OMTI 7250 and 3100 SERIES

SCSI INTELLIGENT DATA CONTROLLERS

REFERENCE MANUAL
April 14, 1988

Scientific Micro Systems
339 North Bernardo Avenue
Mt. View, CA 94039

Printed in U.S.A. 4/88

PUBLICATION NO. **3001640-0001**

SCSI

INTELLIGENT DATA CONTROLLER

REFERENCE MANUAL

Models :

5 1/4 inch Form Factor	**OMTI 7250 Winchester (ESDI and ST506/412) and Flexible Disks**
3.5 inch Form Factor	**OMTI 3120A Winchester (MFM recording)** **OMTI 3127A Winchester (2,7 RLL recording)**

SCIENTIFIC MICRO SYSTEMS, INC.
339 North Bernardo Avenue
P.O. Box 7777
Mountain View
CALIFORNIA 94039

TEL: 415-964-5700
TWX: 910-379-6577
TLX: 184160 SMS MNTV

PRINTED IN THE UNITED STATES OF AMERICA

NOTICE

The information contained in this document is subject to change without notice.

SCIENTIFIC MICRO SYSTEMS MAKES NO WARRANTY OF ANY KIND WITH REGARD TO THIS MATERIAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Scientific Micro Systems shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance or use of this material.

PRINTING HISTORY

New editions are complete revisions of the manual. The date on the title page of the manual changes only when a new edition is published.

First Edition . . . . . .February, 1987 Rev A
Second Edition . . . . . .April, 1988 Rev B

LIST OF EFFECTIVE PAGES

The List of Effective Pages gives the date of the current edition, and lists the dates of all changed pages. Changes are marked with a vertical bar in the margin.

First Edition **February 1987 - Rev A**
Current Edition **April 1988 - Rev B.**

Effective Pages	Date	Effective Pages	Date
Title to iv	4/88	5-6 to 6-3	Original
v	4/88	7-1	Original
1-1 to 1-3	4/88	7-2	4/88
1-4	4/88	7-3 to 7-8	Original
1-5 to 1-7	4/88	7-9 to 7-12	4/88
2-1 to 2-2	4/88	7-13	Original
2-3 to 2-5	Original	7-14	4/88
3-1	Original	7-15 to 7-22	Original
3-2	4/88	7-23 to 7-22	4/88
3-3	Original	7-24 to 7-25	4/88
3-4 to 3-6	4/88	7-26	Original
4-1 to 4-2	4/88	7-27	4/88
4-3 to 4-14	Original	7-28 to 7-29	Original
5-1 to 5-3	Original	7-30	4/88
5-4 to 5-5	4/88	7-31 to 7-38	Original
		A-1 to A-5	Original

OMTI 7250 and 3100 Series
TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF FIGURES

SECTION 1

INTRODUCTION

1.1 PURPOSE

This manual introduces the user to this series of OMTI SCSI (Small Computer System Interface) Data Controllers with OCS (OMTI Command Set). It provides the information needed to install, configure, program, operate, and maintain the controllers. The manual is a reference source for OEM engineers, system integrators, service and maintenance technicians.

1.2 GENERAL

The controllers interface with a maximum of two Winchester Disk Drives which can be either 3-1/2 inch or 5-1/4 inch fixed or removable disk drives. The controllers support up to 16 heads and up to 65,536 cylinders.

The **7250** controllers are contained on a 5-1/4" PCB, which mount directly to the disk drive or chassis. The controllers interface with Winchester Disk Drives and Flexible Disk drives.

OMTI 7250: The controller supports ;
- **ST506/412** compatible, 5 MegaBit/second data transfer rate,
- and **ESDI** compatible, up to 10 MegaBit/second data transfer rate.

The Flexible disk drives can be any industry-standard, 3.5 inch, 5-1/4 inch, or 8 inch drive with a transfer rate of either 250 KBit, 300 Kbit or 500 KBit. These drives can be single or double density, and single or double sided drives with an industry-standard interface.

OMTI 3120A/3127A: The controllers are contained on a 4.0 by 5.75 inch PCB, which mounts directly to a 3-1/2 inch disk drive or chassis. The Winchester drives can have an ST506/412 or ST412R (with OMTI 3127A) compatible interface.

The Data Controllers use SMS's advanced VLSI chip set to provide state-of-the-art data management. When supporting ST506/412 drives, a si\ le chip data separator circuit ensures data integrity. Efficient error detection/correction is accomp\ hed by a powerful "computer generated" 32-bit for ST MFM data drives or 48-bit Error Correcti\ Code for ESDI drives and 2,7 RLL data ST drives (OMTI 3127A).

The host (Initiator) interface is the industry-standard 8-bit parallel bi-directional Small Computer Systems Interface (**SCSI**). The command set complies with the OMTI 5000 series command set, with a few additional commands for ESDI support.

NUMBER AND TYPE OF DRIVES SUPPORTED

	3120A	3127A	7250
Number of drives	2 max	2 max	4 max
Number of LUNs	2	2	4
Winchesters (MFM ST drives)	up to 2	0	up to 2
Winchesters (2,7 RLL ST drives)	0	up to 2	up to 2
Winchesters (ESDI drives)	0	0	up to 2
Flexible disks	0	0	up to 4

1.3 MODEL DESCRIPTION

OMTI 7250:

The 7250 controllers are designed to attach to ST506/412 or ESDI type Winchester disks (3-1/2 inch or 5-1/4), Flexible disks (3-1/2, 5-1/4 or 8 inch), and to a variety of host computer systems through the industry standard SCSI (Small Computer Systems Interface).

Model numbers identify the combination of drives that can be supported. (W = Winchester, F = Flexible).

OMTI 7250 (W + F). This model supports up to four drives, of which up to two may be 5-1/4 or 3-1/2 inch (ST506/412 and ESDI) Winchester disk drives, and up to two may be any combination of industry-standard 3.5 inch, 5.25 or 8 inch Flexible disk drives. The Flexible disk interface can support a data transfer rate of 250, 300 or 500 kilobits, single or double density, and single or double sided drives.

The default setting is :

LUN 0	LUN 1	LUN 2	LUN 3
per jumper	per jumper	Flexible disk 250Kbit	Flexible disk 500Kbit

Note: All above-mentioned models handle the Winchester disk drives similarly, with the same performance, same format, and same command set. Disk mediums written by one model can be read by the other model.

OMTI 3100 SERIES:

OMTI 3120A The command set complies with the OMTI 5000 Series. This is the first product in production of the series. Supports MFM encoding.

OMTI 3127A Same command set as 3120A but with 2,7 RLL encoding. Provides 50% more storage capacity over MFM encoding. Only drives certified by the drive vendors to be reliable with 2,7 RLL may be used on the 3127; otherwise, high error rates may be encountered due to the drive.

Differences between models:

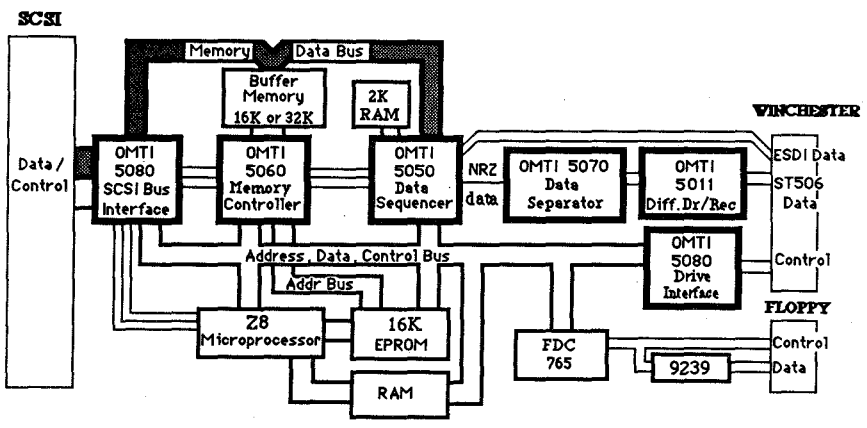
	3120A	3127A
Encoding	**MFM**	**2,7 RLL**
Power required in VDC	+5	**+5, +12**
Device Independence :		
Stores Assign Disk Parameters on Disk	No	**Yes**
Self Test :		
Executes Self diagnostics after RST pulse	**Yes**	**No**
Executes Self Diagnostics at Power On	**Yes**	**Yes**
Bytes per sector :		
512 bytes per sector	**Yes**	**Yes**
532 bytes per sector	No	**Yes ***
1024 bytes per sector	**Yes**	**Yes ***
Buffer Size (in bytes)	2K	**8K**
ECC in bits	32	**48**
ECC correction in bits	5	**11**

2,7 RL encoding (provides 50% increased capacity) over MFM encoding.

* The block size is command programmable on the 3127A and jumper selectable on the 3110 and 3120A.

1.4 FUNCTIONAL ORGANIZATION

The following figure is the OMTI 7250 functional block diagram.

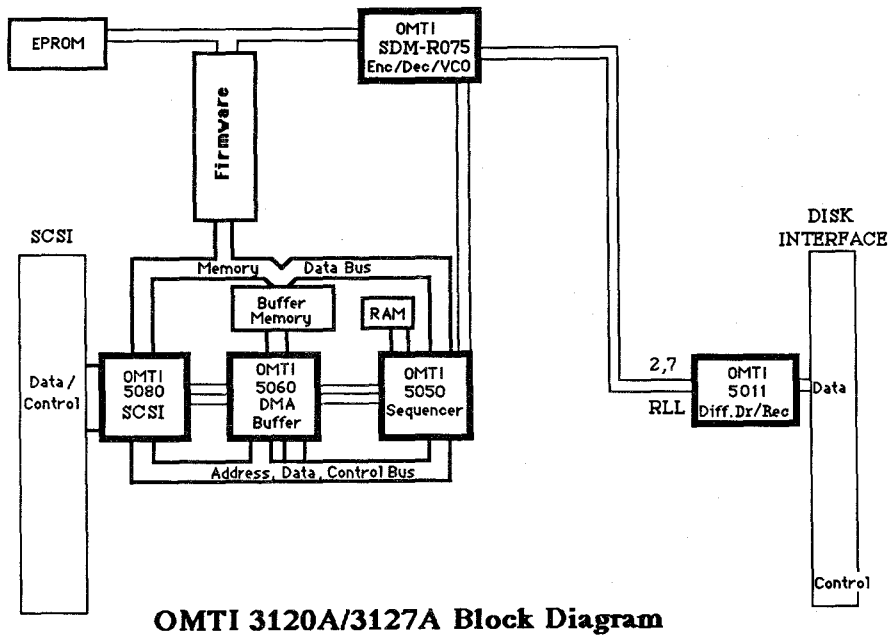


OMTI 7250 Block Diagram

Figure 1-1. Functional Block Diagram.

1.5 FUNCTIONAL ORGANIZATION

The following figure is the OMTI 3120A/3127A Functional Block Diagram.



OMTI 3120A/3127A Block Diagram

Figure 1-2. Functional Block Diagram.

1.5.1 Host Interface

The SCSI host interface is a bi-directional bus interface that provides the computer with device independence so that disk drives, tape drives, optical disks, printers, communication devices, processor devices, and other devices can be added to the system configuration. A single chip, the OMTI 5080 SCSI multifunctional device, supports control and data signals of the SCSI interface, bus delays and embedded single ended drivers/receivers.

1.5.2 Microprocessor

The controller board contains a ROMless Zilog 12 Mhz Z8 Microcomputer. The Z8 provides a powerful instruction set, simplified system expansion off chip, and flexible serial and parallel I/O capabilities. It contains a 16-bit program counter and a separate 16-bit stack pointer. The Z8 has 128 internal registers. The Z8 program resides in a 16K bytes EPROM. The Z8 also has an external 2K bytes RAM which it uses for variables and stacking.

1.5.3 Buffer Memory

The controllers include a static 2Kbyte (3120A) or 8Kbyte (on 3127A) or 16 byte RAM data buffer (on 7250). The buffer is used to enhance the performance of the controller by storing blocks of data while the controller is disconnected from the host and to match the speed of the host and the drive.

1.5.4 VCO/Encode/Decode

These ST drive functions are handled by the OMTI 5070 VCO/Encode/Decode chip. This is a fifth-generation data separator that converts MFM serial data to NRZ data and clock transitions.
The OMTI SDM-R075 device handles these functions on the OMTI 3127A for 2,7 RLL data.

1.5.5 Flexible Disk Controller (OMTI 7250 only)

Flexible Disk control is provided by an LSI flexible disk controller chip (NEC 765), with control functions for interfacing a processor and flexible disk drives. It supports either IBM 3740 single density format or IBM System 34 double-density format, including double-sided recording.

1.5.6 Flexible Disk Data Separator (OMTI 7250 only)

The data separator is the SMC 9239 device.

1.5.7 Kombo (OMTI 3120A/3127A Only)

The Kombo combines the functionality of the OMTI 5060 DMA controller (Two Channel Direct Memory Access) with the OMTI 5050 Data Sequencer.

1.6 SPECIFICATIONS

The following table lists the specifications for the Data Controllers. Included are environmental and power requirements, mounting and dimensional characteristics. All products use the same PCB.

7250 Physical Specifications

Width	5.75 inches	(14.72 cm)
Length	8 inches	(20.48 cm)
Height	0.75 inches	(1.3 cm)
Weight	4.0 ozs	(0.11 kg)

See Figure 3-4 for Mounting Hole locations.

3120A/3127A Physical Specifications

Width -	4.00 inches	(9.52 cm)
Length -	5.75 inches	(14.6 cm)
Height -	0.75 inches	(1.9 cm)
Weight -	4.0 ozs	(0.11 kg)

Environmental Specifications

	Operating	Storage
Temperature	0 to 50C	-40 to 75C
Relative Humidity	10% to 95%	10% to 95%
Max. Wet Bulb	30C	Noncondensing
Altitude	0-10000 ft	0-15000 ft

Power Requirements

The **7250** controllers require +5 V (+/-5%) power only. The maximum ripple and noise (P/P) is 100 mV.

The maximum current drawn by each model is :

OMTI 7250	1.25 Amp.
OMTI 3120A	0.75 Amp.

Requires +5 V (+/-5%) power only. The maximum ripple and noise (P/P) is 100 mV.

OMTI 3127A	0.75 Amp at +5 V. and 100mAmp at +12 V.

Requires +5 V (+/-5%) and +12 V (+/- 10%) power only. The maximum ripple and noise (P/P) is 100 mV.

SECTION 2

STANDARD FEATURES

2.1 GENERAL

This section contains a list of the standard features.

HOST INTERFACE	SCSI (Small Computer Systems Interface). The 3100 Series is compatible with the APPLE Macintosh SCSI port.
MULTIFUNCTION	The 7250 supports Winchester Disks + Flexible Disks. Supports up to 4 LUNs.
COMPACT BOARD	The 7250 controllers are single 5.75 x 8 inch printed circuit boards. The 3120A and 3127A controllers are a single 3.75 x 5.75 inch printed circuit board.
LOWEST POWER CONSUMPTION	The OMTI 3100 series controllers consume the least power among all SCSI controllers available on the market.
2,7 RLL or MFM	The OMTI 3127A with 2,7 RLL encoding offers 50% more capacity over MFM encoding (offered on other products).
SCSI BUS TRANSFER RATE	Up to 1.5 MBytes per second in asynchronous mode.
SCSI BUS PARITY	Jumper selectable. Unless disabled, odd parity is always generated and checked only if enabled on all handshakes.
ERROR RETRIES	Error retry on SEEK or READ errors is performed automatically unless disabled.
BUFFER TYPE	Ring Buffer (Wraps Around) with 3 Independent Ports for fast data transfer.
BUFFER SIZE	16K bytes on 7250. 2K bytes on OMTI 3120A (can store 4 blocks of 512 bytes). 8K bytes on OMTI 3127A (can store 16 blocks of 512 bytes). These large buffers improve performance.

LIMITED PART COUNT	Featuring OMTI VLSI CMOS Chip set for very low power consumption.
TERMINATION POWER	Jumper selectable SCSI termination power (PIN 26)

2.2 WINCHESTER DISK SPECIFIC FEATURES

INTERFACE	ST506/412 Compatible (MFM encoding at 5 megabits per second) on OMTI 7250 and 3120A. ST412R (2,7 RLL encoding at 7.5 megabits per second) on OMTI 3127A. ESDI compatible up to 10 MegaBit/second on OMTI 7250.
CONSECUTIVE SECTOR TRANSFER	Can transfer a Full Track in a single disk revolution.
SECTOR INTERLEAVING	One to One or Programmable.
TRACK SKEWING	On 7250 only. To improve access time, the track skewing is programmable (see FORMAT commands).
PROGRAMMABLE DISK PARAMETERS	The physical disk parameters can be passed to the controller with the ASSIGN DISK PARAMETERS command (for ST506/412 drives only).
NUMBER OF HEADS	Up To 16 Heads Supported.
NUMBER OF CYLINDERS	Up To 65535 Cylinders Supported.
TRACK FORMAT	Compatible with the OMTI 5000 Series (all except 3127A).
BLOCK OR SECTOR SIZE	Jumper Selectable, 256, 512, or 1024 Bytes per Sector or Block on 7250. Jumper Selectable on OMTI 3120A with 256, 512 or 1024 Bytes per Sector or Block. Command programmable on OMTI 3127A with 512, 532 or 1024 Bytes per Block.
IMPLIED SEEK	Supported 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 256 Blocks per command (any block size listed above)
AUTOMATIC READ RETRIES	User Selectable
AUTOMATIC HANDLING OF MEDIA DEFECTS	Supported at Track Level with Alternate Track Assignment
OVERLAPPED SEEK	Allows multiple drives to be positioned simultaneously. While a seek is being performed on one drive, other operations can be performed on other LUNs.
STEP RATE	Accepts a minimum of 14 microseconds between leading edges of two consecutive pulses on ST drives.
SECTORS PER TRACK	Programmable on ST drives, supported through the ASSIGN DISK PARAMETERS Command.
COPY COMMAND	Between Disks or the same disk. Uses the Internal Controller Buffer
COMMAND SET	Compatible with the OMTI 5000 series.
ECC	32 bit Error Correction Code for Header and Data Fields. Polynomial - "Computer Generated" Code on ST506/412 drives. "$x^{24}+x^{18}+x^{15}+x^{14}+x^{11}+x^{8}+x^{7}+x^{0}$" Correction Capability - 5 Bits Detection Capability - 19 Bits Low Misdetection Low Miscorrection 48 bit Error Correction Code for Data Fields. Polynomial - "Computer Generated" Code on ESDI drives and 2,7 RLL ST drives (OMTI 3127A). Correction Capability - 11 Bits Detection Capability - 27 Bits Low Misdetection Low Miscorrection

2.3 FLEXIBLE DISK DRIVE SPECIFIC FEATURES (Model 7250)

5-1/4" or 3-1/2" (250KBits)	Supported.
(300KBits)	Supported. Can read a 250 Kbit format on high capacity (PC AT) drives.
8 Inch Drive (500KBits)	An optional 34 Pin to 50 Pin Adapter (OMTI 528) Interface is needed to connect 8 inch Flexible drives to the controllers (available from SMS).
5-1/4" (500K Bits)	Supports the generation of half height, high capacity, 5-1/4" Flexible disk drives with the same transfer rate as the 8" (500 KBit) Drives.
SECTOR SIZE	Programmable - 128, 256, 512, or 1024 bytes per sector.
NUMBER OF SECTORS/TRACKS	Programmable. Complies to the track and sector format. Gaps are fixed (set by the controller).
IBM FORMAT	Supported, 3740 SD, System 34 2S2D.
IBM PC FORMAT	Supported. (512 Bytes/sector, 9 sectors per track)
IBM PC AT FORMAT	Supported.
CRC	On header and data fields.

2.4 COMMAND SET SUMMARY

DRIVE TYPE : W = Winchester Disk drives, F = Flexible Disk drives (7250 only)

COMMAND	DRIVE TYPE	CODE (HEX)	LENGTH BYTES	DATA BYTES(b) BLOCKS(B)
GROUP 0				
TEST UNIT READY	W,F	00	6	0
RECALIBRATE	W,F	01	6	0
REQUEST SENSE	W,F	03	6	4 bytes
FORMAT UNIT	W,F	04	6	0
CHECK TRACK FORMAT	W	05	6	0
FORMAT TRACK	W,F	06	6	0
FORMAT BAD TRACK	W,F	07	6	0
READ	W,F	08	6	1-256(B)
WRITE	W,F	0A	6	1-256(B)
SEEK	W,F	0B	6	0
ASSIGN ALTERNATE TRACK	W	0E	6	4 bytes
START/STOP UNIT	W,F	1A	6	0
CHANGE CARTRIDGE	W	1B	6	0
Commands specific to the 7250 only.				
READ CONFIGURATION	W	1C	6	10
READ TO BUFFER	W,F	1E	6	
WRITE FROM BUFFER	W,F	1F	6	
GROUP 1				
COPY	W,F	20	10	1-256(B)
READ DEFECT DATA (7250)	W	37	10	
GROUP 6				
DEFINE FLEXIBLE DISK FORMAT	F	C0	6	10(b)
ASSIGN DISK PARAMETERS	W,F	C2	6	10(b)
GROUP 7				
RAM DIAGNOSTICS	N/A	E0	6	0
WRITE ECC	W	E1	6	1(B)+4(b) or 6(b)
READ IDENTIFIER	W,F	E2	6	4(b)
DRIVE DIAGNOSTICS	W,F	E3	6	0
INTERNAL DIAGNOSTICS	N/A	E4	6	0
READ VERIFY (7250)	W,F	E5	6	0
READ ECC	W	EA	6	1(B)+4(b) or 6(b)
READ DATA BUFFER	N/A	EC	6	
WRITE DATA BUFFER	N/A	EF	6	

SECTION 3

INSTALLATION

3.1 UNPACKING AND INSPECTION

Upon receipt of your OMTI Data Controller, inspect the packaging for evidence of damage during transit. Open the package and inspect the controller board for visible damage such as scratches, loose components, or broken connectors. If there is damage, immediately notify the carrier's agent and your SMS customer service representative. Compare the items listed on your original Purchase Order to the actual contents of the package and the packing list. If discrepencies exist, notify your SMS customer service representative.

Retain the shipping container and packing material for examination (if it has been damaged), or for reuse when returning the controller board to the factory.

3.2 BOARD PREPARATION

Figures 3-2, 3-3, 3-4 and 3-5 illustrate the appropriate board layout, the connector locations, and the jumper locations. Consult paragraph 4.3 to ensure that the factory installed jumpers are correctly in place.

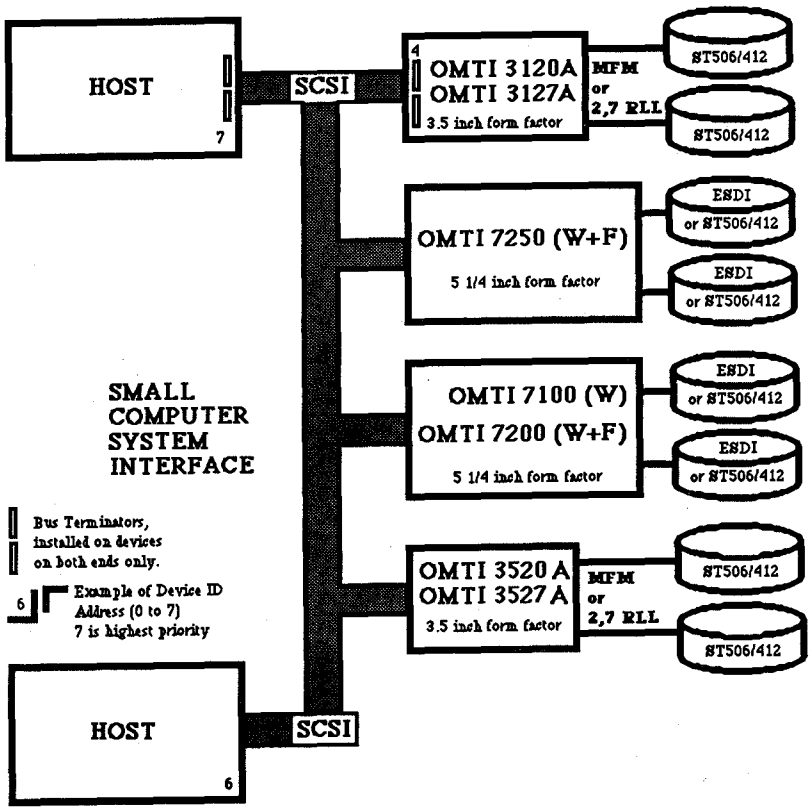
It is also possible to install optional jumpers to tailor the controller's functions to the specific requirements of your system. The controllers have jumpers which allow them to be easily integrated into different systems.

3.3 BOARD MOUNTING

Holes for mounting your controller board are dimensionally shown in Figure 3-4. These holes mate with the four mounting holes typically provided on 5.25 (7250) or 3.5 inch (3100 series) disk drives. The controller may be mounted in a location other than on the disk itself. An important consideration is that air is allowed to freely pass by the board.

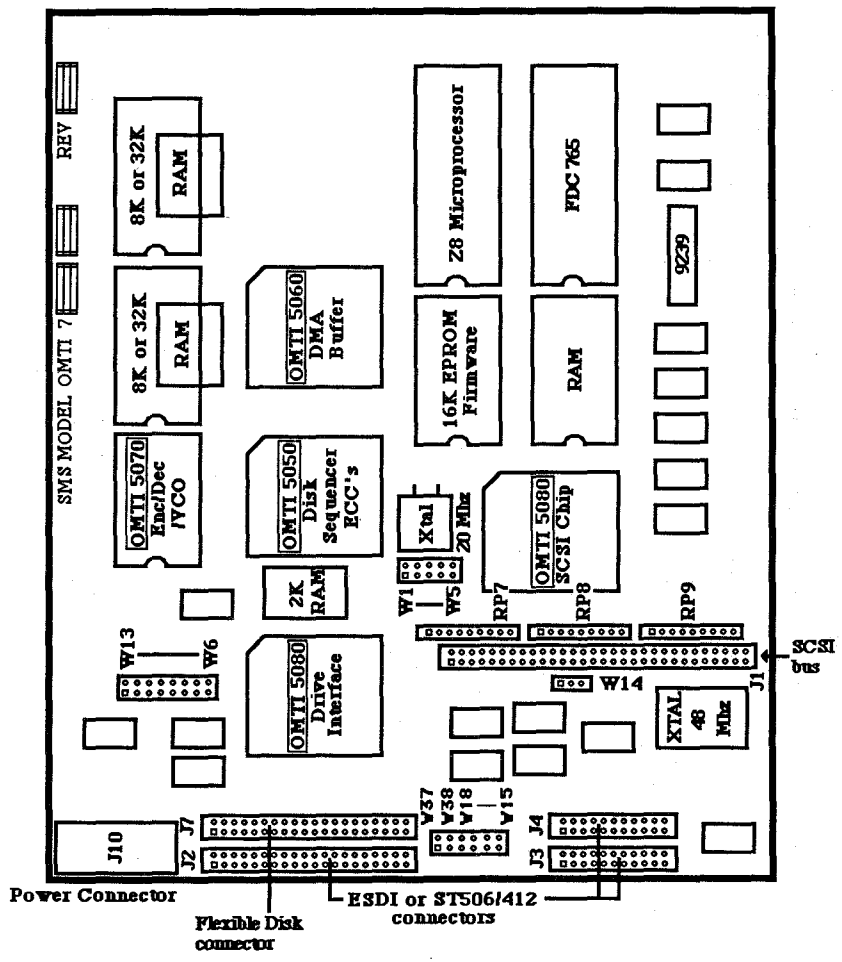
3.4 CABLE CONNECTIONS

After your board is mounted, connect the DC power cord and the cables to the disk drive and host computer. Refer to Figure 3-3 and 3-5 for the location of connectors on your board. The System Configuration drawing (Figure 3-1) will also help in identifying the cable hookup for your particular system.



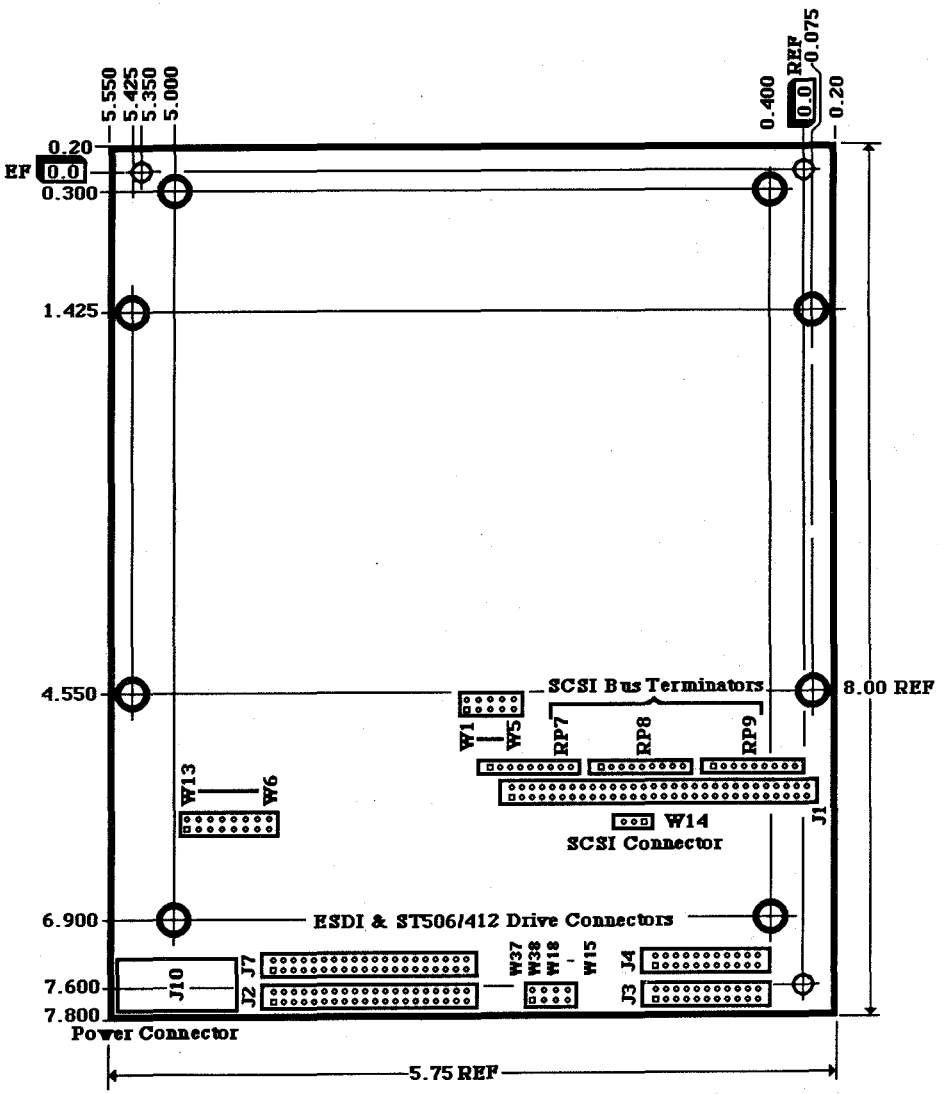
Single or Multiple hosts, Single or Multiple Targets Configuration example

Figure 3-1. System Configuration.



Pin 1 on all connectors is specified by a square solder pad, visible on the soldered side of the board.

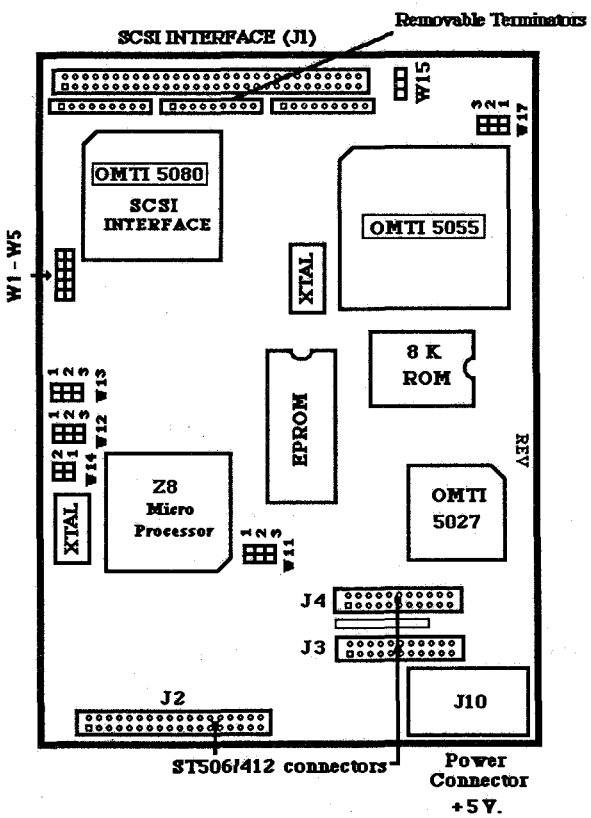
Figure 3-2. 7250 Board Layout



Board Dimensions and Mounting Hole Locations

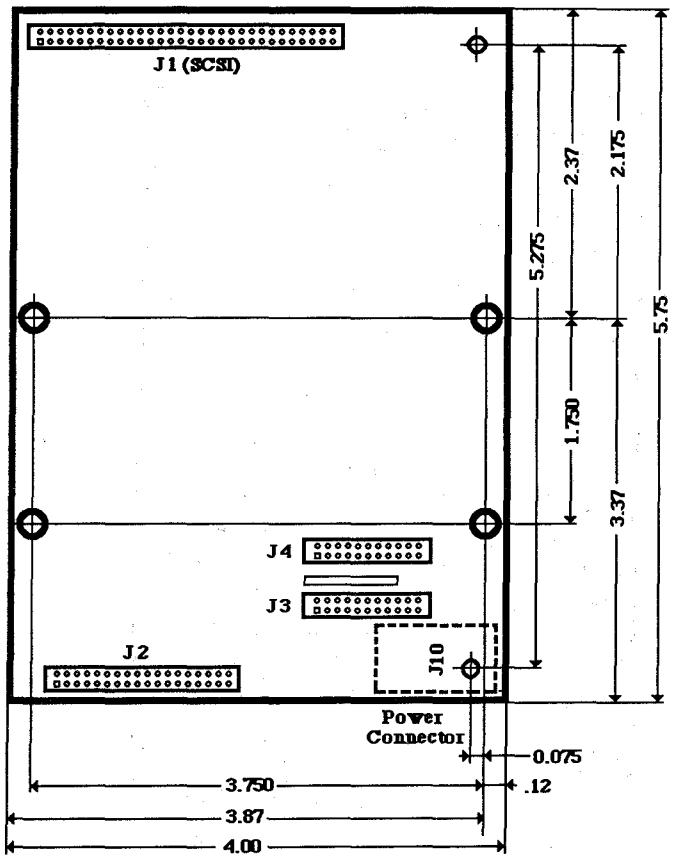
Pin 1 on all connectors is specified by a square solder pad, visible on the soldered side of the board.

Figure 3-3. 7250 Board Dimensions



OMTI 3120A/ 3127A BOARD LAYOUT

Figure 3-4. 3120A/3127A Board Layout



BOARD DIMENSIONS

Pin 1 on all connectors is specified by a square solder pad, visible on the soldered side of the board.

Figure 3-6. All 3100 series Board Dimensions

SECTION 4

SYSTEM CONFIGURATION

4.1 GENERAL

The interface between the host computer and the controller is a 50-pin cable. This cable is connected to J1 on the controller. The length of the host interface cable should not exceed 20 feet (6 meters) from the first to the last device (up to eight devices) on the bus.

Winchester Disks:
The Winchester Disk drive's interface to the controller is via J2, J3, and J4.

J2 is a 34-pin header type connector that connects one or two Winchester Disk drives in a daisy-chain configuration. This cable carries the control signals.

J3 and J4 are 20-pin header type connectors used to radially connect the disk drive data lines to the controller. The cable lengths should not exceed 20 feet (6 meters) or drive manufacturer's limit, whichever is less.

Flexible Disks (valid for the 7250 only):
The Flexible Disk drive's interface to the controller is via J7, a 34-pin header type connector. This cable carries data and control signals. The maximum cable length should not exceed 20 feet (6 meters) or the drive manufacturer's limit, whichever is less. Connect 8 inch Flexible Disk drives with a 50-pin connector to the 34-pin controller connector, through an optional 34-pin to 50-pin adaptor.

Power Connection:
Power is applied to the controller via J10, which is a 4 pin AMP connector.

The recommended mating connectors for J1, J2, J3, J4,J7 and J10 are :

J1	AMP P/N 499956-0
J2 and J7 (7250)	AMP P/N 499956-7
J3 and J4	AMP P/N 499956-4
J10	AMP P/N 480424-0

4.2 PIN ASSIGNMENTS

4.2.1 J10 POWER CONNECTOR

	3120A, 7250 PIN DESCRIPTION		3127A PIN DESCRIPTION
1	No Connection	1	+12 VDC
2	No Connection	2	+12 RTN
3	+5 RTN	3	+5 RTN
4	+5 VDC	4	+5 VDC

4.2.2 J1 SCSI CONNECTOR

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

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

The minus sign next to the signal indicates active low.
See section 6.4 for signal definition.

4.2.3 PIN ASSIGNMENTS

The following tables define the various Winchester Disk Drive's pin assignments .

4.2.4 ST506/412 Winchester Disk Drive Interface (all products)

ST412 COMPATIBLE DISK CONTROL SIGNAL CONNECTOR (J2). CHAINED.

PINS			FIXED DISKS	REMOVABLE DIKS
GND	1	2	HEAD SELECT 3/WSI	CHANGE CARTRIDGE
	3	4	HEAD SELECT 2	
	5	6	WRITE GATE	
	7	8	SEEK COMPLETE	
	9	10	TRACK 000	
	11	12	WRITE FAULT	
	13	14	HEAD SELECT 0	
	15	16	Reserved	SECTOR PULSE
	17	18	HEAD SELECT 1	
	19	20	INDEX	
	21	22	READY	
	23	24	STEP	
	25	26	DRIVE SELECT 1	
	27	28	DRIVE SELECT 2	
	29	30	DRIVE SELECT 3	
	31	32	DRIVE SELECT 4	
GND	33	34	DIRECTION SELECT	

ST412 COMPATIBLE DISK DATA SIGNAL CONNECTOR (J3 &J4) RADIAL

PINS	FIXED DISKS	REMOVABLE DIKS
1	DRIVE SELECTED	
2	GROUND	
3	Reserved	
4	GROUND	
5	Reserved	WRITE PROTECTED
6	GROUND	
7	Reserved	
8	GROUND	
9	Reserved	CARTRIDGE CHANGED
10	Reserved	
11	GROUND	
12	GROUND	
13	+MFM or 2,7 RLL WRITE DATA	
14	-MFM or 2,7 RLL WRITE DATA	
15	GROUND	
16	GROUND	
17	+MFM or 2,7 RLL READ DATA	
18	-MFM or 2,7 RLL READ DATA	
19	GROUND	
20	GROUND	

4.2.5 ESDI Winchester Disk Drive Interface (7250 Model)

ESDI DISK CONTROL SIGNAL CONNECTOR (J2). CHAINED (7250 Model)

	PINS		
GROUND	1	2	HEAD SELECT 2^3
	3	4	HEAD SELECT 2^2
	5	6	WRITE GATE
	7	8	CONFIG/ - STATUS DATA
	9	10	TRANSFER ACK
	11	12	ATTENTION
	13	14	HEAD SELECT 2^0
	15	16	SECTOR/ - ADDRESS MARK FOUND
	17	18	HEAD SELECT 2^1
	19	20	INDEX
	21	22	READY
	23	24	TRANSFER REQ
	25	26	DRIVE SELECT 1
	27	28	DRIVE SELECT 2
	29	30	DRIVE SELECT 3
	31	32	READ GATE
GROUND	33	34	COMMAND DATA

ESDI DISK DATA SIGNAL CONNECTOR (J3 &J4) RADIAL (7250 Model)

PINS	
1	DRIVE SELECTED
2	SECTOR- ADDRESS MARK FOUND
3	COMMAND COMPLETE
4	ADDRESS MARK ENABLE
5	Reserved
6	GROUND
7	+WRITE REF CLOCK
8	-WRITE REF CLOCK
9	Reserved
10	+READ REF CLOCK
11	-READ REF CLOCK
12	GROUND
13	+NRZ WRITE DATA
14	-NRZ WRITE DATA
15	GROUND
16	GROUND
17	+NRZ READ DATA
18	-NRZ READ DATA
19	GROUND
20	INDEX

4.2.6 Flexible Disk Drive Interface (5-1/4 inch) (7250 model)

The following tables define the pin assignments for the 5-1/4" flexible disk drives.

FLEXIBLE DISK CONTROL SIGNAL CONNECTOR (J7)

GROUND	1	2	Reduce Write Current/ Density/Disk Changed
	3	4	In Use / Eject /
	5	6	DRIVE SELECT 4
	7	8	INDEX
	9	10	DRIVE SELECT 1
	11	12	DRIVE SELECT 2
	13	14	DRIVE SELECT 3
	15	16	MOTOR ON
	17	18	DIRECTION SELECT
	19	20	STEP
	21	22	WRITE DATA
	23	24	WRITE GATE
	25	26	TRACK 00
	27	28	WRITE PROTECT
	29	30	READ DATA
	31	32	SIDE SELECT
GROUND	33	34	DRIVE STATUS

A 34-pin to 50-pin adaptor board, Model OMTI 528, connects the 8 inch Flexible Disk drive to the controller connector J7.

OPTIONAL ADAPTOR BOARD (OMTI 528 Paddle Board) CONNECTIONS (7250 model)

34-pin connector	50-pin connector	Signal Name
1	1	GROUND
2	2	WSI/DENSITY
3	-	-
4	-	-
5	-	-
6	32	DRIVE SELECT 4
7	-	-
8	20	INDEX
9	-	-
10	26	DRIVE SELECT 1
11	-	-
12	28	DRIVE SELECT 2
13	-	-
14	30	DRIVE SELECT 3
15	-	-
16	-	-
17	-	-
18	34	DIRECTION SELECT
19	-	-
20	36	STEP
21	-	-
22	38	WRITE DATA
23	-	-
24	40	WRITE GATE
25	-	-
26	42	TRACK 00
27	-	-
28	44	WRITE PROTECT
29	-	-
30	46	READ DATA
31	-	-
32	14	SIDE SELECT
33	-	-
34	22	DRIVE ST + 5 VDC PIN 4

4.3 7250 JUMPER ALLOCATION

W1-W3 **SCSI CONTROLLER ID.** Defines the SCSI device priority. ID 7 is the highest priority in a multi controller configuration.

W3	W2	W1	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

W4 **SCSI BUS PARITY**

* Shorted = PARITY ENABLED
Open = PARITY DISABLED

W6 **TYPE of WINCHESTER connected to DRIVE SELECT 1**

* Open = ST506/412 Winchester
Shorted = ESDI Winchester

The Drive Select jumper setting inside the drive itself is to be set to 1.

W7 **TYPE of WINCHESTER connected to DRIVE SELECT 2**

* Open = ST506/412 Winchester
Shorted = ESDI Winchester

The Drive Select jumper setting inside the drive itself is to be set to 2.

W14 **SCSI POWER TERMINATION**

* **W14** 1-2 = TERMINATION POWER FROM BOARD
W14 2-3 = TERMINATION POWER FROM SCSI BUS

* As shipped or default settings.

OMTI 7250

LUN ALLOCATION for Winchester and Flexible Disks

LUN 0		LUN 1	
ST506/412 Sector type			
W8		**W11**	
*** 0**	**Soft sectored**	*** 0**	**Soft sectored**
1	Hard sectored	1	Hard sectored
if W9, W10 = for Flexible Disk			
W8		**W11**	
*** 0**	**250 Kbit**	*** 0**	**250 Kbit**
1	500 Kbit	1	500 Kbit
Drive type			
W9 W10		**W12 W13**	
*** 0 0**	**ST506/412**	*** 0 0**	**ST506/412**
1 0	ESDI	1 0	ESDI
0 1	REMOVABLE ST	0 1	REMOVABLE ST
1 1	FLEXIBLE DISK	1 1	FLEXIBLE DISK

Note : With ESDI drives, **W8** or **W11** are ignored.

Note : The ASSIGN DISK PARAMETERS command (C2h) may override the jumper allocations. See this command for assigning parameters to LUNs 2 and 3.
ST means ST506/412 drive type.

W15 **READY (Pin 2)**

Installed: Allows READY signal, from connector Pin 2, to be routed to the NEC 765. If the drive supports READY on Pin 2, this jumper should be installed; otherwise, it should not be installed.

* **Removed:** No connection between Pin 2 of the connector and READY on FDC 765.

W16 **READY (Pin 34)**

Installed: Allows READY signal, from connector pin 34, to be routed to the NEC 765. If the drive supports READY on pin 34, this jumper should be installed; otherwise, it should not be installed.

* **Removed:** No connection between Pin 34 of the connector and READY on FDC 765.

W17 **READY OVERRIDE (Only needed on REV B boards)**

Installed: The READY signal to the NEC 765 is forced true.

* **Removed:** READY to the NEC 765 is generated by the drive or set by the firmware for drives that don't support READY.

W18 **MOTOR ON OVERRIDE**

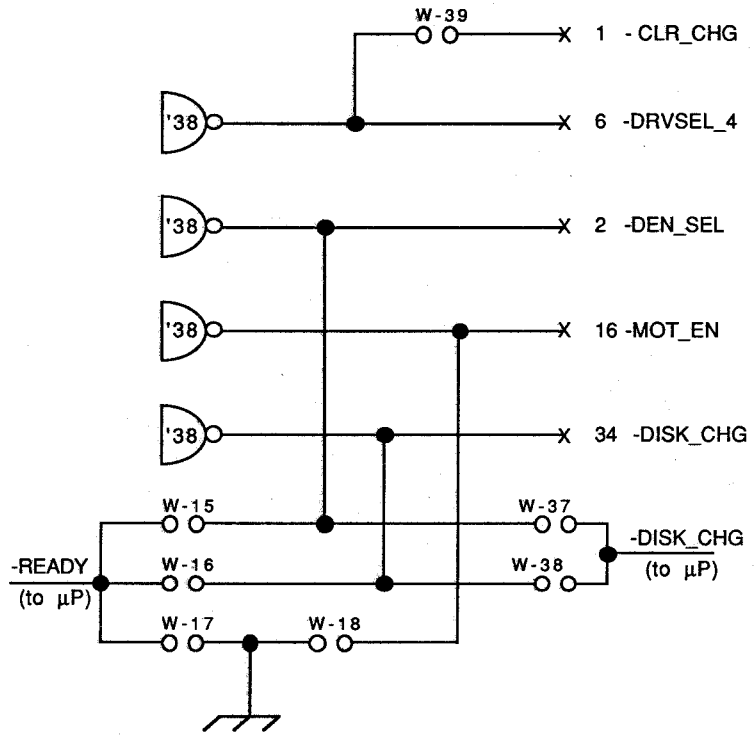
Installed: The MOTOR ON signal will always be asserted. This overrides bit 5 of byte 20 in the MODE SELECT command Page 5.

* **Removed:** The MOTOR ON signal is asserted or deasserted according to the value of bit 5 of byte 20 in the MODE SELECT command Page 5. After the last completed command issued to the floppy, the controller keeps the drive selected with MOTOR ON until the motor off delay timer expires.

W37 IS NOT USED - S/B OPEN

W38 IS NOT USED - S/B OPEN

W39 IS NOT USED - S/B OPEN



OMTI 7250
Floppy Jumper Circuit

Upon power-on or any Reset operation, the controller defaults to the following parameters. The values refer to the parameter list of the ASSIGN DISK PARAMETERS command. (See Paragraph 7.7.2 Flexible Disk Drive Parameters).

Default Values

LUN 0	LUN 1	LUN 2	LUN 3
Per jumper if W9, W10 = Flexible Disk W8 and W11 define 250 K versus 500 Kbit		Flexible disk 250Kbit	Flexible disk 500Kbit

	250 Kbit	500 Kbit
Byte 1 STEP PULSE WIDTH	N/A	N/A
Byte 2 STEP PERIOD	6 milliseconds	3 milliseconds
Byte 3 MAXIMUM CYLINDER ADDRESS	40 Cylinders	80 Cylinders
Byte 4 HEAD SETTLING DELAY	28 milliseconds	22 milliseconds
Byte 5 MOTOR ON	500 milliseconds	500 milliseconds
Byte 6 MOTOR OFF	7 seconds	7 seconds
Byte 7 START REDUCE WRITE CURRENT	(28h)	(50h)
Byte 8 FLEXIBLE DRIVE	(80h)	(80h)
Byte 9 FLEXIBLE DISK TYPE	(00h)	(80h)
Byte 10 START WRITE PRECOMPENSATION	(28h)	(50h)

In both cases, the default track format is as follows:

(side 0, cylinder 0 = FM recording, 16 sectors per track, 128 bytes per sector ;
all other tracks = MFM recording, 16 sectors per track, 256 bytes per sector.)
This is the same as code 06h of the DEFINE FLEXIBLE DISK FORMAT Command.

4.4 3100 SERIES JUMPER ALLOCATION

W1, W2, W3 SCSI CONTROLLER ID. Defines the SCSI device priority. ID 7 is the highest priority in a multi controller configuration.

	W3	W2	W1	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

W4 SCSI BUS PARITY

*	Shorted	= PARITY ENABLED
	Open	= PARITY DISABLED

W5 & W6 SECTOR SIZE on OMTI 3120A

	W5	W6	
	Open	Open	= 512 BYTES PER SECTOR, (18 sectors/track)
	Shorted	Open	= 256 BYTES PER SECTOR, (32 sectors/track)
*	Open	Shorted	= 512 BYTES PER SECTOR, (17 sectors/track)
	Shorted	Shorted	= 1024 BYTES PER SECTOR, (9 sectors/track)

W5 & W6 SECTOR SIZE on OMTI 3120A

	W5	W6	
	Open	Open	= 532 BYTES PER SECTOR, (17 sectors/track)
	Shorted	Open	= 256 BYTES PER SECTOR, (32 sectors/track)
*	Open	Shorted	= 512 BYTES PER SECTOR, (17 sectors/track)
	Shorted	Shorted	= 1024 BYTES PER SECTOR, (9 sectors/track)

NOTE : The block size is command programmable on the **OMTI 3127A**. See C2h command.

W11 SCSI POWER TERMINATION on OMTI 3120A

	W11	1-2 = TERMINATION POWER FROM SCSI BUS
*	W11	2-3 = TERMINATION POWER FROM BOARD

* As shipped.

Note : The ASSIGN DISK PARAMETERS command (C2h) may override the jumper allocations.

W15 SCSI POWER TERMINATION on OMTI 3127A

*	**W15**	1-2 = TERMINATION POWER FROM BOARD
	W15	2-3 = TERMINATION POWER FROM SCSI BUS

4.5 DEFAULT PARAMETERS

4.5 .1 ST506/412 Winchester Disk Drives

Upon power-on or any Reset operation, the controller defaults to the following parameters for ST506/412 drives :

The values refer to the parameter list of the ASSIGN DISK PARAMETERS command (C2h).

Byte 1	STEP PULSE WIDTH = 2.4 (7x50), 1.2 (3100) microseconds	(00h)
Byte 2	STEP PULSE PERIOD = 8.2 (7x50), 6.8 (3100) microseconds	(00h)
Byte 3	STEP MODE = 0	(00h)
Byte 4	NUMBER OF HEADS = 4	(03h)
Byte 5	MAXIMUM CYLINDER ADDRESS (MSB)	(01h)
Byte 6	MAXIMUM CYLINDER ADDRESS (LSB) = 306	(31h)
Byte 7	REDUCED WRITE CURRENT = 128	(80h)
Byte 8	PRECOMP BYTE = 128	(00h)
Byte 9	SECTORS/TRACK (per jumpers)	(xxh)
	Bytes per sector	
	OMTI 3110 and 3120A	
	512 and 532	17 (11h) or 18 (12h) (by jumpers)
	1024	9 (09h)
	OMTI 3127A	
	512 and 532	26 (1Ah)
Byte 10	Reserved	(00h)

Bits 0 and 1 of byte 8 with byte 7 forms the 10 bit precomp address, while REDUCED WRITE CURRENT address is specified by byte 7 only.

SECTION 5

TRACK AND SECTOR FORMAT

5.1 WINCHESTER DISK TRACK FORMAT

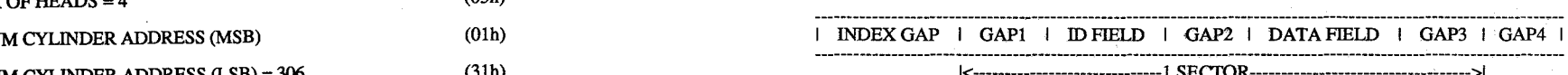
5.1.1 Track Format

The standard track format for hard and soft sectored Winchester Disk drives is organized into numbered data segments, or sectors.

The nominal ST506/412 Winchester Disk capacity is 10,416 Bytes. The minimum track capacity is based on a one percent speed variation. The method of encoding used is Modified Frequency Modulation (MFM).

The nominal ST412R Winchester Disk capacity is 15,624 Bytes. The minimum track capacity is based on a one percent speed variation. The method of encoding used is 2,7 RLL.

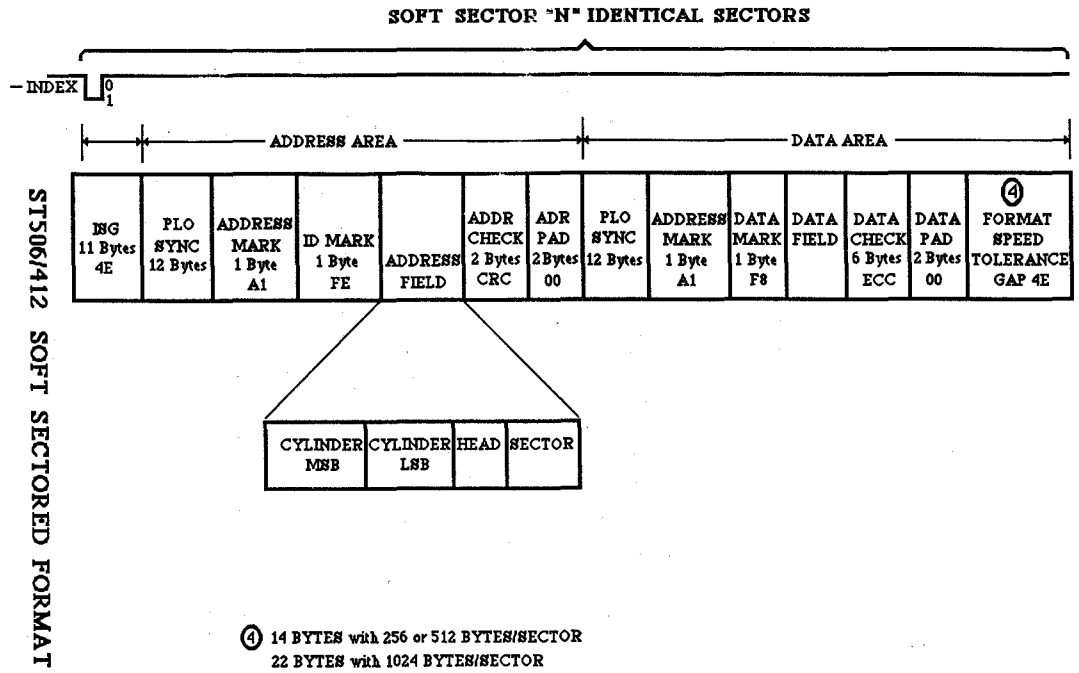
Refer to the ESDI drive vendor specification for the real track capacity.



Winchester Disk Soft Sector Track Format

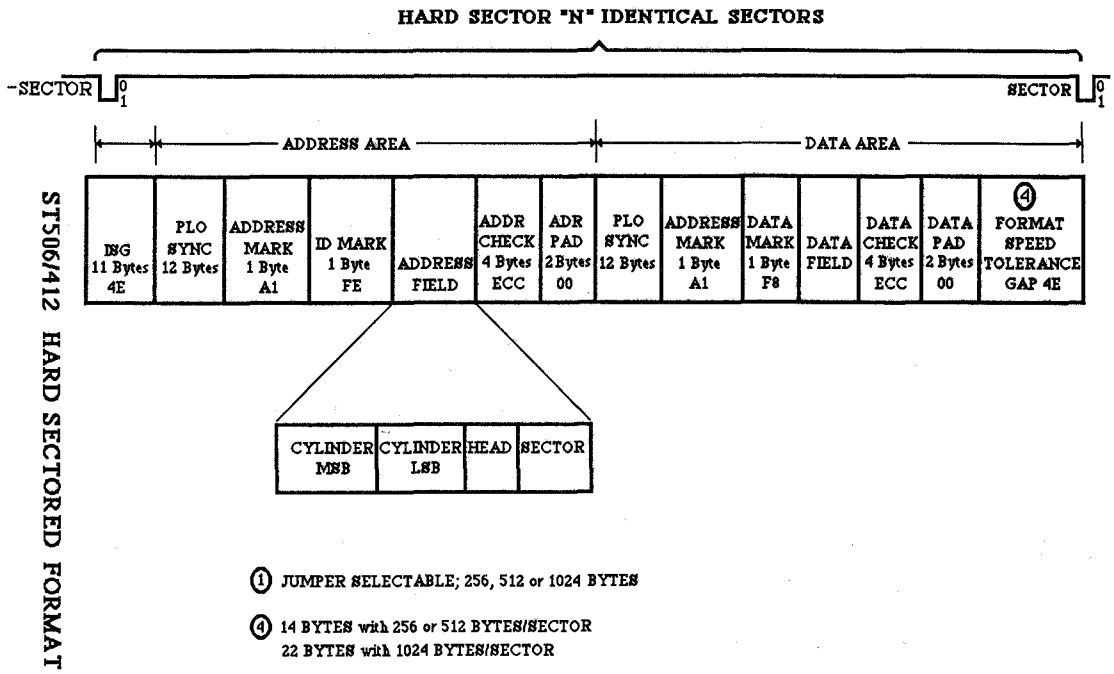
Winchester Disk Hard Sector Track Format

ST506/412 SOFT SECTORED FORMAT



④ 14 BYTES with 256 or 512 BYTES/SECTOR
22 BYTES with 1024 BYTES/SECTOR

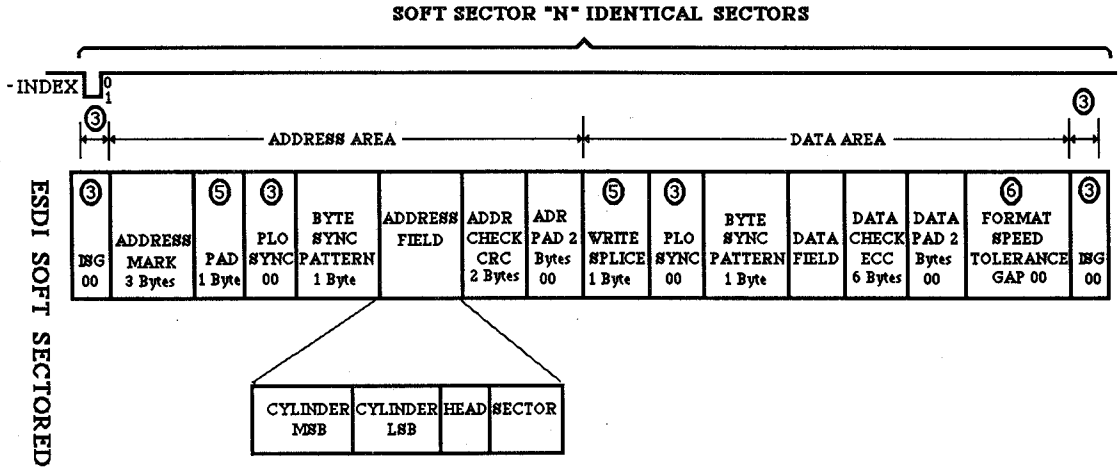
ST506/412 HARD SECTORED FORMAT



① JUMPER SELECTABLE; 256, 512 or 1024 BYTES

④ 14 BYTES with 256 or 512 BYTES/SECTOR
22 BYTES with 1024 BYTES/SECTOR

ESDI SOFT SECTORED FORMAT



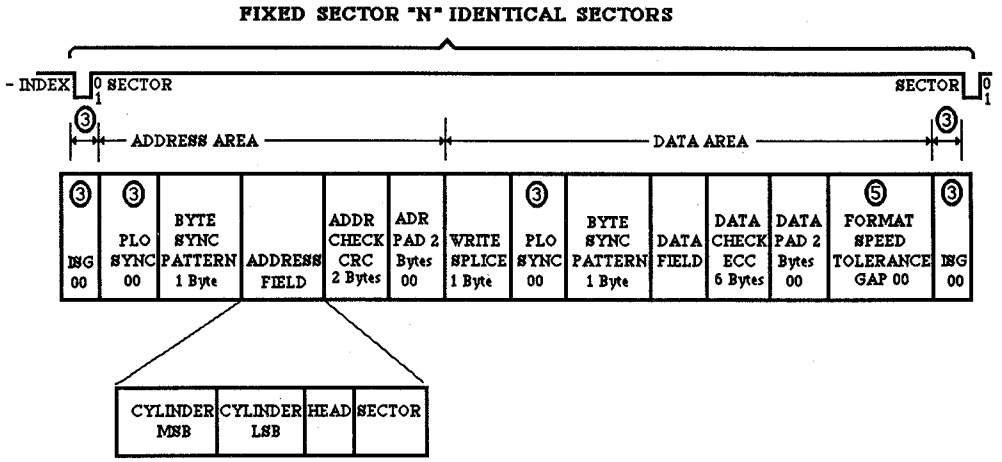
③ PLO SYNC FIELD and ING ARE AS REPORTED IN RESPONSE TO THE ESDI REQUEST CONFIGURATION COMMAND

④ ALL BYTE NUMBERS INDICATED ARE MINIMUMS EXCEPT ADDRESS FIELD LENGTH

⑤ THIS AREA IS PART OF THE PLO SYNC TO ALLOW FOR READ GATE ACTIVATION DELAYS

⑥ FORMAT SPEED TOLERANCE GAP IS REQUIRED IF REFERENCE CLOCK IS NOT TIED TO ROTATIONAL SPEED, THE APPLICABILITY OF THIS GAP IS DEFINED IN ESDI CONFIGURATION DATA BIT 14

ESDI FIXED SECTORED FORMAT



③ PLO SYNC FIELD and ING ARE AS REPORTED IN RESPONSE TO THE ESDI REQUEST CONFIGURATION COMMAND.

④ ALL BYTE NUMBERS INDICATED ARE MINIMUMS EXCEPT ADDRESS FIELD LENGTH

⑤ FORMAT SPEED TOLERANCE GAP IS REQUIRED IF REFERENCE CLOCK IS NOT TIED TO ROTATIONAL SPEED, THE APPLICABILITY OF THIS GAP IS DEFINED IN ESDI CONFIGURATION DATA BIT 14

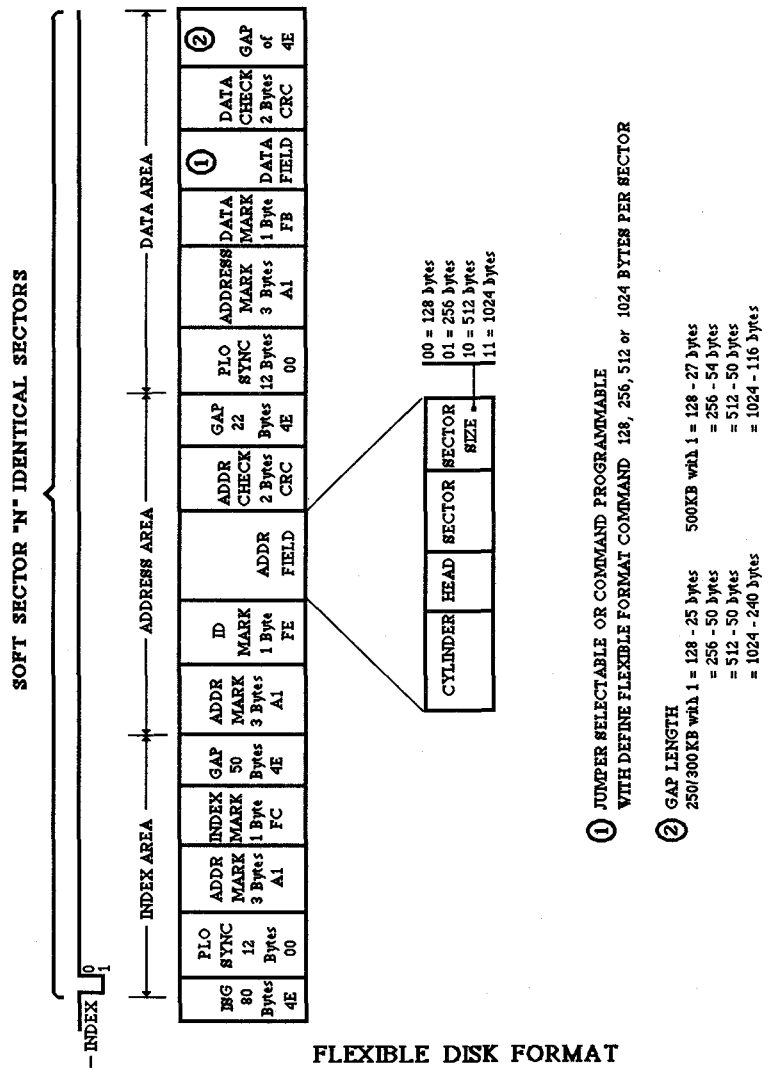
5.2 FLEXIBLE DISK TRACK FORMAT (OMTI 7250)

ADDRESS FIELD :
BYTE 3 - The number of Sectors is programmable.

Default number of sectors :
- for 250 KBit format is 8 (01-08),
however, a 9 sector format (01-09) is possible and can be programmed by issuing a DEFINE FLEXIBLE DISK FORMAT command (C0h) with BYTE 4 set to 09h.

- for 500 KBit format is 15 (01-0F),
however, a 16 sector format (01-10) is possible and can be programmed by issuing a DEFINE FLEXIBLE FORMAT command (C0h) with BYTE 4 set to 10h.

Starting sector number :
- is programmable through the DEFINE FLEXIBLE FORMAT command (C0h) with BYTE 5 bit 4.



FLEXIBLE DISK FORMAT

SECTION 6

FUNCTIONAL DESCRIPTION

6.1 GENERAL

The host-controller interface is the Small Computer Systems Interface (SCSI) general purpose 8-bit bi-directional bus.

All commands are issued to the controller over the host bus using a predefined protocol. The host always initiates a command sequence by first selecting the controller. After the controller accepts selection, it takes control of the bus and requests the appropriate command bytes.

For data transfers, a multiple sector buffer is provided to eliminate any possibility of data overruns. Upon command completion (either successful or not), the controller will issue completion status to the host. Sense Status information is provided through the REQUEST SENSE command.

6.2 ELECTRICAL INTERFACE

All host computer interface 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.

6.3 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 the devices in between. For instance, if the Controller is in the middle of the string, remove its terminators. The host adapter should be terminated in a similar fashion.

The devices driving the controller 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 controller 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 controller output signals with 220/330 ohm terminators.

6.4 SIGNAL DEFINITION

ATN (ATTENTION) Not supported.

RESET (RST) "OR Tied" signal asserted by the host causes the controller to cease all operations and return to the idle condition. This signal is normally used during a power up sequence. A RESET during a write operation would cause incorrect data to be written on the disk. The RESET pulse should be at least twenty-five microseconds (25 us) wide to allow the controller's microprocessor to execute this function properly.

SELECT (SEL) Asserted by the host, along with a single controller address bit (0 through 7), causes the appropriate controller to be selected. The SELECT line must be deasserted by the host after the controller asserts the BUSY line in response to a proper selection. See NOTE in paragraph 6.6.

BUSY (BSY) "OR Tied" signal asserted by the controller indicates that the bus is being used.

CONTROL / DATA (C/D) Signal asserted by the controller indicates that command or data 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 controller indicates that information will be transferred to the host from the controller. Deassertion indicates that information will be transferred to the controller from the host.

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

ACKNOWLEDGE (ACK) Signal asserted by the host indicates data has been accepted by the host or that data is ready to be transferred from the host to the controller.

MESSAGE (MSG) Signal asserted by the controller indicates that the last byte transferred was the Completion Status byte. When the MESSAGE signal is asserted, indicating a Message phase, REQUEST is asserted by the controller in order to transfer an 8-bit byte indicating the end of the operation. When this REQ/ACK handshake is complete, the controller will deassert all interface signal lines and return to the idle state, with BUSY deasserted.

DATA BITS 0-7 (DB0-7) & 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.

6.5 HOST INTERFACE PROTOCOL

For detailed information about the Host Interface Protocol, refer to the SCSI specifications as per ANSC X3T9.2/82-2, Revision 8 minimum.

The Host interface includes the following operational phases:

1. **Bus Free phase (BSY deasserted)**
2. **Selection phase**
3. **Command phase**
4. **Data In or Out phase**
5. **Status phase**
6. **Message In phase**

The Host bus can never be in more than one phase at any given time. The order in which SCSI bus phases are used on the bus follows a prescribed sequence. The Reset condition can interrupt any phase and is always followed by the Bus Free phase.

The controller follows a normal progression from the Bus Free phase to the Selection phase, to one or more of the following Information Transfer phases (Command, Data In or Out, or directly to Status phase). The Message In phase is always the last phase before returning to the Bus Free phase.

6.6 SELECTION PHASE

The host must first test the BSY signal to determine if the SCSI bus is available. If BSY and all other I/O lines are deasserted, the host will assert one of the data lines (DBX = controller ID) and then assert SEL. The selected controller will then respond by asserting BSY. At this point the host must deassert SEL and DBX. The controller responds to SEL deasserted by asserting the C/D line for entering the next phase, the COMMAND phase. I/O remains deasserted throughout the selection sequence.

NOTE: Upon power on reset the controller will execute a comprehensive self test. During this test the controller will not respond to a Selection sequence (SEL signal asserted by the Host) for a period of 400 msec. The controller will not respond and will not assert BSY during this time.

6.7 COMMAND PHASE

After selection acceptance, as explained in the Selection phase, the controller will assert C/D, indicating the start of the command phase, then assert REQ, requesting the first byte of command. The host will then place this first byte of the command descriptor block on the data bus. The host will then assert ACK. The controller will then respond by reading the byte on the data bus and deasserting REQ. The host must then deassert ACK to begin the next REQ/ACK handshake. The handshake continues until all bytes of the command phase have been transferred.

6.8 DATA IN OR OUT PHASE

If the command sent to the controller involves a data transfer, the controller will deassert the C/D line to indicate a data transfer. If the data transfer is from the controller to the host (read data), the I/O line will be asserted. If the data transfer is from the host to the controller (write data), the I/O line will be deasserted. The controller will then assert the REQ line to request a byte transfer. The host responds by transferring a byte across the data bus, and then asserts ACK. The controller then deasserts REQ to finish the data transfer. This handshake continues until all data bytes have been transferred for the block count requested.

6.9 STATUS AND MESSAGE PHASES

Following a command or data transfer, the controller will generate a Completion Status byte and a Message In byte. To send the Completion Status byte, the controller will assert C/D and I/O, along with the assertion of REQ. The host must then accept the status byte on the data bus and assert ACK. The controller will then deassert REQ and the host deasserts ACK. Following the Completion Status byte transfer, a message byte will be transferred to indicate that the command is completed. The controller will assert the MSG line, along with C/D and I/O, then assert REQ. The host accepts the "Command Complete" message byte on the data bus and asserts ACK. The controller then responds by deasserting REQ, and the host by deasserting ACK. At this point BSY and all other controller signal lines will be deasserted and the controller will return to an idle state. SEL remains deasserted throughout this phase.

SECTION 7

COMMAND SET

7.1 GENERAL

The command definition provides continuous logical blocks of a fixed data length. A single command may transfer one or more logical blocks of data.
Upon command completion (successful or unsuccessful), the controller returns a Status byte to the initiator.
Following the Selection phase, the controller requests a Command Descriptor Block (CDB) from the host, the length of which is either six or ten bytes.
The controller checks all incoming CDB's validity and, unless disabled, will check both CDB and data for odd parity. An error in the command structure will terminate the command and cause a "CHECK CONDITION" status to occur.

7.2 COMMAND DESCRIPTOR DEFINITION

7.2.1 Command Descriptor Block (CDB)

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

7.2.2 Reserved

"Reserved" or "Not Used" bits, fields, bytes, and code values are set aside. A reserved bit, field, or byte shall be set to zero by the initiator. When receiving a reserved bit, field, or byte that is not zero, the controller may terminate the command with a CHECK CONDITION status.

7.2.3 Operation Code

The operation code of the CDB 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 -6 reserved
Group 7 - ten byte commands
Refer to Paragraph 2.2 for the Command Set Summary.

Operation Code

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

Typical CDB for Six-byte Commands

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

7.2.4 Logical Unit Number (LUN)

The Logical Unit Number (Byte 2 - Bits 5, and 6) addresses one of up to 4 devices (7250) attached to the controller.

3120A/3127A	7250
Winchester Drive Select 1 = LUN 0	Winchester or Flexible Disk Drive Select 1 = LUN 0
Winchester Drive Select 2 = LUN 1	Winchester or Flexible Disk Drive Select 2 = LUN 1
	Winchester or Flexible Disk Drive Select 3 = LUN 2
	Winchester or Flexible Disk Drive Select 4 = LUN 3

7.2.5 Logical Block Address (LBA)

The Logical Block Address is a 21 bit address which begins with block zero (cylinder 0, head 0, sector 0) and is contiguous up to the last logical block on that logical unit. The Logical Block Address relates to a physical address, typically defined in terms of cylinder, head, and sector.

The Logical Block Address is computed using the following formula:

LOGICAL BLOCK ADDRESS = (CYLADDR * HDCYL + HDADDR) * SECTRK + SECNUM

Where:	CYLADDR	=	Cylinder Address or Number
	HDCYL	=	Number of Heads per Cylinder
	HDADDR	=	Head Address or Number
	SECTRK	=	Number of Sectors per Track
	SECNUM	=	Sector Number

7.2.6 Transfer Length (Block Count) or Track Skewing/Interleave Factor

The Transfer Length or Block Count specifies the number of blocks to be transferred per command. A value of zero will result in a transfer of 256 blocks. A Transfer Length value of 1 to 255 indicates the number of blocks that shall be transferred. A Transfer Length of the commands that are used to send a list of parameters to a controller is called the Parameter List Length. The Parameter List Length specifies the number of bytes sent during the DATA OUT phase.

This byte also specifies the track skewing/interleave factor for some commands. See FORMAT UNIT command (7250 only) for Track Skewing setting. An interleave factor of zero (0) or one will default to an interleave factor of one (1).

An example of the interleave scheme for a track with 9 sectors and an interleave factor of 3 is shown below on the head zero :

PHY. SEC.	0	1	2	3	4	5	6	7	8	9
LOG. BLK.	0	4	7	1	5	8	2	6	9	3

7.2.7 Control Byte (Last byte in all commands)

Control Byte

Bit / Byte	7	6	5	4	3	2	1	0
Last	DR	DC/B	F	Reserved				LINK

DR: Disable Retries

Should a read error occur with the Retry not disabled (bit 7=0), the controller will attempt to read the sector up to eight (8) times. ID field errors will recalibrate and reseek after four (4) rereads.

DC: Disable Error Correction
B: Format with Data in Buffer

D: Should a correctable data error occur with the Error Correction not disabled (bit 6=0), the controller will correct the data prior to transferring it to the host.

If both Retry and Error Correction are not disabled, the retry sequence will be attempted prior to error correction.

B: On all format commands (FORMAT DRIVE, FORMAT TRACK, FORMAT BAD TRACK, and ASSIGN ALTERNATE TRACK, if bit 6 of the Control Byte is set to one, the data in the data buffer is the data written to all the data fields. If it is set to zero, E5h is written in all the data fields.

F: See ASSIGN DISK PARAMETERS command where this bit is used with the OMTI 3110 and 3127 products.

Link: If the LINK command bit of the Control Byte is enabled, and the current command is executed successfully, the controller will bypass the Status and Message In phases, and the Selection phase of the next command. The controller will then request the next command descriptor block.

7.3 COMPLETION STATUS BYTE

At termination of a command or following an error, the controller will cause a status byte to be transferred from the controller to the host. The completion status byte will report that a CHECK CONDITION occurred, not the type of error. To obtain the error code a REQUEST SENSE (03h) command must be issued. Bit 0 will be set to 1 if a Parity error was detected. Bit 1 will be set to 1 if the controller detected an error condition during command execution. Bits 5 and 6 represent the LUN of the device causing the error. If no error occurs, bits 0 - 4 will be set to 0.

Completion Status Byte Format

Bits of Status Byte	Code	Status(es) Represented
7 6 5 4 3 2 1 0		
0 LUN 0 0 0 0 0	00h	**GOOD**
0 LUN 0 0 0 0 1	01h	**PARITY ERROR**
0 LUN 0 0 0 1 0	02h	**CHECK CONDITION,** Error occurred during the command execution.

Bits 6-5 Logical Unit Number (LUN) of the drive

7.4 MESSAGE IN BYTE

Following the transfer of the completion status byte, the controller asserts the MSG line to indicate a Message In phase. This message consists of a single byte transfer, with all bits set to 0, indicating "Command Complete" Message.

7.5 TYPE 0 COMMANDS

GROUP 0

TEST UNIT READY	**00h**
RECALIBRATE	**01h**
REQUEST SENSE	**03h**
FORMAT UNIT	**04h**
CHECK TRACK FORMAT	**05h**
FORMAT TRACK	**06h**
FORMAT BAD TRACK	**07h**
READ	**08h**
WRITE	**0Ah**
SEEK	**0Bh**
ASSIGN ALTERNATE TRACK	**0Eh**
START/STOP	**1Ah**
CHANGE CARTRIDGE	**1Bh**
READ TO BUFFER	**1Eh**
WRITE FROM BUFFER	**1Fh**
READ CONFIGURATION	**1Ch**
READ TO BUFFER	**1Eh**
WRITE FROM BUFFER	**1Fh**

7.5.1 TEST UNIT READY Command (00h)

The command selects the LUN specified and returns a Zero Status during the Status phase of the command execution to indicate that the drive is selected, ready, and SEEK complete.

TEST UNIT READY Command Descriptor Block

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	Zero Value							**LINK**

7.5.2 RECALIBRATE Command (01h)

With ST drives :
The drive specified by the LUN is stepped toward the outside cylinder until either:

1. Track 0 signal is detected or
2. More steps have been issued than available cylinders for the device type.

The controller issues one step pulse, waits for SEEK complete, and tests the Track 000 signal until Track 000 is true. If the unit is defined as a Removable device, a "buffered" recalibrate is performed, where the controller issues a number of step pulses equal to the maximum number of cylinders plus five at the step rate currently defined for this unit, then waits up to 3 seconds for the Track on signal to become true.

With ESDI drives :
This command selects the Logical Unit Number (LUN) specified and issues a recalibrate to cylinder zero.

RECALIBRATE Command Descriptor Block

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	Zero Value							**LINK**

7.5.3 REQUEST SENSE Command (03h)

Following a CHECK CONDITION status in the Completion Status byte of the previous command, the host may perform a REQUEST SENSE command to obtain more detailed information about the error. If, after a CHECK CONDITION, a command is issued to another LUN, the Logical Block Address for the check condition will be lost.

REQUEST SENSE Command Descriptor Block

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	0	**B**	0	0	0	0	0	**LINK**

The following four bytes are returned to the host during the Data In phase of the command execution.

SENSE BYTES FORMAT

Bit / Byte	7	6	5	4	3	2	1	0
1	**AV**			**SENSE CODE**				
2	**Logical Unit Number**			**Logical Block Address 2 (MSB)**				
3	**Logical Block Address 1**							
4	**Logical Block Address 0 (LSB)**							

AV set to one indicates that the Logical Block Address in bytes 2 through 4 is valid.

SENSE CODE : Each command description contains a list of valid error codes. Refer to APPENDIX A for further description of error codes and to APPENDIX B for which code may be encountered with which command.

SENSE CODE SUMMARY (SENSE BYTE 1)

SENSE DESCRIPTION	CODE (Hex)
No error	00
No Index	01
No Seek/Command Complete	02
Write/Drive Fault	03
Drive Not Ready	04
Drive Not Selected	05
No Track Zero or Cylinder Zero Found	06
Multiple drives selected	07
Not used	08
Cartridge changed	09
Not used	0A to 0C
Seek/Command in progress	0D
Not used	0E to 0F
ECC error in ID field	10
Uncorrectable error in data field	11
No address mark in ID field	12
No address mark in data field	13
No record found	14
Seek error	15
Sequencer/DMA failure	16
Write protected	17
Correctable ECC error	18
Bad Track flag set	19
Illegal or incorrect interleave/ Skew factor	1A
Not used	1B
Unable to read alternate track data	1C
Alternate or Bad Track Already Assigned	1D
Illegal direct access to alternate track	1E
Not used	1F
Invalid command	20
Illegal parameters	21
Illegal Function for drive type	22
Volume Overflow	23
Not Used	24 to 2F
Diagnostic error	30
FDC 765 Error	31
Not Used	32 to 8F
Not Used	A0 through FF

7.5.4 FORMAT UNIT Command (04h)

This command causes the specified LUN to be formatted using the track skewing (7250 only) and interleave factor specified in byte 4. 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.

Track Skewing (applicable to all 7250 commands where specified in the CDB):
Track skewing is a scheme implemented to improve access time when switching heads while transferring multiple blocks. It's value tailored to the application. Track Skewing avoids losing a disk revolution when switching heads. With a track skewing of zero, the first sector after index is always sector zero. With a track skewing different than zero, only on head zero is the first sector after index the sector zero. The physical location of the sector zero on the subsequents heads is offset by the skew value from the previous head.

Example :
Skew = 1 **Interleave = 3**

Physical Sector	0	1	2	3	4	5	6	7
Head 0	0	3	6	1	4	7	2	5
Head 1	5	0	3	6	1	4	7	2
Head 2	2	5	0	3	6	1	4	7

Interleave Factor:
The Interleave is a speed matching scheme between the disk data transfer rate and the host data transfer rate. It is provided because the disk is often faster than the host. An interleave factor of zero is set equal to one and is the fastest. Interleave factors greater than or equal to the number of sectors per track are illegal. With a large buffer (minimum of 8K bytes) as supported by some controllers, it is recommended to set the interleave factor to one as any other value would not significantly improve the data transfer speed. Track and cylinder overflow is handled automatically by the controller.

If **B** bit 6 of the Control Byte is set to zero, all data fields are filled with E5h. If bit 6 of the Control Byte is set to one, all data fields are filled with whatever data is in the data buffer. This allows a "worst case" data pattern to be sent to the data buffer using the WRITE DATA BUFFER command and then written to the disk.

NOTE: This command does not check data, and does not handle media defects. For media defect handling, see the ASSIGN ALTERNATE TRACK command.

FORMAT UNIT Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Logical Block Address 2 (MSB)				
2	Logical Block Address 1							
3	Logical Block Address 0 (LSB)							
4	Track Skewing (7250)				Interleave Factor			
5	DR	B	0	0	0	0	0	LINK

A value of zero in the Logical Block Address will result in formatting the entire drive. The format process will start at the Logical Block Address specified.

7.5.5 CHECK TRACK FORMAT Command (05h)

This command checks the integrity of the track specified by the Logical Block Address. ID fields and data fields are verified against ECC value recorded. No data is transferred to the host. The command also ensures that the skew/ interleave recorded matches the value in Byte 4. See the FORMAT UNIT command for comments on Track skewing and Interleave. To specify the track address, any Logical Block Address on that track may be used. A READ DATA BUFFER command (ECh) executed immediately following a CHECK TRACK FORMAT command will show all the sector IDs of the track implied. The sector IDs are listed by groups of 4 bytes. The first 4 bytes represent sector zero of the track. The 4 bytes include: cylinder high, cylinder low, head and sector number (with interleave) as described in the data byte format in the READ IDENTIFIER command (E2h). The third byte may indicate with bits 7, 6 and 5 if the track is bad, alternated or is a bad alternate.

CHECK TRACK FORMAT Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Logical Block Address 2 (MSB)				
2	Logical Block Address 1							
3	Logical Block Address 0 (LSB)							
4	Track Skewing (7250)				Interleave Factor			
5	DR	DC	0	0	0	0	0	LINK

7.5.6 FORMAT TRACK Command (06h)

This command causes the track specified by the Logical Block Address in bytes 1 - 3 to be formatted using the track skewing and interleave factor specified in byte 4. The track is written starting with index. See the FORMAT UNIT command for comments on Track skewing (7250 only), Interleave and the B bit in the Control byte. To specify the track address, any Logical Block Address on that track may be used.

If **B** bit 6 of the Control Byte is set to zero, all data fields are filled with E5h. If bit 6 of the Control Byte is set to one, all data fields are filled with whatever data is in the data buffer. This allows a "worst case" data pattern to be sent to the data buffer using the WRITE DATA BUFFER command and then written to the disk.

This command includes an implied recalibrate and re-seek to the specified track.

FORMAT TRACK Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Logical Block Address 2 (MSB)				
2	Logical Block Address 1							
3	Logical Block Address 0 (LSB)							
4	Track Skewing (7250)				Interleave Factor			
5	DR	B	0	0	0	0	0	LINK

7.5.7 FORMAT BAD TRACK Command (07h)

This command is identical to the FORMAT TRACK command except that the defective track flag is set in the ID field. All subsequent accesses to the sectors on this track will result in Bad Track Flag set errors. To specify the track address, any Logical Block address on that track may be used. See the FORMAT UNIT command for comments on Track skewing (7250 only), Interleave and the B bit in the Control byte.

FORMAT BAD TRACK Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Logical Block Address 2 (MSB)				
2	Logical Block Address 1							
3	Logical Block Address 0 (LSB)							
4	Track Skewing				Interleave Factor			
5	0	B	0	0	0	0	0	LINK

7.5.8 READ Command (08h)

This command causes the number of blocks specified by byte 4 to be transferred from the disk to the host. The command executes an implied seek to the starting block specified by the Logical Block address in bytes 1, 2, and 3. Up to 256 blocks can be transferred with a single READ command (if Byte 5 is equal to zero, 256 blocks will be transferred).

READ Command Descriptor Block

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

7.5.9 WRITE Command (0Ah)

This command causes the number of blocks specified by byte 4 to be transferred from the host to the disk. The command executes an implied seek to the starting block specified by the logical block address in bytes 1, 2, and 3. Up to 256 blocks can be transferred with a single WRITE command. (If Byte 4 is equal to zero, the block count is set to 256 blocks).

WRITE Command Descriptor Block

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

7.5.10 SEEK Command (0Bh)

This command causes the device addressed by the LUN to be physically positioned on the track as defined by the logical block address in bytes 1, 2, and 3.

No attempt to verify a seek position is made until a READ or WRITE command is issued. Completion status is returned to the host immediately after issuing all required step pulses. This allows overlap seek operations. As READ and WRITE commands are issued with implied seek, the SEEK command need not be issued, unless overlap operations are desired.

SEEK Command Descriptor Block

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

7.5.11 ASSIGN ALTERNATE TRACK Command (0Eh)

This command is used to assign an alternate track to the track specified in bytes 1 - 3 so that any future accesses to the blocks on the specified track cause the controller to automatically access those blocks on the alternate track. This command sets flags in the ID field and writes the alternate track address in all blocks on the specified track. The alternate track is then formatted with flags set to indicate that this track has been assigned as an alternate track. Future direct accesses to the alternate track will result in an error.

To specify the track address, any Logical Block address on that track may be used. See the FORMAT UNIT command for comments on Track skewing, Interleave and the B bit in the Control byte.

If **B** bit 6 of the Control Byte is set to zero, all data fields are filled with E5h. If bit 6 of the Control Byte is set to one, all data fields are filled with whatever data is in the data buffer. This allows a "worst case" data pattern to be sent to the data buffer using the WRITE DATA BUFFER command and then written to the disk.

This command includes an implied recalibrate and re-seek to the specified track.

ASSIGN ALTERNATE TRACK Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	**Operation Code**							
1	**Logical Unit Number**			**Logical Block Address 2 (MSB)**				
2	**Logical Block Address 1**							
3	**Logical Block Address 0 (LSB)**							
4	**Track Skewing (7250)**				**Interleave Factor**			
5	0	**B**	0	0	0	0	0	**LINK**

The alternate track address is passed to the controller during the Data Out phase of the command execution using the following format (any Logical Block address on the alternate track may be used):

ALTERNATE TRACK ADDRESS Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	**Logical Block Address 2 (MSB)**							
1	**Logical Block Address 1**							
2	**Logical Block Address 0 (LSB)**							
3	Zero Value							

NOTE: Data written on the original track and on the alternate track will be destroyed.

The controller checks if the track assigned as an alternate track has been previously used as an alternate track for another track or has been formatted as bad.

A track reserved as an alternate track may not have another alternate assigned to it (multiple levels of alternate tracks are not allowed).

7.5.12 START/STOP Command (1Ah) Valid for ESDI and Flexible Disk drives only. (7250 Model only)

Bit / Byte	7	6	5	4	3	2	1	0
0	**Operation Code**							
1	**Logical Unit Number**			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							**START**
5	0	0	0	0	0	0	0	**LINK**

This command can only be executed if the drive supports the bit 5 byte 5 of the Drive Configuration Word (see READ CONFIGURATION command).
To start the unit, the **Start** bit shall be set to one.
To stop the unit, the **Start** bit shall be set to zero.
This command returns status immediately after receiving the command bytes, then does not wait for the start or stop spindle operation to complete.

7.5.13 CHANGE CARTRIDGE Command (1Bh)

This command is valid only for units assigned as Removable Winchester Disks but not valid for Flexible disks. This causes the "Change Cartridge" line (J2-Pin 2) to be asserted for a period of one (1) millisecond.

CHANGE CARTRIDGE Command Descriptor Block

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	0	0	0	0	0	0	0	**LINK**

7.5.14 READ CONFIGURATION Command (1Ch) valid for 7250 only.

This command returns to the host ESDI drive physical parameters as available directly from the drive interface.

READ CONFIGURATION Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	**Operation Code**							
1	**Logical Unit Number**				Reserved			
2 through 4	Reserved							
5	0	0	0	0	0	0	0	**LINK**

HARD and SOFT SECTORED Drives

0	**NUMBER OF CYLINDERS (MSB)**
1	**NUMBER OF CYLINDERS (LSB)(-1)**
2	**NUMBER OF HEADS (-1)**
3	**NUMBER OF SECTORS (-1)**
4	**DRIVE CONFIGURATION WORD (MSB)**
5	**DRIVE CONFIGURATION WORD (LSB)(-1)**
6	**ISG AFTER INDEX**

SOFT SECTORED Drives

7	**PLO SYNC Field (ID)**
8	**PLO SYNC Field (DATA)**
9	**ISG AFTER SECTOR**

HARD SECTORED Drives

7	**PLO SYNC Field (ID/DATA)**
8	**ISG AFTER SECTOR**
9	Zero Value

DRIVE CONFIGURATION WORD (Bytes 4 and 5) :
The following tables list the supported functions of the ESDI drive configuration.

Byte 4	**Bits**	
ESDI TAPE Drive	7,15	CHECK CONDITION status.
FORMAT SPEED TOLERANCE GAP REQUIRED	6,14	Supported
TRACK OFFSET OPTION AVAILABLE	5,13	Not supported as yet.
DATA STROBE OPTION	4,12	Not supported as yet.
ROTATIONAL SPEED TOLERANCE IS > 0.5 %	3,11	Supported
TRANSFER RATE T > 10 MHZ	2,10	Not Supported
TRANSFER RATE T = 10 MHZ	1,9	Supported
TRANSFER RATE T = 5 MHZ	0,8	Supported

Byte 5	**Bits**	
ESDI REMOVABLE MEDIA	7	Supported
ESDI FIXED MEDIA	6	Supported
ESDI MOTOR START/STOP OPTION	5	Supported
HEAD SWITCHING TIME > 15 MICROSECONDS	4	Supported
RLL ENCODED, NOT MFM	3	Controller ignores
ESDI SOFT SECTORED	2	Supported
ESDI HARD SECTORED	1	Supported
Reserved	0	

PLO SYNC Field, ISG after INDEX and ISG after SECTOR :
Bytes 6, 7, 8, 9
The controller accepts a value of up to 255 or FFh for each of these fields.

7.5.15 READ DATA TO BUFFER Command (1Eh)

This command causes the number of blocks specified by byte 4 to be transferred from the disk to the controller buffer. The command executes an implied seek to the starting block specified by the Logical Block address in bytes 1, 2, and 3. The maximum allowable transfer block size is limited by the buffer size.

READ DATA TO BUFFER Command Descriptor Block

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

7.5.16 WRITE DATA FROM BUFFER Command (1Fh)

This command causes the number of blocks specified by byte 4 to be transferred from the controller buffer to the disk. Up to the buffer size can be transferred, therefore the block size is to be considered when specifying the Transfer Length.

WRITE DATA FROM BUFFER Command Descriptor Block

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

7.6 TYPE 1 COMMANDS

7.6.1 COPY Command (20h)

This command copies a specified number of blocks from a Source LUN to a Destination LUN. Source and Destination LUNs may be the same. Block sizes on both Source and Destination LUNs must be identical. Because the controller uses its internal buffer, no data is transferred to the host.

COPY Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	**Operation Code**							
1	**Source LUN**			**Source Logical Block Address 2 (MSB)**				
2	**Source Logical Block Address 1**							
3	**Source Logical Block Address 0 (LSB)**							
4	**Transfer Length**							
5	**Destination LUN**			**Dest. Logical Block Address 2 (MSB)**				
6	**Dest. Logical Block Address 1**							
7	**Dest. Logical Block Address 0 (LSB)**							
8	Reserved							
9	**DC**	**DR**	0	0	0	0	0	**LINK**

7.6.2 READ DEFECT DATA Command (37h)

Valid for ESDI drives with the 7250 only .

The READ DEFECT DATA command requests that the controller transfer the medium defect data recorded by the drive manufacturer to the host.

READ DEFECT DATA Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	**Operation Code**							
1	**Logical Unit Number**			Reserved				
2	Reserved			**1**	**0**	**1**	**0**	**0**
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	**Allocation Length (MSB)**							
8	**Allocation Length (LSB)**							
9	**DC**	**DR**	0	0	0	0	0	**LINK**

The Defect List format is returned by Bytes From Index.

If the controller is unable to read the defect list from the disk, it will create the CHECK CONDITION status.

The **Allocation Length** specifies the number of bytes that the host 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 are being transferred.

The controller terminates the DATA IN phase when the Allocation Length bytes have been transferred or when all available READ DEFECT DATA data have been transferred to the host, 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							
1	Reserved			**1**	**0**	**1**	**0**	**0**
2	**Defect List Length (MSB)**							
3	**Defect List Length (LSB)**							

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 host may be informed about the exact number of defects by dividing the Defect List Length by 8 (the Defect Descriptor Length).

7.7 TYPE 6 COMMANDS

7.7.1 DEFINE FLEXIBLE DISK FORMAT Command (C0h) (OMTI 7250 only.)

This command specifies the track format to be used on a LUN assigned as a Flexible disk drive. This command should be issued after all power-on or reset operations if values other than default are desired, and should always be issued after successful completion of the ASSIGN DISK PARAMETERS Command.

DEFINE FLEXIBLE DISK FORMAT Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	**Operation Code**							
1	**Logical Unit Number**			Reserved				
2	Reserved							
3	Reserved							
4	**SECTORS PER TRACK**							
5	**FDD TRACK FORMAT**							

BYTE 4: Sectors per track is normally to be set to zero because the SECTOR PER TRACK is implied in the FDD Track Format code in Byte 5. Byte 4 can be used to override that value when, for example, it is necessary to increase by one the number of sectors per track (See codes 8A and 8B following).

BYTE 5: specifies the **Flexible Disk Drive track format.**

If byte 4 is set to zero, the number of blocks per track will be as described in the table on page 24. If byte 4 is non-zero, the number of blocks per track will be as specified in byte 4.

FDD TRACK FORMAT Byte 5 Bit Definition

7	6	5	4	3	2	1	0
MFM =1	ignored		Starting Sector	Block Size 00 = 128 01 = 256 10 = 512 11 = 1024		Cyl. 0 Head 0 FM block size 128	=1 means Double Sided =0 means Single Sided

If Bit 7 = 1, Bit 1 is ignored.

Bit 4 = 0 the starting sector is one (IBM standard)
Bit 4 = 1 the starting sector is zero (non-standard)

Bits 2 and 3 : If Bit 1 = 1, configurations 10 (512 bytes) and 11 (1024 bytes) are illegal.

The default condition is 06h - Single sided, Cylinder 0: Single density, FM recording, 128 bytes per sector, 16 sectors per track. All other tracks: Double density, MFM recording, 256 bytes per sector, 16 sectors per track.

BYTE 5 : 250 and 500 KBit TRACK FORMAT CODES

	Track.	Recording	Bytes per Sector	Sectors per 250 Kbit	Sectors per 500Kbit
00h	Single density, Single sided	FM	128	16	26
01h	Single density, Double sided	FM	128	16	26
06h *	Single sided, Cylinder 0: Single density	FM	128	16	26
	All other tracks: Double density	MFM	256	16	26
07h	Side 0, Cylinder 0: Single density, Double sided	FM	128	16	26
	All other tracks: Double density, Double sided	MFM	256	16	26
86h	Double density, Single sided	MFM	256	16	26
87h	Double density Double sided	MFM	256	16	26
8Ah**	Double density, Single sided	MFM	512	8	15
8Bh **	Double density, Double sided	MFM	512	8	15
8Eh	Double density, Single sided	MFM	1024	4	8
8Fh	Double density, Double sided	MFM	1024	4	8

* = Default
** = Also supports 16 sectors per track using Byte 4 at 500 Kbit
** = Also supports 9 sectors per track using Byte 4 at 250 Kbit

7.7.2 ASSIGN DISK PARAMETERS Command (C2h)

This command allows the host to specify disk drive parameters for the specified LUN. This command is mainly used for ST506/412 and Flexible Disk drives, but may be used for ESDI drives (see Byte 8 bits 5 and 4 of the parameter list). This allows the controller to communicate with a wide variety of drives from the same or different vendors. This command should be issued after every power-up sequence or reset for each LUN, unless the LUN matches the default values set at initialization.

OMTI 3120 andA 3127A:
On the 3120A, if the F bit of the CDB is set to zero, this command should be issued after every power-up sequence or reset for each LUN unless the LUN matches the default values set at initialization. When the F bit is set to one, this command needs to be issued once; the drive parameters are then stored in ID fields of the track zero of the drive. This provides software device independence. The data fields of the track zero are still used to store and retrieve data.

The associated Parameter List, including all characteristics of the drive connected, is sent to the controller during the Data Out phase of the command execution. There is no drive access during execution of this command.

ASSIGN DISK PARAMETERS Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	**Operation Code**							
1	**Logical Unit Number**			Reserved				
2	Reserved							(00h)
3	Reserved							(00h)
4	**Interleave (3127A)**							
5	**DR**	**B**	**F**	0	0	0	0	**L**

The following is only valid for the OMTI 3127A:
Interleave factor (byte 4) is requested on the OMTI 3127A controller only.
The F bit is only for the OMTI 3127A.. If the F bit is set to one (mandatory on 3127A), the track zero is formatted during the command execution with the disk drive parameters sent in the data out phase.
Warning: Setting this bit in the command will destroy any previously written data on track zero.

The controller does not check if further format operation is taking place on track zero. If a FORMAT UNIT or FORMAT TRACK or FORMAT BAD TRACK is issued to track zero, any previously assigned drive parameters will be lost and any future access to track zero will result in a Seek Invalid Parameter error. When issuing the FORMAT UNIT command (04) after the ASSIGN DISK PARAMETERS command (C2), the Logical Block Address in the FORMAT UNIT's CDB shall be set to Cylinder 0, Head 1.
This is the end of the comments for the 3127A.

WINCHESTER DISK DRIVE PARAMETER LIST

When Bit 7 of byte 8 of the Parameter List is set to zero, the Parameter List is defined for Winchesters as follows.

Bit / Byte	7	6	5	4	3	2	1	0
1	STEP PULSE WIDTH							
2	STEP PERIOD							
3	STEP MODE							
4	NUMBER OF HEADS (-1)							
5	CYLINDER ADDRESS HIGH							
6	CYLINDER ADDRESS LOW (-1)							
7	WSI/ WRITE PRECOMPENSATION CYLINDER							
8	0	0	TYPE		H/S	0	WSI	
9	SECTORS PER TRACK (-1)							
10	Reserved						BLOCK SIZE	

DEFINITION OF THE WINCHESTER DISK PARAMETER BYTES

BYTE 1 - STEP PULSE WIDTH : The length of time the step pulse is asserted. The value of this byte specifies the width of the step pulse in 2.4 (7250) or 1.2 (3100 series) microsecond increments. The minimum value of the step pulse is 2.4 microseconds for a byte value of 0 with the 7250 or a byte value of 0 or 1 with the 3100 series. A byte value of 1 creates a step pulse width of 4.4 microseconds with the 7250.

BYTE 2 - STEP PERIOD : The length of time between the trailing and leading edges of step pulses. A zero value in this byte results in 8.2 (7250) or in 6.8 (3100 series) microsecond step periods. A non-zero value specifies the time in 50 microsecond increments. With the 3100 series, the Step Rate is fixed at 15 microsecond pulse width with a 50 microsecond period.

BYTE 3 - STEP MODE : This byte must be set to zero (buffered or normal mode).

BYTE 4 - NUMBER OF HEADS (-1): The value of this byte specifies the number of user heads (minus one) on the disk drive. The maximum value of this byte is 15 (0Fh). Any value greater than 07h causes the reduced write current (WSI) function to be disabled. Write precompensation is not affected.

BYTES 5-6 - NUMBER OF CYLINDERS (-1) : These 2 bytes specify the maximum number of user cylinders (minus one) on the disk drive. The maximum number of cylinders is 65K (FF, FFh. Byte 5 is the most significant byte.)

BYTE 7 (and Bits 0-1 of Byte 8) - WSI/WRITE PRECOMPENSATION CYLINDER ADDRESS : This byte specifies the cylinder address where reduced write current and/or precompensation is first applied. Reduced write current is applied to all cylinders greater than or equal to the value of the byte. Write precompensation is applied to all cylinders greater than or equal to the 10 bit value (byte 7 and bits 0-1 of byte 8). A value of 0 in byte 7 means the reduced write current function is disabled. A 10 bit value of 0 (byte 7 and bits 0-1 of byte 8) means that the write precompensation function is disabled.

EXAMPLE :

BYTE 8 | BYTE 7		
Bits 1 0 | 7 6 5 4 3 2 1 0		
0 0 | 0 0 0 0 0 0 0 0	No WSI No Precompensation	
0 0 | 0 0 0 0 1 1 1 1	WSI Starts at Precomp. starts at	0Fh 0Fh
0 1 | 0 0 0 0 0 0 0 0	No WSI Precomp. starts at	100h
0 1 | 1 0 0 1 0 0 0 0	WSI Starts at Precomp. Starts at	90h 190h

BYTE 8: Bits 7, 6, and 2 should be set to zero.

7	6	5	4	3	2	1	0
0	0	TYPE		H/S	0	WSI	

TYPE with the 7250 :

Bits 5	4	
0	0	**ST506/412**
0	1	**ESDI.** Any other parameters sent by the C2h command are ignored. If the LUN is 0 or 1, this setting overrides jumpers W9 and W10. This 2 bit setting allows LUNs 2 and 3 to be allocated to ESDI drives.
1	0	**Removable ST506/412**
1	1	Reserved

TYPE with the 3120A series :
Bits 5 and 4 of byte 8 : These bits specify whether the device is a Fixed or Removable disk drive.

Bits 5	4	
0	0	**Fixed disk drive**
1	1	**Removable disk drive**
0	1	Reserved
1	0	Reserved

H/S Bit 3 of Byte 8 specifies whether the device is a hard or soft sectored disk drive
0 = **Soft sectored**
1 = **Hard sectored**

Bits 1 and 0 define **WSI/Write Precompensation** as MSB bits.

BYTE 9 - SECTORS PER TRACK (-1): This byte specifies in hexadecimal the number of sectors per track (minus one).
A zero value with the 7250 is interpreted as 9, 17 or 18 sectors per track, depending upon the position of the sector size jumpers, W5 and W6.

On the 3110 and 3120A a zero value is interpreted as :

Sectors per track	Block Size
9	1024
17	512, 532
18	512, 532

On the 3127A, a zero value is interpreted as 26 sectors per track with 512 or 532 bytes per sector.

BYTE 10 bits 0 and 1, BLOCK SIZE :
This byte shall be set to zero on 3120A and 7250.

The following configuration is for the 3127A only. The Block Size is jumper selectable on 3120A but command programmable as follows on 3127A.

Bit 1	0	
0	0	512 bytes per sector
0	1	532 bytes per sector
1	0	1024 bytes per sector
1	1	Reserved

FLEXIBLE DISK DRIVE PARAMETERS (valid for OMTI 7250 only)

When bit 7 of byte 8 of the Parameter List is set to one, the following Flexible Disk Parameter List allows connection of 3.5", 5 1/4" or 8" Flexible Disk drives. High-capacity, half-height 5 1/4" flexible disk drives with the 500 Kbit/sec transfer rate are supported as well by this list.

Flexible Disk Parameter List

Bit / Byte	7	6	5	4	3	2	1	0
1	STEP PULSE WIDTH (not analyzed)							(00h)
2	STEP PERIOD							
3	MAXIMUM CYLINDER ADDRESS (-1)							
4	HEAD SETTLING DELAY							
5	MOTOR ON DELAY							
6	MOTOR OFF DELAY							
7	REDUCE WRITE CURRENT CYLINDER							
8	1	Reserved						(80h)
9	DATA RATE		M	STEP PULSES			PRECOMP. VALUE	
10	START WRITE PRECOMP CYLINDER							

DEFINITION OF FLEXIBLE DISK PARAMETER BYTES

BYTE 1 - STEP PULSE WIDTH: (00h) The step pulse width is not analyzed. A value of zero is recommended. The FDC 765 controls the step pulses. Typical values are 5 microseconds when using a 500 KBit transfer rate, and 10 microseconds when using a 250 KBit transfer rate.

BYTE 2 - STEP PERIOD: The time between two step pulses. The value of this byte is specified with bits 3, 2, 1 and 0 only. Bits 6, 5, 4 are not used. Since the FDC 765 controls these step pulses, the period changes depending on the drive data rate as follows :

500 Kbit	300 Kbit	250 Kbit
0 = 16 Milliseconds	0 = 27.2 Milliseconds	0 = 32 Milliseconds
1 = 1 Milliseconds	1 = 1.7 Milliseconds	1 = 2 Milliseconds
2 = 2 Milliseconds	2 = 3.4 Milliseconds	2 = 4 Milliseconds
3 = 3 Milliseconds	3 = 5.1 Milliseconds	3 = 6 Milliseconds
" "	" "	" "
" "	" "	" "
15 = 15 Milliseconds	15 = 25.5 Milliseconds	15 = 30 Milliseconds

BYTE 3 - NUMBER OF CYLINDERS (- 1) : The maximum number of cylinders minus one (- 1).

BYTE 4 - HEAD SETTLING DELAY : The delay required from the last step pulse to a valid read or write. The value of this byte specifies the delay in two (2) millisecond increments for a 500 Kbit transfer rate drive, and in four (4) millisecond increments for a 250 KBit transfer rate drive.

500 Kbit	300 Kbit	250 Kbit
0 = 256 Milliseconds	0 = 435.2 Milliseconds	0 = 512 Milliseconds
1 = 2 Milliseconds	1 = 3.4 Milliseconds	1 = 4 Milliseconds
2 = 4 Milliseconds	2 = 6.8 Milliseconds	2 = 8 Milliseconds
3 = 6 Milliseconds	3 = 10.2 Milliseconds	3 = 12 Milliseconds
" "	" "	" "
" "	" "	" "
127 = 254 Milliseconds	127 = 431.8 Milliseconds	127 = 508 Milliseconds

BYTE 5: MOTOR ON DELAY. This byte defines the Motor On delay. This delay determines the time from the assertion of the MOTOR Signal to any FDC 765 command. The time is measured in 100 millisecond increments.

BYTE 6: MOTOR OFF DELAY. This byte defines the Motor Off delay. This delay determines the time from the last drive access to de-assertion of the MOTOR Signal. The time is measured in 100 millisecond increments.

BYTE 7:REDUCE WRITE CURRENT CYLINDER. Defines the starting cylinder at which Reduced Write Current is applied. This value is not (-1) as of byte 3. The value is only valid if PIN 2 (REDUCE WRITE CURRENT) on the interface is asserted. If this byte is equal to zero, Reduce Write Current is applied on all cylinders. If this byte is set to one, Reduce Write Current is not applied on cylinder zero, but is applied from cylinder one to the last cylinder. If this byte is set to 0Ah, Reduce Write Current is not applied on cylinder zero through 9, but is applied from cylinder 10 to the last cylinder.

BYTE 8: Bit 7 indicates that the parameters defined in bytes 1 through 10 are for Flexible Disks.
Bits 6, 5, 4, 3, 2, 1, 0 are not used.

BYTE 9 - Bits 7, 6 define the DATA RATE:

Bit 7	Bit 6	
0	0	250 Kbit
0	1	300 Kbit
1	0	500 Kbit
1	1	Reserved

Note : Use of the reserved data rate will result in a 500 Kbit data rate and will cause an ILLEGAL PARAMETER error on the ASSIGN DISK PARAMETERS command.

Bit 5 = 0 means that Pin 16 (motor on) will be asserted.

Bit 5 = 1 means that Pin 16 (motor on) shall remain de-asserted. This bit shall be set to 1 when using high capacity Disk Drives (192 TPI) and their pre-formatted diskettes.

Bits 4 and 3 are used to specify the number of step pulses per cylinder. Non-zero values allow a drive to read a diskette formatted on a drive with lower TPI. For example a value of Bit 4 = 0, and a Bit 3 = 1 will allow a 96 TPI drive to access tracks on a diskette from a 48 TPI drive.

Bit 4	Bit 3	Steps/Cylinder
0	0	1 (Normal Usage)
0	1	2
1	0	3
1	1	4

Bits 2, 1 and 0 define the Write Precompensation values as follows :

500 KBits/second	300 KBits/second	250 KBits/second
0 = 0.0 NSEC	0 = 0.0 NSEC	0 = 0.0 NSEC
1 = 62.5 NSEC	1 = 104.2 NSEC	1 = 125.0 NSEC
2 = 125 NSEC	2 = 208.3 NSEC	2 = 250.0 NSEC
3 = 187.5 NSEC	3 = 312.5 NSEC	3 = 375.0 NSEC
4 = 250.0 NSEC	4 = 416.7 NSEC	4 = 500.0 NSEC
5 = 250.0 NSEC	5 = 416.7 NSEC	5 = 500.0 NSEC
6 = 312.5 NSEC	6 = 520.8 NSEC	6 = 625.0 NSEC
7 = 312.5 NSEC	7 = 520.8 NSEC	7 = 625.0 NSEC

BYTE 10 - STARTING WRITE PRECOMPENSATION CYLINDER: Write precompensation is applied from the specified cylinder to all cylinders greater than the cylinder value specified.

7.8 TYPE 7 COMMANDS (DIAGNOSTIC Commands)

7.8.1 RAM DIAGNOSTIC Command (E0h)

This command performs a pattern test on the sector buffer. A 55h pattern is written and verified, and then a AAh pattern is written and verified.

RAM DIAGNOSTIC Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1 through 5	Reserved							(00h)

7.8.2 WRITE ECC Command (E1h)

This command writes a "long" data field on the disk to allow testing c the ECC logic. This command requests the number of data bytes, as determined by the sector size, plus four (4 for ST drives) or six (6 for ESDI or 2,7 RLL drives) more data bytes. These four or 6 bytes are written where the four or 6 ECC bytes normally reside. A subsequent READ command will treat these extra four or six bytes as ECC. More than one sector can be transferred. This command is not valid for LUNs assigned to Flexible disk drives (7250 only).

WRITE ECC Command Descriptor Block

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

Data patterns that will not result in ECC errors with an ECC of 4 bytes are as follows:

256 BYTE SECTOR		512 BYTE SECTOR		1024 BYTE SECTOR	
0-255	6C	0-511	6C	0-1023	6C
256	3C	512	77	1024	7B
257	FD	513	FB	1025	65
258	1E	514	4C	1026	BE
259	B4	515	DC	1027	79

7.8.3 READ IDENTIFIER Command (E2h)

The ID field of the sector specified by the logical block address is transferred to the host. Only one sector is processed. The command will return four data bytes during the Data In phase of the command execution. On LUNs assigned as Flexible disk drives, the first ID field encountered is transferred. No seek is performed.

READ IDENTIFIER Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Logical Block Address 2 (MSB)				
2	Logical Block Address 1							
3	Logical Block Address 0 (LSB)							
4	Reserved							(00h)
5	DR			Zero Value				LINK

Data Byte Format

Bit / Byte	7	6	5	4	3	2	1	0
1	HIGH CYLINDER NUMBER for Winchesters or ZERO for Flexible Disk							
2	CYLINDER NUMBER, LOW for Winchester.							
3	HEAD/FLAGS for Winchesters or HEAD for Flexible Disk							
4	PHYSICAL SECTOR NUMBER							

Byte 2 is set to FFh if Flexible Disk and Bad track (by FORMAT BAD TRACK command).

BYTE 3 for Winchesters, **HEAD/FLAGS** is as follows:

Bit	0	=	Head 1
	1	=	Head 2
	2	=	Head 4
	3	=	Head 8
	4	=	0
	5	=	Alternate track flag
	6	=	Bad track with Alternate assigned
	7	=	Bad track

7.8.4 DRIVE DIAGNOSTICS Command (E3h)

This command causes the controller to perform the following drive functions:

- Recalibrate
- Sequentially seek to every track and read sector zero.

DRIVE DIAGNOSTICS Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved				
2	Reserved							(00h)
3	Reserved							(00h)
4	Reserved							(00h)
5	DR			Zero Value				

7.8.5 INTERNAL DIAGNOSTICS Command (E4h)

This command causes the controller to perform some internal diagnostics including ROM checksum and Sequencer self-test.

INTERNAL DIAGNOSTICS Command Descriptor Block

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

7.8.6 READ VERIFY Command (E5h) for (7250 only).

This command is similar to the READ command, but data is not transferred to the host. This command is used to verify the data integrity of the medium.

READ VERIFY Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Logical Block Address 2 (MSB)				
2	Logical Block Address 1							
3	Logical Block Address 0 (LSB)							
4	VERIFY Length							
5	DR	DC	0	0	0	0	0	LINK

7.8.7 READ ECC Command (EAh)

This command returns the specified block plus four (with ST drives) or six (with ESDI and 2,7 RLL drives) bytes of ECC data for that block. More than one block can be transferred. This command is not valid for LUNs assigned to Flexible disk drives.

READ ECC Command Descriptor Block

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

7.8.8 READ DATA BUFFER Command (ECh)

The controller data buffer is transferred to the host as if a single sector READ had occurred. The LUN can be any number since no device participates, however, the number of bytes returned is determined by the block size for the specified LUN. The host can use this command following a WRITE DATA BUFFER command to verify READ/WRITE sequences without drive participation or, on a permanent ECC error in the data field, to obtain the bad record. Issued after Initialization (Power ON or Reset operation), the buffer contains specific identification data in ASCII.

READ DATA BUFFER Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Logical Unit Number			Reserved				
2	Reserved							(00h)
3	**Index** (7250 only)							
4	**Transfer Length** (7250 only)							
5	Zero Value							(00h)

READ DATA BUFFER FORMAT AT INITIALIZATION

Address	Contents
00-0F	mynnVx.xMMDDYYzz m = 7 for 7250, 3 for 3120A series y = 2 for 7250, = 1 for others nn = 50 for 7250, = 10 for 3110, = 27 for 3127A x.x = Firmware revision MMDDYY = Month/Day/Year zz = Checksum
10 bit 0	ROM checksum error
11 bit 0	Processor Register error
12 bit 0	Buffer Ram error
13 bit 0	Sequencer Register error
14	**Information Byte** (see below)
15-1D	Undefined
1E-1F	00-FF
20-2F	**LUN 0 default values** (see below)
30-3F	**LUN 1 default values** (see below)
40-4F	**LUN 2 default values** (see below)
50-5F	**LUN 3 default values** (see below)

Information Byte 14 :

7	6	5	4	3	2	1	0
Buffer Size		Rom error	Z8 error	Ram error	Seq. error	Reserved	
0 0 = 8K							
0 1 = 16K							
1 0 = 32K							
1 1 = 64K							

LUN default values are as follows:

	ST506/412 Drives		ESDI Drives		Flexible Disks		
Byte	Value		Value		250Kb Value	500Kb Value	
0	Reserved	00	Reserved	00	Motor Off timer	00	00
1	Reserved	00	Reserved	00	Motor On time	05	05
2	Reserved	00	Reserved	00	Motor Off time	46	46
3	Reserved	00	Reserved	00	Current Cylinder	00	00
4	Cylinder High	01	Cylinder High	FF	Current Head	00	00
5	Cylinder Low	31	Cylinder Low	FF	Current Sector	00	00
6	Heads	03	Heads	0F	Max. Cylinder	27	4F
7	Sectors/Track (per jumpers)	xx	Sectors/Track	FF	# of heads	00	00
8	Write Precomp High	00		00	Max sector #	00	00
9	Write Precomp Low	80		00	Write Precomp	28	50
A	Reduced Wrt Current High	00		00	Reduce Write Cur.	28	50
B	Reduced Wrt Current Low	80		00	Head Settle Time	07	0B
C	Step Pulse Width	00		00	Step Rate (ms)	4C	4C
D	Step Pulse Period	00		00	FDD format	30	B0
E	Reserved	00	Reserved	00	LUN status byte	00	00
F	**LUN Flag Bits**	8x	**LUN Flag Bits**	8x	**LUN Flag Bits**	8x	8x

LUN FLAG Bits:
Byte = 1000 00xx
where **xx** is the number of sectors per track as follows ;

ST506/412 MFM Winchesters	**Flexible Disks**
00 = 18 (512 bytes/sec)	00 = 16 (128 bytes/sec)
01 = 32 (256 bytes/sec)	01 = 16 (256 bytes/sec)
10 = 17 (512 bytes/sec)	10 = 8 (512 bytes/sec)
11 = 9 (1024 bytes/sec)	11 = 4 (1024 bytes/sec)

7250 only: Index indicates from which block size of data to read in the buffer. As an example, assuming the buffer contains 8 blocks of data, an Index of 5 with a **Transfer Length** of 3 will transfer the block 5, 6 and 7 to the host. The **Transfer Length** is valid for the length of blocks in the buffer considering the Index value. With the above example, a value of 5 in the Transfer Length would generate an error.

7.8.9 WRITE DATA BUFFER Command (EFh)

This command causes data to be written from the host to the controller data buffer. The LUN can be any number since no device participates; however, the number of bytes written is determined by the block size for the specified LUN. The host can use this command preceding a READ DATA BUFFER command to verify a READ/WRITE sequence without device participation.

WRITE DATA BUFFER Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	**Operation Code**							
1	**Logical Unit Number**			Reserved				
2	Reserved							(00h)
3	**Indexv (7250 only)**							
4	**Transfer Length**							
5	Zero Value							(00h)

7250 only: Index indicates from which block size of data to write into the buffer. As an example, assuming the buffer contains 8 blocks of data, an Index of 5 with a **Transfer Length** of 3 will transfer the data blocks 5, 6 and 7 to the controller. The **Transfer Length** is valid for the length of blocks in the buffer considering the Index value. With the above example, a value of 4 in the **Transfer Length** would generate an error.

APPENDIX A

SENSE BYTES

At the completion of a command, if the completion Status Byte reports a CHECK CONDITION, the host may issue a REQUEST SENSE Command (03h), during which four bytes of Sense data are returned:

SENSE BYTES FORMAT

Bit / Byte	7	6	5	4	3	2	1	0
1	**AV**			**SENSE CODE**				
2	**Logical Unit Number**			**Logical Block Address 2 (MSB)**				
3	**Logical Block Address 1**							
4	**Logical Block Address 0 (LSB)**							

AV = Address Valid. If set, indicates that the SENSE code in byte 1 applies to the logical block address in bytes 2,3,4. If after a command completes with a Check Condition, subsequent command is issued to a different LUN, the Logical Block Address associated with the Check Condition will be lost.

SENSE CODE SUMMARY (SENSE BYTE 1)

SENSE TYPE (Bits 5 and 4 of Byte 0):

5	4	
0	0	Drive Errors
0	1	Data errors
1	0	Command Errors
1	1	Diagnostic Errors

TYPE 0 - DRIVE ERRORS

5	4	3	2	1	0	
0	0	0	0	0	0	No error
0	0	0	0	0	1	No Index
0	0	0	0	1	0	No Seek/Command Complete
0	0	0	0	1	1	Write/Drive Fault
0	0	0	1	0	0	Drive not Ready
0	0	0	1	0	1	Drive not Selected
0	0	0	1	1	0	No track or cylinder zero found
0	0	0	1	1	1	Multiple Drives Selected
0	0	1	0	0	0	Seek/command in progress
0	0	1	0	0	1	Cartridge changed

TYPE 1 - DATA ERRORS

5	4	3	2	1	0	
0	1	0	0	0	0	ID CRC error (ESDI and Flexible Disk), ID ECC error (ST506/412)
0	1	0	0	0	1	Uncorrectable Data Error for Winchesters, CRC error for Floppies
0	1	0	0	1	0	ID address Mark not found
0	1	0	0	1	1	Data address mark not found
0	1	0	1	0	0	Record not found
0	1	0	1	0	1	Seek error
0	1	0	1	1	0	Sequencer/DMA failure
0	1	0	1	1	1	Write protected
0	1	1	0	0	0	Correctable Data Error (except on Flexible disk drives)
0	1	1	0	0	1	Bad track encountered
0	1	1	0	1	0	Illegal Interleave or Track Skewing Factor
0	1	1	1	0	0	Unable to read Alt. Track address Illegal access to an alternate track
0	1	1	1	0	1	Alternate or Bad Track Already Assigned
0	1	1	1	1	0	No Alternate Track Found
0	1	1	1	1	1	Illegal Alternate track address (Assigned To Itself)

TYPE 2 - COMMAND ERRORS

5	4	3	2	1	0	
1	0	0	0	0	0	Invalid Command
1	0	0	0	0	1	Illegal Disk Address
1	0	0	0	1	0	Illegal Function for the current Drive Type
1	0	0	0	1	1	Volume Overflow

TYPE 3 - DIAGNOSTIC ERRORS

5	4	3	2	1	0	
1	1	0	0	0	0	Data buffer RAM error or general purpose diagnostic error
1	1	0	0	0	1	FDC 765 error

DESCRIPTION OF ERROR CODES

TYPE 0 - ERROR CODE DESCRIPTIONS

00 **No error or no sense information.** Indicates that there is no specific sense information to be reported for the designated Logical Unit Number. This is the case for the successful completion of the previous command. If a REQUEST SENSE command is issued when there is no error, the Sense information reported specifies the last Block Address processed.

01 **No Index.** This indicates that during a FORMAT command, no INDEX signal was received from the Logical Unit Number selected within three seconds.

02 **No Seek/Command Complete.** This indicates that no SEEK COMPLETE (ST506/412) signal or the SEEK/COMMAND COMPLETE (ESDI) signal was received from the Logical Unit Number selected within three seconds.

03 **Write/Drive Fault.** This indicates that during a WRITE/FORMAT command, a fault condition occured. Refer to the disk drive specification for all possible conditions relating to this error.

04 **Drive Not Ready.** This error occurs when the specified drive did not return the DRIVE READY signal. Absence of cartridge or medium inserted in a removable drive may also cause this error.

05 **Drive Not Selected.** This error occurs when the specified drive did not return the DRIVE SELECTED signal. Reasons for this error vary from drive to drive, however, a common fault is the select configuration jumpers located on the drive.

06 **No Track zero or Cylinder zero found.** This indicates that during a RECALIBRATION (command or if retries are enabled) no Track or Cylinder zero was detected by the drive. This error occurs if the controller issued 5 steps more than the total number of cylinder as currently defined for this Logical Unit Number, and did not detect the TRACK ZERO or CYLINDER ZERO signal from the drive.

07 **Multiple Drives Selected.** This indicates that the controller detected multiple DRIVE SELECTED signals when it attempted to select the specified Logical Unit Number.

08 **Seek/Command in progress.** This indicates that a seek or command is in progress. This error code is only returned in response to a TEST UNIT READY command. The controller will report this error for every TEST UNIT READY command issued until the seek or command has completed.

09 **Cartridge Changed.** This indicates that the cartridge has been changed since the last access to the specified Logical Unit Number. This error code may only occur on Removable type drives.

TYPE 1 - ERROR CODE DESCRIPTION

10 **ID CRC or ECC error .** This indicates that at least one ID field on the specified track has a CRC (ESDI or Flexible disk) or ECC error (ST506/412 drives). This error can only occur on a CHECK TRACK FORMAT command. If a CRC or ECC error was encountered on a READ or WRITE command, a RECORD NOT FOUND error will be reported. This is because there is no sure way to determine if the ID in error is the one the controller is searching for.

11 **Uncorrectable Data error .** This indicates that a data ECC on Winchesters or CRC error (on Flexible disk drives) was detected which was uncorrectable or irrecoverable. The sector in error is NOT transferred to the HOST and the command is terminated without exhausting the block count. The data can be recovered by issuing the READ DATA BUFFER command provided that no other command requiring the data buffer has been issued.

12 **ID Address Mark Not Found.** This indicates that the controller was unable to detect any ADDRESS MARK signals from the selected Logical Unit Number.

13 **Data Address Mark Not Found.** This indicates that the controller was able to locate the sector specified but was unable to locate the data address mark associated with it.

14 **Record Not Found .** This indicates that the controller was able to locate the correct cylinder and head numbers but was unable to locate the correct sector. An ID CRC error can also generate this error.

15 **Seek .** This indicates that a mis-compare of the cylinder and/or head occurred between the specified block address and the actual block address recorded on the track selected.

16 **Sequencer/DMA.** This indicates that a sequencer/DMA overrun/underrun error occured. These functions are internal to the controller and inform about a serious hardware failure.

17 **Write Protected.** This indicates that during a WRITE/FORMAT command, the controller detected a WRITE PROTECTED signal from the selected Logical Unit Number.

18 **Correctable ECC .** This indicates that a READ command was issued with the DISABLE ECC bit SET and a correctable ECC was encountered. This is only valid for Winchester disk drives. The corrected data will be transferred to the HOST; however, the command will be terminated exhausting the block count. A READ ECC BURST LENGTH command, if issued, will specify the length of the ECC error. If the DISABLE ECC bit was cleared, the controller will automatically correct the data error and continue the command as if no data error had occurred.

19 **Bad Track Encountered.** This indicates that the specified track has previously been formatted with the BAD TRACK FLAG set in the ID field. It is not possible to access data on this track and the command will be terminated.

1A **Illegal Interleave or Track Skewing Factor.** This indicates that a FORMAT/CHECK TRACK FORMAT command was issued with an INTERLEAVE FACTOR greater than the number of sectors on the track or during a CHECK TRACK FORMAT command, the recorded track skewing / interleave factor did not match the TRACK SKEWING / INTERLEAVE FACTOR specified in the CDB.

1C **Illegal Access To An Alternated Track/Unable To Read The Alternate Track Address.** This indicates that a direct access to an alternate track was attempted or upon detecting the ALTERNATE and BAD TRACK flags both SET in an ID field the controller was unable to read the alternate track data specifying the destination cylinder.

1D **Alternate of Bad Track Already Assigned.** This indicates that the destination track of a FORMAT ALTERNATE TRACK command has previously been formatted as an alternate or bad destination . In order to use the specified track as an alternate destination, a FORMAT TRACK command must be issued.

1E **No Alternate Track Found.** This indicates that the controller was directed to an alternate track but did not find the ALTERNATE bit SET in the ID field.

1F **Illegal Alternate Track Address.** This indicates that a FORMAT ALTERNATE TRACK command was issued with the source and destination block addresses equal.

TYPE 2 - ERROR CODE DESCRIPTION

20 **Invalid Command.** This indicates that the controller decoded a command code that it does not support.

21 **Illegal Disk Address.** This indicates that the controller received a command with a Block Address beyond the capacity of the drive. Check the number of cylinders, heads and sector size that the drive is configured for.

22 **Illegal Function for Drive Type.** This indicates that a Change Cartridge command ($1B_H$) was issued to a LUN assigned as a Fixed drive type.

23 **Volume Overflow.** This indicates that after the commencement of a multiblock command, the end of volume was reached.

TYPE 3 - ERROR CODE DESCRIPTION

30 **Data Buffer RAM error or General Purpose Diagnostic error.** This indicates that the controller detected a data error with its internal RAM buffer of 8K bytes.

31 **FDC 765 error.** (7250 only) This situation occurs when the FDC 765 chip is in an unexpected state. For more information, consult the chip documentation regarding two lines RQM (Request for Master) and DIO.