive returns a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST.

7.22 SEND DIAGNOSTIC - 1Dh

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (1Dh)							
1	Logical Unit Number			PF	Rsrv	Self Test	Dev OfL	Unit OfL
2	Reserved							
3	(MSB) Parameter List Length							
4	Parameter List Length (LSB)							
5	Control							

Table 7-74
SEND DIAGNOSTIC Command

The SEND DIAGNOSTIC command, Table 7-74, requests that the drive perform diagnostic operations on itself, on the logical unit, or on both. The only mandatory implementation of this command is the self-test feature with the parameter list length of zero. Except when the self-test bit is one, this command is usually followed by a RECEIVE DIAGNOSTIC RESULTS command.

PF

A page format (PF) bit of one specifies that the SEND DIAGNOSTIC parameters conform to the page structure as specified in this manual. The implementation of the PF bit is optional. A PF bit of zero indicates that the SEND DIAGNOSTIC parameters are as specified in SCSI-2 (that is, all parameters are vendor specific).

SelfTest

A self-test (SelfTest) bit of one directs the drive to complete its default self-test. If the self-test successfully passes, the command is terminated with GOOD status; otherwise, the command is terminated with CHECK CONDITION status and the sense key is set to HARDWARE ERROR.

A self-test bit of zero requests that the drive perform the diagnostic operation specified in the parameter list. The diagnostic operation might or might not require a drive to return data which contains diagnostic results. If the return of data is not required, the return of

GOOD status indicates successful completion of the diagnostic operation. If the return of data is required, the drive will either:

(1) performs the requested diagnostic operation, prepares the data to be returned, and indicates completion by returning GOOD status. The initiator issues a RECEIVE DIAGNOSTIC RESULTS command to recover the data.

or:

(2) accepts the parameter list, and if no errors are detected in the parameter list, returns GOOD status. The requested diagnostic operation and the preparation of the data to be returned is performed upon receipt of a RECEIVE DIAGNOSTIC RESULTS command.

NOTE: *To ensure that the diagnostic command information is not destroyed by a command sent from another initiator, the SEND DIAGNOSTIC command should either be linked to the RECEIVE DIAGNOSTIC RESULTS command or the logical unit should be reserved.*

DevOfL and UnitOfL

The device off-line (DevOfL) and unit off-line (UnitOfL) bits are generally set by operating system software while the parameter list is prepared by diagnostic application software. These bits grant permission to perform vendor-specific diagnostic operations on the drive which may be visible to attached initiators. Thus, by preventing operations that are not enabled by these bits, the drive assists the operating system in protecting its resources.

NOTE: *The DevOfL and UnitOfL bits are not implemented by the drive.*

A UnitOfL bit of one grants permission to the drive to perform diagnostic operations that may affect the user accessible medium on the logical unit , for example, write operations to the user accessible medium, or repositioning of the medium on sequential access devices. The implementation of the UnitOfL bit is optional. A UnitOfL bit of zero prohibits any diagnostic operations that may be detected by subsequent I/O processes.

A DevOfL bit of one grants permission to the drive to perform diagnostic operations that may affect all the logical units on a drive, for example, alterations, log parameters, or sense data. The implementation of the DevOfL bit is optional. A DevOfl bit of zero prohibits diagnostic operations that may be detected by subsequent I/O processes.

Parameter List Length

The parameter list length field specifies the length in bytes of the parameter list that will be transferred from the initiator to the drive. A parameter list length of zero indicates that no data will be transferred. This condition will not be considered as an error. If the specified parameter list length results in the truncation of one or more pages (PF bit set to

one), the drive returns CHECK CONDITION status with a sense key of ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN CDB.

7.22.1 Diagnostic Pages

This section describes the diagnostic page structure and the diagnostic pages that are applicable to direct-access devices.

A SEND DIAGNOSTIC command with a PF bit of one specifies that the SEND DIAGNOSTIC parameter list consists of zero or more diagnostic pages. This also specifies that the data returned by the subsequent RECEIVE DIAGNOSTIC RESULTS command use the diagnostic page format described in this manual. See Table 7•75.

Each diagnostic page defines a function or an operation which the drive performs. The page contains a page header followed by the analysis data which is formatted according to the page code specified in the previous SEND DIAGNOSTIC command.

Drives that implement diagnostic pages are only required to accept a single diagnostic page per command.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Page Code							
1	Reserved							
2	(MSB) Page Length (n-3)							
3	(LSB)							
4 to n	Diagnostic Parameters							

Table 7•75
Diagnostic Page Format

The page code field identifies which diagnostic page is being sent or returned. The page codes are defined in Table 7•76.

The page length field specifies the length in bytes of the diagnostic parameters which follow this field. If the initiator sends a page length that results in the truncation of any pa-

rameter, the drive will terminate the command with CHECK CONDITION status. In this case, the sense key will be set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The diagnostic parameters are defined for each page code. The diagnostic parameters within a page may be defined differently in a SEND DIAGNOSTIC command than in a RECEIVE DIAGNOSTIC RESULTS command.

PAGE CODE	DESCRIPTION
01h - 3Fh	Reserved
40h	Translate Address Page
41h - 7Fh	Reserved
80h	Microwire Pass Through
81h - FFh	Vendor Specific Pages

Table 7•76
Diagnostic Page Codes

7.22.2 Translate Address Page - SEND DIAGNOSTIC

The translate address page allows the initiator to translate a logical block address, physical sector address, or physical bytes from index address into any one of the other formats. The address to be translated is passed to the drive with the SEND DIAGNOSTIC command and the results are returned to the initiator by the RECEIVE DIAGNOSTIC RESULTS command. The format of the translate address page - SEND DIAGNOSTIC is shown in Table 7•77. The translated address is returned in the translate address page - RECEIVE DIAGNOSTIC RESULTS. See Table 7•59, RECEIVE DIAGNOSTIC RESULTS Command.

BIT / BYTE	7	6	5	4	3	2	1	0
0	Page Code (40h)							
1	Reserved							
2	(MSB) Page Length (000Ah)							
3	(LSB)							
4	Reserved					Supplied Format		
5	Reserved					Translate Format		
6 to 13	Address to Translate							

Table 7-77
Translate Address Page - SEND DIAGNOSTIC

The supplied format field specifies the format of the address to translate field. Valid values for this field are defined in Table 7-6, FORMAT UNIT CDB. If the drive does not support the requested format it terminates the SEND DIAGNOSTIC command with CHECK CONDITION status. The sense key is set to ILLEGAL REQUEST and an additional sense code is set to INVALID FIELD IN PARAMETER LIST.

The translate format field specifies the format to which the initiator would like the address to be translated. Valid values for this field are defined in the FORMAT UNIT command. If the drive does not support the requested format, it terminates the command with CHECK CONDITION status. The sense key is set to ILLEGAL REQUEST and an additional sense code is set to INVALID FIELD IN PARAMETER LIST.

The address to translate field contains a single address that the initiator is requesting the drive to translate. The format of this field depends on the value in the supplied format field. If the logical block format is specified, the block address is in the first four bytes of the field with the remaining bytes set to zero.

7.23 START/STOP UNIT - 1Bh

The START/STOP UNIT command requests that the drive spin up or spin down.

7.23.1 Command Parameters

The CDB for the START/STOP UNIT command is formatted as shown in Table 7•78.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (1Bh)							
1	LUN			Reserved (Zeros)				Immed
2	Reserved (Zeros)							
3	Reserved (Zeros)							
4	Reserved (Zeros)							Start
5	Control Byte							

Table 7•78
START/STOP UNIT CDB

Immed
An immediate (Immed) bit of one instructs the status to be returned immediately. If the immediate bit is zero, the drive returns the status when the operation is completed.

NOTE: *The immediate bit is not implemented by the drive.*

Start
A start bit of one instructs the drive to spin up. A start bit of zero instructs the drive to spin down.

7.23.2 Error Conditions

If a command which accesses the medium is sent to the drive after a STOP UNIT command, the drive terminates the command with a CHECK CONDITION status. The sense data is set to NOT READY/DRIVE NOT READY (02h/04h).

7.24 TEST UNIT READY - 00h

The TEST UNIT READY command provides a way for the initiator to see if the drive is ready. If the drive is ready (able to access the medium without returning a CHECK CONDITION status) this command will return a GOOD status. However, if the drive is not operational or in a state that requires an initiator action (START/STOP unit command) a CHECK CONDITION status with a sense key of NOT READY will be returned.

7.24.1 Command Parameters

The CDB for the TEST UNIT READY command is formatted as shown in Table 7•79.

BIT / BYTE	7	6	5	4	3	2	1	0
0	Operation (00h)							
1	LUN			Reserved (Zeros)				
2	Reserved (Zeros)							
3	Reserved (Zeros)							
4	Reserved (Zeros)							
5	Control Byte							

Table 7•79
TEST UNIT READY CDB

7.24.2 Error Conditions

If the drive is not ready, a CHECK CONDITION or BUSY status is returned. The initiator can issue a REQUEST SENSE command to find out why the drive is not ready.

7.25 VERIFY - 2Fh

The VERIFY command requests that the drive verify the data written on the medium.

7.25.1 Command Parameters

The VERIFY CDB is formatted as shown in Table 7•80.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (2Fh)							
1	LUN			DPO	Reserved (Zeros)		BytChk	RelAdr
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved (Zeros)							
7	Verification Length (MSB)							
8	Verification Length (LSB)							
9	Control Byte							

Table 7•80
VERIFY CDB

DPO
The disable page out (DPO) bit should be set to zero. This feature is not supported.

BytChk
A byte check (BytChk) bit of one causes the specified logical blocks to be read from the disk and compared with the data transferred from the initiator. The ECC is also checked.

Data is transferred from the initiator in a DATA OUT phase, just as in a write operation. If the byte check (BytChk) bit is set to zero, the data is read from the disk and the ECC is checked for correctness; no DATA OUT phase occurs between the initiator and the drive.

Logical Block Address
The logical block address (LBA) field specifies the logical block at which the verify operation begins.

Verification Length
The verification length field specifies the number of contiguous logical blocks of data to be verified. A verification length of 0000h is not considered an error.

7.25.2 Error Conditions

If the LBA is invalid, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/ILLEGAL BLOCK ADDRESS (05h/21h).

If the LBA plus the verification length result in an invalid block address, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/ILLEGAL BLOCK ADDRESS (05h/21h).

7.26 WRITE - 0Ah

The WRITE command directs the drive to write the data transferred from the initiator to the medium. It also causes the drive to perform an implied seek to the cylinder, head, and sector which corresponds to the specified LBA.

7.26.1 Command Parameters

The CDB for the WRITE command is formatted as shown in Table 7•81.

BIT / BYTE	7	6	5	4	3	2	1	0
0	Operation Code (0Ah)							
1	LUN			Logical Block Address (MSB)				
2	Logical Block Address							
3	Logical Block Address							
4	Transfer Length							
5	Control Byte							

Table 7•81
WRITE CDB

Logical Block Address
The logical block address (LBA) field specifies the logical block at which the write operation begins.

Transfer Length
The transfer length field specifies the number of contiguous logical blocks of data to be transferred. A transfer length of 00h indicates that 256 logical blocks will be transferred.

7.26.2 Error Conditions

If the LBA is invalid and/or if the LBA plus the transfer length result in an invalid block address, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/ILLEGAL BLOCK ADDRESS (05h/21h). No data is transferred if this condition occurs.

***NOTE**: When using the 6 byte READ Command, the entire capacity of the MXT–1240S is not addressable at 512 bytes per sector. Extended READs and WRITEs are required.*

7.27 WRITE (EXTENDED) - 2Ah

The WRITE (EXTENDED) command directs the drive to write the data transferred from the initiator to the medium. It also causes the drive to perform an implied SEEK to the cylinder, head, and sector which corresponds to the specified LBA.

7.27.1 Command Parameters

The CDB for the WRITE (EXTENDED) command is formatted as shown in Table 7•82.

BIT / BYTE	7	6	5	4	3	2	1	0
0	Operation Code (2Ah)							
1	LUN			Resrvd (Zeros)	FUA	Reserved (Zeros)		RelAdr
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Addresss							
5	Logical Block Address (LSB)							
6	Reserved (Zeros)							
7	Transfer Length (MSB)							
8	Transfer Length (LSB)							
9	Control Length							

Table 7•82
WRITE (EXTENDED) CDB

FUA

A Forced Unit Access (FUA) bit of 01h will cause the drive to write the data to the disk prior to returning a GOOD status. This may be used to temporarily disable write cache.

A FUA bit of zero allows the drive to be responsive to write caching if write caching has been enabled.

Logical Block Address

The logical block address (LBA) field specifies the logical block at which the write operation begins.

Transfer Length

The transfer length field specifies the number of contiguous logical blocks of data to be transferred. A transfer length of 0000h indicates that no data is transferred and is not considered an error.

7.27.2 Error Conditions

If the LBA field is invalid and/or if the LBA plus the transfer length result in an invalid block address, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/ILLEGAL BLOCK ADDRESS (05h/21h). No data is transferred if this condition occurs.

7.28 WRITE AND VERIFY - 2Eh

The WRITE AND VERIFY command requests that the drive write the data transferred from the initiator to the drive and then verify that the data is correctly written. The drive supports the medium verification against ECC.

7.28.1 Command Parameters

The WRITE AND VERIFY CDB is formatted as in Table 7•83.

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (2Eh)							
1	LUN			DPO	Reserved (Zeros)		BytChk	RelAdr
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved (Zeros)							
7	Transfer Length (MSB)							
8	Transfer Length (LSB)							
9	Control Byte							

Table 7•83
WRITE AND VERIFY CDB

DPO
The disable page out (DPO) bit is not supported by the drive and must be set to zero

BytChk

A byte check (BytChk) bit of one causes the specified logical blocks to be read from the disk and compared with the data transferred from the initiator. The ECC is also checked. Data is transferred from the initiator in a DATA OUT phase, just as in a write operation. If the byte check (BytChk) bit is set to zero, the data is read from the disk and the ECC is checked for correctness; no DATA OUT phase occurs between the initiator and the disk drive.

RelAdr

Logical Block Address

The logical block address (LBA) field specifies the logical block at which the write operation begins.

Transfer Length

The transfer length field specifies the number of contiguous logical blocks of data that are transferred. A transfer length of 0000h is not considered an error.

7.29 WRITE BUFFER - 3Bh

BYTE \ BIT	7	6	5	4	3	2	1	0
0	Operation Code (3Bh)							
1	Logical Unit Number			Reserved		Mode		
2	Buffer ID							
3	(MSB) Buffer Offset							
4								
5								(LSB)
6	(MSB) Parameter List Length							
7								
8								(LSB)
9	Control							

Table 7•84
WRITE BUFFER Command

The WRITE BUFFER command, shown in Table 7•84, is used in conjunction with the READ BUFFER command as a diagnostic for testing drive memory and the SCSI bus integrity. Additional modes are provided for downloading microcode and for downloading and saving microcode.

This command does not alter any medium of the drive when the data mode or the combined header and data mode is specified.

The function of this command and the meaning of fields within the command descriptor block depend on the contents of the mode field. The mode field is defined in Table 7•85.

MODE	DESCRIPTION	IMPLEMENTATION REQUIREMENTS
000b	Write Combined Header and Data	Optional
001b	Not Used	Not Used
010b	Write Data	Optional
011b	Reserved	Reserved
100b	Download Microcode	Optional
101b	Download Microcode and Save	Optional
110b	Reserved	Reserved
111b	Reserved	Reserved

Table 7•85
WRITE BUFFER Mode Field

NOTE: *Modes 000b and 001b are included for compatibility with CCS products that were designed prior to the generation of this manual. These products restrict the maximum transfer length to 65,535 bytes.*

7.29.1 Combined Header and Data Mode (000b)

In this mode, data to be transferred is preceded by a four-byte header. The four-byte header consists of all reserved bytes. The buffer ID and the buffer offset fields are zero. The parameter list length field specifies the maximum number of bytes that are transferred during the DATA OUT phase. This number includes four bytes of header, so the data length to be stored in the drive's buffer is parameter list length minus four. The initiator should attempt to ensure that the parameter list length is not greater than four plus the available length that is returned in the header of the READ BUFFER command (mode 00b). If the parameter list length exceeds the available length plus four, the drive will return CHECK CONDITION status and set the sense key to ILLEGAL REQUEST.

7.29.2 Data Mode (010b)

In this mode, the DATA OUT phase contains buffer data. The buffer ID field identifies a specific buffer within the drive. The vendor assigns buffer ID codes to buffers within the drive. Buffer ID zero will be supported. If more than one buffer is supported, additional

buffer ID codes will be assigned contiguously, beginning with one. If an unsupported buffer ID code is selected, the drive returns CHECK CONDITION status and sets the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

Data is written to the drive buffer starting at the location specified by the buffer offset. The initiator should conform to the offset boundary requirements returned in the READ BUFFER descriptor. If the drive is unable to accept the specified buffer offset, it returns CHECK CONDITION status and sets the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

The parameter list length specifies the maximum number of bytes that are transferred during the DATA OUT phase to be stored in the specified buffer beginning at the buffer offset. The initiator should attempt to ensure that the parameter list length plus the buffer offset does not exceed the capacity of the specified buffer. (The capacity of the buffer can be determined by the buffer capacity field in the READ BUFFER descriptor.) If the buffer offset and parameter list length fields specify a transfer that would exceed the buffer capacity, the drive will return CHECK CONDITION status and will set the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

7.29.3 Download Microcode Mode (100b)

In this mode, vendor-specific microcode or control information is transferred to the control memory space of the drive . After a power-cycle or reset, the drive operation reverts to a vendor-specific condition. The meanings of the buffer ID, buffer offset, and parameter list length fields are not specified by this manual and are not required to be zero-filled. When the microcode download has completed successfully, the drive will generate a unit attention condition for all initiators except the one that issued the WRITE BUFFER command. The additional sense code will be set to MICROCODE HAS BEEN CHANGED.

7.29.4 Download Microcode and Save Mode (101b)

In this mode, vendor-specific microcode or control information is transferred to the drive. If the WRITE BUFFER command is completed successfully, this information will be saved in a non-volatile memory space (on the disk or medium). The downloaded code is then effective after each power-cycle and reset until it is supplanted in another download microcode and save operation. The meanings of the buffer ID, buffer offset, and parameter list length fields are not specified by this manual and are not required to be zero-filled. When the download microcode and save command have been successfully completed, the drive generates a unit attention condition for all initiators except the one that issued the WRITE BUFFER command. When reporting the unit attention condition, the drive sets the additional sense code to MICROCODE HAS BEEN CHANGED.

7.30 WRITE LONG - 3Fh

The WRITE LONG command requests the drive to perform a write operation of one data block and seven bytes of ECC information. The data and ECC bytes are supplied by the initiator during the DATA OUT phase.

7.30.1 SCSI Deviations

The drive recognizes 3Fh as being the WRITE LONG command. One block of data is transferred rather than the amount normally specified by a byte transfer length field.

7.30.2 Command Parameters

The CDB for the WRITE LONG command is formatted as shown in Table 7•86.

BIT / BYTE	7	6	5	4	3	2	1	0
0	Operation Code (3Fh)							
1	LUN			Reserved (Zeros)				RelAdr
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved (Zeros)							
7	Byte Transfer Length							
8	Byte Transfer Length							
9	Control Byte							

Table 7•86
WRITE LONG CDB

Logical Block Address
The logical block address field (LBA) specifies the block at which the write long operation begins.

Byte Transfer Length
This field specifies the number of bytes of data that are available for transfer. This is the sum of the data sector size and the ECC bytes. The ECC field is 11 bytes.

CAUTION: *The physical location of the READ LONG and WRITE LONG block address is computed using the physical sector size instead of the logical block size.*

7.30.3 Error Conditions

If the LBA is invalid, the drive terminates the command with a CHECK CONDITION status. The sense data is set to ILLEGAL REQUEST/ILLEGAL BLOCK ADDRESS (05h/21h).

APPENDIX A: CDB BIT DEFINITIONS

Abbreviation	Meaning
ARRE	automatic read reallocation enabled bit
AWRE	automatic write reallocation enabled bit
BytChk	byte check bit
DCR	disable correction bit
DCRT	disable certification bit
DevOfl	device off-line bit
DPO	disable page out bit
DPRY	disable primary bit
DT	defective track bit
DTE	disable transfer on error bit
EEC	enable early correction bit
FmtData	format data bit
FOV	format options valid bit
HSEC	hard sector format bit
ILI	incorrect length indicator bit
Immed	immediate bit
INS	inhibit save bit
PCF	page control field bit
PER	post error bit
PF	page format bit
PMI	partial medium indicator bit
PS	parameters saveable bit
RC	read continuous bit
RelAdr	relative address bit
RMB	removable media bit
SlfTst	self-test bit
SP	save parameters bit
SS	spare sector bit
SSEC	soft sector format bit
STPF	stop format bit
SURF	surface bit
TB	transfer block bit
3rdPty	third party reservation bit
UntOfl	unit off-line bit
VU	vendor unique bit
WP	write protect bit

APPENDIX B: UNITS OF MEASURE

Abbreviation	Meaning
A/m	amps per meter
AWG	American wire gauge
bpi	bits per inch
C	Celsius
dBA	decibel, A-weighted
F	Fahrenheit
fci	flux changes per inch
ft	foot
g	gram
Gbyte	gigabyte
Hz	hertz
in.	inch
Kg	kilogram
lb	pound
Mbit	megabit
Mbyte	megabyte
µA	microamp
µm	micrometer
µsec	microsecond
mA	milliamp
mm	millimeter
msec	millisecond
mV	millivolt
nsec	nanosecond
Oe	oersted
RH	relative humidity
rpm	revolutions per minute
W	watt
tpi	tracks per inch
xxb	binary values
xxh	hexadecimal values

LIST OF ABBREVIATIONS

ACK. Acknowledge

ADR. Address

ANSC. American National Standards Committee

ANSI. American National Standards Institute

async. Asynchronous

BCV. Buffer control valid

C/C. Continuous/composite (format)

CCS. Common Command Set

C/D. CONTROL/DATA signal

CDB. Command descriptor block. The structure used to communicate requests from an initiator to a logical unit on the SCSI bus.

cmd. Command

CRC. Cyclic redundancy check

CSA. Canadian Standards Association

DB (7-0, P). Eight data-bit signals, plus a parity-bit signal, that form a DATA BUS.

DC. Direct current

DCR. Disable error correction

DMA. Direct memory access

EBP. Erase bypass

ECC. Error correction code

ECL. Emitter-coupled logic

EDAC. Error detection and correction

EIA. Electrical Industry Association

ENDEC. Encoder/decoder

EPROM. Erasable Programmable Read Only Memory

ERA. Erase all

FCC. Federal Communications Commission

FW. Firmware

G. Constant of gravitation

gnd. Ground

HDA. Head/disk assembly

h. Hexadecimal

hex. Hexadecimal

HW. Hardware

I/O. Input and/or output

ISG. Intersector gap

ISO. International Standardization Organization

LBA. Logical block address

LED. Light-emitting diode

LSB. Least significant bit

LSI. Large-scale integration

LSTTL. Low power Schottky transistor-transistor logic

LUN. Logical unit number, an encoded 3-bit identifier for the logical unit.

µC. Microcomputer

µcomputer. Microcomputer

MFM. Modified frequency modulation (encoding)

MO. Magneto optics

µP. Microprocessor

MSB. Most significant bit

MSG. Message

MTBF. Mean time between failures

MTTR. Mean time to repair

N.C. No connection

nom. Nominal

OEM. Original equipment manufacturer

PC. Polycarbonate

PCB. Printed circuit board

PLL. Phase-locked loop

PLO. Phase-locked oscillator

PM. Preventive maintenance

P/N. Part number

POH. Power-on hours

P-P. Peak to Peak

PROM. Programmable Read Only Memory

ptrn. Pattern

RAM. Random-Access Memory

REQ. Request

RLL. Run-length limited

ROM. Read-only memory

rsrv. Reserved

R/W. Read and/or write

SCSI. Small Computer Systems Interface

std. Standard

SW. Software

sync. Synchronization, synchronous

TBD. To be determined.

TLA. Top level assembly

TTL. Transistor-transistor logic

typ. Typical

UL. Underwriter's Laboratories, Inc.

UNC. Unified National Coarse

UNF. Unified National Fine

VCO. Voltage-controlled oscillator

VDE. Verband Deutscher Electrotechniker

WORM. Write Once Read Multiple

XFER. Transfer

GLOSSARY

arbitration winner. The arbitrating SCSI device which has the highest SCSI address.

assert. A signal driven to the true state.

bit. Binary digit

byte. Eight consecutive binary digits

connect. The function that occurs when an initiator selects a target to start an operation.

disconnect. The function that occurs when a target releases control of the SCSI bus allowing it to go to the BUS FREE phase.

false. A signal value of zero

firmware. Computer programs encoded permanently into a ROM

hard error. An error which is not recoverable by read retries, excluding ECC correction.

initiator. A SCSI device, usually a host system, that requests that an operation be performed by another SCSI device.

INTERMEDIATE status. A status code sent from a target to an initiator upon completion of each command in a set of linked commands, except for the last command in the set.

logical thread. The logical path which exists between an initiator's memory and a bus device LUN, even though the physical path may be disconnected.

logical unit. A physical or virtual device addressable through a target.

negate. A signal driven to the false state

one. True signal value

parity. A method of ensuring the accuracy of byte values

reconnect. The function that occurs when a target selects an initiator to continue an operation after having been disconnected.

reserved. Bits, bytes, fields and code values that are set aside for future standardization.

SCSI address. The representation of the unique address (0 - 7) assigned to a SCSI device.

SCSI ID. The bit-significant representation of the SCSI address, referring to one of the signal lines DB (7 - 0).

status. One byte of information sent from a target to an initiator upon completion of each command.

target. A SCSI device that performs an operation requested by an initiator, in this manual, usually a disk drive.

TBD. To be determined. Values which are not defined as of the date the manual is published.

true. A signal value of one

vendor unique. The bits, fields, or code values that are vendor specific.

zero. False signal value