XT-3000

Product Specification and OEM Manual

MAXTOR

XT - 3000

PRODUCT SPECIFICATION

&

OEM MANUAL

PRELIMINARY DOCUMENT -- SUBJECT TO CHANGE WITHOUT NOTICE

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**************************************************************
* USER NOTE:  Two additional documents may be useful in      *
*             using this manual and the referenced           *
*             hardware.  The Small Computer Systems          *
*             Interface (SCSI) is explicitly defined         *
*             in the American National Standards             *
*             Committee X3T9.2 specification,                *
*             Revision 17-B, dated December 16, 1985.        *
*             The Common Command Set is detailed in          *
*             an associated document designated as           *
*             X3T9.2/85-52:  Addendum 4B to Revision         *
*             Four, dated June 23, 1986.                     *
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1.0 INTRODUCTION

1.1 General Description

The XT-3000™ disk drives are low cost, high capacity, high performance random access storage devices utilizing non-removable 5 1/4-inch disks as storage media. Each disk surface employs one moveable head to access the data tracks. The total unformatted capacity of these disk drives can be either 170 or 280 MB.

The XT-3000 drive family offers the Small Computer System Interface (SCSI) embedded in the drive electronics. Some of the resulting benefits of having an integrated controller include the elimination of a separate controller PCB, reduction in the number of associated cables and elimination of the controller-specific power supply.

Low cost and high performance are achieved through the use of a rotary voice coil actuator and a closed loop servo system utilizing a dedicated servo surface. The innovative **MAXTORQ**™ rotary voice coil actuator provides performance usually achieved only with larger sized, higher powered linear actuators. The closed loop servo system and dedicated servo surface combine to allow state-of-the-art recording densities (1070 tpi, 11,155 bpi) in a 5 1/4-inch package.

High capacity is achieved by a balanced combination of data encoding, high areal density and high density packaging techniques. Maxtor's advanced **MAXPAK**™ electronic packaging techniques utilize miniature, surface mount devices to allow all electronic circuitry to fit on one printed circuit board. Advanced 3380 Whitney-type head flexures and sliders allow closer spacing of disks, allowing a higher number of disks in a 5 1/4-inch package. Maxtor's unique integrated drive motor/spindle design allows a deeper deck casting than conventional designs, thus permitting more disks to be used.

The XT-3000 electrical interface is compatible with the industry standard SCSI peripherals. The XT-3000 size and mounting is also identical to the industry standard 5 1/4-inch minifloppy and Winchester disk drives, and uses the same DC voltages and connectors. No AC power is required.

1.1.1 Key XT-3000 Drive Features:

* Storage capacity of 170 to 280 megabytes unformatted
* Same physical size and mounting as standard 5 1/4-inch Winchester disk drives.
* Power supply requirements compatible with industry standard 5 1/4-inch fixed disk drives
* No AC voltage required.

* Rotary voice coil and closed loop servo system for fast, accurate head positioning.

* Microprocessor controlled servo for fast access times, high reliability, and high density functional packaging.

* Imbedded SCSI controller supporting the industry-standard Common Command Set.

* Thin film metallic media for higher bit density and resolution plus improved durability.

* Single printed circuit board for improved reliability.

* Automatic actuator lock, with dedicated head landing and shipping zone.

* Brushless DC spindle motor inside hub.

* Microprocessor controlled spindle motor for precision speed control ($\pm$ 0.1%) under all load conditions.

* Dynamic braking during power-down cycle.

1.1.2 Key XT-3000 Controller Features

This section contains a summary listing of the standard features for the controller functions of the XT-3000. Each feature has a brief description. Sections 4.1 through 13.2 of this manual contain more detailed information.

FEATURE	DESCRIPTION
BUS TRANSFER RATE	The XT-3000 operates up to 1.5 MBytes per second in asynchronous mode.
DISCONNECT/ RECONNECT SUPPORT	The XT-3000 supports Disconnect/Reconnect to enhance total system performance for multi-tasking operations.
DEVICE INDEPENDENCE AND AUTO CONFIGURATION SUPPORT	The XT-3000 memorizes Host selected parameters, simplifying Host software by providing device independence and auto configure at each Power On sequence.
SCSI BUS PARITY	Jumper selectable. On all data transfers, odd parity is generated and, unless disabled, is checked.
AUTOMATIC LOGICAL UNIT IDENTIFICATION	The XT-3000 defaults to LUN 0.
MULTIPLE DRIVE SUPPORT	The SCSI bus allows up to seven targets and hosts in any combination to be attached on the bus. All devices are daisy-chain connected with a 50-pin cable. The XT-3000 is selectable to be one of the eight devices with the selection address of 0 to 7.

COMMAND QUEUEING	When the XT-3000 is executing a command from a host, but is disconnected from that host, it will accept commands from other hosts.
COMMAND LINKING	Upon successful completion of a command, the XT-3000 allows chaining of commands, which prevents the entering of a new Selection phase.
ERROR RETRY	The XT-3000 does automatic retry on errors (unless disabled by the host).
ERROR REPORTING	The XT-3000 uses Extended Sense error reporting with additional sense codes to further define errors. The host may also define error recovery parameters and reporting via a Mode Select command.
PROGRAMMABLE PARAMETER SUPPORT	The XT-3000 uses the Mode Sense command to specify which parameters the host can modify. This allows the host to modify the system parameters using the Mode Select command.
DATA/COMMAND BUFFER	The XT-3000 is equipped with an 8 KByte Ring Buffer (wrap around).
CONTINUOUS TRANFSER RATE	7.5 Megabits/Second, using 2,7 RLL Encoding.
SYSTEM PERFORMANCE CONSIDERATIONS	The XT-3000 disconnects during implied seeks to maximize the system performance. It uses the ring buffer to allow consecutive sector and track transfers without missing a revolution.
SECTOR INTERLEAVING	One to One or programmable interleaving is supported.

BLOCK OR SECTOR SIZE	The XT-3000 supports 256, 512, 1024 and 2048 byte sectors.
IMPLIED SEEKS	Supported by the XT-3000 with all data transfer commands
LOGICAL BLOCK ADDRESSING	All data transfer commands.
AUTOMATIC HEAD OR CYLINDER SWITCHING	Supported on multi-block data transfers
MULTI-BLOCK TRANSFER	Up to 65,535 blocks per extended command (any block size listed above).

OPTIONAL SECTOR LEVEL DEFECT HANDLING

During the FORMAT operation, the XT-3000 may map out all bad sectors unless disabled by the host.

- Uses the manufacturer defect list.
- Optionally accepts a list of defects from the host.
- Optionally does a verify of the format and maps out any bad sectors found during the format.
- Maintains permanent and dynamic lists of all defects on the disk. The host can read these lists using the Read Defect Data command. The host can select to have the disk use these lists and/or delete the dynamic list during a format.
- Allows the host to determine the number of spare sectors per zone. The zones are variable and can be one track, one cylinder or the whole disk.

ERROR CORRECTION CODES (ECC)

The XT-3000 uses powerful, computer generated polynomial on the data to check transmitted accuracy.

Several options are available:

- Halt or don't halt on correctable ECC error
- Report or don't report correctable ECC errors
- Retry either before or after ECC.
- Number of retries is programmable by the host.

Detection capability: 27 bits

Correction capability: 11 bits

1.1.3 Command Set Summary Supported by XT-3000

COMMAND	CODE (HEX)	CMD LENGTH (BYTES)	*
GROUP 0			
TEST UNIT READY	00	6	R
REZERO UNIT (RECAL)	01	6	O
REQUEST SENSE (EXTENDED)	03	6	R
FORMAT UNIT (WITH OR WITHOUT DEFECT MAPPING)	04	6	R
REASSIGN BLOCKS	07	6	O
READ	08	6	R
WRITE	0A	6	R
SEEK	0B	6	O
INQUIRY	12	6	R
MODE SELECT	15	6	O
RESERVE UNIT	16	6	R
RELEASE UNIT	17	6	R
MODE SENSE	1A	6	O
START/STOP UNIT	1B	6	O
SEND DIAGNOSTIC	1D	6	R
GROUP 1			
READ CAPACITY	25	10	R
READ	28	10	R
WRITE	2A	10	R
SEEK	2B	10	O
WRITE & VERIFY	2E	10	O
VERIFY	2F	10	O
READ DEFECT DATA	37	10	O
WRITE DATA BUFFER	3B	10	O
READ DATA BUFFER	3C	10	O
GROUP 7			
READ LONG	E8	10	O
WRITE LONG	EA	10	O
WRITE PRIMARY DEFECT LIST	FE	10	O

*Required (R), Optional (O)
as defined by Common Command Set Draft Proposal, Revision 4B

1.2 SPECIFICATION SUMMARY

1.2.1 Physical Specifications

Environmental Limits

Ambient Temperature
Operating: 50^{o} to 113^{o} F (10^{o} to 45^{o} C)
Non-Operating: -40^{o} to 140^{o} F (-40^{o} to 60^{o} C)

Maximum Temperature Gradient
Operating or Non-operating:
18^{o} F/hr. (10^{o} C/hr)
below condensation

Relative Humidity: 8 to 95%

Maximum Elevation
Operating: 10,000 ft.
Non-Operating: -1000 ft. to 40,000 ft.

Shock (inputs to the frame of drive)
Operating shock (all axes): 11 ms. pulsewidth (1/2 sine)......2G
Non-operating shock (all axes): 11 ms. pulsewidth (1/2 sine) 20G

Vibration (inputs to frame of drive)
Operating vibration (all axes)
5-25 hz, 0.006 inches p-p
25-500 hz, 0.2G peak acceleration

Non-operating vibration (all axes)
5-31 hz, 0.02 inches p-p
31-500 hz, 1G peak acceleration

DC Power Requirements
+12V ± 5%, 1.57A typical, 4.5A max. (at power on)
+5V ± 5%, 1.7A typical, 1.9A maximum
+5V Maximum Ripple = 50mV P-P
+12V Maximum Ripple = 120mV P-P

Mechanical Dimensions
Height .... 3.25 inches
Width .... 5.75 inches
Depth .... 8.20 inches
Weight .... 6.3 lbs (2.8kg)
Shipping Weight .... 8.0 lbs (3.6kg)

Heat Dissipation
30 watts typical, 35 watts maximum

1.2.2 Performance Specifications

Performance Specifications	XT-3170	XT-3280
Capacity, unformatted		
Per drive (MB)	172.12	286.86
Per surface (MB)	19.12	19.12
Per track (Bytes)	15,624	15,624
Formatted Capacity, 256 byte sectors		
Per drive (MB)	129.72	216.15
Per surface (MB)	14.41	14.41
Per track (Bytes)	11,776	11,776
Per sector (Bytes)	256	256
Sector/track	46	46
Formatted Capacity, 512 byte sectors		
Per drive (MB)	146.64	244.41
Per surface (MB)	16.29	16.29
Per track (Bytes)	13,312	13,312
Per sector (Bytes)	512	512
Sectors/track	26	26
Formatted Capacity, 1024 byte sectors		
Per drive (MB)	157.93	263.71
Per surface (MB)	17.55	17.55
Per track (Bytes)	14,336	14,336
Per sector (Bytes)	1024	1024
Sector/track	14	14
Formatted Capacity, 2048 byte sectors		
Per drive (MB)	157.93	263.71
Per surface (MB)	17.55	17.55
Per track (Bytes)	14,336	14,336
Per sector (Bytes)	2048	2048
Sector/track	7	7

SCSI Bus Transfer Rate, MBytes/sec ------1.5----------

Seek Time, msec, maximum

Average*	------30-----------
Track-to-track*	--------4-----------
Maximum*	------54-----------

* Includes settling

1.2.3 Functional Specifications

Rotational Speed (rpm) *	3600	
Recording density (bpi)	16,732	
Flux Density (fci)	11,155	
Track density	1070	
Cylinders	1224	
Tracks	11,016	18,360
Data heads	9	15
Servo heads	1	1
Disks	5	8

* Accurate to +0, -0.2%

1.2.4 Reliability Specifications:

MTBF .... 20,000 POH, typical usage
PM .... Not required
MTTR .... 30 minutes
Component Design Life .... 5 years

1.2.5 Error Rates at the SCSI Interface

Soft read errors ....less than 10 per 10^{11} bits read
Hard read errors ....less than 10 per 10^{13} bits read
Seek errors ....less than 10 per 10^{7} seeks
Error Correction Capability ....11 bits
Error Detection Capability ....27 bits

2.0 FUNCTIONAL CHARACTERISTICS

2.1 General Theory of Operation

The XT-3000 disk drive consists of read/write, control and Small Computer Systems Interface (SCSI) interface electronics, read/write heads, a servo head, a head positioning actuator, media, and an air filtration system. The components perform the following functions:

1. Interpret and generate control signals.
2. Position the heads over the desired track.
3. Read and write data.
4. Provide automatic error correction to the data.
5. Provide a contamination free environment.

2.2 Read/Write Control and SCSI Controller Electronics

All the drive and controller electronics are packaged on a single printed circuit board. This board, which includes three microprocessors, performs both traditional drive and controller functions:

Drive Functions

1. Reading/writing of data
2. Index detection
3. Head positioning
4. Head selection
5. Drive selection
6. Fault detection
7. Voice coil actuator drive circuitry
8. Track 0 detection
9. Recalibration to track 0 on power-up
10. Track position counter
11. Power and speed control for spindle drive motor
12. Braking for the spindle drive motor
13. Drive up-to-speed indication
14. Reduced write current on the inner tracks
15. Monitoring for write fault conditions
16. Control of all internal timing
17. Generation of seek complete signals

Controller Functions

1. Data separation
2. Error correction and reporting
3. SCSI bus disconnect/reconnect functions
4. SCSI bus arbitration
5. Defect handling
6. Information transfer management
7. Automatic retries
8. Data Buffering
9. Command Queueing
10. Command Linking

2.3 Drive Mechanism

A brushless DC drive motor contained within the spindle hub rotates the spindle at 3600 rpm. The spindle is direct driven with no belt or pulleys being used. The motor and spindle are dynamically balanced to insure a low vibration level. Dynamic braking is used to quickly stop the spindle motor when power is removed. The head/disk assembly is shock-mounted to minimize transmission of vibration through the chassis or frame.

2.4 Air Filtration System (Figure 2-1)

The disks and read/write heads are assembled in an ultra clean-air environment and then sealed within the module. The module contains an internal absolute filter mounted inside the casting to provide constant internal air filtration. A second filter, located on the enclosure top cover, permits pressure equalization between internal air and ambient air.

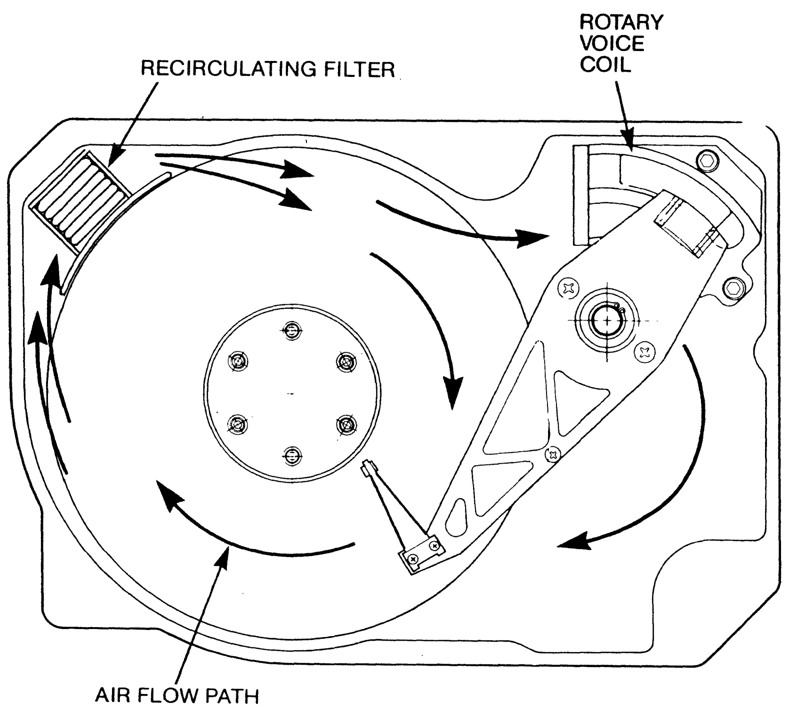

Figure 2-1

XT-3000 Air Filtration System

2.5 Positioning Mechanism (Figure 2-2)

The read/write heads are mounted on a head arm assembly which is then mounted to a ball-bearing supported shaft. 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, causes 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. Since the head-arm assemblies are mounted to the voice coil, the voice coil movement is translated through the pivot point directly to the heads and achieves positioning over the desired cylinder.

Actuator movement is controlled by the servo feed-back signal from the servo head. The servo head is located on the lower surface of the bottom disk, where servo information is pre-written at the factory. This servo information is used as a control signal for the actuator to provide track-crossing signals during a seek operation, track-following signals during ON CYLINDER operation, and timing information such as index and servo clock.

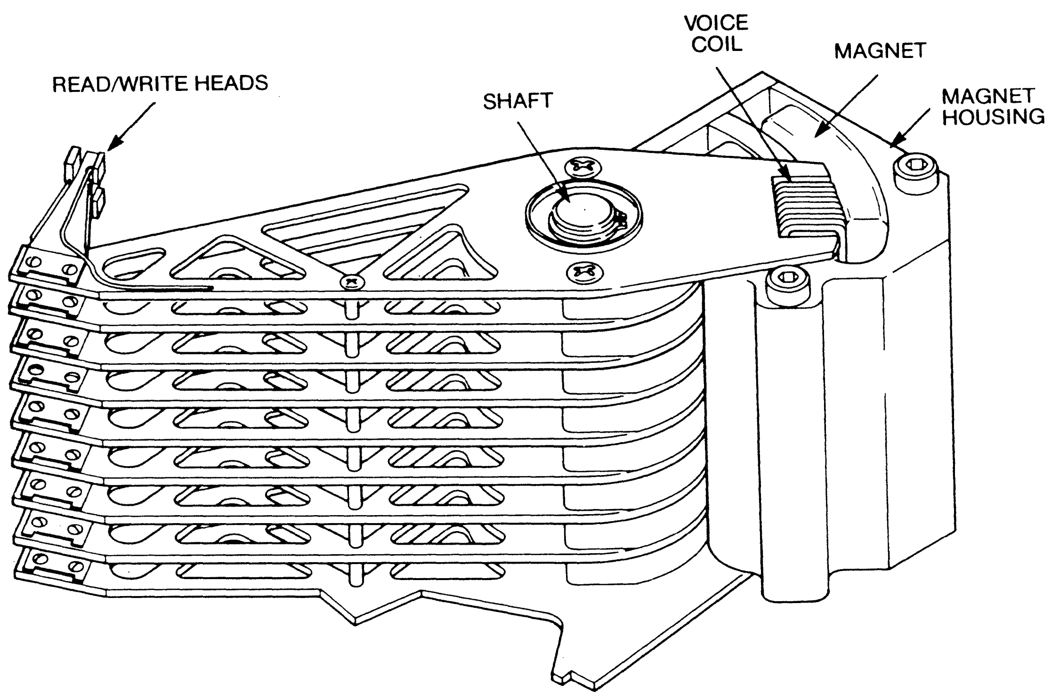

Figure 2-2

XT-3000 Head Positioning System

2.6 Read/Write Heads and Disks

The XT-3000 employs state-of-the-art 3380 Whitney-type head sliders and flexures. The Whitney type sliders and flexures provide improved aerodynamic stability, superior head/disk compliance and a higher signal-to-noise ratio.

The XT-3000 media utilizes thin metallic film deposited on 130mm diameter aluminum substrates. The coating formulation together with the low load-force/low mass Whitney-type heads permits highly reliable contact start/stop operation. The nickel-cobalt metallic film yields high amplitude signals, and very high resolution performance compared to conventional oxide coated media. The metallic media also provides a highly abrasion-resistant surface, decreasing the potential for damage caused by shipping shock and vibration.

Data on each of the data surfaces is read by one read/write head, each of which accesses 1224 tracks. There is one surface dedicated to servo information in each drive.

2.7 SCSI Host Interface

The SCSI host interface offers a number of unique advantages which facilitate the interconnection of the XT-3000 with one (or more) computer systems. Unlike traditional microcomputer disk interfaces, such as ST-506, SCSI supports multiple peripherals all operating on the same bus structure. Figure 2-3 shows an example of typical configuration geometry.

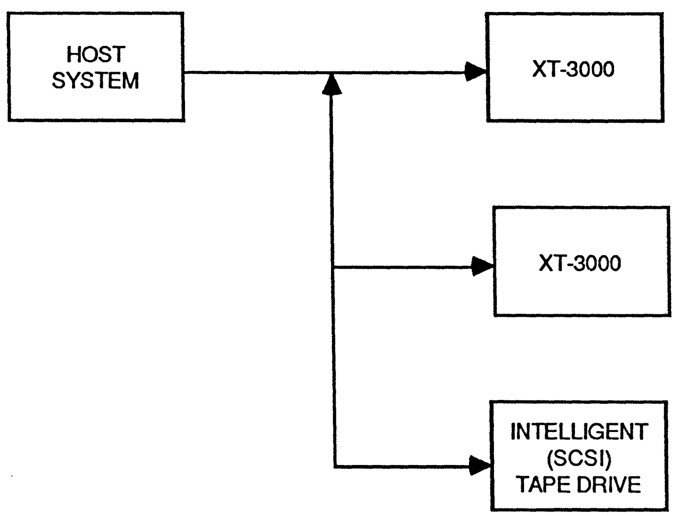

Figure 2-3

Typical SCSI Configuration Geometry -- Single Host System

The XT-3000 also supports multiple master configurations (see Figure 2-4) consistent with the established arbitration (or voting) cycle outlined in the SCSI standards. The only hardware change required is for the XT-3000 SCSI address jumpers to be manually set (Jumper settings are covered in Section 5.0.) when the disk drive is installed in the system.

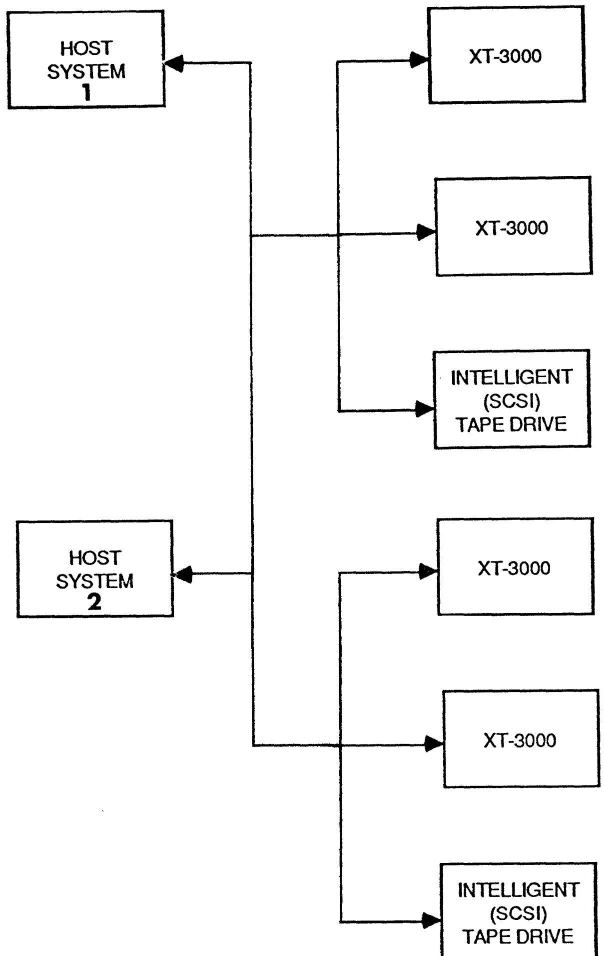

Figure 2-4

Typical SCSI Configuration Geometry -- Multiple Master Configuration

The SCSI implementation used on the XT-3000 is intended to facilitate large data transfers between the host system and the disk drive. Interconnection between the host system(s) and the XT-3000 is via a 50-pin ribbon cable which may be up to 6 meters.

The SCSI bus uses 18 signals (discussed in detail in Sections 3.5 and 3.6). Nine signals are for the eight-bit data bus with one data parity bit; the other nine signals are control lines which help the XT-3000 coordinate bus access and transfers of commands, data, status and messages.

3.0 XT-3000 PCB JUMPER OPTIONS

3.1 SCSI Controller ID Jumpers (JP 83, JP 84, JP 85)

In multiple SCSI device configurations, it is necessary to configure each device with a priority. The priority identification for each drive is determined by the three (3) jumpers designated JP 83, JP 84 and JP 85, shown below in Figure 3-1. An ID of 7 is the highest priority in a multi-device configuration. Figure 3-2 provides a convenient reference table of priority values.

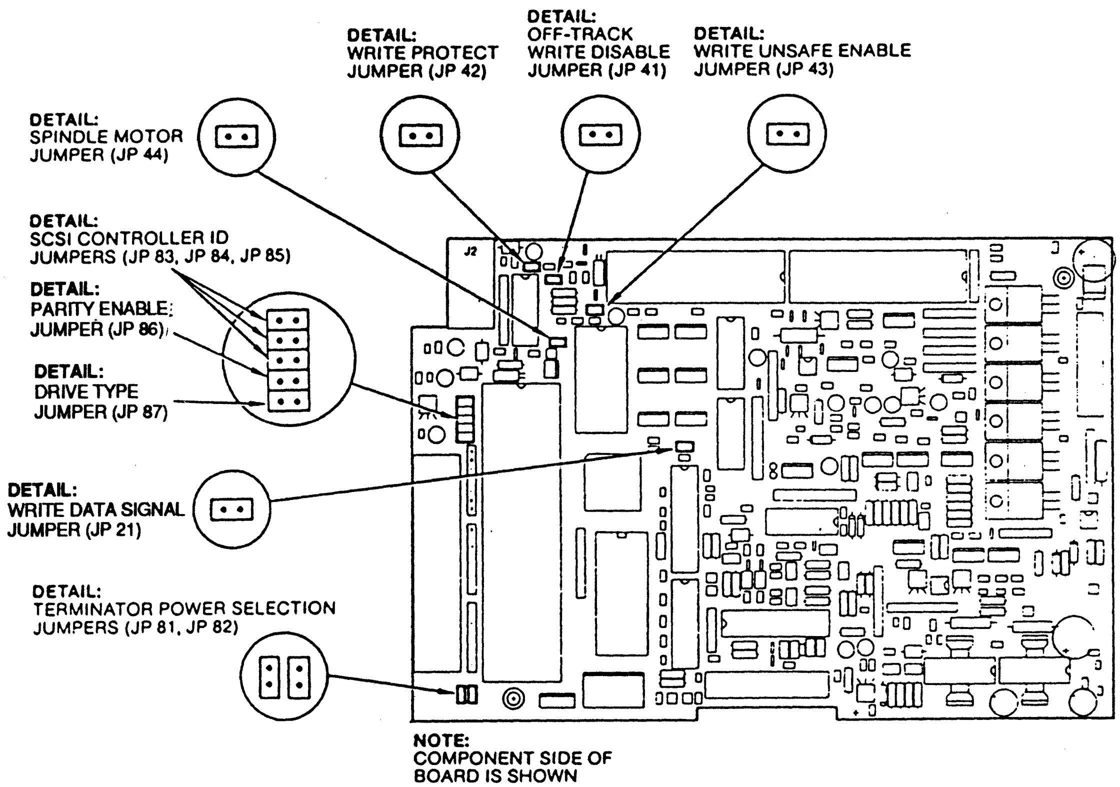

Figure 3-1

XT-3000 Drive Jumper Options

As shipped from the factory, all the jumpers are open, giving the XT-3000 a priority value/ID of zero.

Jumper	JP 85	JP 84	JP 83	Controller ID
	shorted	shorted	shorted	7
	shorted	shorted	open	6
	shorted	open	shorted	5
	shorted	open	open	4
	open	shorted	shorted	3
	open	shorted	open	2
	open	open	shorted	1
	open	open	open	0

Figure 3-2

SCSI Controller ID Jumpers

3.2 Spindle Motor Jumper (JP 44)

When installed, the motor will start as soon as power is applied. When removed, the ID value will be used to facilitate a sequential drive power-up process. The spindle motor turn-on, after power-up, is delayed by 13 seconds for each priority ID level as shown in Figure 3-3 below.

CONTROLLER ID	MOTOR ON DELAY
0	0 SECONDS
1	13 SECONDS
2	26 SECONDS
3	39 SECONDS
4	52 SECONDS
5	65 SECONDS
6	78 SECONDS
7	97 SECONDS

Figure 3-3

Sequential Motor Delay Table

This technique is used to reduce the instantaneous load on the power supply when it is handling more than one drive.

Once the drive is under power, the motor start/stop command ($1B_H$) can be used to stop and start the drive.

3.3 SCSI Bus Parity Jumper (JP 86)

Located near the SCSI connector, the parity jumper acts to enable (shorted) or disable (open) parity operation for the XT-3000. As shipped the XT-3000 has bus parity enabled (shorted).

3.4 Drive Type (JP 87)

Located near the SCSI connector, the drive type jumper allows the XT-3000 to report out over the interface the model of the drive in response to the Inquiry Command. This feature allows the host to query the controller portion of the drive even if the disks are not spinning, as would be the case if the drive motor had not been started. With the jumper installed, the drive reports its type as an XT-3170 (170 MB); if the jumper is removed, the drive reports as a XT-3280 (280 MB). This jumper is also used to set the default values of unsaved selectable mode parameters.

3.5 Terminator Power Jumpers (JP 81, JP 82)

Located between the 50-pin SCSI connector and the corner of the PCB, are the two terminator power jumpers. If JP 81 is shorted, the terminator power is internal. If JP 82 is shorted, the terminator power is from the host. As shipped, JP 81 is installed (shorted).

3.6 Write Data Jumper (JP 21)

This test jumper is located near the middle of the PCB. It is used for test purposes in the manufacturing process. As shipped from the factory, this jumper is installed (shorted).

3.7 Write Unsafe Enable Jumper (JP 43)

This jumper is located near the J2 power connector. When removed, it enables the write unsafe circuitry. As shipped from the factory, this jumper is installed (shorted).

3.8 Off-track Write Disable Jumper (JP 41)

Also located by the J2 power connector, the off-track jumper, when installed, acts to prevent the drive from writing during an off-track condition. As shipped from the factory, this jumper is installed (shorted).

3.9 Write Protect Jumper (JP 42)

Located very close to the J2 power connector and the corner of the PCB, the write protect jumper is used to protect the data written to the XT-3000. When the jumper is installed (shorted), data cannot be written on the drive; only read operations can be executed. As shipped from factory, the jumper is removed (open) allowing normal reading/writing.

4.0 TRACK AND SECTOR FORMAT

4.1 Track Format

The standard track format is organized into numbered data segments, or sectors (See Figure 4-1 and 4-2). The nominal track capacity is 15,624 bytes. The method of encoding used is 2,7 Run Length Limited (RLL) Encoding.

```
---------------------------------------------------------------
|INDEX GAP | GAP1 | ID FIELD | GAP2 | DATA FIELD | GAP3 | GAP4|
---------------------------------------------------------------
           |                                            |
           |<--------------One SECTOR---------------->|
                      (repeated n times)
```

Figure 4-1

XT-3000 Sector Track Format

4.2 Sector ID Field

The beginning of each sector is defined by a prewritten identification (ID) field. This five byte field is registered during the Format operation, and contains the Cylinder Address (MSB), Cylinder Address (LSB), Head Address, the Sector Address, and the Flag byte. A 2 byte CRC is used to detect any errors in the ID field.

BYTE	CONTENTS
1	A1 Address Mark (Drop Clock Bit)*
2	FE Address Mark
3	Cylinder (MSB)
4	Cylinder (LSB)
5	Head
6	Sector
7	Flag
8-9	CRC
10-11	Zero

Figure 4-2

Sector ID Field

4.3 Sector or Block Data Field

The second field contains the user data bytes, selectable at 256, 512, 1024 or 2048 bytes per sector or block. The format for this field varies with the field size (See Figure 6-3). The data field uses a powerful computer generated 48 bit Error Correcting Code to detect and correct errors in the data field.

256 BYTE DATA FIELD

BYTE	CONTENTS
1	A1 *
2	F8
3-258	User Data Field (256 Bytes)
259-264	ECC (48 bits)

512 BYTE DATA FIELD

BYTE	CONTENTS
1	A1 *
2	F8
3-514	User Data Field (512 Bytes)
515-520	ECC (48 Bits)

1024 BYTE DATA FIELD

BYTE	CONTENTS
1	A1 *
2	F8
3-1026	User Data Field (1024 Bytes)
1027-1032	ECC (48 Bits)

2048 BYTE DATA FIELD

BYTE	CONTENTS
1	A1 *
2	F8
3-2051	User Data Field (2048 Bytes)
2052-2057	ECC (48 Bits)

* = Drop Clock Bit

Figure 4-3

Sector or Block Data Field

4.4 Soft Sectored Gaps

For the XT-3000, the sector track format begins with an Index gap and ends with a Speed Tolerance gap. Each sector contains three gaps. Figure 4-4 illustrates this format.

INDEX GAP	= 11 Bytes of 4E Head Switching Recovery Period
GAP 1	= 12 Bytes of 00 Sync for ID Field
GAP 2	= 12 Bytes of 00 Write Update Splice and Sync for Data Field
GAP 3	= xx Bytes of 4E Speed Tolerance for the sector
	= 36 or 24_H Bytes of 4E (Block size less than 2000 Bytes/Sector)
	= 44 or $2C_H$ Bytes of 4E (Block size greater than 2000 Bytes/Sector)
GAP 4	= xxx Bytes of Speed Tolerance for the track

Figure 4-4

Soft Sector Gaps

5.0 FUNCTIONAL DESCRIPTION

5.1 Power Sequencing

DC power (+5V and +12V) may be supplied to the drive in any order, but +12VDC is required to start the spindle motor. When the spindle reaches full speed, the actuator lock automatically disengages and the heads then recalibrate to track 0. The recalibration sequence typically takes a maximum of 2.2 seconds to complete. The XT-3000 will spin up and come ready in 20 seconds or less. The drive executes its spin-up sequence whenever power is applied or the SCSI start/stop command is invoked, via the SCSI bus. A sequential drive power-up is possible with the XT-3000 and depends upon the controller ID value. This feature is covered in more detail in Section 3.2. NOTE: Audible noise during a recalibration sequence is normal.

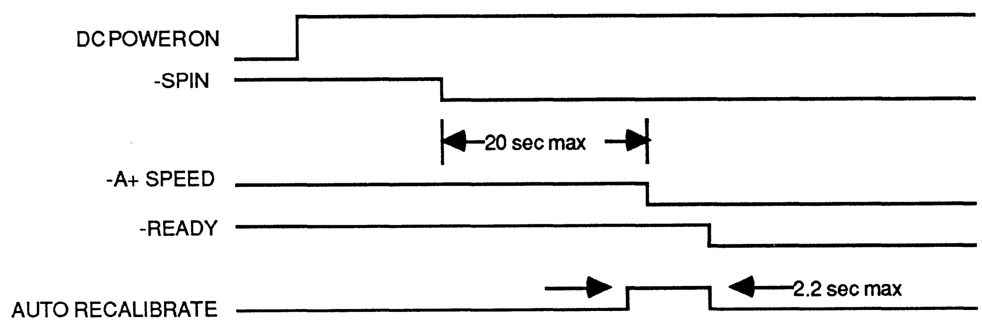

Figure 5-1

Power-Up Sequence

5.2 Electrical Interface

The interface to the XT-3000 can be divided into two categories, each of which is physically separated:

(1) SCSI bus
(2) DC Power

Across the SCSI bus all host computer signals are negative true. The signals are "ASSERTED" or active at 0 to 0.4 VDC and "DEASSERTED" or inactive at 2.5 to 5.25 VDC.

5.3 Interface Termination

As shipped, all assigned interface signal lines are terminated with a removable 220/330 ohm resistor network. The first device and the last device (Host or Controller) on the daisy-chain SCSI bus must be terminated. Remove the terminators from any devices in between. For instance, if the XT-3000 is in the middle of the string, remove its terminators. (Any host adapters being used should be terminated in a similar fashion.)

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

Devices receiving the drive outputs should be of "SCHMITT" trigger type to improve noise immunity, 74LS14, 74LS240 or equivalent. The host adapter should not load the bus with more than one standard LSTTL input load per line, and should terminate the drive output signals with 220/330 ohm terminators.

The XT-3000 terminators are shown below in Figure 5-2.

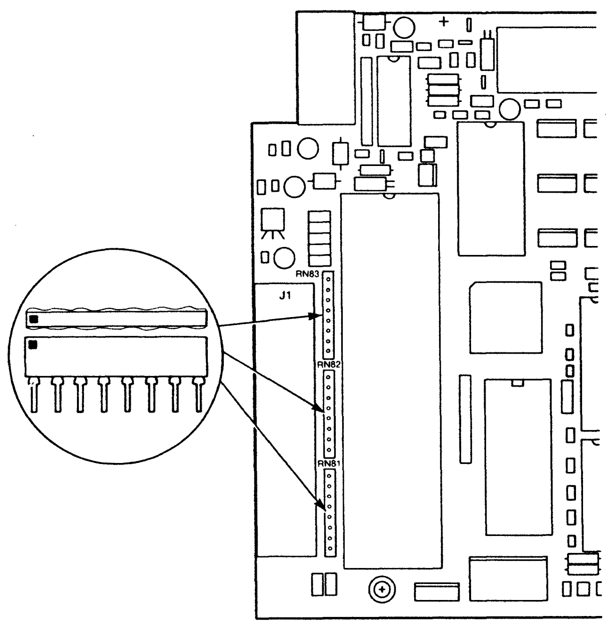

Figure 5-2

SCSI Bus Terminations

5.4 Signal Interface

The host computer interface signals are as shown below. All signals are low true.

	Pin Number		Signal	Driven By
GND	1	2	-DATA BIT 0 (DB0)	H + D
	3	4	-DATA BIT 1 (DB1)	H + D
	5	6	-DATA BIT 2 (DB2)	H + D
	7	8	-DATA BIT 3 (DB3)	H + D
	9	10	-DATA BIT 4 (DB4)	H + D
	11	12	-DATA BIT 5 (DB5)	H + D
	13	14	-DATA BIT 6 (DB6)	H + D
	15	16	-DATA BIT 7 (DB7)	H + D
	17	18	-DATA PARITY (DBP)	H + D
	19	20	OPEN	
	21	22	OPEN	
	23	24	OPEN	
	25	26	POWER TERMINATION	H or D
	27	28	OPEN	
	29	30	OPEN	
	31	32	-ATTENTION (ATN)	H
	33	34	OPEN	
	35	36	-BUSY (BSY)	H + D
	37	38	-ACKNOWLEDGE (ACK)	H
	39	40	-RESET (RST)	H + D
	41	42	-MESSAGE (MSG)	D
	43	44	-SELECT (SEL)	H + D
	45	46	-CONTROL / DATA (C/D)	D
	47	48	-REQUEST (REQ)	D
GND	49	50	-INPUT / OUTPUT (I/O)	D

Key: H = Host, D = Drive

5.5 Signal Definitions

- RESET (RST)

"OR Tied" signal asserted by the host, causes the XT-3000 to do a hard reset, execute its self test, self configure and return to the idle condition. This signal is normally used during a power-up sequence. The RESET pulse should be at least twenty-five microseconds wide to allow the XT-3000's microprocessor to execute this function properly.

- SELECT (SEL)

Asserted by the host, along with a single drive address bit (0 through 7), causes the appropriate drive to be selected. The SELECT line must be deasserted by the host after the drive asserts the BUSY line in response to a proper selection. Asserted by the arbitrator (host or XT-3000 drive) in the arbitration phase. Asserted by the XT-3000 during the reselection phase. Details are covered under selection phase operation in Section 7.3.

- BUSY (BUS)

"OR Tied" signal asserted by the XT-3000 indicates that the bus is being used. Asserted by the arbitrator during the arbitration phase. Also asserted by the host and the XT-3000 drive during the reselection phase.

- CONTROL/DATA (C/D)

Signal asserted by the XT-3000 indicates that command, status or message information is to be transferred on the data bus. Deassertion of this line indicates that data information is to be transferred on the data bus.

- INPUT/OUTPUT (I/O)

Signal asserted by the XT-3000 indicates that information will be transferred to the host from the drive. Deassertion indicates that information will be transferred to the drive from the host.

- REQUEST (REQ)

Signal asserted by the XT-3000 indicates that an 8-bit byte is to be transferred on the data bus. REQUEST is deasserted following assertion of the ACKNOWLEDGE line.

- ACKNOWLEDGE (ACK)

Signal asserted by the host, following the assertion of the REQUEST line, indicates data has been accepted by the host or that data is ready to be transferred from the host to the XT-3000. ACKNOWLEDGE is deasserted following deassertion of the REQUEST line.

- ATTENTION (ATN)

Signal asserted by the host to indicate the attention condition, which is a request by the host for the XT-3000 to enter the Message out phase.

- MESSAGE (MSG)

Signal asserted by the XT-3000 during the Message phase.

- DATA BITS 0-7 (DBO-7) & PARITY

The 8 bidirectional data and odd parity lines are used to transfer 8-bit parallel data to/from the host computer. Bit 7 is the most significant bit. Bits 0 through 7 are also used as SCSI ID bits during the arbitration, selection and reselection phases.

6.0 HOST INTERFACE PROTOCOL

For detailed information about the SCSI Interface Protocol, refer to the SCSI specifications as per ANSC X3T9.2/82-2, Revision 17.B minimum and to the Common Command Set Revision 4-A as agreed to by the ANSI subcommittee on Direct Access Devices.

The SCSI architecture includes 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 SCSI bus can never be in more than one phase at any given time.

Bus Signal					
MES-SAGE	COMMAND/ DATA	INPUT/ OUPUT	Phase Name	Direction Of Transfer	Comment
1	1	1	DATA OUT	Host to drive \	Data
1	1	0	DATA IN	Host from drive /	Phase
1	0	1	COMMAND	Host to drive	
1	0	0	STATUS	Host from drive	
0	1	1	*		
0	1	0	*		
0	0	1	MESSAGE OUT	Host to drive \	Message
0	0	0	MESSAGE IN	Host from drive /	Phase

Key: 1 = False, 0 = True, * = Reserved
All lines are low true.

Figure 6-1

Information Transfer Phases

6.1 Bus Free Phase

The BUS FREE phase (-SEL=1, -BSY=1) 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 In phases (i.e., 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 a host or drive. The arbitrating device waits for the BUS FREE phase to occur. It then asserts its own SCSI ID bit and BSY. The arbitrating device then examines the data bus. If a higher priority SCSI ID bit exists on the data bus, the arbitrating device has lost arbitration and it releases BSY and the data bus. Otherwise, the arbitrating device has won arbitration and it asserts SEL.

NOTE: Implementation of the ARBITRATION phase is a system option. Systems that do not implement this option can have only one initiator. The ARBITRATION phase is required for systems that use the disconnect/reconnect feature.

6.3 Selection Phase

If the host has won arbitration, it will enter the selection phase by continuing to assert its own host SCSI ID bit and asserting the drive's SCSI ID bit. The host then deasserts BSY (SEL remains asserted by the host). Typically, in arbitrating systems, the host asserts the ATN line prior to the deassertion of BSY.

If the host does not support arbitration, then the selection phase is entered from the bus free phase. The host asserts only the drive's SCSI ID bit and asserts SEL.

During the selection phase, the drive maintains a deasserted 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).

If two or more ID's are asserted on the DATA BUS or parity is enabled and bad parity is detected, the drive will not respond to the select.

After detecting it has been selected, the drive will assert BUSY. At this point, the host must deassert SEL and may remove the ID's from the DATA BUS.

NOTE: Upon power-on reset (or bus reset), the drive will execute a comprehensive self test and self configuration. During this period the controller will respond to any selects with BUSY status.

T = Target (XT-3000), I = Initiator (Host)

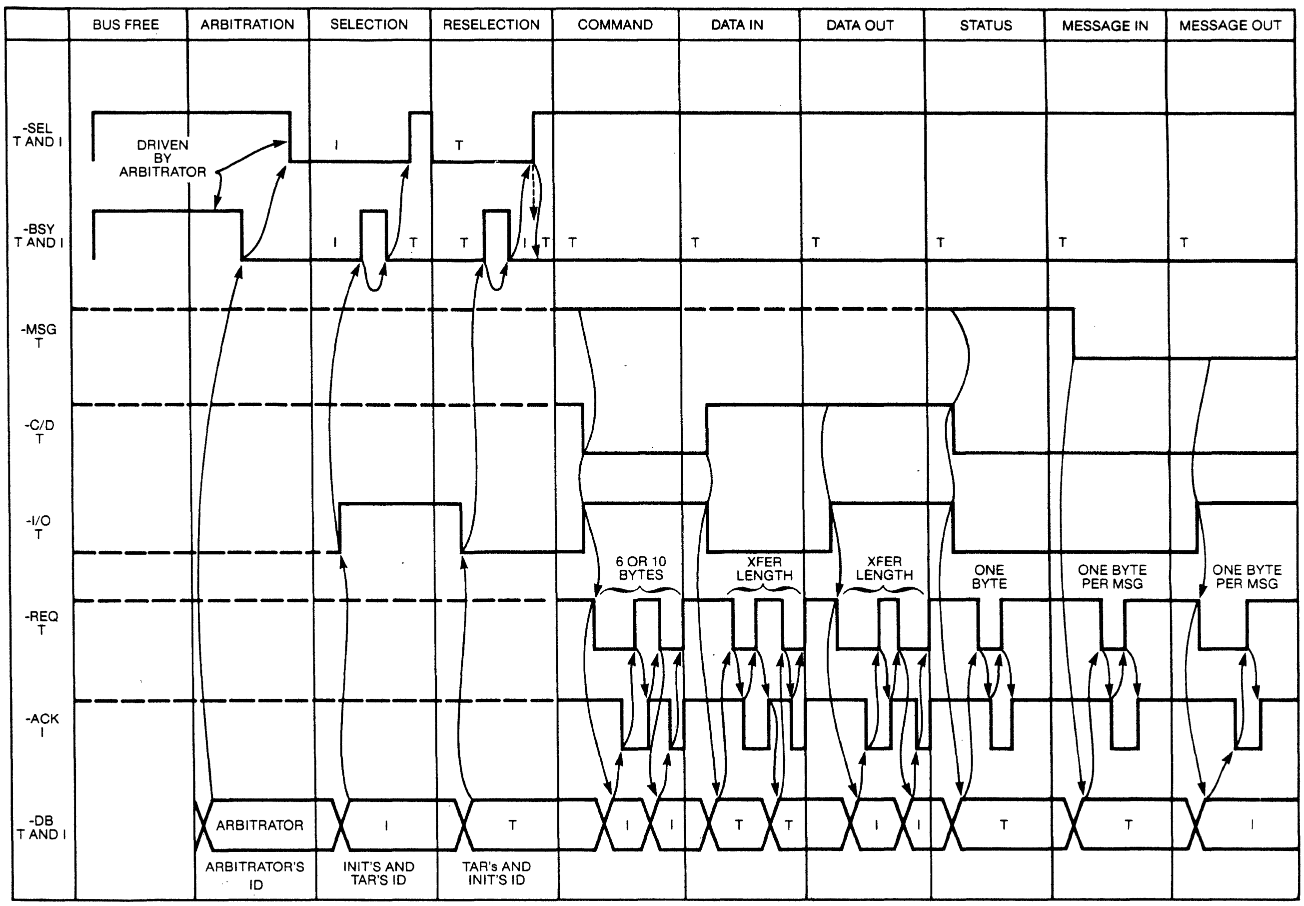

Figure 6.2

Signal Sequence Chart for SCSI Phases

6.4 Message Out Phase

After being selected, the drive will go to the MESSAGE OUT phase. If the host has ATN asserted, the drive will request a message from the host by asserting REQ. The first message is expected to be an IDENTIFY message, but the drive will accept a BUS DEVICE RESET or ABORT message. If any other message is received, the drive will go to the BUS FREE phase. (Section 7.9 provides additional information.)

If, during the selection, the host did not assert its ID on the bus, the drive will not examine the ATN signal. The drive will assume the host cannot support any message except COMMAND COMPLETE and does not support DISCONNECT/RECONNECT. The drive will also assume the host ID is zero and will save any status for that host as host zero.

If, during the selection phase, the host asserted its ID on the bus, the drive will examine the ATN signal. If ATN is asserted (in a typical arbitrating system, it will be asserted), the drive responds to the attention condition by entering the MESSAGE OUT phase. (-MSG=0, -C/D=0, -I/O=1). (See Figure 6-1.)

6.5 Command Phase

After being selected and processing the IDENTIFY message, if any, the drive will normally switch to the COMMAND phase, (-C/D=0, -MSG=1 and -I/O=1). The 6 or 10 bytes of command information (Command Descriptor Block) are transferred from the host to the drive.

If enabled, parity is checked on each command byte. If bad parity is detected, the command will be aborted. The drive will switch to the STATUS phase, return a "Check Condition" status and set the Sense Key/Error code to "Aborted Command/Parity Error" for that host. The drive will then switch to the MESSAGE phase and return a COMMAND COMPLETE message and go to the BUS FREE phase.

After each command byte transfer, the ATN bit is checked; if set, the drive will switch to the MESSAGE OUT phase, receive, then act on the message.

The commands are transferred under the control of a microprocessor on the drive and the timing will vary depending on the state of the drive. Additional command information is provided in Sections 10.0 and 11.0 of this manual.

6.6 Data In and Data Out Phases

In commands that require a Data Phase (Read, Write, Mode Select, etc.), the drive will enter a Data Phase. During the Data In Phase (-I/O=0, -C/D=1, -MSG=1), data is transferred from the drive to the host. The Data Out Phase (-I/O=1, -C/D=1, -MSG=1) reverse the process: data is transferred from the host to the drive.

The data block transfers are handled by the DMA directly between the SCSI bus and the buffer.

The time required to change phases and to initiate DMA transfers is command dependent. It also depends on which other commands and processes are in progress at the time.

The drive checks to see if bus parity is enabled, after each block or group of blocks is transferred to the drive. If bad parity is detected, the command will be aborted. The controller will switch to the STATUS phase, return a "Check Condition" status and set the Sense Key/Error code to "Aborted Command/Parity Error" for that host. The drive will then switch to the MESSAGE phase and return a COMMAND COMPLETE message and go to the BUS FREE phase.

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

6.7 Status Phase

The drive switches to the STATUS phase (-I/O=0, -C/D=0, -MSG=1) and returns the status byte to the host after completing, successfully or unsuccessfully as indicated by the status byte, any command. The drive also switches to the status phase for reporting busy status and reservation conflict status. The drive does not go to the STATUS phase under certain conditions, such as BUS DEVICE RESET and ABORT messages. Following the status phase, the drive enters the message phase.

The XT-3000 will send a status byte to the host during the STATUS phase at the termination of each command as specified in the following table unless the command is cleared by an ABORT message, by a BUS DEVICE RESET message, by a "hard" RESET condition, or by a hardware error in the drive.

Bits of Status Byte									
7	6	5	4	3	2	1	0	HEX	Status(es) Represented
0	0	0	0	0	0	0	0	00	GOOD
0	0	0	0	0	0	1	0	02	CHECK CONDITION
0	0	0	0	1	0	0	0	08	BUSY
0	0	0	1	0	0	0	0	10	INTERMEDIATE/GOOD
0	0	0	1	1	0	0	0	18	RESERVATION CONFLICT

A description of the status byte codes is given below:

GOOD. This status indicates that the XT-3000 has successfully completed the command.

CHECK CONDITION. Any error, exception, or abnormal condition that causes sense data to be set, shall cause a CHECK CONDITION status. The REQUEST SENSE command should be issued following a CHECK CONDITION status, to determine the nature of the condition. Note that if any other command is issued followng a CHECK CONDITION, the sense status will be lost.

BUSY. The XT-3000 is busy. The drive will return 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 after being powered up or reset.

INTERMEDIATE/GOOD. This status is to be 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 this 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 a host attempts to access the drive that is reserved by another host.

Figure 6-3

Status Byte Code Bit Values

6.8 Reselection Phase

After disconnecting to free the bus for other activity, the drive will reconnect when it is ready to transfer data or status across the bus. The drive will arbitrate for the bus and, if it wins, it will reselect the host. (Additional information on arbitration is provided in Section 7.2.) Reselection is very similar to the selection phase except that the I/O signal line is asserted. The drive also asserts its own SCSI ID bit and the SCSI ID bit of the host which is being reselected. The drive releases BSY (BSY was already asserted during arbitration) and continues to assert SEL. The host 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 host and the drive are holding the BSY signal low.) The drive then releases SEL and the host responds by releasing BSY. (BSY is still being asserted by the drive.) (Refer to Figure 7.2)

After reselecting the host, the drive will send an IDENTIFY message to identify itself to the host.

If the host does not respond to the reselection within a Selection Timeout Delay (250 milliseconds), the drive will release the bus and then rearbitrate for the bus trying to reselect the host again. It will do this until the host responds or the drive is reset. The drive will respond to selects from the same (or other) hosts between reselection retries.

6.9 Message in and Message out Phases

This section describes the messages the Maxtor XT-3000 drive supports.

During the Message In (-I/O=0, -C/D=0, -MSG=0) Phase, a message is transferred from the drive to the host. The drive may enter this phase at any time. During the Message Out phase (-I/O=1, -C/D=0, -MSG=0), a message is transferred from the host to the drive. The host requests the drive to enter the Message Out phase by asserting the ATN line. The drive frequently monitors the ATN line and will enter the Message Out phase at its earliest convenience, in response to the host's assertion of ATN.

Code	Description	Direction
00	COMMAND COMPLETE	to host
02	SAVE DATA POINTERS	to host
03	RESTORE POINTERS	to host
04	DISCONNECT	to host
05	INITATOR DETECTED ERROR	to disk
06	ABORT	to disk
07	MESSAGE REJECT	both ways
08	NO OPERATION	to disk
09	MESSAGE PARITY ERROR	to disk
0A	LINKED COMMAND COMPLETE	to host
0B	LINKED COMMAND COMPLETE(FLAG)	to host
0C	BUS DEVICE RESET	to disk
8X	IDENTIFY	both ways

Figure 6-4

XT-3000 Message Codes

6.9.1 COMMAND COMPLETE (00). This message is sent from the drive to the host 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 host. After sending this message successfully, the drive goes to the BUS FREE phase by releasing BSY.

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

If the host rejects this message with a MESSAGE REJECT, the drive will go to the bus free phase and not consider this an error.

6.9.2 SAVE DATA POINTER (02). This message is sent before every DISCONNECT message, when doing disconnects. If the host rejects this message with a MESSAGE REJECT, the drive will not disconnect.

6.9.3 RESTORE POINTERS (03). This message is sent from the drive to direct the host. It 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 shall be restored to the active pointers. Command and status pointers should be restored to the beginning of the present command and status areas. The data pointer should be 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 host rejects this message with a MESSAGE REJECT, the drive will immediately terminate the present command with a "CHECK CONDITION" status and set the Sense Key/Error Code to "HARDWARE ERROR/MESSAGE REJECT ERROR" for that host.

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

6.9.4 DISCONNECT (04). This message is sent from the drive to inform the host that the present physical path will be broken (the drive plans to disconnect by releasing BSY), but that a later reconnect will be required in order to complete the current operation. This message will not cause the host to save the data pointer.

If the host rejects this message with a MESSAGE REJECT, the drive will not disconnect.

6.9.5 ABORT (06). This message is sent from the host to the drive to clear the present operation. If a logical unit has been identified, all pending data and status for the issuing host from the affected logical unit will be cleared, and the drive will go to BUS FREE phase. Pending data and status for other hosts will not be cleared. If a logical unit has not been identified, the drive will go to BUS FREE phase. No status or ending message will be 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 host.

NOTE: Abort also clears any operations the host has pending. Status will not be returned and no reconnects will be done for pending commands.

6.9.6 MESSAGE REJECT (07). This message is sent from either the INITIATOR or drive to indicate the last message received was inappropriate or has not been implemented.

In order to indicate its intentions of sending this message, the host should assert ATN prior to its release of ACK for the handshake of the message to be rejected. When the drive sends this message, it will change to MESSAGE IN phase and send this message prior to requesting additional message bytes from the host. This provides an interlock so that the host can determine which message is rejected.

If the host responds to this message with a MESSAGE REJECT message, the drive will immediately terminate the present command with a "Check Condition" status and set the Sense Key/Error Code to "Hardware Error/Message Reject Error" for that host.

6.9.7 NO OPERATION (08). The host sends this message when it has no valid message for the drive request.

The drive receives and ignores this message.

6.9.8 MESSAGE PARITY ERROR (09). The host sends this message to indicate a parity error on one or more bytes of the last message sent from the drive. The host should assert ATN prior to release of ACK for the last byte of the message in error, so that the drive knows which message is in error. The drive will resend the message a second time. If the MESSAGE PARITY ERROR is received again the disk will go to the Bus Free Phase and will abort the current command for that INITIATOR. No further reconnection will be attempted and no status or Command Complete message will be returned for the command. The Sense Key/Error Code will be set to "Aborted Command/Parity Error" for that host.

6.9.9 LINKED COMMAND COMPLETE (0A). This message is sent to the host to indicate that the execution of a linked command has completed and the status has been sent.

If the INITATOR responds with a MESSAGE REJECT message, the drive will go to the Bus Free Phase and not read the next command. The Sense Key/Error Code will be set to "Hardware Error/Message Reject Error" for that host.

6.9.10 LINKED COMMAND COMPLETE (WITH FLAG) (0B). This message is sent to the host to indicate that the execution of a linked command (with the flag bit set to one) has completed and the status has been sent.

If the INITATOR responds with a MESSAGE REJECT message the drive will go to the Bus Free Phase and not read the next command. The Sense Key/Error Code will be set to "Hardware Error/Message Reject Error".

6.9.11 BUS DEVICE RESET (0C). A host may send this message to the drive to clear all current commands on that SCSI device. The drive will clear all commands, go through its initial power-up checks, its self configuration and go to the BUS FREE state (Hard Reset).

6.9.12 IDENTIFY (80). This message is sent by a host after it selects the drive.

It is sent by the drive as the first message after a reconnect.

It is used to establish a physical path connection between the two for a particular logical unit.

Figure 6-5

Identify Message Codes

BITS	IDENTIFY MESSAGE FUNCTION
7	ALWAYS SET
6	SET INDICATES ABILITY TO DISCONNECT AND RECONNECT (ONLY INITIATORS)
5-3	RESERVED
2-0	SPECIFY LOGICAL UNIT NUMBER (always zero value)

If the host responds to this message with a MESSAGE REJECT, the drive will immediately terminate the present command with a "Check Condition" status and set the Sense Key/Error Code to "Hardware Error/Message Reject Error" for that host and LUN.

6.10 SCSI BUS ERROR HANDLING

If the host detects the BUS FREE phase (other than as a result of a RESET condition) without first receiving a DISCONNECT or COMMAND COMPLETE message, the host should consider this as a catastrophic error condition. If the drive intentionally creates this condition, then it will clear the current command.

6.10.1 IDENTIFY Message Parity Error

If the drive detects a parity error while receiving the IDENTIFY message, it will attempt to receive the IDENTIFY a second time. If the second attempt also fails, the drive will ignore the select and go to the Bus Free Phase.

6.10.2 Message Out Phase Parity Error

If the drive detects a parity error during the Message Out Phase (Other than a IDENTIFY message), it will attempt to receive the message again. If the second attempt fails, the drive will go to the Bus Free Phase, clear the present command and set the Sense Key/Error Code to "Aborted Command/Parity Error.

6.10.3 Command or Data Out Phase Parity Error

If the drive detects a parity error during the Command Phase or the Data Out Phase, it will terminate the command with a "Check Condition" Status and set the Sense Key/Error Code to "Aborted Command/Parity Error" for that host and LUN.

7.0 POWER UP or BUS RESET

The drive does a hard reset/recalibrate after each POWER-UP or BUS RESET.

After being reset the XT-3000 executes the following tests of the on-board controller:

TEST	DEVICE TESTED	COMMENTS
0	Program ROM	Uses the ROM checksum to verify the ROM.
1	Micro RAM	Uses a moving inversion test to test the RAM. Leaves the RAM filled with zeros.
2	SCSI chip	Tests the SCSI device including the interrupt.
3	DMA	Tests the DMA including the interrupt. Channel 2 REQ and ACK are tied together to perform a test of the DMA, and timing its execution speed.
4	Sequencer	Tests the Sequencer, including the interrupt.
5	Sequencer State	Tests then initializes the drive RAM State drive RAM.
6	Buffer RAM	Determines the size of the buffer RAM then tests it. Leaves the buffer filled with zeros. Uses the path through the Sequencer chip and the DMA, channel 3.

Figure 7-1

Power Up/Bus Reset Test Table

7.1 Self Test Failure Status

If tests 0 through 4 fail, this is considered a fatal drive error. The drive will still respond to host selects, if possible, but will not execute any commands except REQUEST SENSE, INQUIRY, and SEND DIAGNOSTIC. If any other of the self tests fail, this is still a drive error; but if the component that failed does not affect another path, commands for the unaffected path will be executed.

TEST	SENSE KEY	ADDITIONAL SENSE CODE	ALLOWED COMMANDS
0	04	70	REQUEST SENSE, INQUIRY & SEND DIAGNOSTIC
1	04	71	REQUEST SENSE, INQUIRY & SEND DIAGNOSTIC
2	04	72	REQUEST SENSE, INQUIRY & SEND DIAGNOSTIC
3	04	73	REQUEST SENSE, INQUIRY & SEND DIAGNOSTIC
4	04	74	REQUEST SENSE, INQUIRY & SEND DIAGNOSTIC
5	04	75	None
6	04	76	None

Figure 7-2

Self Test Failure Codes

7.2 Self Configuration

If the self configuration fails, the Sense Key/Error Code will be set to "Unit Attention/Self Configuration" (06/90). This status will be reported on the first command issued from a host.

The drive is LUN 0. The disk will create the CHECK CONDITION status with the Sense Key/Error code set to "ILLEGAL REQUEST/Invalid LUN" in response to a REQUEST SENSE command to any other LUN.

7.3 Unit Attention Condition

A unit attention condition is created for each initiator whenever the drive has been reset (by a BUS DEVICE RESET message or a "hard" RESET condition) or when the MODE SELECT parameters have been changed from other hosts. The UNIT ATTENTION condition (Sense Key = 6_H) is returned into the sense data by the drive in response to a REQUEST SENSE command. The host issues the REQUEST SENSE command in response to the check condition (02) status byte. The Unit Attention condition persists for each initiator until that initiator issues a command other than REQUEST SENSE or INQUIRY for which the drive returns CHECK CONDITION status. If the next command from that initiator (following the CHECK CONDITION status) is REQUEST SENSE, a CHECK CONDITION and the UNIT ATTENTION sense key is returned. If any other command is received, the unit attention condition is cleared.

If an INQUIRY command is received from an initiator with a pending Unit Attention condition (before the drive reports CHECK CONDITION status), the drive performs the INQUIRY command and does not clear the Unit Attention condition.

If a REQUEST SENSE command is received from an initiator with a pending Unit Attention condition (before the drive reports CHECK CONDITION status), then the drive will report any pending sense data and preserve the Unit Attention condition.

8.0 XT-3000 BUFFERING SCHEME

8.1 Theory of Operation

The XT-3000 includes a static 8K-byte data buffer. The buffer is used to enhance the performance of the drive (by storing blocks of data while the drive is disconnected from the host) and to match the speed of the host and the drive.

The buffer used is a ring buffer, controlled by the Integrated SCSI Module (ISM). The chip includes 4 channels (ports). Each channel has its own separate 16-bit address and byte count register. The channels operate simultaneously, allowing read and write operations to the buffer from various data paths at the same time.

Of these channels:

- channel 0 is dedicated to the drive and is used to transfer data between the buffer and the drive,
- channel 1 is only used for diagnostic purposes. channel 1 REQ is tied to channel 1 ACK. This allows the microprocessor to issue commands to channel 1 and check that it actually does transfers.
- channel 2 is connected to the SCSI bus and operates in the SCSI mode.
- channel 3 is used by the controller's Z8 microprocessor to transfer data between the microprocessor bus and the buffer memory. The microprocessor uses this channel to read and write the buffer memory.

8.2 Buffer Use Example

The following case is a multi-block READ command from the drive:

1) The first logical block, specified as the starting block address in the SCSI command is read from the drive and written into the buffer, using ISM Memory chip channel 0.
2) When the ECC is calculated, the data block is available for transfer to the host bus.
3) If the drive has disconnected from the host, the drive will reconnect
4) The data block is then transferred asynchronously at the host memory speed (Handshake Timing).
5) The next block on the drive is stored in the buffer as soon as it is read (at the address below the previous block). Reading of data from the drive and sending data to the host are independent, and take place at the same time.
6) Blocks are stored below each other in the buffer, until the maximum address is reached; then the channel wraps around to the first address in the buffer (assuming that the first block has already been transferred to the host).

7) If the host is too slow to empty all data blocks stored in the buffer from the drive, and another block is ready to be stored, (with no space available) an overrun situation occurs. In this case, the XT-3000 drive will stop reading and wait for one block size to be available to start reading again. This will occur only if the host transfer rate is much slower than the drive transfer rate, 7.5 Mbits/sec.

9.0 SCSI COMMANDS/DEFINITIONS/OPERATION

The command definitions provide continuous logical blocks of a fixed data length.

A single command may transfer one or more logical blocks of data. Multiple commands may be linked. The drive may disconnect from the SCSI bus to allow activity by other SCSI devices while it is being prepared to transfer data.

Upon command completion (successful or unsuccessful), the drive returns a status byte to the initiator (see 10.1.9).

9.1.1 Reserved

All reserved bits, fields, bytes, and code values must be set to zero by the initiator. When receiving a reserved bit, field, or byte that is not zero, the drive terminates the command with a CHECK CONDITION status and the sense key is set to ILLEGAL REQUEST.

9.1.2 Command Descriptor Block (CDB)

A request from the initiator is performed by sending a CDB to the drive. For some commands, the request is accompanied by a list of parameters sent during the DATA OUT phase.

9.1.3 Operation Code

The operation code of the command descriptor block has a group code field and a command code field.

The group code specifies one of the following groups:

Group 0 - six-byte commands
Group 1 - ten-byte commands
Group 2-6 - reserved
Group 7 - ten byte commands

Bit / Byte	7	6	5	4	3	2	1	0
0	Group Code			Command Code				

Figure 9-1

Operation Code

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Logical Block Addrs (if rqd) (MSB)				
2				Logical Block Addrs (if required)				
3				Logical Block Addrs (if rqd) (LSB)				
4				Transfer Length (if required)				
5				Control Byte				

Figure 9-2

Typical CDB for Six-byte Commands

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (Zeros)				
2				Logical Block Addrs (if rqd) (MSB)				
3				Logical Block Addrs (if required)				
4				Logical Block Addrs (if required)				
5				Logical Block Addrs (if rqd) (LSB)				
6				Reserved (00_H)				
7				Transfer Length (if rqd) (MSB)				
8				Transfer Length (if rqd) (LSB)				
9				Control Byte				

Figure 9-3

Typical CDB for Ten-byte Commands

9.1.4 Logical Unit Number (LUN)

The logical unit number is set to zero. This method of addressing is provided for systems that do not implement the IDENTIFY message. Systems implementing the IDENTIFY message ignore the LUN specified within the CDB.

The drive is LUN 0. If a command other than Request Sense is issued to any other LUN, the drive will respond with Check Status. The drive will return Extended Status with the Sense Key/Error Code set to "Illegal Request/Invalid LUN" in response to a Request Sense command to any other LUN.

9.1.5 Logical Block Address (LBA)

The logical block address begins with block zero and is contiguous up to the last logical block.

Group 0 commands contain 21-bit logical block addresses.

Group 1 and 7 commands contain 32-bit logical block addresses.

In order to convert physical addresses to logical block addresses, the following formula is useful:

Logical Block Address = (CYLADR * HDCYCL + HDADR) * SECTRK + SECNUM

Where:
- CYLADR = Cylinder Address
- HDCYCL = Number of Heads per Cylinder
- HDADR = Head Address
- SECTRK = Number of Sectors per Track
- SECNUM = Sector Number

9.1.6 Transfer Length

The Transfer Length specifies the amount of data to be transferred. Expect for the read and write buffer commands, the transfer length specifies the number of sectors (blocks) to be transferred.

Six byte commands use one byte for Transfer Length allow up to 256 blocks of data to be transferred by one command. A Transfer Length value of 1 to 255 indicates the number of blocks that shall be transferred. A value of zero indicates 256 blocks.

Ten byte commands use two bytes for Transfer Length, allowing up to 65,535 blocks of data to be transferred by one command. In this case, a Transfer Length of zero indicates that no data transfer shall take place. A value of 1 to 65,535 indicates the number of blocks that shall be transferred.

The Transfer Length of the commands that are used to send a list of parameters to a drive is called the Parameter List Length. The Parameter List Length specifies the number of bytes sent during the DATA OUT phase.

The Transfer Length of the commands that are used to return sense data (e.g. REQUEST SENSE, INQUIRY, MODE SENSE, etc.) to an initiator is called the Allocation Length. The Allocation Length specifies the number of bytes that the initiator has allocated for returned data. The drive shall terminate the DATA IN phase when Allocation Length bytes have been transferred or when all Available Sense Data has been transferred to the initiator, whichever is less.

9.1.7 Control Byte

The Control Byte is the last byte of every command descriptor block.

Bit / Byte	7	6	5	4	3	2	1	0
Last	Reserved						FLAG	LINK

Bit	Description
7 through 2	Reserved
1	Flag bit - If the Link bit is zero, then the Flag bit shall be set to zero. If the Link bit is one, and if the command terminates successfully, the drive will send LINKED COMMAND COMPLETE message if the Flag bit is zero and will send LINKED COMMAND COMPLETE (WITH FLAG) message if the Flag bit is one.
0	Link bit- Used to prevent a bus free phase between commands. This bit is set to one to indicate that the host desires an automatic Link to the next command upon successful completion of the current command. If the Link bit is one, the drive will, upon successful termination of the command, return INTERMEDIATE status and then send one of the two messages defined by the Flag bit (above). Next, the drive will enter the "COMMAND" phase for the next command from the host link list.

Figure 9-4

Control Byte

9.1.8. Command Processing

The following sequence is common to all commands.

After being selected the XT-3000 sets C/D, I/O and MSG for the MESSAGE OUT phase and, if the host bus asserted the ATN signal, the drive will issue the REQ signal and get the IDENTIFY message from the host. Next, the drive normally switches to the COMMAND phase and tranfers the command into the registers of the controller portion of the drive unless the drive is disconnected executing a command, in which case, the command is not transferred, but is queued. If the host did not assert ATN, the drive will enter the command phase directly from the selection phase.

1) The drive checks if a self-test failure exists. If the XT-3000 has failed one of its self-tests and the command is not a REQUEST SENSE, INQUIRY or DIAGNOSTIC command, the drive returns CHECK condition status and sets the Sense Key/Error Code to "Hardware Error/7X", where X is the self-test number.

2) The drive checks if this is the first command after power-up or reset for this host. If so, the Unit Attention condition exists for this host and the drive returns CHECK condition status.

3) The drive checks if a Format is required. If the host has issued a MODE SELECT command and changed any parameters that affect the format on the XT-3000, such as block size, then a format unit operation is required. If the command requires access to the drive and is not a FORMAT UNIT command, CHECK condition status is returned and the Sense Key/Error Code is set to "Unit Attention/MODE SELECT Parameters changed".

4) If the command is not REQUEST SENSE, the XT-3000 clears the flag indicating there is valid sense for this host.

5) The drive decodes the command operation code. If unsupported the command returns CHECK condition status and sets the Sense Key/Error Code to "Illegal Request/Invalid Command Operation Code".

6) The drive checks the reserved bits in the Control Byte. If nonzero, it returns CHECK condition status and sets the Sense Key/Error Code to "Illegal Request/Illegal Field in CDB".

7) If the LUN is for a nonexistent drive and the command is not REQUEST SENSE, or INQUIRY, the drive returns CHECK condition status and sets the Sense Key/Error Code to "Illegal Request/Invalid LUN".

10.0 XT-3000 COMMAND SET

Operation Code	Command Name	Section
00_H	TEST UNIT READY	11.1
01_H	REZERO UNIT	11.2
03_H	REQUEST SENSE	11.3
04_H	FORMAT UNIT	11.5
07_H	REASSIGN BLOCKS	11.6
08_H	READ	11.7
$0A_H$	WRITE	11.8
$0B_H$	SEEK	11.9
12_H	INQUIRY	11.10
15_H	MODE SELECT	11.11
16_H	RESERVE	11.12
17_H	RELEASE	11.13
18_H	COPY	11.14
$1A_H$	MODE SENSE	11.15
$1B_H$	START/STOP UNIT	11.16
$1D_H$	SEND DIAGNOSTIC	11.17

Figure 10-1

Group 0 Commands

10.1 TEST UNIT READY Command

Operation Code: 00_H

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (00_H)				
2	Reserved (00_H)							
3	Reserved (00_H)							
4	Reserved (00_H)							
5	Control Byte							

This command selects the drive; and if the drive is ready and not seeking, GOOD STATUS is returned.

Figure 10-2

TEST UNIT READY Command

Valid responses:

	SENSE KEY	ADDITIONAL CODE
Drive not ready	NOT READY	DRIVE NOT READY
Drive not selected	HARDWARE ERROR	DRIVE NOT SELECTED
Seek/Command in Progress	NOT READY	NO SEEK COMPLETE

10.2 REZERO UNIT Command

Operation Code: 01_H

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (00_H)				
2	Reserved (00_H)							
3	Reserved (00_H)							
4	Reserved (00_H)							
5	Control Byte							

The actuator on the drive is positioned at track zero. The drive will disconnect from the host while this command is in progress, if the host supports disconnects.

Figure 10-3

REZERO UNIT Command

10.3 REQUEST SENSE Command

Operation Code: 03_H

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (00_H)				
2	Reserved (00_H)							
3	Reserved (00_H)							
4	Allocation Length							
5	Control Byte							

Figure 10-4

REQUEST SENSE Command

The REQUEST SENSE command requests that the drive transfer sense data to the host via a DATA OUT phase. The drive will transfer sense data in the extended sense data format, which is typically 16 bytes in length.

The sense data is valid for a CHECK CONDITION status returned on the prior command. This sense data is preserved by the drive for the host until retrieved by the REQUEST SENSE command or until the receipt of any other command from the host that issued the command resulting in the CHECK CONDITION status. Sense data is cleared upon receipt of any subsequent command from the host receiving the CHECK CONDITION status. In the case of the single host option, the drive will assume that the REQUEST SENSE command is from host zero.

The Allocation Length specifies the number of bytes that the host has allocated for returned sense data. An Allocation Length of zero indicates that four bytes of sense data is to be transferred. Any other value indicates the maximum number of bytes to be transferred. The drive will terminate the DATA IN phase when the Allocation Length bytes have been transferred or when all available sense data have been transferred to the host, whichever is less. The drive will return up to 16 bytes of sense data.

The REQUEST SENSE command will return the CHECK CONDITION status only to report fatal errors for the REQUEST SENSE command. For example:

(1) The drive receives a nonzero reserved bit in the CDB.

(2) An unrecovered parity error occurs on the DATA BUS.

(3) A drive malfunction prevents return of the sense data.

If any non-fatal error occurs during the execution of the REQUEST SENSE command, the drive will return the sense data with GOOD status. Following a fatal error on a REQUEST SENSE command, sense data may be invalid.

10.3.1 Extended Sense Data

Error class 7 specifies extended sense. Error code zero specifies the Extended Sense data format.

The Extended Sense Data Format is shown in the following figure.

Bit / Byte	7	6	5	4	3	2	1	0
0	Valid	Class (7)			Error Code (0)			
1	Zero Value (00_H)							
2	0	0	0	0	Sense Key			
3	Information Byte (MSB)							
4	Information Byte							
5	Information Byte							
6	Information Byte (LSB)							
7	Additional Sense Length (08_H)							
8	Zero Value (00_H)							
9	Zero Value (00_H)							
10	Zero Value (00_H)							
11	Zero Value (00_H)							
12	Additional Sense Code							
13	Zero Value (00_H)							
14	Zero Value (00_H)							
15	Zero Value (00_H)							

Figure 10-5

Extended Sense Data Format

The information bytes are not defined if the valid bit is zero. If the valid bit is one, the information bytes contain the unsigned LBA associated with the sense key.

The Additional Sense Length specifies the number of additional sense bytes to follow byte 7 (This value always = 8.) If the Allocation Length of the CDB was too small to transfer all of the additional sense bytes, the Additional Sense Length is not adjusted to reflect the truncation.

The Additional Sense bytes contain Additional Sense codes listed in Figure 11-6. The additional Sense codes are either defined as in this figure, or reserved.

Sense Key (Bit 0-3 of Byte 2)	Description
0_H	NO SENSE. Indicates that there is no specific sense key information to be reported. This is the case for a successful command.
1_H	RECOVERED ERROR. Indicates that the last command was completed successfully with some recovery action performed by the drive. Details may be determinable by examining the additional sense bytes and the information bytes.
2_H	NOT READY. Indicates that the drive cannot be accessed. Operator intervention may be required to correct this condition.
3_H	MEDIUM ERROR. Indicates that the command terminated with a nonrecovered error condition that was probably caused by a flaw in the disk media or an error in the recorded data.
4_H	HARDWARE ERROR. Indicates that the drive detected a nonrecoverable hardware failure (for example, drive failure, device failure, parity error, etc) while performing the command or during a self test.
5_H	ILLEGAL REQUEST. Indicates that there was an illegal parameter in the CDB or in the additional parameters supplied as data for some commands. If the drive detects an invalid parameter in the CDB, then it will terminate the command without altering the medium.
6_H	UNIT ATTENTION. Indicates that the drive has been reset or that Mode Select Parameters have been changed. This status is reported to all hosts as the initial status after the drive is powered-up or reset unless the drive had a self-test failure. (Refer to Section 7.3)
7_H	DATA PROTECT. Indicates that a command that reads or writes to/from the drive was attempted on a block that is protected from this operation. The READ or WRITE operation is not performed.
B_H	ABORTED COMMAND. Indicates that the drive aborted the command. The host may be able to recover by trying the command again.
E_H	MISCOMPARE. Indicates that the source data did not match the data read from the medium,

Figure 10-6
Sense Key Description

The Additional Sense code 00 indicates that the drive does not support any additional sense code for the related Sense Key or does not have any appropriate Additional Sense to return for the CHECK CONDITION status that it created.

Sense Code (Byte 12)	Description
00	No Additional Sense Information.
01	No Index/Sector signal
02	No Seek Complete
03	Write Fault
04	Drive Not Ready
05	Drive Not Selected
06	No track zero found
07 through OF	Reserved
10	ID CRC error
11	Unrecovered Read error of data blocks
12	No Address Mark found in ID field
13	No Address Mark found in Data field
14	No record found
15	Seek positioning error
16	Reserved
17	Recovered Read data with drive's Read retries (not with ECC)
18	Reserved
19	Defect List Error
1A	Parameter Overrun
1B	Reserved
1C	Primary Defect List not found
1D	Reserved
1E through IF	Reserved
20	Invalid Command Operation Code
21	Invalid Logical Block Address (LBA). Address greater than the LBA returned by the READ CAPACITY data with PMI bit set to 0 in the CDB.
22	Reserved
23	Reserved
24	Illegal field in CDB
25	Invalid LUN
26	Invalid field Parameter List
27	Write Protected
28	Reserved
29	Power On or Reset or Bus Device Reset occurred.
2A	Mode Select Parameters changed
2B through 30	Reserved
31	Format Failed
32	No Defect Spare Location Available
33 through 3F	Reserved

40	RAM failure
41	Data Path diagnostic failure
42	Power On diagnostic failure
43	Message Reject Error
44	SCSI Hardware/Firmware Error
45	Select/Reselect failed
46	Reserved
47	SCSI Parity Error
48	Initiator Detected Error
49	Inappropriate/Illegal Message
4A through 4F	Reserved
50 through 5F	Reserved
60 through 69	Reserved
6A	Format Required (Mode Select changed device parameters)
6B through 6F	Reserved
70 through 7F	SelfTest "7x" Failed
80 through 8B	Correctable ECC error, number of bits correctable = x (0 through B)
8C through 8F	Reserved
90	Configuration Error
91 through 9F	Reserved

Figure 10-7

Additional Sense Codes in HEX

10.4 FORMAT UNIT Command

Operation Code: 04_H

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			FmtData	CmpLst	Defect List Format		
2	Reserved (00_H)							
3	Interleave Factor (MSB)							
4	Interleave Factor (LSB)							
5	Control Byte							

Figure 10-8

FORMAT UNIT Command

The FORMAT UNIT command formats the medium on the drive. It also creates control structures for the management of defects. The MODE SELECT Page 3 defines parameters to be set by the host for the defect management (if requested). Initialization and Mode Select Parameters are stored on the disk media after the format process is completed successfully. On all subsequent power-up sequences the XT-3000 will read these parameters and configure itself.

The FORMAT UNIT command should be preceded by a MODE SELECT command which defines the format and drive parameters other than the default parameters. The recommended sequence of commands to perform a format is: RESERVE UNIT to prevent other devices from changing parameters during this sequence, MODE SENSE to find the default and/or current parameters and which options are supported and changeable, MODE SELECT to define the format parameters, FORMAT UNIT to perform the actual format, and a RELEASE UNIT to release the unit.

Formatting starts from track 0 of cylinder 0, and proceeds until the last track of the unit is formatted. The track is written starting with the index. All data fields are filled with $E5_H$.

The Interleave field requests that the logical blocks be related in a specific fashion to the physical blocks to facilitate speed matching. An interleave value of zero requests that the drive use its default interleave which is one to one. An interleave value of one requests that consecutive logical blocks be placed in consecutive physical order. The drive will not accept a value different from zero or one. The ring buffer of the drive electronics allows simultaneous access to the LUN and the Host and its large buffer size avoids the need for interleave factors greater than one.

The drive defaults to a defect mapping scheme of one spare sector per track with the P-list mapped out. This occurs without a prior Mode Select Command and the following values for the Format Unit command: CDB = (04,00,00,00,00,00).

If a Mode Select Command changes the zone size and the number of alternates per zone does not equal zero, the drive will still automatically map out the P-list if the Format Unit CDB values equal: 04,00,00,00,00,00. However, if the host selects zero alternates per zone via a Mode Select Command, page 3, then a Format Unit Command CDB value of (04,00,00,00,00,00) will not map out any defects and no spare sectors will be deallocated.

The XT-3000 will disconnect, assuming the host supports Disconnect/Reconnect, while executing this command.

10.5 Bad Sector Handling

The host may select how the drive shall handle the list by use of the bits in the CDB and the host supplied Defect List Header (refer to Figure 11-9).

The XT-3000 has the capability of mapping out bad sectors so the drive media appears error free to the host. In the Defect List Header during the DATA OUT phase of a format unit command, the host may use the DPRY and FOV bits to request whether or not the drive deallocates the list of flaws recorded by Maxtor prior to shipment (P-list). Also, the drive will maintain and map out an additional list of flaws (G List) on the disk if requested by the host in the format unit CDB by using the Cmplst bit. The G list, if it exists and is readable, may include any errors identified by the host in the Data Defect List (D List) supplied in the Defect Descriptors during the Data Out Phase of the FORMAT UNIT command. The G list may also include any errors identified by the drive (C List) during the verify process of the FORMAT UNIT command. The user may request the certification process (C List) by using the DCRT and FOV bits in the Defect List Header during the DATA OUT phase of a format unit command. The G list will also include errors previously identified by all REASSIGN BLOCKS commands that have been issued since the last completion of a format unit command with the Cmplist bit = 1.

With the MODE SELECT command, the host specifies how many sectors are de-allocated either per track or cylinder or for the whole disk to handle bad sectors. See the "zone" definition in the MODE SELECT command "Page 3." If the host de-allocates no spare sectors with the MODE SELECT command (zero tracks/zone and zero alternates/zone), then the XT-3000 will not map out any flaws or create any spare sectors (The host operating system must handle the defects.) If the host attempts either a REASSIGN BLOCK command or a FORMAT UNIT command which involves block reassignment, without first deallocating spare sectors with the MODE SELECT command, or using the default values, the drive will return an error condition.

A FmtData (format data) bit of one indicates that a DATA OUT Phase takes place during the command execution. This data specifies the four byte defect list header. The header defines if the drive is to format using the P-List and/or C-List, if the drive is to stop on an error during format, and the length of the D-List, if any. Additionally, an optional list of defects (D-List) may follow the header during the DATA OUT phase. The D-List consists of one or more defect descriptors. The flaw areas of this map will be removed by the drive from the host addressable blocks. The format of the D-List is determined by the Defect List Format defined by bits 0 through 2 of the CDB. If bit 2 of byte 1 of the CDB equals zero, only the 4 byte Defect List Header is transferred from the host during the DATA OUT phase. In this case, the Defect List Length of the header (bytes 2 and 3) <u>must</u> equal zero.

A FmtData bit of zero indicates that the DATA OUT phase shall not occur (no Defect List Header and no Defect Descriptors are supplied by the host). If Mode Select Page 3 (alternates per zone) does not equal zero, then the P-list will be mapped out. If alternates per zone equals zero, then no defects are mapped out and the drive is not requested to handle defects at all. No spare locations will be deallocated by the drive. Further REASSIGN BLOCKS commands will be rejected with CHECK CONDITION status and ILLEGAL REQUEST Sense Key.

A CmpLst (complete list) bit of one indicates the lists defined by the host during the DATA OUT phase of the command execution are the complete lists of known defects. Any previous host-specified defect map or defect data (G List) will be erased by the drive. The result is to erase the current G List and build a new G List.

Note: The FmtData bit must equal one if the CmpLst bit equals one.

A CmpLst bit of zero indicates that the data supplied by the host during the DATA OUT phase (header only or header and descriptors) is an addition to existing defect data already removed from the host addressable blocks and using the current format. The result is that the existing G List (if one exists) is used. At the host request, the P, C and/or D Lists will also be used.

The Defect List Format (Bits 0-2) is used to specify the format of the Defect Descriptors used for a D-List. The only values allowed in this field are binary 000 (no D-List) and 100 (D-List is in the "Bytes from Index" format). If this field is set to binary 000, then the defect list in the header must also be zero. If this field is set to binary 100, then the defect list length may be zero (no D-List), or eight (8) times the number of defects (use D-List as defined by the Defect Descriptors).

The XT-3000 will disconnect and reconnect while executing the command if the host supports disconnect.

The four schemes of flaws P, C, D and G are further defined on the following page.

P = PRIMARY DEFECT LIST: This list refers to the list of defects recorded on the drive (if any) by Maxtor.

During the FORMAT UNIT command, if CDB bit FmtData = 1, Header bit FOV = 1, and the header bit DPRY = 0, the XT-3000 accesses this list in order to remove the P List flaws from the host addressable data blocks. This list is not subject to additions.

The host can select that the drive use only the P List flaws, to return to the "as shipped" condition from Maxtor. This assumes that the list of defects had grown during the lifetime of the drive media. The host may also request that the drive use the P-List in addition to any other list of flaws (C, D and/or G) the host may have selected. The drive also maps out the P-list flaws if Mode Select, Page 3, (alternates per zone) does not equal zero.

C = DRIVE CERTIFICATION: Includes the defects detected by the XT-3000 during a verify process executed during the FORMAT UNIT command. The drive certification flaws are added to the grown list (G List) by the XT-3000. During the FORMAT UNIT command, if CDB bit FmtData = 1, Header bit FOV = 1, and Header Bit DCRT = 0, the drive will automatically develop and map out the resulting C List.

D = DATA DEFECT LIST: This list is the Defect Descriptor/s supplied to the XT-3000 by the host in the DATA OUT phase. This list is supplied by the host when bits 4 and 2 of byte 1 of the CDB are set to 1 and bytes 2 and/or 3 of the Defect List Header are not a zero value. If the Defect List Length (Byte 2 and 3) of the Defect List Header is null, no Defect Descriptor/s (D List) is transferred. The defects identified by the host in the D List are mapped out and added to the Grown List (G List).

G: GROWN DEFECT LIST : This list includes defects identified to or by the XT-3000 (the C, D and G Lists). This list does not include the Primary list defects. These defects are classified as flaws appearing once the medium has been formated and used to store and retrieve data. The host may request that the current G List be used during format (CDB bit CmpLst = 0 and FmtData = 1) or that the current G List be erased and a new one begun (CDB bit CmpLst = 1 and FmtData = 1). Entries to this Grown List include:

- Defects provided to the drive in Data Defect Lists (D List) during previous FORMAT UNIT commands.

- The drive certification defects (C List) detected during the previous FORMAT UNIT commands.

- Defects appended by the result of successful completion of the REASSIGN BLOCKS commands.

The defective blocks classified in this Grown List are automatically reassigned to an area on the drive reserved for this purpose (only if the FmtData bit in the FORMAT UNIT command was set to one).

NOTE: Because the Grown List incorporates dynamic lists (C and D and Reassign Block Command Locations), it is the only list recorded by the XT-3000 after shipment.

Options	CDB Byte One Fmt Data Bit 4	Cmp List Bit 3	Def List Format Bit 2	Defect List Header Byte One FOV Bit 7	DPRY Bit 6	DCRT Bit 5	Bytes 2 & 3 (Defect List Length)	Lists Used*	Description
a	0	0	0	X	X	X	X	No Lists	No data out phase (no defect list header or defect descriptors). If Mode Select, page 3 alternates/zone does not equal zero, then map out P-list. If Mode Select, page 3 alternates/zone equals zero then format with no defect mapping. No spares are created.
b	1	0	0	0	X	X	X	G	Reformat using existing G List for defect mapping. Data out phase of 4 byte defect list header. No defect descriptors.
c	1	0	0	1	1	1	X	G	Same as b
d	1	0	0	1	1	0	X	G, C	Same as b; also perform certification process and map out resulting C List. No P List.
e	1	0	0	1	0	0	X	G, C, P	Same as d; also map out P List.
f	1	0	0	1	0	1	X	G, P	Same as b; also map out P List. No C List.
g	1	0	1	1	0	1	0	G, P	Same as f; note that when Def List Fmt bit equals one and Defect List Length equals zero, no D List is transferred. This chart does not list this possibility again.
h	1	0	1	1	0	1	non-zero	G, P, D	Same as f; also map out D List (Defect Descriptors) transferred from Host during Data Out Phase (following the Defect List Length).
i	1	0	1	1	0	0	non-zero	G, P, D,	Same as h; also perform certification and map out C List.
j	1	0	1	1	1	0	non-zero	G, D, C	Same as i; except P List is not mapped out.
k	1	0	1	1	1	1	non-zero	G, D	Same as j; except No Certification Process (C List).
l	1	0	1	0	X	X	non-zero	G, D	Same as k.
m	1	1	1	0	X	X	non-zero	D	Same as l; except existing G list is erased and not used.
n	1	1	1	1	1	0	non-zero	D, C	Same as m; also certification process (C List) is used.
o	1	1	1	1	0	0	non-zero	D, C, P	Same as n; also P List is mapped out.
p	1	1	1	1	0	1	non-zero	D, P	Same as o; except No Certification Process (C List)
q	1	1	0	1	0	1	X	P	Same as p; except no D List. P List only.
r	1	1	0	1	0	0	X	P, C	Same as q; also map out C List.
s	1	1	0	1	1	0	X	C	Same as r; except no P List. C List only.
t	1	1	0	1	1	1	X	None	No defect mapping. Data Out Phase of 4 byte header. However, alternate sectors will still be reserved in each zone.
u	1	1	0	0	0	0	X	None	Same as t.
v	1	X	0	X	X	X	non-zero		Illegal request. When Def. List Fmt. bit = 0, the Defect List Length <u>MUST</u> also be zero.

X = Don't care
*G indicates that existing (if any) G list will be used.

Figure 10-9
Format Options

The defect list shown in the following Figure 11-10 contains a four-byte Header followed by one or more Defect Descriptors. The Defect List Length is equal to eight times the number of Defect Descriptors. If the Defect List Length equals zero, no Defect Descriptors are transferred.

Defect List Header

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	FOV	DPRY	DCRT	STPF	Reserved (Zeros)			
2	Defect List Length (MSB)							
3	Defect List Length (LSB)							

Defect Descriptor(s)

Bit / Byte	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)							

Figure 10-10

Defect List (D-List) - Bytes from Index Format

Each Defect Descriptor for the Bytes From Index format specifies the starting Byte address of the defect on the medium. The Defect Descriptor is defined as an eight-byte defect location. Each Defect Descriptor is comprised of the Cylinder Number of Defect, the Head Number of Defect, and the Defect Bytes from Index. The Defect Descriptors shall be in ascending order. For determining ascending order, the Cylinder Number of Defect is considered the most significant part of the address and the Defect Bytes from Index is considered the least significant part of the address.

A defect Bytes From Index of FFFFFFFFh indicates that the entire track is to be reassigned. During the process of finding alternates for the defects, the controller uses a table to hold the defect addresses that are being remapped. The maximum size of this table is 128 addresses.

As an example, one sector per track is deallocated. The combined P and G lists (if both requested) have two sectors to be reassigned in the first track and 3 in the following track. The first sector of the first track to be reassigned will use the alternate sector of the first track. The second sector of the first track to be reassigned will use the alternate sector of the second track. Prior to formatting the third track, the address of the 3 sectors of the second track are stored in the table limited to 128 addresses.

As another example with 32 sectors per track, no more than 4 tracks (or 4 times 32 sectors) in a row can be specified as Defect Descriptor with a value of FFFFFFFFh.

The maximum number of defects that the drive can handle per P or G lists is 390 each, for a total of 780 defects.

The Byte 1 of the Defect List Header defines how the host may optionally control the Primary Defect List and the XT-3000 Certification flaw management schemes during the FORMAT UNIT command.

- Bits 0 through 3 are reserved.
- FOV (Format Options Valid) Bit 7 set to zero indicates that the initiator requests the drive's default values to be set for the functions defined by bits 4 through 6. If bit 7 is set to zero, the initiator shall set bits 4 through 6 to zero, otherwise the drive creates the CHECK CONDITION status with ILLEGAL REQUEST Sense Key. If FOV = 0, the drive defaults to DPRY = 1, DCRT = 1, and STPF = 0.

- FOV Bit 7 of one authorizes the setting of bits 4 through 6.

- DPRY (Disable Primary) bit set to zero and FOV set to one indicates that the drive shall manage the Primary List of defects while formatting.

- DPRY bit set to one and FOV set to one indicates that the drive shall exclude the Primary List from the list of flaws to manage while formatting.

- DCRT (Disable Certification) bit set to zero and FOV set to one indicates that the drive shall enable the certification routine while formatting.

- DCRT bit set to one and FOV set to one indicates that the drive shall disable the certification routine while formatting.

- STPF (Stop Format) bit set to zero indicates that the drive shall continue the format process even if either of the Lists of Defects P or G are not successfully accessed in whole or in part. The drive will create the CHECK CONDITION status after completion of the format process with RECOVERED ERROR Sense key, if no other error occurred other than the unsuccessful access of the P or G Lists.

- STPF bit set to one indicates that the drive shall stop the format process upon failing to successfully access, in whole or in part, any of the Lists of Defects P or G. The drive creates the CHECK CONDITION status with MEDIUM ERROR Sense key.

- During FORMAT or REASSIGN BLOCKS command, the controller skips known defects as shown in the following example. This scheme is designed to minimize the number of revolutions necessary to read consecutive tracks. In the following example shown, the 3 tracks will be read in 3 disk revolutions (even with 2 defects included).

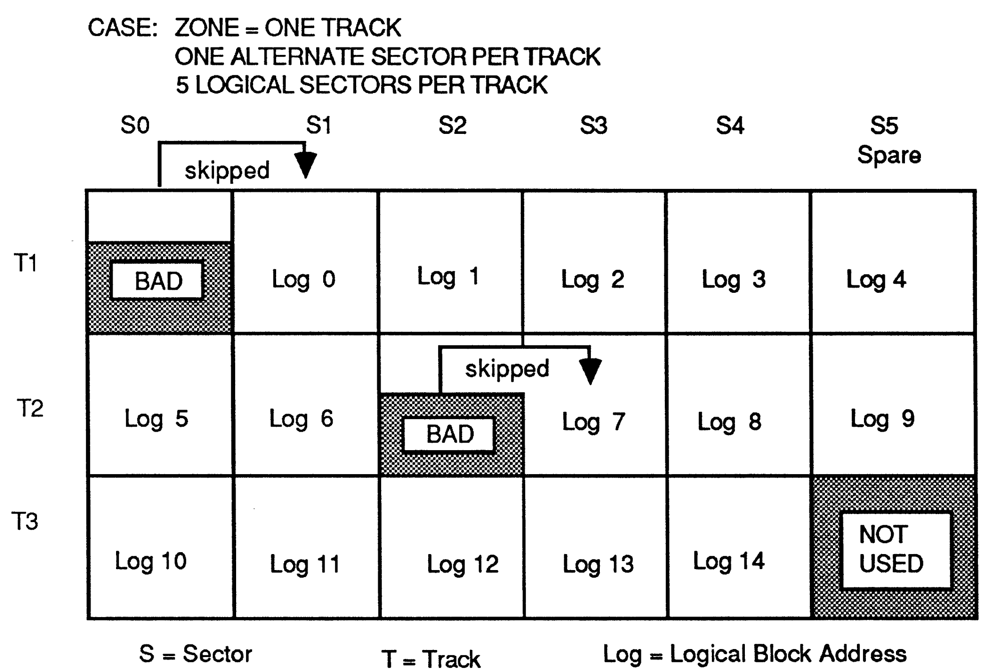

Figure 10-11

Defect Mapping Example

10.6 REASSIGN BLOCKS Command

Operation Code: 07H

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (Zeros)				
2	Reserved (00_H)							
3	Reserved (00_H)							
4	Reserved (00_H)							
5	Control Byte							

Figure 10-12

REASSIGN BLOCKS Command

The REASSIGN BLOCKS command requests the XT-3000 to reassign the defective logical blocks to an area on the drive reserved for this purpose. If the FORMAT UNIT command was issued with FmtData set to zero in the CDB and Mode Select Page 3 alternates per zone equals zero, then the drive was not requested to reserve blocks for the defect management. In this case, the drive will reject the REASSIGN BLOCKS command with the CHECK CONDITION status and Sense Key/Error Code set to ILLEGAL REQUEST/No Defect Spare Location Available.

The host transfers a Defect List that contains the logical block addresses to be reassigned. The drive will reassign the physical media used for each logical block address in the list. The data contained in the logical blocks specified in the Defect List may be altered, but the data in all other logical blocks on the disk surface is preserved.

The effect of specifying a logical block to be reassigned that previously has been reassigned is to reassign the block again. Thus, over the life of the media, a logical block can be assigned to multiple physical addresses (until no more spare locations remain on the media).

The REASSIGN BLOCKS Defect List contains a four-byte Header followed by one or more Defect Descriptors. The length of each Defect Descriptor is four bytes.

The Defect list length specifies the total length in bytes of the Defect Descriptors that follow. The Defect List Length is equal to four times the number of Defect Descriptors. All defects specified by the Reassign Blocks Command will be recorded in the G-list and are limited to 390 defects.

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved (00_H)							
1	Reserved (00_H)							
2	Defect List Length (MSB)							
3	Defect List Length (LSB)							

Defect Descriptor(s)

Bit / Byte	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)							

Figure 10-13

REASSIGN BLOCKS Defect List

The Defect Descriptor specifies a four-byte Defect Logical Block address that specifies the defect location. These addresses are the values of the Information Bytes of the Extended Sense Data for which MEDIUM ERROR or RECOVERED ERROR Sense Keys were reported. The Defect Descriptors are to be sent by the host in ascending order.

If the XT-3000 has insufficient capacity to reassign all of the Defective Logical Blocks, the command terminates with a CHECK CONDITION status and the Sense Key/Error Code is set to "MEDIUM ERROR/No Defect Locations Available". The Logical Block Address of the first logical block not reassigned is returned in the information bytes of the Extended Sense Data.

10.7 READ Command

Operation Code: 08_H

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Logical Block Address (MSB)				
2	Logical Block Address							
3	Logical Block Address (LSB)							
4	Transfer Length							
5	Control Byte							

Figure 10-14

READ Command

The READ command requests that the XT-3000 transfers data to the host.

The Logical Block Address specifies the logical block at which the read operation will begin.

The Transfer Length specifies the number of contiguous logical blocks of data to transfer. A Transfer Length of zero indicates that 256 logical blocks are transferred. Any other value indicates the number of logical blocks that are transferred. The most recent data value written in the addressed logical block will be returned.

If any of the following conditions occur, this command is terminated with a CHECK CONDITION status, and the sense key is set as indicated in the following table. This table does not provide an exhaustive enumeration of all conditions that may cause the CHECK CONDITION status. See additional sense byte 12 of the Extended Sense Data format.

The progress of the command is also influenced by the options selected. See the MODE SENSE and SELECT commands for more information. This command disconnects, for hosts that support disconnect/reconnect, while processing the command.

Condition	Sense Key
Invalid Logical Block Address	ILLEGAL REQUEST (see note below)
Drive reset since last command from this initiator or Mode Select Parameters changed.	UNIT ATTENTION
Unrecoverable Read Error	MEDIA ERROR
Recovered Read Error	RECOVERED ERROR

NOTE: The extended sense information bytes are set to the Logical Block Address of the last Logical Block Address plus one (first invalid address) (See Mode Select Error Recovery Parameters.)

10.8 WRITE Command

Operation Code: $0A_H$

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Logical Block Address (MSB)				
2	Logical Block Address							
3	Logical Block Address (LSB)							
4	Transfer Length							
5	Control Byte							

Figure 10-15

WRITE Command

The WRITE command requests that the drive write the data transferred by the host to the medium. The Logical Block Address specifies the logical block at which the write operation will begin.

The Transfer Length specifies the number of contiguous logical blocks of data to be transferred. A Transfer Length of zero indicates that 256 logical blocks are to be transferred. Any other value indicates the number of logical blocks that are to be transferred.

If any of the following conditions occur, this command terminates with a CHECK CONDITION status, the sense key is set as indicated in the following table.

The progress of the command is also influenced by the options set up by the MODE SELECT command, such as enable retries. Refer to the MODE SENSE and MODE SELECT commands for more information. This command disconnects, for hosts that support disconnect/reconnect, while processing the command.

Condition	Sense Key
Invalid Logical Block Address	ILLEGAL REQUEST (see note below)
Drive reset or MODE SELECT Parameters changed.	UNIT ATTENTION

<u>NOTE</u>: The extended sense information bytes are set to the Logical Block Address of the last Logical Block Address plus one (first invalid address)(See Mode Select Error Recovery Parameters.)

10.9 SEEK Command

Operation Code: $0B_H$

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Logical Block Address (MSB)				
2	Logical Block Address							
3	Logical Block Address (LSB)							
4	Reserved (00_H)							
5	Control Byte							

Figure 10-16

SEEK Command

The SEEK command causes the XT-3000 to be physically positioned to the cylinder as defined in bytes one to three. No attempt to verify seek position is made until a READ or WRITE command is issued.

NOTE: The drive returns completion status while the seek is in progress.

10.10 INQUIRY Command

Operation Code: 12_H

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (Zeros)				
2	Reserved (00_H)							
3	Reserved (00_H)							
4	Allocation Length							
5	Control Byte							

Figure 10-17

INQUIRY Command

The INQUIRY command requests that information regarding parameters of the drive be sent to the initiator.

The Allocation Length specifies the number of bytes that the initiator has allocated for returned INQUIRY data. An Allocation Length of zero indicates that no INQUIRY data is transferred. This condition will not be considered as an error. Any other value indicates the maximum number of bytes that are to be transferred. The drive will terminate the DATA IN phase when Allocation Length bytes have been transferred or when all available INQUIRY data have been transferred to the host, whichever is less. The drive will return up to 36 bytes of INQUIRY data.

The INQUIRY command will return a CHECK CONDITION status only when the drive cannot return the requested INQUIRY data. The INQUIRY data is returned even though the peripheral device may not be ready for other commands.

If an INQUIRY command is received from an initiator with a pending unit attention condition (before the drive reports CHECK CONDITION status), the drive will perform the INQUIRY command and will not clear the unit attention condition.

The INQUIRY data contains a 5 byte Header followed by 31 bytes of Data Format as follows.

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Device Type (00_H) or ($7F_H$)							
1	Zero Value (00_H)							
2	Version (00_H)							
3	Reserved (Zeros)			Response DataFormat = CCS (1_H)				
4	Additional Length ($1F_H$)							
5-7	Reserved (00_H)							
8-15	Vendor Identification "MAXTOR" in ASCII							
16-31	Product Identification "XT-3170" or "XT-3280" in ASCII							
32-35	Firmware Revision Level A through Z in ASCII							

Note: Spaces in the above ASCII messages are 20_H.

Figure 10-18

INQUIRY Data

The peripheral device type (byte 0) is shown in the following table.

Code	Description
00_H	Direct-Access device (Winchester disk)
$7F_H$	Logical Unit not present

Figure 10-19

Peripheral Device Type

The version byte 2 is a zero value to represent the implemented version of the SCSI standard and is defined in the formal SCSI specification.

The Additional Length (Byte 4) specifies the length in bytes of the Data Format parameters. If the Allocation Length of the CDB is too small to transfer all of the parameters, the Additional Length is not adjusted to reflect the truncation.

The XT-3000 complies with the Common Command Set (CCS) specifications. Thus, the Response Data Format field of byte 3 is 1_H for the common command set.

10.11 MODE SELECT Command

Operation Code: 15_H

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			PF	Reserved (Zeros)			SP
2	Reserved (00_H)							
3	Reserved (00_H)							
4	Parameter List Length							
5	Control Byte							

Figure 10-20

MODE SELECT Command

The MODE SELECT command provides a means for the initiator to specify or change peripheral device parameters to the XT-3000.

The Parameter List Length specifies the length, in bytes, of all the information transferred during the DATA OUT phase of the MODE SELECT command. For example, when transferring a parameter list that includes the Block Descriptor, use 10_H for Page Code 1, use 24_H for Page Code 3 and use 20_H for Page Code 4. A Parameter List Length of zero indicates that no data is transferred. This condition will not be considered as an error.

PF (Page Format) bit 4 byte 1 set to one indicates that the data sent by the initiator after the MODE SELECT Header and the Block Descriptors (if any) complies to the Page Format.

PF (Page Format) bit 4 byte 1 set to zero indicates that the data sent by the initiator after the MODE SELECT Header and the Block Descriptors (if any) is vendor unique. The drive will return an Illegal Request error if the PF bit equals zero and the SP bit = 1.

SP (Save Parameters) bit 0 byte 1 set to one indicates that the drive shall:
- update the Current Page values with the values defined in the Pages, if issued;
- save the values defined in the pages, if issued. When the pages are saved, the information is written on the drive in a special area. When the drive is powered up, it reads this area and uses the information as its parameters. If the host has not saved any pages, the page "default" values are used. The saved values may be read by the host via a MODE SENSE "report saved values" command.

- report command complete with no CHECK CONDITION status when successfully completing the above.
  Pages are reported as saveable in the MODE SENSE command with the PS bit (bit 7 byte 0) of the Page Header set to one.

SP bit 0 byte 1 set to zero indicates that the drive shall:

- update the Current Page values with the values defined in the Pages, if issued;
- shall not save the values defined in the pages, if issued (i.e., modified values will be lost at power-down.) Previously saved values will not be altered.
- shall report command complete with no CHECK CONDITION status when successfully completing the above.

Important: The SP bit should only be set to one for saving Page Code 1_H values. Never use the SP bit for saving Page Codes 3_H and 4_H. Page Codes 3_H and 4_H are saved automatically when a Format Unit Command is issued immediately following the alteration of Page Codes 3_H and 4_H. Using the SP bit with pages 3 and 4 risks the chance of being unable to recover the configuration track and/or user data. The only situations for using the SP bit for saving Page Codes 3_H and 4_H is during special data recovery procedures needed when the configuration track has been altered without format, or a drive malfunction.

The MODE SELECT parameter list contains a four-byte Header, followed by one or no Block Descriptor, followed by zero or more pages of parameters, if any.

MODE SELECT HEADER

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved (00_H)							
1	Medium Type (00_H)							
2	Reserved (00_H)							
3	Block Descriptor Length (08_H) or (00_H)							

BLOCK DESCRIPTOR

Bit / Byte	7	6	5	4	3	2	1	0
0	Density Code (00_H)							
1	Number of Blocks (MSB) (00_H)							
2	Number of Blocks (00_H)							
3	Number of Blocks (LSB) (00_H)							
4	Reserved (00_H)							
5	Block Length (MSB) (00_H)							
6	Block Length 01_H = 256 Bytes/Sector 02_H = 512 Bytes/Sector 04_H = 1024 Bytes/Sector 08_H = 2048 Bytes/Sector							
7	Block Length (LSB) (00_H)							

PAGE DESCRIPTOR/S

0-n	Refer to each page

Figure 10-21

MODE SELECT Parameter List

Code value for the media type field is assigned as follows :

00_H	Default (currently mounted media type)

Figure 10-22

Media Type

The Block Descriptor Length (Byte 3) specifies the length in bytes of the Block Descriptor. The drive only accepts one or no Block Descriptor. A Block Descriptor Length of zero indicates that no Block Descriptor is included in the Parameter List. This condition will not be considered as an error.

The Block Descriptor specifies the media characteristics for the entire drive. The Block Descriptor contains a Density Code, a Number of Blocks, and a Block Length.

Code value for the Density Code field is assigned as follows:

00_H	Default (default density of media)

Figure 10-23

Density Code

The Number of Blocks field specifies the number of Logical Blocks on the media that meet the Density Code and Block Length in the Block Descriptor. A number of blocks of zero, the only value accepted, indicates that all logical blocks of the drive have the same characteristics.

The Block Length specifies the length in bytes of each Logical Block. The drive is formatted with either 256, 512, 1024 or 2048 bytes per block. The data fields in each sector on the disk are the same size as the block size. When Block Length is changed, Page 3 must also be sent in the same MODE SELECT command with the "sectors per track" (Byte 11) altered to reflect the new Block Length (i.e., a 512 byte sector can have as many as 26 sectors per track, while a 1024 byte sector can only accommodate 14 sectors per track.)

Additional blocks of parameters called "Pages" may be sent to the XT-3000, following the MODE SELECT header, if the Block Descriptor Length is set to zero, or following the Block Descriptor. The Block Descriptor Length does not include the length of the Pages.

10.11.1 Description of Pages

The Pages are separated into sub-blocks containing a list of related flags and/or values. Each Page is preceded by a Page Code and the Length of the Page. The length byte value shall not include itself. The Page Code identifies the meaning of the following bytes within the page Length. Those pages in which the host requests parameters to be changed shall be sent to the drive. All Pages may be sent by the host. The Pages do not have to be sent in ascending order.

It is recommended that the host issues a MODE SENSE command requesting Changeable values in byte 2 of the CDB, prior to issuing a MODE SELECT command, in order to find out which Pages are implemented by the drive, the length of each Page, and what values within each page are changeable.

Page Code	Description
1_H	Error Recovery parameters
3_H	Format Parameters
4_H	Disk Drive Geometry parameters

The XT-3000 will return a CHECK CONDITION status and set the Sense Key to ILLEGAL REQUEST for a value different than those above.

Figure 10-24

Page Codes

Bit / Byte	7	6	5	4	3	2	1	0
0	0	0	Page Code = 1_H					
1	Page Length (in bytes) (02_H)							
2	AWRE	ARRE	TB	RC	EEC	PER	DTE	DCR
3	Retry Count							

Figure 10-25

ERROR RECOVERY PARAMETERS: Page code 1

A DCR (Disable Correction), bit 0, of one indicates that the data is to be transferred without applying correction, whether or not it is actually possible to correct the data.

A DCR bit of zero indicates that the data is to be corrected if possible.

A DTE (Disable Transfer on Error), bit 1, of one and if the PER bit is set to one, indicates that the drive creates the CHECK CONDITION status and terminates the data transfer to the host immediately upon detection of a recoverable error. In this case the Transfer Length is not exhausted. The block in error, which is the first erring block encountered, may or may not be transferred to the host depending upon the setting of the TB bit. The DTE bit can only be set to one by the host if the PER bit is also set to one. The drive creates the Check Condition status with Illegal Request Sense Key if it receives PER bit of zero and DTE bit set to one.

A DTE bit of zero enables data transfer for any data which can be recovered within the limits of the Error Recovery Flags. Any erroring block that would be posted, which is the last recovered block encountered, is not posted until the Transfer Length is exhausted.

A PER (Post Error), bit 2, of one indicates that the drive enables the reporting of the CHECK CONDITION status for recovered errors, with the appropriate Sense Key. The CHECK CONDITION shall happen during the data transfer depending either on the DTE bit value or if an unrecoverable error occurred. If multiple errors occur, the Sense data shall report the Block Address of either the unrecoverable error, or if no unrecoverable error occurred, the last block with recovered error (DTE = 0), or the first block with recovered error (DTE = 1).

A PER bit of zero indicates that the XT-3000 will not create the CHECK CONDITION status for errors recovered within the limits established by the other Error Recovery Flags. Recovery procedures exceeding the limits established by the other Error Recovery Flags are posted accordingly. The transfer of data may terminate prior to exhausting the Transfer Length depending on the error type of (recoverable or unrecoverable) and the state of the other Error Recovery Flags.

An EEC (Enable Early Correction) bit 3, of one indicates that the XT-3000 enables the use of the error correction, before applying retries. Seek or positioning retries and the recovery procedure retries of the message system are not affected by the value of this bit. EEC and DCR both of one is an Invalid Request for which the drive will create the CHECK CONDITION with Illegal Request Sense Key.

An EEC bit of zero, indicates that the drive exhausts the defined retry limit prior to enabling error correction.

An RC (Read Continuous), bit 4, of one requests the XT-3000 to transfer the Transfer Length without adding delays which would increase or ensure data integrity (ie. Delays caused by the drive's Error recovery schemes). This implies that the drive may send data which may be erroneous or fabricated in order to maintain a continuous flow of data and avoid delays. The drive assigns priority to this bit over conflicting error control bits within this byte.

An ARRE (Automatic Read Reallocation of defective blocks Enabled) bit 6 set to one indicates that the target shall enable automatic reallocation of defective data blocks during READ operations. The execution of the automatic reallocation is similar to the function of the REASSIGN BLOCKS command, but is initiated at the discretion of the target. The implementation is device specific.

An ARRE bit set to zero indicates that the target shall not perform automatic reallocation of defective data blocks during READ operations, but instead shall create the CHECK CONDITION Status with Sense Key of MEDIUM ERROR upon encountering such defective data blocks.

An AWRE (Automatic Write Reallocation of defective data blocks Enabled) bit 7 set to one indicates that the target shall enable automatic reallocation of defective data blocks during WRITE operations. The execution of the automatic reallocation is similar to the function of REASSIGN BLOCKS command, but is initiated at the discretion of the target. The implementation is device specific.

An AWRE bit sets to zero indicates that the target shall not perform automatic reallocation of defective data blocks during WRITE operations, but instead shall create the CHECK CONDITION Status with Sense Key of MEDIUM ERROR upon encountering such defective data blocks.

Implementors note: Fabricated data may be data already in the buffer or any other drive scheme.

An RC bit of zero, indicates that error recovery operations which cause reasonable delays are acceptable during the data transfer. Data is not fabricated.

A TB (Transfer Block), bit 5, of one, indicates that the failing block data is to be transferred to the host.

A TB bit of zero indicates the the failing block data is not to be transferred to the host.

Bit 6 and 7 are not used and must be 0.

The following table summarizes all modes of operation.

EEC	PER	DTE	DCR	Description
0	0	0	0	Retries then Correction are attempted. Recovered and/or corrected data (if any) is transferred corrected (EEC and DCR off) with no CHECK CONDITION Status (PER off) at the end of the transfer. - Transfer Length is exhausted. Data transfer stops only if an unrecoverable error is encountered. The drive creates CHECK CONDITION status with the appropriate Sense Key. - The data of the unrecoverable Block (if any) may or may not be transferred to the initiator depending on the setting of the TB bit.
0	0	0	1	Same as (0 0 0 0) above but No Correction Applied (EEC off, DCR on).
0	0	1	0	Invalid Request (DTE on, PER off)
0	0	1	1	Invalid Request (DTE on, PER off)
0	1	0	0	Report Last Data Block in error at the end of transfer. Retries then Correction (EEC off, DCR off) are attempted and recovered data (if any) is transferred corrected. -The Transfer Length is exhausted if no unrecoverable error occured (DTE off). - The drive creates Check Condition status with RECOVERED ERROR Sense Key and reports, in the Information bytes field of the Extended Sense data, the last block for which recovered error occurred, if any (PER on). - The data of the unrecoverable Block (if any) may or may not be transferred to the initiator depending on the setting of the TB bit.
0	1	0	1	Same as (0 1 0 0) above but No Correction Applied (EEC off, DCR on).
0	1	1	0	Stop Transfer on First Recovered Error Encountered. Retries then Correction (EEC off, DCR off) are attempted and recovered data (if any) is transferred corrected, but transfer stops (DTE on) after the first recovered (or not) or unrecoverable error is detected.

EEC	PER	DTE	DCR	Description
				- The drive creates CHECK CONDITION status (PER on) with RECOVERED ERROR Sense Key on the first block for which a recovered error occurred, if any. - This combination is only valid if the corrected data is transferred, therefore TB bit shall be set to one. TB bit not set to one is an Invalid Request.
0	1	1	1	Same as (0 1 1 0) above but No Correction Applied (EEC off, DCR on). - The data of the erring Block (if any) may or may not be transferred to the initiator depending on the setting of the TB bit.
1	0	0	0	Correction then Retries (DCR off, EEC on). Same as (0 0 0 0) except apply ECC Correction first.
1	0	0	1	Invalid Request (EEC on, DCR on).
1	0	1	0	Invalid Request (DTE on, PER off).
1	0	1	1	Invalid Request (DTE on, PER off)(EEC on, DCR on).
1	1	0	0	Report Last Data Block in error at the end of transfer. Same as (0 1 0 0) except apply ECC Correction first.
1	1	0	1	Invalid Request (EEC on, DCR on).
1	1	1	0	Stop transfer on First Recovered Error Encountered. Same as 0110 except Correction then Retries are attempted.
1	1	1	1	Invalid Request (EEC on, DCR on).

The XT-3000 will return a CHECK CONDITION status and set the Sense Key/Error code to "ILLEGAL REQUEST/ Illegal Function for Device Type" for any invalid combination.

Retry Count is the number of times that the drive shall attempt its read recovery algorithm.

Bit / Byte	7	6	5	4	3	2	1	0
0	0	0	Page Code = 3_H (03_H)					
1	Page Length (in bytes) (16_H)							

HANDLING OF DEFECT FIELDS

2	Tracks per Zone (MSB) (00_H)
3	Tracks per Zone (LSB)*
4	Alternate Sectors per Zone (MSB)
5	Alternate Sectors per Zone (LSB)
6 through 9	Zero Value (00_H)

* (00_H) or (01_H) or (Data Tracks per Cylinder $_H$)

TRACK and SECTOR FORMAT FIELDS

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 through 19	Zero Value (00_H)

(Note: Interleave Factor is selected with the Format Command (See Section 11.5).

Figure 10-26

Format Parameters: Page Code 3_H (Bytes 0 through 19)

(The following page contains bytes 20 through 23.)

(Continued from previous figure)

DRIVE TYPE FIELD

Bit	7	6	5	4	3	2	1	0
20	SSEC	0	0	0	INS	Reserved		
21 through 23	Reserved							

Figure 10-27

FORMAT PARAMETERS: Page code 3_H (Bytes 20 through 23)

Important: Page Code 3 parameters must never be changed unless a Format Unit Command Follows.

10.11.2 Handling of Defect Fields; Page Code 3

The bad sector mapping scheme supported by the XT-3000 allows the host to allocate spare sectors per zone: The host defines that the size of the zone may be a track, cylinder or the entire drive. The host also defines how many spare sectors will be assigned to each zone. The spare sectors are physically located at the end of the zone. When tracks per zone equals one track, and a bad sector is mapped out, it will be mapped to the following sector. All subsequent sectors are shifted until the end of the zone. This is done to minimize the performance degradation due to bad sectors. When tracks per zone equals a cylinder or the entire drive, and a sector is mapped out, it is mapped to a spare sector at the end of the zone.

If the host specifies a value for the Tracks Per Zone that is not supported by the drive, the drive will round up or round down the value to a supported zone size and reject the command with CHECK CONDITION status. The Sense Key/Error Code will be set to "ILLEGAL REQUEST/Illegal Block Descriptor. The host may then issue a MODE SENSE command requesting the Current values to be returned, in order to be informed about which value has been set by the controller in response to the initially requested value of the MODE SELECT command. The round up or down value is only available with the current values, and will be available as saved values after successful completion of the Format Unit Command.

Tracks Per Zone indicates that the controller shall divide the capacity of the XT-3000, prior to format, in equal number of tracks for the purpose of allocating with the next four bytes, an equal number of alternate sectors or tracks per zone for handling defects. A zone can be one track (01_H) or one cylinder (number of heads; 09_H = 3170 or $0F_H$ = 3280) or the whole disk (00_H). The last zone of the device may not include the same number of tracks as the previous zone(s). The capacity of the XT-3000 is represented by the Number of Cylinders and Number of Heads returned in the "Page 4" of a MODE SENSE command.

Alternate Sectors per Zone indicates the number of sectors that the controller deallocates from the host addressable blocks prior to the FORMAT UNIT command. These sectors will be available as replaceable sectors for defective sectors. These alternates will be located at the end of tracks, or cylinders, or the enter drive depending on the zone size. If this field equals zero, then the FmtData bit of the FORMAT UNIT command should also equal zero.

There are two ways to disable XT-3000 defect handling:

(1) The host sets the Mode Select Page 3 alternates per zone field to zero and sets the FmtData bit of the FORMAT UNIT command to zero. No spare sectors are deallocated.

(2) The host sets the FmtData and the CmpLst bits in the FORMAT UNIT command to one and sets the Defect List Length of the Header (sent during the Data Out phase of the FORMAT UNIT command) to zero. Byte one of the Header must equal an $E0_H$ or an $F0_H$. This will cause the alternates per zone to be deallocated, but no defects will be mapped out.

10.11.3 Track Format Field: Page Code 3

Sectors per Track indicates the number of physical sectors that the drive shall format (or has formatted in the case of a Mode Sense Command) per disk track. The drive will set an equal data sector size to all sectors accordingly. The drive will format as many sectors as it can. For performance reasons it is strongly recommended to use the default values of the sectors per track according to the sector size. The MODE SENSE command returns the number of user addressable sectors per track. If one sector per track is deallocated for defect handling, the XT-3000 will not include that sector in this Sectors Per Track field.

10.11.4 Sector Format Field: Page Code 3

Data Bytes for physical sector indicates the number of data bytes that the drive has allocated per physical sector. This field is only returned by MODE SENSE commands and matches the logical block length value indicated in the Block Descriptor and in the READ CAPACITY data.

Interleave is the same parameter value of the CDB of the last successfully completed FORMAT UNIT command, and is only returned by the MODE SENSE command. The drive reports this field as non changeable in the corresponding MODE SENSE commands. The drive ignores this field in MODE SELECT commands.

10.11.5 Drive Type Field: Page Code 3

A SSEC bit of one indicates that the controller uses soft sector formatting. This bit is not changeable by the initiator, therefore cannot be set by MODE SELECT commands.

The INS bit set to one indicates that the host requests the parameters of Page Codes 3 and 4 shall be saved by the drive. The drive saves the parameters of Pages 3 and 4 whether the INS bit is set or not.

Bit / Byte	7	6	5	4	3	2	1	0
0	0	0	Page Code = 4_H (04_H)					
1	Page Length (in bytes) (12_H)							
2	Number of Cylinders (MSB)							
3	Number of Cylinders							
4	Number of Cylinders (LSB)							
5	Number of Heads							
6	Zero Value (00_H)							
7	Zero Value (00_H)							
8	Zero Value (00_H)							
9	Zero Value (00_H)							
10	Zero Value (00_H)							
11	Zero Value (00_H)							
12	Zero Value (00_H)							
13	Zero Value (00_H)							
14 through 19	Zero Value (00_H)							

Figure 10-28

Disk Drive Geometry Parameters: Page Code 4

The Number of Cylinders and number of heads is changeable and can be up to the value returned by the MODE SENSE command with Default values. The drive will create a CHECK CONDITION status when receiving a value greater than the default value. The READ CAPACITY DATA value is calculated by the drive according to the MODE SELECT value. The FORMAT UNIT command will format the drive up to the cylinder value received in the MODE SELECT command.

All other parameters shall be set to zero by the initiator.

10.12 RESERVE Command

Operation Code: 16_H

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			3rd Pty	Third Party Device ID			0
2	Reserved (00_H)							
3	Reserved (00_H)							
4	Reserved (00_H)							
5	Control Byte							

Figure 10-29

RESERVE Command

The RESERVE command is used to reserve the drive.

The initiator requests that the entire drive be Reserved until the reservation is released by a RELEASE command from the same initiator, by a BUS DEVICE RESET message from any initiator, or by a "hard" RESET condition. A drive reservation will not be granted if the drive is reserved by another initiator. It is permissible for an initator to reserve a drive that is currently reserved for that initiator. If, after honoring the reservation, any other initiator then subsequently attempts to perform any command on the reserved drive other than a RESERVE command, which will be queued, then the command is rejected with RESERVATION CONFLICT status.

The XT-3000 supports the third party reservation option.

The third party reservation option for the RESERVE command allows an initiator to reserve a drive for another SCSI device.

If the third-party (3rdPty) bit is zero, then the third-party reservation option is not requested. If the 3rdPty bit is one the RESERVE command will reserve the specified logical unit for the SCSI device specified in the third-party device ID field. The drive will preserve the reservation until it is released by the same initiator (or by a BUS DEVICE RESET message from any initiator or a "hard" RESET condition). The XT-3000 will ignore any attempts to release the reservation made by any other initiator.

10.13 RELEASE Command

Operation Code: 17_H

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			3rd Pty	Third Party Device ID			0
2	Reserved (00_H)							
3	Reserved (00_H)							
4	Reserved (00_H)							
5	Control Byte							

Figure 10-30

RELEASE Command

The RELEASE command is used to release the previously reserved drive. It is not an error for an initiator to attempt to release a reservation that is not currently active.

The initiator requests the XT-3000 to terminate all drive reservations from the initiator.

The XT-3000 supports the third party release option.

The third-party release option for the RELEASE command allows an initiator to release a logical unit or that was previously reserved using the third-party reservation option.

If the third-party (3rdPty) bit is zero, then the third-party release option is not requested. If the 3rdPty bit is one then the logical unit will be released, but only if the reservation was made using the third-party reservation option by the same initiator for the same SCSI device as specified in the third-party device ID field.

10.14 COPY Command

Operation Code: 18_H

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (Zeros)				
2	Parameter List Length (MSB)							
3	Parameter List Length							
4	Parameter List Length (LSB)							
5	Control Byte							

Figure 10-31

COPY Command

The COPY command provides a means to copy data between logical units.

Further definition of this command will soon be available.

10.15 MODE SENSE Command

Operation Code: $1A_H$

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (Zeros)				
2	Page Control Field		Page Code					
3	Reserved (00_H)							
4	Allocation Length							
5	Control Byte							

Figure 10-32

MODE SENSE Command

The MODE SENSE command provides a means for the XT-3000 to report its peripheral device parameters to the Initiator. It is a complementary command to the MODE SELECT command.

It is recommended that the Initiator issue a MODE SENSE command requesting the drive to return all Changeable values (PCF field configuration 0 1 and Page Code 3FH in byte 2 of the MODE SENSE CDB) prior to issuing any MODE SELECT commands, in order to find out which Pages are implemented by the drive, the length of each Page, and which bits and bytes are changeable.

An initiator may request a particular Page 1, 3 or 4 to be returned from the drive by selecting its code in byte 2 of the CDB. A page code of $3F_H$ will return all pages.

Page Control Field bits 7 and 6 byte 2 of the CDB.

7	6	
0	0	Report Current Values. - If the Page Code is equal to $3F_H$, all Pages 1,3 and 4 are returned to the initiator with fields and bits set to Current values. - If the Page Code is different than $3F_H$, the Page defined by the Page Code is returned to the initiator with fields and bits set to Current values. The Current values are either : - as set in the last successfully completed MODE SELECT command since Power On. - or are identical to the Saved values if no MODE SELECT command has been issued since the last Power On. - or are identical to the Default values. If no saved parameters exist and no MODE SELECT command has been issued since Power On.

Fields and bits not supported by the drive shall be set to zero.
The Page Length byte value of each Page returned by the drive indicates up to which fields are supported within the particular Page.

0 1 Report Changeable Values.
- If the Page Code is equal to $3F_H$, all Pages 1,3 and 4 are returned to the initiator with bits and fields that are allowed to be changed by the initiator set to one. Fields and bits not allowed to be changed by the initiator are set to zero.
- If the Page Code is different than $3F_H$, the Page defined by the Page Code is returned to the initiator with bits and fields that are allowed to be changed by the initiator set to one. Fields and bits not allowed to be changed by the initiator are set to zero.

1 0 Report Default Values.
- If the Page Code is equal to $3F_H$, all Pages 1,3 and 4 are returned to the initiator with fields and bits set to the drive default values.
- If the Page Code is different than $3F_H$, the Page defined by the Page Code is returned to the initiator with fields and bits set to the drive default values.
Fields and bits not supported by the drive are set to zero.
The value of the fields returned with this code aids in avoiding confusion over whether the value of zero is the default or the non supported value.

1 1 Report Saved Values.
- If the Page Code is equal to $3F_H$, all Pages 1, 3 and 4 are returned to the initiator with fields and bits set to the saved values.
- If the Page Code is different than $3F_H$, the Page defined by the Page Code is returned to the initiator with fields and bits set to the saved values.
The Saved values are either:
- the values saved during the last successfully completed FORMAT UNIT or MODE SELECT commands.
- or identical to the Default values if no saving has been done.
The saved values are recorded on disk. Pages 3 and 4 are saved automatically after a FORMAT UNIT command. Page 1 is saved when the host sets the SP bit to one in the Mode Select CDB, Page 1.
Fields and bits not supported by the drive in the Pages are set to zero.

The Allocation Length specifies the number of bytes that the initiator has allocated for returned MODE SENSE data. An Allocation Length of zero indicates that no MODE SENSE data is to be transferred. This condition will not be considered as an error. Any other value indicates the maximum number of bytes that are to be transferred. The XT-3000 will terminate the DATA IN phase when Allocation Length bytes have been transferred or when all available MODE SENSE data have been transferred to the initiator, whichever is less. Thus, if the host wants all available data to be transferred from the drive, byte 4 may equal FF_H.

The MODE SENSE data contains a four-byte Header, followed by one eight-byte Block Descriptor, followed by zero or more Pages. Byte 2 of the CDB is allocated to the selection of the Pages. The PCF field defines in which format the Pages shall be returned to the initiator, and the Page Code field specifies which Pages to return.

MODE SENSE HEADER

Bit / Byte	7	6	5	4	3	2	1	0
0	Sense Data Length							
1	Medium Type (00_H)							
2	WP	Reserved (80_H) or (00_H)						
3	Block Descriptor Length (08_H)							

BLOCK DESCRIPTOR

Bit / Byte	7	6	5	4	3	2	1	0
0	Density Code (00_H)							
1	Number of Blocks (MSB) (00_H)							
2	Number of Blocks (00_H)							
3	Number of Blocks (LSB) (00_H)							
4	Reserved (00_H)							
5	Block Length (MSB) (00_H)							
6	Block Length (01_H) (02_H), (04_H) or (08_H)							
7	Block Length (LSB) (00_H)							

PAGE DESCRIPTOR/S

Bit / Byte	7	6	5	4	3	2	1	0
0	PS	0	Page Code					
1	Page Length							
2-n	Refer to Page Descriptor Definitions							

Figure 10-33

MODE SENSE Data

The Sense Data Length (Byte 0 of the Header) specifies the length in bytes of the following MODE SENSE data that is available to be transferred during the DATA IN phase. The Sense Data Length does not include byte 0. The medium type value returned is 00_H.

A WP (Write Protected) bit set to zero indicates that the XT-3000 is Write Enabled. A WP set to one indicates that the drive is Write Protected. (Jumper JP 42 is shorted.)

The Block Descriptor Length (Byte 3) specifies the length in bytes of the Block Descriptor which is always 08_H.

The Block Descriptor specifies the media characteristics for the entire drive. The Block Descriptor contains a Density Code, a Number of Blocks, and a Block Length.

The Number of Blocks field specifies the number of logical blocks on the media that meet the Density Code and Block Length in the Block Descriptor. A Number of Blocks of zero, value returned, indicates that all logical blocks of the drive have the same media characteristics. The XT-3000 returns 00_H for these values.

The Block Length specifies the length in bytes of each logical block (sector size). The drive is formatted with either 256,512, 1024 or 2048 bytes per block. The data fields in each sector on the disk are the same size as the block size.

Each Page is preceded by a Header of two bytes defining that the page is savable (PS bit = 1), the Page Code and the length of the Page. Following the Header, the Pages are separated into sub-blocks containing a list of related flags and/or values.

10.15.1 Page Description

PS (Parameters Savable) bit 7 byte 0 of each Page Header is always set to one by the drive indicating that the supported parameters in the Page defined by the Page Code can be saved by the drive. Page Codes 3 and 4 are always automatically saved with the subsequent Format Unit command. Also, when successfully completing a MODE SELECT command of Page Code 1 issued with the SP bit set in the CDB, the drive will save the error recovery parameters of the defined Page Code 1. Thus, all Page Codes are saveable. See MODE SELECT command definition.

Bit 6 of byte 0 is reserved.

The Page Code identifies the meaning of the subsequent bytes in the Page. The Page Length indicates the number of bytes that the drive supports in each Page. The Page Length value of each page does not include the Page Length byte. The XT-3000 returns in the Pages of the MODE SENSE commands as many consecutive bytes that it supports, for each Page that it supports. The Page Length shall be set in the Pages of the MODE SELECT commands to the exact same value returned by the drive in the MODE SENSE Page Length bytes. Otherwise, the XT-3000 shall create CHECK CONDITION status with the Sense Key of ILLEGAL REQUEST.

Changeable values of Pages may be modified by successfully completing a MODE SELECT command. Saved values of Pages 3 and 4 may only be updated by a successfully completed FORMAT UNIT command. A FORMAT UNIT command completing with NO CHECK CONDITION status indicate that the saved values have been successfully saved.

Page code	Meaning
1_H	Error Recovery parameters
3_H	Direct Access Device Format parameters
4_H	Disk Drive Geometry parameters
$3F_H$	Return all Pages to the initiator.

Figure 10-34

Page Codes (bits 0 through 5 of byte 0 in the Page Header and bits 0 through 5 of byte 2 of the CDB)

The XT-3000 returns the same Page Length value in each Page that it supports with the 3FH Page Code whether Changeable, Current, Default or Saved values are requested in Page Control Field of the CDB.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS = 1	0	Page Code = 1_H (81_H)					
1	Page Length (in bytes) (02_H)							
2	0	0	TB	RC	EEC	PER	DTE	DCR
3	Retry Count							

MODE SENSE values

	Current	Changeable	Default	Saved
Byte 0	81_H	81_H	81_H	81_H
Byte 1	02_H	02_H	02_H	02_H
Byte 2	Host dependent	$3F_H$	24_H	Host dependent
Byte 3	Host dependent	FF_H	08_H	Host dependent

Figure 10-35

ERROR RECOVERY PARAMETERS Page Code 1

Saved values are only valid if Page 1 was altered by a previous Mode Select Command withthe SP bit in the CDB set to one.

Refer to MODE SELECT Page 1 for the definition of Bytes 2 and 3.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS = 1	0	Page Code = 3_H (83_H)					
1	Page Length (in bytes) (16_H)							
2	Tracks per Zone (MSB)							
3	Tracks per Zone (LSB) (00_H, 01_H, 09_H or $0F_H$)							
4	Alternate Sectors per Zone (MSB)							
5	Alternate Sectors per Zone (LSB)							
6	Zero Value (00_H)							
7	Zero Value (00_H)							
8	Alternate Tracks per Volume (MSB)							
9	Alternate Tracks per Volume (LSB)							
10	Sectors per Track (MSB)							
11	Sectors per Track (LSB)							
12 through 13	Zero Value							
14	Interleave (MSB)							
15	Interleave (LSB)							
16 through 19	Zero Value (00_H)							
20	SSEC=1	0	0	0	INS=1	Reserved (88_H)		
21 through 23	Zero value (00_H)							

Figure 10-36

Direct Access Device
Format Parameters Page code 3
Current, Changeable, Default and Saved values.

MODE SENSE values

	Current	Changeable	Default		Saved
Byte 0	83_H	83_H	83_H		83_H
Byte 1	16_H	16_H	16_H		16_H
Byte 2 & 3	Host dependent	$FFFF_H$	0001_H	(one track)	Host dependent
Byte 4 & 5	Host dependent	$FFFF_H$	0001_H	(one sector)	Host dependent
Byte 6 to 9	Zero	Zero	Zero		Zero
Byte 10 & 11	Host dependent	$FFFF_H$	$001A_H$	(26 sectors)	Host dependent
Byte 12 & 13	Host dependent	$FFFF_H$	0200_H	(512 bytes)	Host dependent
Byte 14 & 15	Host dependent	0000_H	0001_H		Host dependent
Byte 16 to 19	Zero	Zero	Zero		Zero
Byte 20	Host dependent	08_H	88_H		Host dependent
Byte 21 to 23	Zero	Zero	Zero		Zero

Figure 10-37

FORMAT PARAMETERS Page Code 3

Refer to MODE SELECT Page 3 for definitions of Bytes 2 through 23.

Bit / Byte	7	6	5	4	3	2	1	0
0	PS = 1	R	Page Code = 4_H (84_H)					
1	Page Length (in bytes) (12_H)							
2	Number of Cylinders (MSB)							
3	Number of Cylinders							
4	Number of Cylinders (LSB)							
5	Number of Heads							
6 through 19	Reserved							

Figure 10-38

DISK DRIVE GEOMETRY PARAMETERS Page code 4

Current, Changeable Default and Saved Values

The Number of Cylinders is a changeable parameter, but cannot be set to a value greater than the default value. (1224 or $04C8_H$), a value greater than the real capacity will result in an error in the next Format Unit command. Defining a number of cylinders less than the real capacity of the XT-3000 is allowed. From this value, the XT-3000 deallocates 3 tracks from the user if no defect handling is requested or 11 tracks if defect handling is requested. Additionally, the XT-3000 always deallocates track zero from the user addressable blocks, where the drive device independence information will be stored.

The Number of Heads is changeable to any value equal to or less than the actual number of heads. The default value depends on the drive model: XT-3170 = 9, XT-3280 = 15 ($0F_H$).

MODE SENSE Page 4 returned values

	Current	Changeable	Default	Saved
Byte 0	84_H	84_H	84_H	84_H
Byte 1	12_H	12_H	12_H	12_H
Byte 2 to 4	Host dependent	$FFFFFF_H$	$0004C8_H$	Host dependent
Byte 5	Host dependent	FF_H	Drive Dependent*	Host dependent
Byte 6 to 19	Zero	Zero	Zero	Zero

*(09_H or $0F_H$)

10.16 START/STOP UNIT Command

Operation Code: $1B_H$

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			0	0			Immed
2	Reserved (00_H)							
3	Reserved (00_H)							
4	Reserved (Zeros)							
5	Control Byte							

Figure 10-39

START/STOP UNIT Command

An Immed (immediate) bit of one indicates that status will be returned as soon as the operation is initiated.

An Immed bit of zero indicates that status will be returned after the operation is completed.

If the Immediate bit is not set and the host supports disconnect/reconnect, the command will disconnect while performing the command.

A Start bit of one requests the drive be made ready for use.

A Start bit of zero requests that the drive be stopped.

Important: To use this command, jumper JP 44 must be removed. With JP 44 installed, the drive will spin-up immediately when power is applied. (See Section 5.2).

10.17 SEND DIAGNOSTIC Command

Operation Code: $1D_H$

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved		SelfTest	0	UnitOfl
2	Reserved (00_H)							
3	Reserved (00_H)							
4	Reserved (Zeros)							
5	Control Byte							

Figure 10-40

SEND DIAGNOSTIC Command

The SEND DIAGNOSTIC command requests the XT-3000 to perform diagnostic tests on itself.

A SelfTest bit of zero or one directs the drive to complete its default self test. If the self test successfully passes, the command is terminated with a GOOD status; otherwise, the command will be terminated with a CHECK CONDITION status and the sense key is set to HARDWARE ERROR.

A UnitOfl bit set to one enables read and write operations on all heads of the following cylinder number:

Default value of maximum cylinder + 1

A UnitOfl bit set to zero disables any access to the above-described cylinder.

11.0 GROUP 1 COMMANDS

Unlike the six byte command descriptor blocks of Group 0 commands, Group 1 command descriptor blocks are ten bytes in length.

The Group 1 commands that the drive supports are as shown in the following Table.

Operation Code	Command Name	Section
25_H	READ CAPACITY	12.1
28_H	READ EXTENDED	12.2
$2A_H$	WRITE EXTENDED	12.3
$2B_H$	SEEK EXTENDED	12.4
$2E_H$	WRITE AND VERIFY	12.5
$3F_H$	VERIFY	12.6
37_H	READ DEFECT DATA	12.7
$3B_H$	WRITE BUFFER	12.8
$3C_H$	READ BUFFER	12.9

Figure 11-1

Group 1 Commands

11.1 READ CAPACITY Command

Operation Code: 25_H

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (Zeros)				
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address (LSB)							
5	Reserved (00_H)							
6	Reserved (00_H)							
7	Reserved (00_H)							
8	Reserved (Zeros)							PMI
9	Control Byte							

Figure 11-2

READ CAPACITY Command

The READ CAPACITY command provides a means for the initiator to request information regarding the capacity of the logical unit.

A partial media indicator (PMI) bit of zero indicates that the information returned in the READ CAPACITY Data is the Logical Block Address and Block Length (in bytes) of the last user addressable logical block of the drive. If spare sectors are deallocated, only user addressable blocks are counted in the calculation of the last logical block address; alternate sectors are not counted. The 11 tracks reserved at the end of the drive are also not counted if defect mapping is enabled. Three (3) tracks are not counted if defect mapping is not enabled. In addition, track zero (0) is never counted. The LBA in the CDB is to be set to zero for this option.

A PMI bit of one indicates that the information returned is the LBA and Block Length (in bytes) of the last logical block after the LBA specified in the CDB before a substantial delay in data transfer will be encountered. Such delay may be dependent on Disconnect/Reconnect timings, when the buffer is empty or full or when the drive is seeking. This function is intended to assist storage management software in determining whether there is sufficient space on the current track, cylinder, etc. to contain a frequently accessed data structure such as a file directory or file index.

The eight bytes of READ CAPACITY Data shown in the following figure, are sent during the DATA IN phase of the command.

Bit / Byte	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 (00_H)							
6	Block Length 01_H = 256 Bytes/Sector 02_H = 512 Bytes/Sector 04_H = 1024 Bytes/Sector 08_H = 2048 Bytes/Sector							
7	Block Length (LSB) (00_H)							

Figure 11-3

READ CAPACITY Data

11.2 READ EXTENDED Command

Operation Code: 28_H

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (Zeros)				
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved (00_H)							
7	Transfer Length (MSB)							
8	Transfer Length (LSB)							
9	Control Byte							

Figure 11-4

READ EXTENDED Command

The READ EXTENDED command is the same as the READ command except that the Transfer Length occupies two bytes and the starting Logical Block Address occupies four bytes. The Transfer Length can be from 0000 to 65K-1 blocks.

The maximum LBA allowed is the LBA value returned in the READ CAPACITY Data (See Figure 12-3) with PMI bit set to zero.

Refer to the READ command for more information.

11.3 WRITE EXTENDED Command

Operation Code: $2A_H$

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (Zeros)				
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved (00_H)							
7	Transfer Length (MSB)							
8	Transfer Length (LSB)							
9	Control Byte							

Figure 11-5

WRITE EXTENDED Command

The WRITE EXTENDED command is the same as the WRITE command except the Transfer Length occupies two bytes and the starting Logical Block Address occupies four bytes. The Transfer Length can be from 0000 to 65K-1 blocks.

The maximum LBA allowed is the LBA value returned in the READ CAPACITY Data (See Figure 12-3) with PMI bit set to zero.

Refer to the WRITE command for more information.

11.4 SEEK EXTENDED Command

Operation Code: $2B_H$

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (Zeros)				
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved (00_H)							
7	Reserved (00_H)							
8	Reserved (00_H)							
9	Control Byte							

Figure 11-6

SEEK EXTENDED Command

The SEEK EXTENDED is similar to the SEEK command.

The maximum LBA allowed is the LBA value returned in the READ CAPACITY Data (See Figure 12-3) with PMI bit set to zero.

Refer to the SEEK command description in Section 11.

11.5 WRITE AND VERIFY Command

Operation Code: $2E_H$

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (Zeros)				
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved (00_H)							
7	Transfer Length (MSB)							
8	Transfer Length (LSB)							
9	Control Byte							

Figure 11-7

WRITE AND VERIFY Command

The WRITE AND VERIFY command requests that the XT-3000 write the data transferred from the initiator to the media and then verify that the data is correctly written. The drive performs media verification against CRC, ECC.

The LBA specifies the logical block at which the write operation will begin. The maximum LBA allowed is the LBA value returned in the READ CAPACITY Data (See Figure 12-3) with PMI bit set to zero.

The Transfer Length specifies the number of contiguous logical blocks of data that shall be transferred. A Transfer Length of zero indicates that no logical blocks are transferred. This condition will not be considered as an error and no data is written. Any other value indicates the number of logical blocks that shall be transferred.

11.6 VERIFY Command

Operation Code: $2F_H$

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (Zeros)				
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved (00_H)							
7	Verification Length (MSB)							
8	Verification Length (LSB)							
9	Control Byte							

Figure 11-8

VERIFY Command

The VERIFY command requests that the XT-3000 verify the data written on the media. The drive performs media verification against CRC, ECC.

The LBA specifies the logical block at which the verify operation will begin. The maximum LBA allowed is the LBA value returned in the READ CAPACITY Data (See Figure 12-3) with PMI bit set to zero.

The Verification Length specifies the number of contiguous logical blocks of data that is to be verified. A Transfer Length of zero indicates that no logical blocks are to be verified. This condition will not be considered as an error. Any other value indicates the number of logical blocks that will be verified.

11.7 READ DEFECT DATA Command

Operation Code: 37_H

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (zeros)				
2	Reserved (zeros)			P	G	Defect List Fmt (4_H)		
3	Reserved (00_H)							
4	Reserved (00_H)							
5	Reserved (00_H)							
6	Reserved (00_H)							
7	Allocation Length (MSB)							
8	Allocation Length (LSB)							
9	Control Byte							

Figure 11-9

READ DEFECT DATA Command

The READ DEFECT DATA command requests that the controller transfer the media defect data to the initiator.

The meaning of the Defect List Format field (bits 0 through 2 of byte 2) is similar to the bit definition of the Defect List Format field (bits 0 through 2 of the byte 1) of the FORMAT UNIT command. The Defect List Format the controller supports is bytes from Index (4_H).

If the host requests another format, the controller will return the list requested in the Bytes from Index format and create the CHECK CONDITION status with the Sense Key/Error Code set to "RECOVERED ERROR" at the end of the Read Defect Data data transfer.

- The P bit set to one indicates that the initiator requests that the Primary List of Defects be returned. The P bit of zero indicates that the controller will not return the P List of Defects.

- The G bit set to one indicates that the initiator requests that the G List of Defects be returned. The G bit of zero indicates that the controller will not return the G List of Defects.

- With bits P and G bits both set to one, the controller will return the Primary and the Growing Lists of Defects.

- With bits P and G set to zero, only the Defect List Header is to be returned.

If the controller is unable to read the defect list from the drive, the controller will create the CHECK CONDITION status and set the Sense Key/Error Code to "MEDIUM ERROR/No Record Found".

The Allocation Length specifies the number of bytes that the initiator has allocated for returned READ DEFECT DATA. An Allocation Length of zero indicates that no READ DEFECT DATA is to be transferred. Any other value indicates the maximum number of bytes that is requested to be transferred.

The controller terminates the DATA IN phase when the Allocation Length bytes have been transferred or when all available READ DEFECT DATA have been transferred to the initiator, whichever is less.

The READ DEFECT DATA contains a four byte Header, followed by zero or more Defect Descriptors.

DEFECT LIST HEADER

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved (00_H)							
1	Reserved (Zeros)			P	G	Defect List Fmt (4_H)		
2	Defect List Length (MSB)							
3	Defect List Length (LSB)							

DEFECT DESCRIPTOR/S

Bit / Byte	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)							

Figure 11-10

DATA RETURNED IN THE READ DEFECT DATA COMMAND

The meanings of bits 0 through 2 of byte 1 are similar to the Defect List Format of the FORMAT UNIT command. The bits P and G and the Defect List Format indicate which Defect List is actually returned by the controller, Bytes From Index. The format of the Defect Descriptors, if the Defect List Length is different than zero, are shown in the FORMAT UNIT command. The length of each Defect Descriptor is eight bytes. The Defect List Length specifies the total length in bytes of the Defect Descriptors that follow. The Defect List Length is equal to eight times the number of Defect Descriptors. If the Allocation Length of the CDB is too small to transfer all of the Defect Descriptors, the Defect List Length is not adjusted by the controller to reflect the truncation.

The Defect Descriptors may not be in ascending order. The initiator may be informed about the exact number of Defects by dividing the Defect List Length by 8 (the Defect Descriptor Length).

11.8 WRITE BUFFER Command

Operation Code: $3B_H$

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (Zeros)				
2	Reserved (00_H)							
3	Reserved (00_H)							
4	Reserved (00_H)							
5	Reserved (00_H)							
6	Reserved (00_H)							
7	Byte Transfer Length (MSB)							
8	Byte Transfer Length (LSB)							
9	Control Byte							

Figure 11-11

WRITE BUFFER Command

The WRITE BUFFER Command is used in conjunction with the READ BUFFER command as a diagnostic function for testing the drive's buffer memory and the SCSI bus integrity. There is no access to the media during the execution of this command. The Byte Transfer Length specifies the maximum number of bytes to be transferred to and retained in the drive buffer. The Byte Transfer Length contains a four byte header, followed by the WRITE BUFFER data. A Byte Transfer Length of zero indicates that no Write Buffer Header and no WRITE BUFFER data shall be transferred. This condition does not create the CHECK CONDITION status. If the Byte Transfer Length is greater than available length plus four reported by the Read Buffer Command, the drive creates the CHECK CONDITION status with the Sense Key of ILLEGAL REQUEST. In this case no data is transferred from the initiator. It is not an error to request a Byte Transfer Length less than the Available Length.

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved (00_H)							
1	Reserved (00_H)							
2	Reserved (00_H)							
3	Reserved (00_H)							

Figure 11-12

WRITE BUFFER Header

It is recommended that the initiator link the WRITE BUFFER and READ BUFFER commands and do not allow disconnection during the process to guarantee that the data buffer not be corrupted by uncompleted commands issued from the same or other initiators.

11.9 READ BUFFER Command

Operation Code: $3C_H$

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (Zeros)				
2	Reserved (00_H)							
3	Reserved (00_H)							
4	Reserved (00_H)							
5	Reserved (00_H)							
6	Reserved (00_H)							
7	Allocation Length (MSB)							
8	Allocation Length (LSB)							
9	Control Byte							

Figure 11-13

READ BUFFER Command

The READ BUFFER Command may be used in conjunction with the WRITE BUFFER command as a diagnostic function for testing the drive's buffer memory and the SCSI bus integrity. There is no access to the media during the execution of this command.

The Allocation Length specifies the maximum number of bytes that the initiator has allocated for returned READ BUFFER data. The Allocation Length contains a four byte header, followed by the READ BUFFER data called Available Length. The maximum Available Length is determined by the drive. An Allocation Length of zero indicates that no Read Buffer Header and no READ BUFFER data shall be transferred. This condition does not create the CHECK CONDITION STATUS sent during the WRITE BUFFER command. Up to 8 kilobytes may be requested to be transferred including four bytes of Header and up to 8 kilobytes of READ BUFFER data. If the Allocation Length is greater than the Available Length, added to the four bytes of Read Buffer Header, the Read Buffer Header with the Available Length shall be transferred to the initiator. It is not an error to request an Allocation Length less than the Available Length.

The drive terminates the DATA IN phase when Allocation Length bytes have been transferred or when the Read Buffer Header and the Available Length have been transferred to the initiator, whichever is less.

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved (00_H)							
1	Reserved (00_H)							
2	Available Length (MSB)							
3	Available Length (LSB)							

Figure 11-14

READ BUFFER Header

It is recommended that the initiator issues the RESERVE UNIT command prior to the WRITE BUFFER command, and issues the RELEASE UNIT command after the READ BUFFER command is completed, in order to avoid corruption of the drive's data buffer by another initiator.

12.0 GROUP 7 COMMANDS

Group 7 commands are ten bytes in length.

The group 7 commands supported by the XT-3000 are shown in the following figure:

Operation Code	Command Name	Section
$E8_H$	READ LONG	12.1
EA_H	WRITE LONG	12.2
FE_H	WRITE PRIMARY DEFECT LIST	12.3

Figure 12-1

Group 7 Commands

12.1 READ LONG Command
Operation Code: $E8_H$

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (Zeros)				
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved (00_H)							
7	Reserved (00_H)							
8	Reserved (00_H)							
9	Control Byte							

Figure 12-2

READ LONG Command

The READ LONG command is used to read the block addressed by the LBA and the 6 byte Error Correction Code that was written by the XT-3000 for that block.

NOTE: The number of bytes transferred by this command is the block size + 6 bytes.

12.2 WRITE LONG Command

Operation Code: EA_H

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved (Zeros)				
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved (00_H)							
7	Reserved (00_H)							
8	Reserved (00_H)							
9	Control Byte							

Figure 12-3

WRITE LONG Command

The WRITE LONG command is used to write the block addressed by the LBA plus the 6 byte Error Correction Code.

NOTE: The number of bytes transferred by this command is the block size + 6 bytes.

12.3 WRITE PRIMARY DEFECT LIST Command

Operation Code: FE_H

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Parameter List Length							
9	Control Byte							

Figure 12-4

WRITE PRIMARY DEFECT LIST Command

The WRITE PRIMARY DEFECT LIST command is used to record on the innermost cylinder of the drive the Primary Defect list of the drive. The cylinder number on which the drive records this information is either the Cylinder Default value as specified in the MODE SENSE Default values or with the cylinder number specified by the MODE SELECT if changed from the default value.

This command is normally exclusively used by the drive manufacturer.

The Parameter List Length is sent by the host during the Data Out phase of the command execution and shall be computed for the exact number of defects specified.

- -The first 64 bytes of the first block of data of this parameter list shall be sent by the host as specified in the following table. The drive checks if these 64 bytes are sent correctly.
- -After these 64 bytes, each defect descriptor occupies 9 bytes. The last 9 bytes shall be set to FF_H to indicate the end of the list.

Parameter List length shall be = [64 + (9 * Number of Defect Descriptors) + 9] divided by the Block Size

-The maximum number of Defect Descriptors that the host is allowed to send is 390. Therefore the maximum number of bytes to send is 3583 (391 * 9 + 64).

As an example with a block size of 512 bytes,

for one to 49 defects, the Parameter List Length shall be set to 01_H

for 390 defects the Parameter List Length shall be 07_H

Figure 12-5

PARAMETER LIST

HEADER (64 bytes or 40_H)

Bit / Byte	7	6	5	4	3	2	1	0
0	Sector Size (MSB) example (02_H) for 512 bytes/sector							
1	Sector Size (LSB) example (00_H) for 512 bytes/sector							
2	Number of Sectors per Track (not counting spare sectors, if any) example for 512 bytes/sector 26 sectors/track and one spare/track (19_H)							
3	P in ASCII (50_H)							
4	Blank (20_H)							
5	L in ASCII ($4C_H$)							
6	I in ASCII (49_H)							
7	S in ASCII (53_H)							
8	T in ASCII (54_H)							
9	Reserved							
10	Reserved							
11	Reserved							
12	Reserved							
13	Reserved							
14	Reserved							
15	Reserved							
16	Reserved							
17	Reserved							
18	Reserved							
19	Reserved							
20 through 39	Reserved							

Figure 12-5 (Cont.)
DRIVE MODEL (XT 3170 or XT 3280)

40	X in ASCII	(58_H)
41	T in ASCII	(54_H)
42	3 in ASCII	(33_H)
43	1 or 2 in ASCII	(31_H) or (32_H)
44	7 or 8 in ASCII	(37_H) or (38_H)
45	0 in ASCII	(30_H)
46	Blank (in ASCII)	(20_H)
47	Blank (in ASCII)	(20_H)
48	Blank (in ASCII)	(20_H)
49	Blank (in ASCII)	(20_H)
50	Blank (in ASCII)	(20_H)
51	Blank (in ASCII)	(20_H)
52	Blank (in ASCII)	(20_H)
53	Blank (in ASCII)	(20_H)
54	Blank (in ASCII)	(20_H)
55	Blank (in ASCII)	(20_H)

Figure 12-5 (Cont.)
FIRMWARE REVISION

56	FIRMWARE REVISION (MSB)	
57	FIRMWARE REVISION	
58	FIRMWARE REVISION	
59	FIRMWARE REVISION (LSB)	
60	Reserved	(00_H)
61	Reserved	(00_H)
62	Reserved	(00_H)
63	Reserved	(00_H)

These two above fields (Drive Model and Firmware Revision) shall be the exact same fields as returned by the INQUIRY Data in the INQUIRY command.

Bit / Byte	7	6	5	4	3	2	1	0
0	CYLINDER NUMBER (MSB)							
1	CYLINDER NUMBER (LSB)							
2	HEAD NUMBER							
3	BYTES FROM INDEX (MSB)							
4	BYTES FROM INDEX (LSB)							
5	Reserved (00_H)							
6	Reserved (00_H)							
7	Reserved (00_H)							
8	Reserved (00_H)							

Figure 12-6

PRIMARY DEFECT LIST DEFECT DESCRIPTOR (9 bytes per defect)

These 9 bytes are to be sent after the last Defect Descriptor specified to indicate to the drive that this is the end of the list.

Bit / Byte	7	6	5	4	3	2	1	0
0	(FF_H)							
1	(FF_H)							
2	(FF_H)							
3	(FF_H)							
4	(FF_H)							
5	(FF_H)							
6	(FF_H)							
7	(FF_H)							
8	(FF_H)							

Figure 12-7

FORMAT OF THE LAST 9 BYTES

13.0 PHYSICAL INTERFACE

The electrical interface between the XT-3000 and the host controller is via three connectors:

1. J1 - SCSI connector (50 pin)
2. J2 - DC power input
3. J3 - Frame ground

Refer to Figure 14-1 for connector locations.

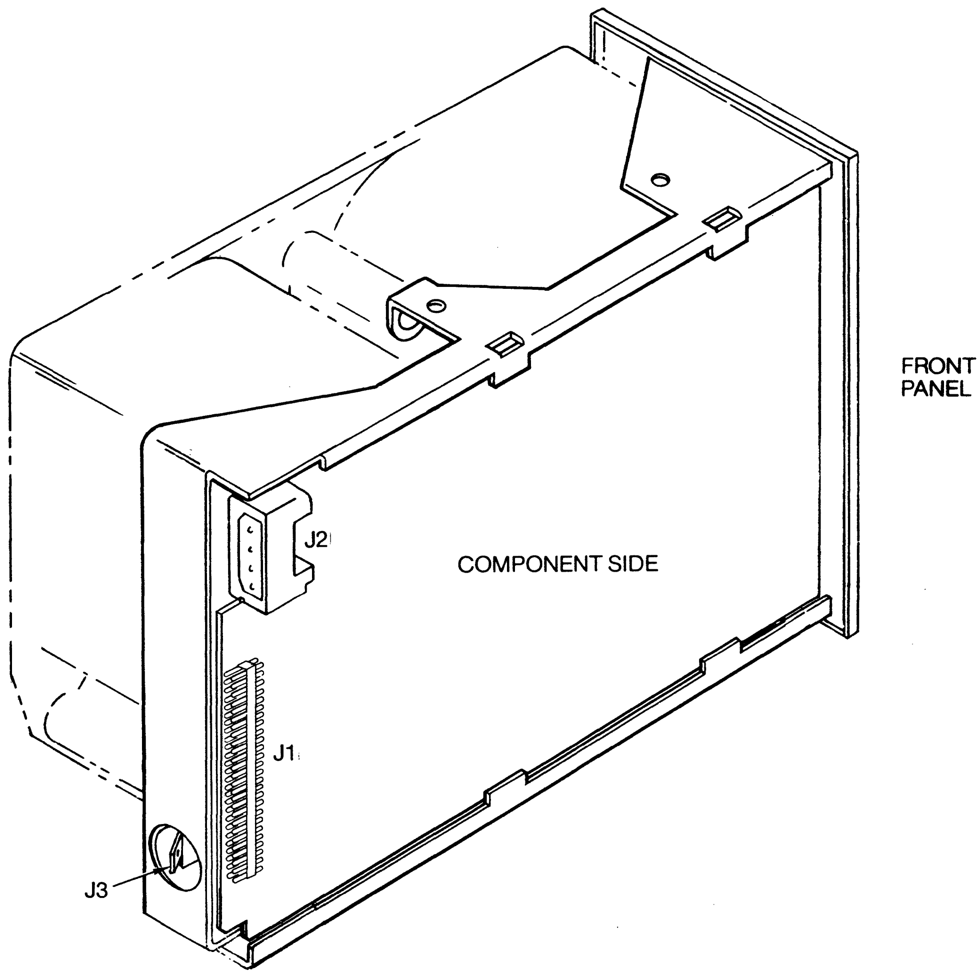

Figure 13-1

INTERFACE CONNECTOR PHYSICAL LOCATION

13.1 J1/P1 Connector

Connection to J1 is via a non-shielded 50 - conductor connector consisting of two rows of 25 female contacts on 100 mil centers, as shown in Figure 14.2. The J1 pins are numbered 1 through 50, with the odd pins located closest to the component side of the PCB. Pin 1 is located on the end of the connector closest to the white DC power connector (J2/P2). Figure 14-2 shows the configuration and dimensions of a suitable mating connector. Recommended strain-relief connectors are AMP part number 1-499506-2 or Dupont part number 669002 (66900-250).

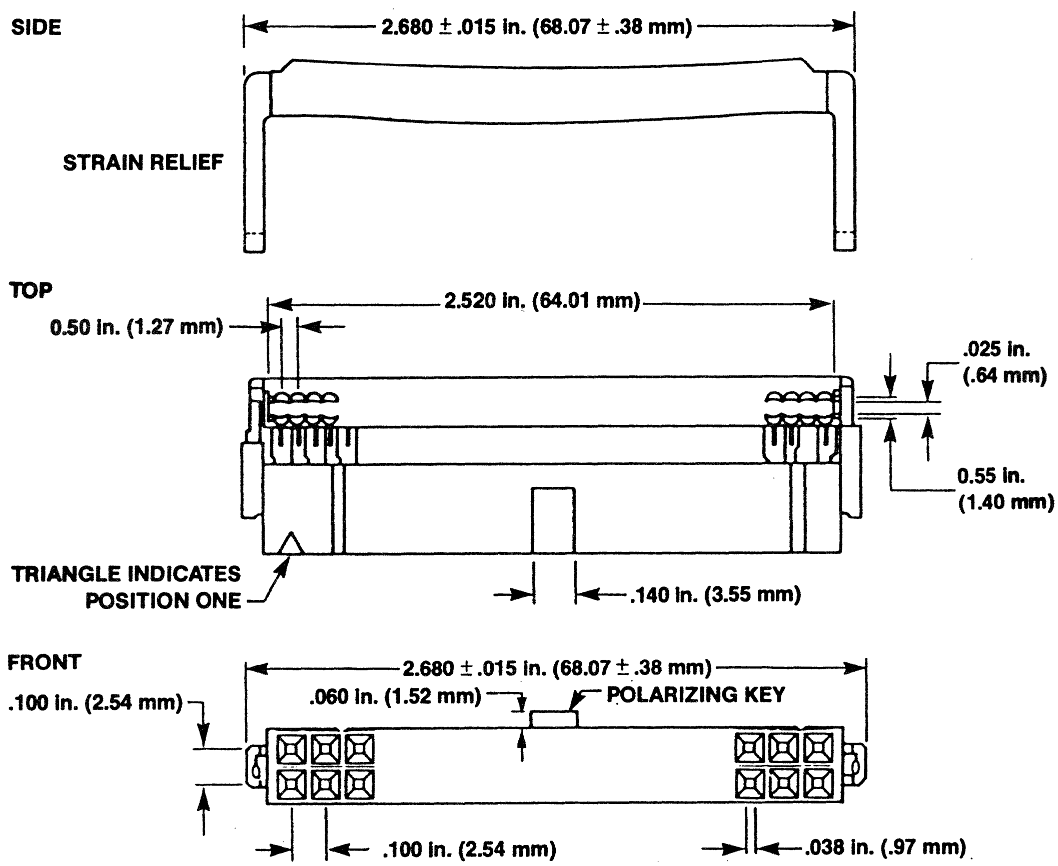

Figure 13-2

XT-3000 SCSI Cable Connector

13.2 J2/P2 Connector

The DC power connector (J2), Figure 14-4, is a 4 pin AMP MATE-N-LOCK connector P/N 3505430-1 mounted on the solder side of the PCB. The recommended mating connector (P2) is AMP P/N1-480424-0 utilizing AMP pins P/N 350078-4 (strip) or P/N 61173-4 (loose piece). J2 pins are numbered as shown in Figure 14-4.

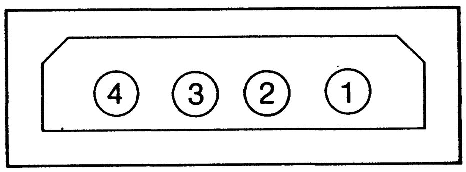

Figure 13-3

J2 Connector (Drive PCB Solder Side)

The required voltages and current levels on connector J2/P2 are shown below.

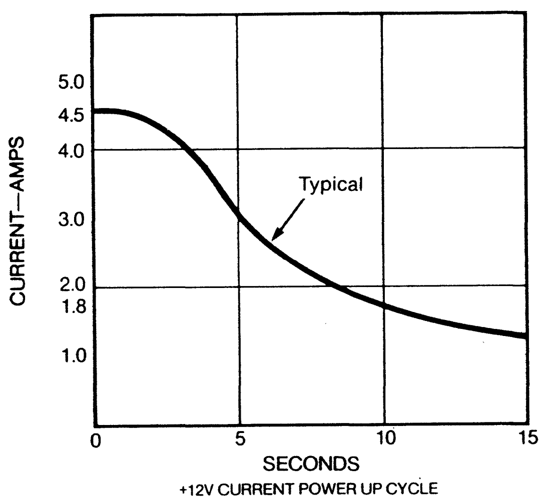

Figure 13-4
Motor Start Current Requirements

J2 CONNECTOR
PIN 4 +5 VOLTS DC ±5% PIN 3 +5 VOLT RETURN
PIN 1 +12 VOLTS DC ±5%* PIN 2 +12 VOLT RETURN

*10% AT POWER ON OR SEEKING

Figure 13-5
DC Power Requirements

14.0 PHYSICAL SPECIFICATIONS

This section describes the mechanical and mounting recommendations for the XT-3000.

14.1 Mounting Orientation

The XT-3000 may be mounted in any orientation. In any final mounting configuration, insure that the operation of the three shock mounts which isolate the base casting from the frame is not restricted. Certain switching power supplies may emanate electrical noise which will degrade the specified read error rate. For best results, it is suggested that the XT-3000 be oriented so that the PCB assembly is not adjacent to these noise sources.

14.2 Mounting Holes

Eight mounting holes, four on the bottom and two on each side are provided for mounting the drive into an enclosure. The size and location of these holes, shown in Figure 11-1, are identical to industry standard minifloppy drives.

```
*********************************************************************
*                              CAUTION                              *
* The casting is very close to the frame mounting holes in some*
* locations. Mounting screw lengths must be chosen such that no     *
* more than .125" of the screw is available to enter the frame      *
* mounting hole. The torque applied to the mounting screws should   *
* be at least 9 inch-pounds; but to avoid stripping the threads, the*
* maximum torque applied shall not exceed 12 inch-pounds.           *
*********************************************************************
```

14.3 Cooling Requirements

Reliability of the XT-3000 will be further enhanced if proper cooling is provided. Forced air cooling of approximately 500 linear feet/minute (approximately 5 cubic feet/minute) across the PCB is suggested for optimum performance.

14.4 Physical Dimensions

Overall height, width, and depth along with other key dimensions are shown in Figures 15-1 and 15.2.

14.5 Shipping Requirements

At powerdown, the heads are automatically positioned over the non-data, dedicated landing zone on each disk surface. The automatic shipping lock solenoid is also engaged at this time.

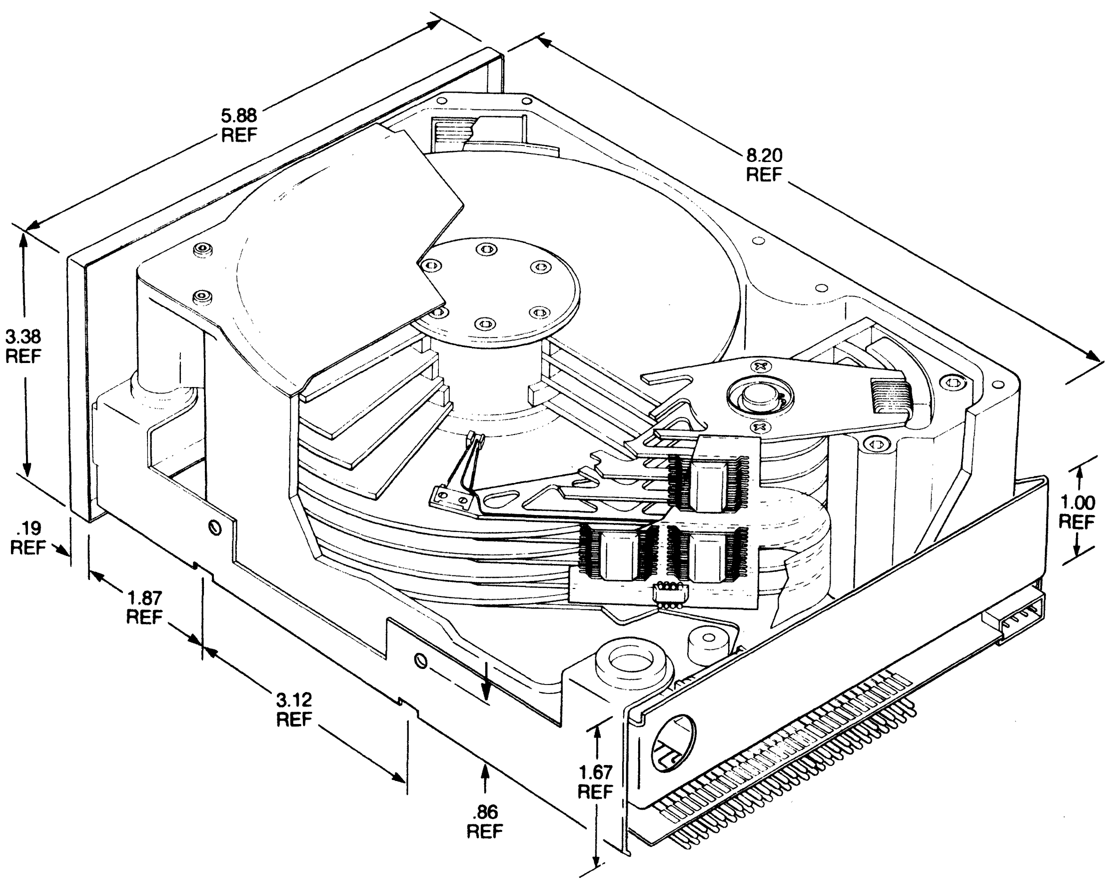

Figure 14-1
XT-3000 Mechanical Outline
and Mounting Hole Location

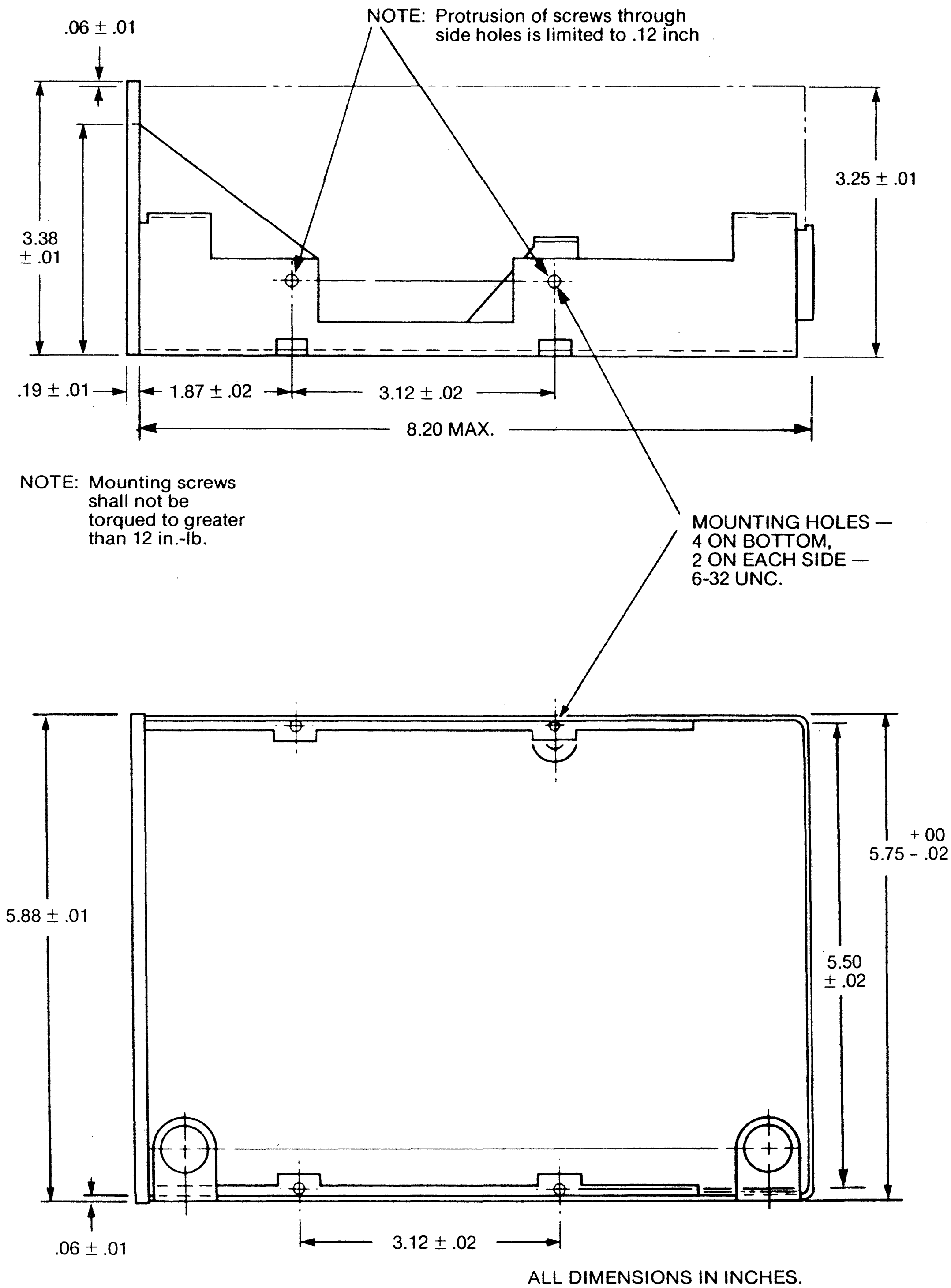

Figure 14-2
XT-3000 Mechanical Outline
Bottom and Side Views

Appendix A: SCSI Command Examples

This guide is intended to provide specific examples of some of the more complex SCSI commands.

Example #1 - Mode Select - Page 3, four spare sectors per cylinder on an XT-3280. Also, change the sector size to 1024 bytes/sector.

First, the host data buffer is initialized as follows:

Buffer Byte Number	Value to Input (Hex)	Comments
0	00	
1	00	
2	00	
3	00	
4	00	
5	00	
6	00	
7	00	
8	00	
9	00	
10	04	Bytes/sec changed here
11	00	
12	03	Page Code.
13	16	Number of following bytes.
14	00	
15	0F	Tracks per zone.
16	00	
17	04	Alternates per zone.
18	00	
19	00	
20	00	
21	00	
22	00	
23	0E	Physical sectors/track changed here.
24	00	
25	4 or 00	Does not matter. Mode Select ignores this field.
26	00	
27	01 or 00	Does not matter. Mode Select ignores this field.
28	00	
29	00	
30	00	
31	00	
32	88 or 00	Does not matter. Mode Select ignores this field.
33 - 35	00(s)	

Then, issue the following command:

Command Byte Number	Value to Input (Hex)	Comments
0	15	OP code
1	00	
2	00	
3	00	
4	24	Transfer length
5	00	

Example #2 - FORMAT UNIT COMMAND - Use P-list, C-list, G-list and send two defects to be mapped out via D-list. The two defects are:

Cylinder	Head	Bytes from Index
21	11	10624
7	15	720

First, the host data buffer is initialized as follows:

Buffer Byte Number	Value to Input (Hex)	Comments
0	00	
1	80	Use P and C list
2	00	
3	10	Length of D list
4	00	
5	00	
6	07	Cylinder
7	0F	Head
8	00	
9	00	
10	02	Bytes from index
11	00	
12	00	
13	00	
14	15	
15	0B	
16	00	
17	00	
18	29	
19	80	

Then issue the following command:

Command Byte Number	Value to Input (Hex)	Comments
0	04	Format Unit command.
1	14	Transfer header and D list and use G list
2	00	
3	00	
4	00	
5	00	

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