OMTI 7X00/3500 REFERENCE MANUAL

OMTI 7X00 and 3500 SERIES

SCSI INTELLIGENT DATA CONTROLLERS

Reference Manual
February 3, 1988

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

Printed in U.S.A. 2/88

PUBLICATION NO. 3001546

SCSI

INTELLIGENT DATA CONTROLLER

REFERENCE MANUAL

Models :

	|OMTI 7000 Flexible disk only
	|OMTI 7100 Winchesters
	|OMTI 7200 Winchesters and Flexible Disks
5 1/4 inch Form Factor	**|OMTI 7400 Winchesters, Flexible Disks and Tape**
3.5 inch Form Factor	**|OMTI 3520 or 3520A (MFM) Winchesters**
	|OMTI 3527 or 3527A (MFM) Winchesters

SCIENTIFIC MICRO SYSTEMS, INC.
339 North Bernardo Avenue
P.O. Box 7777
Mountain View
CALIFORNIA 94039
Telephone: 415/964-5700
TLX: 184169 SMS MNTV
FAX 415 968-4861

PRINTED IN THE UNITED STATES OF AMERICA

FCC APPROVAL

This equipment generates and uses radio frequency energy and, if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Re-orient the receiving antenna
Relocate the computer with respect to the receiver
Move the computer away from the receiver
Plug the computer into a different outlet so that computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful:

"How to Identify and Resolve Radio-TV Interference Problems".

This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock No. 004-000-00345-4.

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

The OMTI 7X00/3500 Series manual has been divided into two parts: the *OMTI 7xX0/3500 Series Programmers manual* and the *OMTI 7X00/3500 Series Reference manual.* The current part number for each manual are as follows:

OMTI 7X00/3500 Programmers Manual	#3001775-0001
OMTI 7X00/3500 Reference Manual	#3001546-0001

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 1988

LIST OF EFFECTIVE PAGES

The List of Effective Pages gives the date of the current edition, and lists the dates of all changed pages. Unchanged pages are listed as "ORIGINAL". Within the manual, any page changed since the last edition is indicated by printing the date the changes were made on the bottom of the page. Changes are marked with a vertical bar in the margin.

OMTI 7X00 and 3500 Series
TABLE OF CONTENTS

LIST OF FIGURES

SECTION 1

INTRODUCTION

1.1 PURPOSE

This manual introduces the user to the OMTI series of high performance SCSI (Small Computer System Interface) Data Controllers. It provides the information needed to install, configure and maintain the OMTI series Data Controller. The manual is a reference source for OEM engineers, system integrators, service and maintenance technicians.

1.2 GENERAL

The OMTI SCSI Data Controllers use SMS's advanced VLSI chip set to provide state-of-the-art data management. A single chip data separator circuit ensures data integrity with Winchester disk drives. Error detection/correction on Winchester disk drives is provided by powerful 48-bit Error Correction Code generated by the OMTI controller.

SCSI is the industry-standard 8-bit parallel bidirectional Small Computer Systems Interface . The command set complies with the Industry Standard 8-Bit SCSI Common Command Set (ANSC X3T9.2).

For both series, the Winchester drives can be either 3-1/2 inch or 5-1/4 inch, fixed or removable disk drives. The OMTI SCSI Data Controller can support up to 16 heads on ST compatible drives and up to 32 heads on ESDI comptaible drives. Both drive types can have up to 65,535 cylinders.

The OMTI 3520, 3520A, 3527 and 3527A are intelligent data controllers contained on a 3.5" PCB, which mounts directly to the disk drive or chassis. The controllers support Winchester Disk Drives only with the following interfaces :

- ST506/412 compatible, 5 MegaBit/second data transfer rate with MFM encoding,
- ST412R compatible, 7.5 MegaBit/second data transfer rate with 2,7 RLL encoding,

The OMTI 7X00 series are intelligent, multi-functional data controllers contained on 5-1/4" PCB's, which mount directly to the disk drive or chassis. The controllers interface with Winchester Disk Drives, Flexible Disk Drives and QIC 02 Tape drives depending on models.

1.3 MODEL DESCRIPTION

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

3.5 inch Form Factor controllers

OMTI 3520 or 3520A (W). These models support up to two Winchester disk drives. Either drives are ST506/412 interface type drives recording MFM data. Up to two LUNs are supported.

OMTI 3527 or 3527A (W). These models support up to two Winchester disk drives. Either drives are ST412R interface type drives recording 2,7 RLL data. Up to two LUNs are supported.

5 1/4 inch Form Factor controllers

OMTI 7000 (F). This model supports up to four Flexible disk drives. They can be any combination of industry-standard 3-1/2", 5-1/4" or 8" Flexible disk drives. The Flexible disk interface can support a data transfer rate of 250 Kbits, 300 Kbits or 500 Kbits/sec, single or double density, and single or double sided drives.

OMTI 7100 (W). This model supports up to two Winchester disk drives. Either drive can be ESDI or ST506/412 interface type drives.

OMTI 7200 (W + F). This model supports up to six drives, of which up to two may be ESDI or ST506/412 Winchester disk drives, and up to four may be any combination of industry-standard 3-1/2", 5-1/4" or 8" Flexible disk drives. The Flexible disk interface can support a data transfer rate of 250 Kbits, 300 Kbits or 500 Kbits/sec, single or double density, and single or double sided drives.

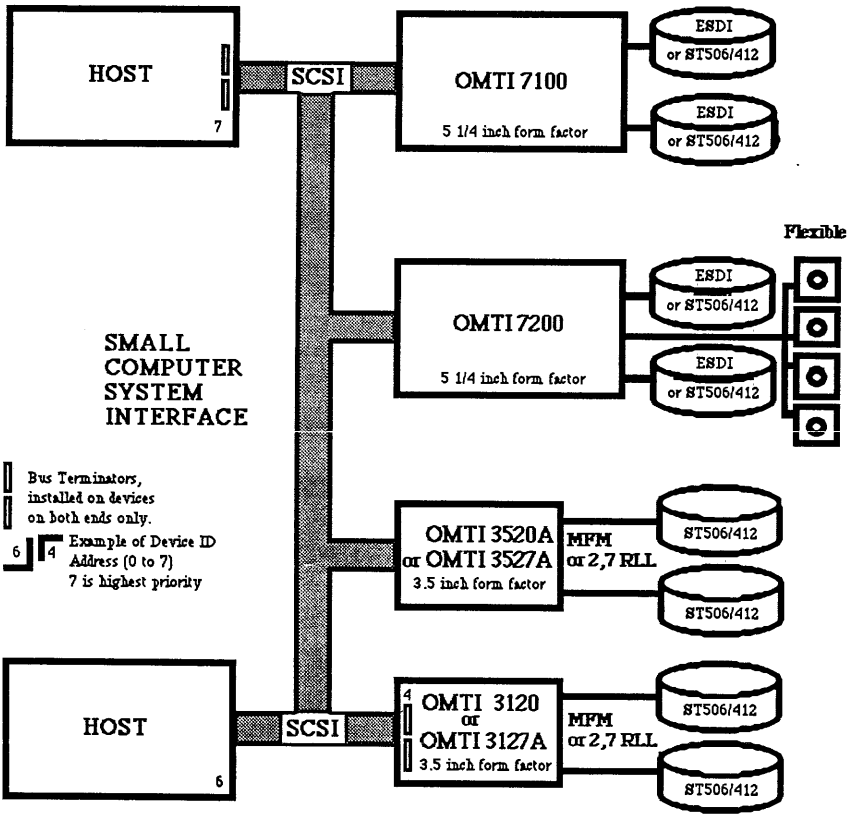
OMTI 7400 (W + F + T). This model supports up to seven drives, of which up to two may be ESDI or ST506/412 Winchester disk drives, up to four may be 3.5", 5-1/4" or 8" Flexible disk drives, and one may be a QIC-02 Streaming tape drive.

Note: The 7100, 7200 and 7400 models handle ESDI or ST506/412 Winchester disk drives identically with the same performance, format, protocol and Command Set. The 7000, 7200 and 7400 Flexible disk interfaces are identical with the same performance, format, protocol and Command Set.

1.4 NUMBER AND TYPE OF DRIVES SUPPORTED

Model	3520 (A)	3527 (A)	7000	7100	7200	7400
Number of drives	2 max	2 max	4 max	2 max	6 max	7 max
Number of LUNs	2	2	4	2	6	7
Winchesters (ST506/412, MFM)	up to 2	0	0	up to 2	up to 2	up to 2
Winchesters (ST506/412, 2,7)	0	up to 2	0	0	0	
Winchesters (ESDI)	0	0	0	up to 2	up to 2	up to 2
Flexible disks	0	0	up to 4	0	up to 4	up to 4
QIC 02 Streaming Tape	0	0	0	0	0	up to 1

Note: If your system configuration will use multiple versions of the OMTI 7X00 Data Controller, it is advised to initially configure the system using the OMTI 7400. This will format Track 0 of the Winchester Disk with all pertinent information and will allow freedom of movement between models.



Single or Multiple hosts, Single or Multiple Targets Configuration example.

Figure 1-1 SCSI Configuration

1.5 FUNCTIONAL ORGANIZATION

1.5.1 Host Interface

The SCSI host interface is a bidirectional 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 multi-functional device, provides control and data signals to the SCSI interface 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, external program expansion capabilities, 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.

1.5.3 Four-Channel DMA Controller (2 channel on 35XXA)

Data control functions are handled by the OMTI 5060 four-channel or 5055 two channel Direct Memory Access Controller (DMA Controller). The DMA manages the flow of block-level information between buffer memory and host and/or byte-oriented peripheral interfaces.

1.5.4 Data Sequencer

Winchester disk data function is handled by the OMTI 5050 or 5055 Data Sequencer chip. The Sequencer manages the flow of block-level information between the winchester disks and the DMA. It also handles SERDES (Serialize, Deserialize) functions to and from NRZ data, format operations, and ECC generation and checking.

1.5.5 VCO/Encode/Decode

These functions are handled either by the OMTI 5070 VCO/Encode/Decode chip or by the OMTI SDM-M050 VCO/Encode/Decode device for MFM encoding, or by the OMTI SDM-R075 VCO/Encode/Decode device for 2,7 RLL encoding. These are fifth-generation data separators that convert MFM or 2,7 RLL serial data to NRZ data and clock transitions.

1.5.6 Flexible Disk Controller (7000, 7200 and 7400)

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. Format parameters are user definable. Formats supported include IBM 3740 single density format, IBM System 34 double-density format, including double-sided recording and IBM PC AT high density format.

1.5.7 Flexible Disk Data Separator (7000, 7200 and 7400)

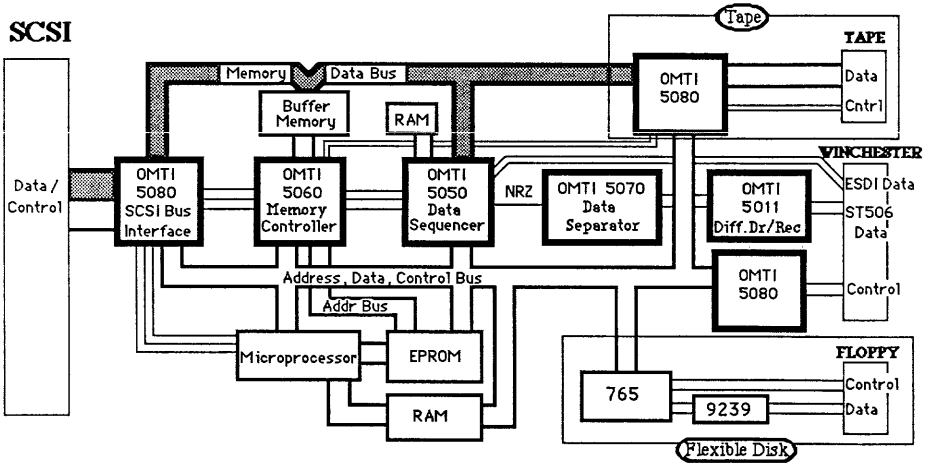
The flexible disk data separation is handled by a SMC 9239 device.

1.5.8 Tape Interface Controller (7400)

The multifunction chip OMTI 5080 supports control and data signal of the QIC-02 interface.

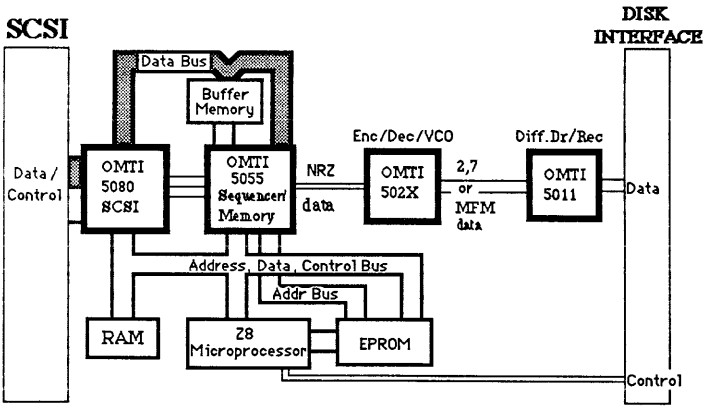
1.5.9 Winchester Interface Controller

The OMTI 5080 provides control interface support for both ST506/412 and ESDI disk drives and embedded single ended drivers/receivers



OMTI 7400 BLOCK DIAGRAM

Figure 1-2. 5 1/4 inch Controller Functional Block Diagram



OMTI 3500A Series Block Diagram

Figure 1-3. 3.5 inch Controller Functional Block Diagram

1.6 BUFFERING SCHEME

The controller includes a static 8K byte data buffer on 3500 and 7000 series controllers, and 16K byte data buffer on 7100, 7200 and 7400 series controller data buffers. 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 controller.

The buffer is used as a ring buffer, controlled by the OMTI 5060 DMA Controller chip in the 7X00 series or by the OMTI 5055 in the 3500A series. The 5060 includes four channels (ports). The 5055 includes 2 channels. Each channel has its own separate 16-bit address and byte count register. The channels operate simultaneously, allowing read and write operations to the buffer from various data paths at the same time.

Of these channels :

- Channel 0 is dedicated to the OMTI 5050 (or 5055) Sequencer chip and is used to transfer data between the buffer and the winchester disks,
- Channel 1 is connected to the QIC-02 Tape bus (valid for 7400 Models),
- Channel 2 of the 5060 (or channel 1 of the 5055) is connected to the SCSI bus and operates in the SCSI mode,
- Channel 3 (7X00 series only) is used by the Z8 micro-processor to transfer data between the micro-processor bus and the buffer memory. The micro-processor uses this channel to read and write the buffer memory.

EXAMPLE OF BUFFER USE:

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

- the first logical block, specified as the starting block address in the SCSI command, is read from the disk and written into the buffer using the chip channel 0.
- when the ECC is calculated, the data block is available for transfer to the host bus;
- if the controller has disconnected from the host, the controller will reconnect,
- the data block is then transferred asynchronously at the host memory speed (Handshake Timing).
- the next block on the disk is stored in the buffer (at the address, in the buffer, below the previous block), as soon as it is read, independently of the access from the host. Reading of data from the disk, and sending data to the host are independent, and take place at the same time.
- blocks are stored below each other in the buffer,until the maximum address is reached, then the channel wraps around to the first address in the buffer (assuming that the first block has already been transferred to the host).
- if the host is too slow to empty all data blocks stored in the buffer from the disk, and another block is ready to be stored in the buffer with no space available, an overrun situation occurs. In this case, the controller will stop reading from the disk and wait for one block size to be available to start reading again. This will occur only if the host transfer rate is much slower than the disk transfer rate, 5 or up to 10 Megabit/second.
- The controller allows switching heads and cylinders without losing a disk revolution during READ or WRITE operations.

1.7 SPECIFICATIONS

The following lists environmental, power requirements, and mounting and dimensional characteristics. All 7X00 series models use the same Printed Circuit Board.

1.7.1 Physical Specifications (all 7X00 series models)

Width	5.75 inches	(14.6 cm)
Length	8 inches	(20.3 cm)
Height	0.75 inches	(1.9 cm)

See Figure 3-1 for mounting hole locations.

1.7.2 Physical Specifications (3500 series models)

Width	4 inches	(10.2 cm)
Length	5.75 inches	(14.6 cm)
Height	0.62 inches	(1.55 cm)

See Figure 3-2 for mounting hole locations.

1.7.3 Environmental Specifications (all models)

	Operating	Storage
Temperature	0 to 50C	-40 to 75C
Relative Humidity	10% to 95%	10% to 95%
Max. Wet Bulb	30C° Non-condensing	
Altitude	0-10000 ft (Operational)	0-15000 ft (Storage)

1.7.4 Power Requirements

The products require the following power :

+5 VDC (+/-5%)
and +12 VDC (+/- 10%) on 3500 series

The maximum ripple and noise (P/P) is 100 mV. The maximum current drawn per model is :

OMTI 3520(A)	3527(A)	7000	7100	7200	7400
0.75 Amp	0.75 Amp	0.75 Amp	0.75 Amp	1 Amp	1.50 Amp
50 mA at +12 V					

SECTION 2

STANDARD FEATURES

2.1 GENERAL

This section contains a list of the standard features for the OMTI Series Data Controller. Each feature has a brief description. For additional information see Section 3 through Section 5 of this manual .

HOST INTERFACE	SCSI (Small Computer System Interface) - Including Arbitration, Disconnect and Reconnect, and all messages (except extended messages) - Supports the Common Command Set.
MULTI-FUNCTION	The OMTI 7X00 series support ST506/412 (5 Megabit/second) and ESDI (up to 10 Megabit/second) type Winchester Disks (up to 2 LUNs), + Flexible Disk drives (up to 4 LUNs). Supports total of up to 6 LUNs, + QIC 02 Streaming Tape drive (one LUN). Supports a total of up to 7 LUNs. The OMTI 3500 series support ST506/412 (5 Megabit/second with MFM encoding) and ST412R (7.5 Megabit/second with 2,7 RLL encoding) type Winchester Disks. Supports up to 2 LUNs.
SCSI BUS TRANSFER RATE	Up to 1.5 MegaBytes per second in asynchronous data transfer mode.
DISCONNECT/ RECONNECT	Supports Disconnect/Arbitration/Reconnect to enhance system performance.
SCSI BUS PARITY	Jumper selectable. On all data transfers, odd parity is generated and, unless disabled, is checked.
COMPACT BOARD	The 7X00 Series Controllers are single 5.75 by 8 inch printed circuit boards (5 1/4 inch form factor). The 3500 Series Controllers are single 4 by 5.75 inch printed circuit boards (3.5 inch form factor).
MULTIPLE DEVICES	The SCSI bus allows multiple controllers and multiple Hosts for a total of seven devices to attach to the Bus in any combination. All devices are daisy-chain connected. Each controller is selectable to be one of the eight devices with the selection address of 0 to 7. Several OMTI controllers can be connected to the same SCSI bus.

DEVICE INDEPENDENCE AUTO CONFIGURATION	The controllers save the drive characteristics and MODE SELECT parameters (if requested) on the Winchester disks. On Power Up or Reset these parameters are used to automatically configure the controller and provide complete device software independence. (NOT APPLICABLE TO 7000)
COMMAND LINKING	Upon successful completion of a command, chaining of *LINKING* commands is allowed, which prevents the entering of a new Selection phase. See Control Byte definition.
ERROR RETRY	Performs automatic retry on errors unless disabled by the host.
ERROR REPORTING	Uses Extended Sense error reporting with Additional Sense codes to further define errors. Allows the host to disable recoverable error reporting and other error recovery parameters (see MODE SELECT and MODE SENSE Page 1).
PROGRAMMABLE PARAMETERS	Uses the MODE SENSE command to inform the host which parameters are changeable, current, default and saved. Allows the host to set system parameters using the MODE SELECT command.
BUFFER	The 7X00 Series offer 8K (OMTI 7000 only) or 16K or (32K-optional) Bytes Ring Buffer (wraps around) with 4 independent ports.depending on model. The 3500 Series offer 8K Bytes Ring Buffer (wraps around) with 2 independent ports.
LOW POWER CONSUMPTION	By the use of OMTI VLSI Chips CMOS technology, the OMTI products consume minimum power between 0.75 to 1.50 Amp depending on models.
LIMITED PART COUNT	Featuring OMTI VLSI Chips.

2.2 WINCHESTER DISK SPECIFIC FEATURES

INTERFACE	7X00 series controllers support two ESDI or two ST506/412 MFM or one ESDI and one ST506/412 MFM compatible interfaces. The 3500 series controllers provide ST506/412 MFM or ST506/412 RLL compatible interfaces.
TRANSFER RATE	Up to 10 (ESDI) or 7.5 (ST506/412 with 2.7 RLL data) or 5 (ST506/412 with MFM data) Megabit/Second.

PERFORMANCE	Disconnects during seeks and at other times to maximize system performance. Uses the RING buffer to allow simultaneous transfer of data between devices and the SCSI bus
INTERLEAVING	One to One sector interleaving.
SKEWING	Programmable track and cylinder skewing.
SECTORING	Hard or Soft (for both ESDI and ST506/412 devices).
ESDI TYPE OF DRIVES	Serial Data transfer only. (Step Mode and Byte Clock not supported.)
NUMBER OF HEADS	Up to 16 heads on the ST506/412 drives, and up to 32 heads on ESDI drives are supported.
NUMBER OF CYLINDERS	Up to 65,535 cylinders supported.
BLOCK OR SECTOR	Programmable through MODE SELECT command from 128 to *SIZE* 4096 bytes per sector. The block size is determined by the product of two byte registers.
IMPLIED SEEK	Supported with all data transfer commands.
HEAD PARKING	Heads are parked by using the Stop Motor command.
LOGICAL BLOCK ADDRESSING	With all data transfer commands.
AUTOMATIC HEAD OR CYLINDER SWITCHING	Supported on multi-block data transfers.
MULTI-BLOCK TRANSFER	Up to 65,535 blocks per command (with any block size listed above).
SECTOR LEVEL DEFECT HANDLING	During FORMAT UNIT all bad sectors (if any) are mapped out (if requested by the initiator). - The controller performs in-line sparing during FORMAT UNIT and REASSIGN BLOCKS commands by skipping known defects for better performance. - Controller uses the drive manufacturer defect list (if available and readable). This list is defined as Primary (P) defect list. - A WRITE PRIMARY DEFECT LIST command allows the user to generate a P list from the list of defects provided by the manufacturer of the ST506/412 drive. - Optionally accepts a list of defects from the host. Defined as Data Out (D) defect list. - Optionally performs a Verify process of the formatted drive in search of new defects. Defined as Certification (C) defect list. - Maintains a list of grown defects in ascending order recorded twice on the disk (G list). The host can read this list using the

READ DEFECT DATA command.

- The host may request to use or delete the G list during a new FORMAT UNIT command.
- The controller remaps defects automatically with a changed sector size.
- Host programmable Zone size. The Zone may be one track or one cylinder.
- Programmable number of spare sector(s) per Zone .
- When all alternate sectors of a zone are used or bad, the controller searches in the next consecutive zone(s) for an available spare sector to be used as an alternate.

ERROR CORRECTING CODE

Powerful computer generated 48 bit polynomial. 11 bit correction. 27 bit detection.

Properties when polynomial is used for error detection only ;

- Single burst detection span ; any single burst not exceeding 48 bits in length is guaranteed to be detected regardless of record length.
- Double burst detection span ; any combination of double bursts is guaranteed to be detected provided the sum of the two bursts does not exceed x, where x is specified in the table below.

Record Length (bytes)		x
292		36
548		33
> 1060	up to 4132	29

- Misdetection Probability ; is 3.55 E-15 regardless of record length

Properties when polynomial is used for error correction ;

- Single burst correction span

Record Length (bytes)		bits
292		19
548		18
> 1060	up to 4132	15

- Single burst detection span

Record Length (bytes)		correction span	detection span
292		11	27
548		11	27
> 1060	up to 4132	11	25

- Double burst detection span

Record Length (bytes)	correction span	detection span
292	8	12
548	7	12
1060	6	11
2084	4	11

- Miscorrection Probability (Pmc)

$Pmc = n * 2^{(b-1)-48}$ n= record length, b = single burst correction span in bits

Data Correction options. See MODE SELECT Page 1 :

- Halt or don't halt on correctable ECC errors.
- Report or don't report correctable ECC errors.
- Correct first occurrance of ECC error or get two matching syndromes before applying correction.

STEP RATE	Accepts a minimum of 7.7 microseconds between leading edges of two consecutive pulses.
SECTORS PER TRACK	Programmable for ST506/412 drives, supported through the pages of MODE SENSE and MODE SELECT commands.
COMMAND SET	The SCSI Common Command Set (CCS) plus some additional commands.

2.3 FLEXIBLE DISK DRIVE SPECIFIC FEATURES (Models 7000 7200 and 7400)

DATA TRANSFER RATES	250, 300 and 500Kbit/second.
High Density (300KBits)	Supported. Can read a 250 Kbit format on high capacity (PC AT compatible) 360 RPM drives.
8 Inch Drive (500KBits)	An optional 34 Pin to 50 Pin Adapter (OMTI 528 available from SMS) interface is needed to connect 8 Inch Flexible drives.
5-1/4" (500KBITS)	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 (FM only), 256, 512, 1024, 2048 or 4096 bytes per sector (See MODE SELECT command).
NUMBER OF SECTORS/TRACK	Programmable (See MODE SELECT command). 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	Supported.
CRC	On header and data fields.
SPEED CONTROL/ DENSITY	Supported.
REDUCED WRITE CURRENT	Programmable.

WRITE PRECOMPENSATION,	Programmable. (Starting cylinder and level).
MOTOR ON and OFF DELAYS	Programmable.
STARTING SECTOR NUMBER	Programmable.
DISK CHANGE	Supported.
HEAD LOAD/UNLOAD	Supported.
TRUE READY	Supported.
EJECT	Supported.

2.4 TAPE DRIVE SPECIFIC FEATURES (Model 7400)

DRIVE TYPE	Streaming tape drive.
INTERFACE	ARCHIVE only QIC 02 - Intelligent 1/4 inch cartridge interface compatible. QIC 104 ANSC compatible.
NUMBER OF DRIVES	One ARCHIVE drive is supported.
FIXED BLOCK MODE	READ, WRITE and COPY commands use 512 bytes long blocks.
LUN	Default is LUN 3. LUN is programmable to any other LUN value 0 through 7 through the MODE SELECT command Page 22h.
QIC 02 PARITY	Supported. Jumper selectable.
COPY	Data can be transferred between disk and tape without the intervention of the host.
STREAMING MODE	Continuously maintained. Utilizes the controller's Buffer.
DATA PATHS	Two data paths are available : - Host To/From Tape - Disk To/From Tape using COPY command.
SPACING FORWARD	Three modes : - By blocks - By File Marks - To end of data (EOD)

SECTION 3

INSTALLATION

3.1 UNPACKING AND INSPECTION

Upon receipt of your Data Controller, inspect the packaging for evidence of shipping damage. 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 Scientific Micro Systems' 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 Scientific Micro Systems' customer service representative.

Retain the shipping container and packing material for examination (if there are signs of damage), or for reuse when returning the controller board to the factory.

3.2 BOARD PREPARATION

Figure 3-1 illustrates the appropriate board layout, connector locations and jumper locations. Consult section 4.5 and 4.6 for the various jumper selectable controller functions and 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.

3.3 BOARD MOUNTING

Holes for mounting your controller board are dimensionally located. These holes mate with the four mounting holes provided on ST506/412 or ESDI Type devices. If desired, the controller can be mounted in a location other than on the device itself. An important consideration is that air be 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 the appropriate Connector and Jumper Location drawing for the location of connectors on your board. The System Configuration drawings presented in the next section will also help in identifying the cable hookup for your particular system.

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

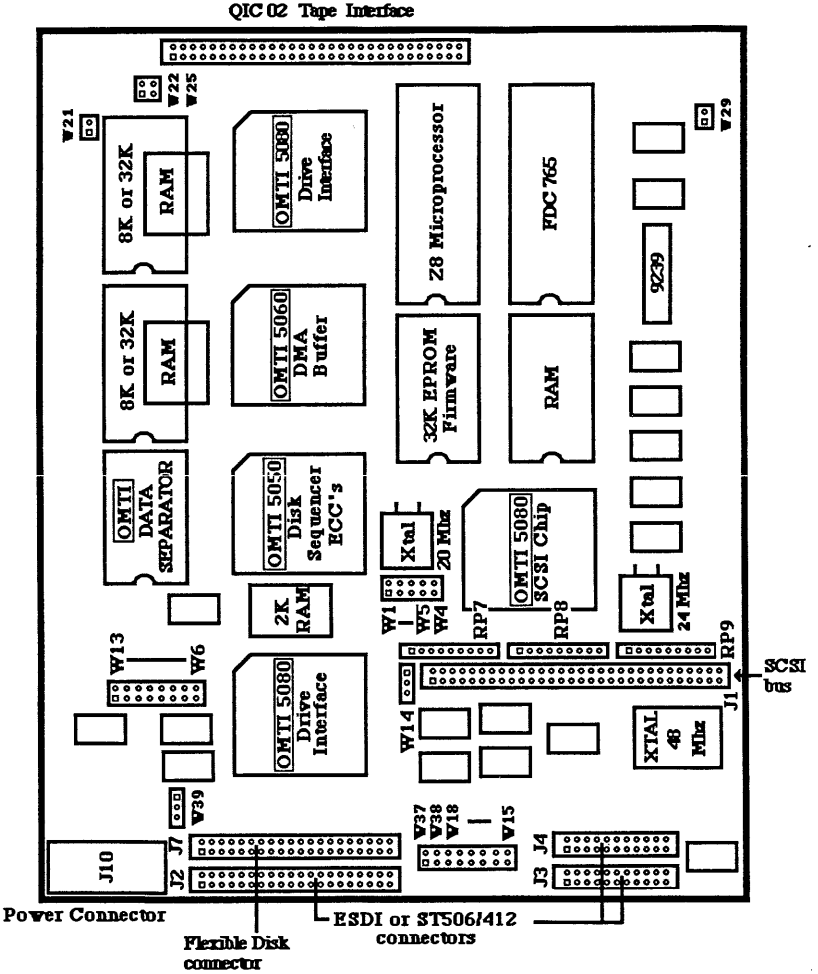


Figure 3-1 OMTI 7X00 Series Board Layout

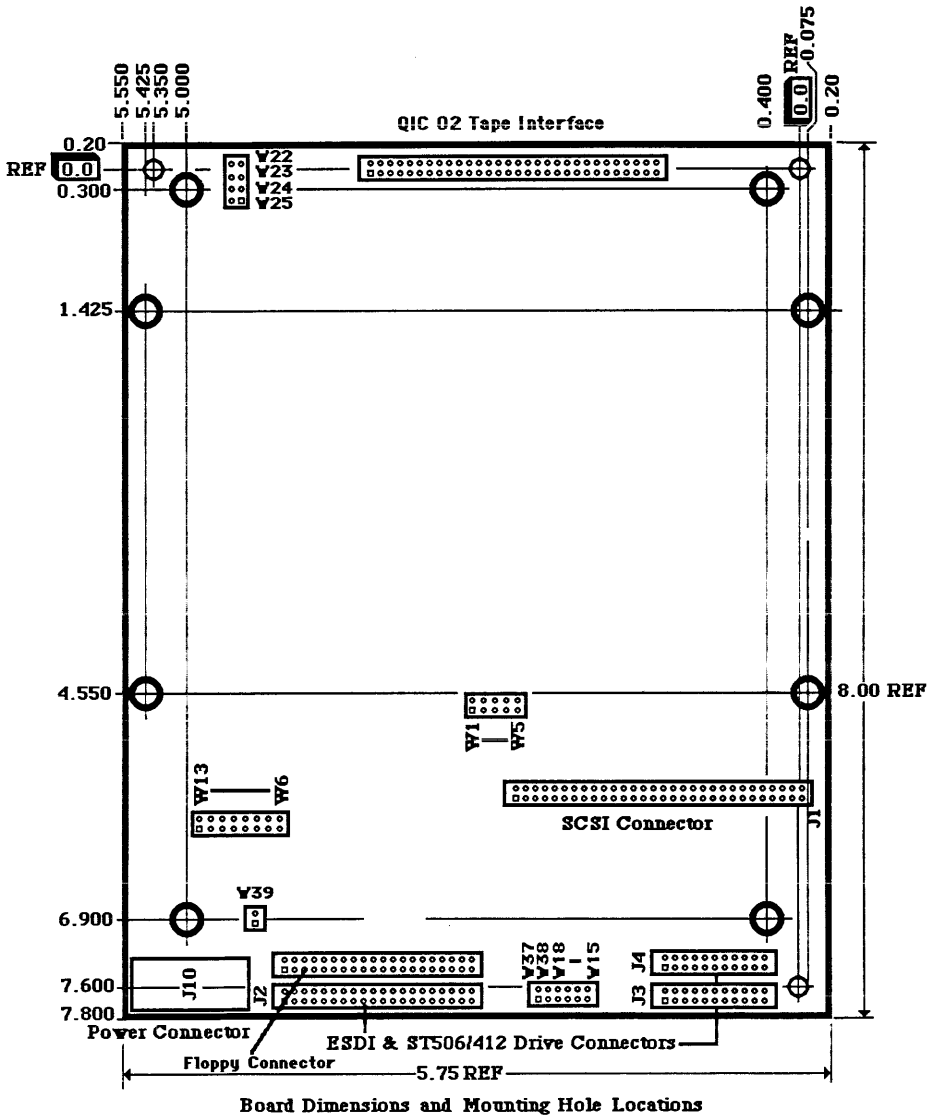


Figure 3-2 OMTI 7X00 Series Board Dimensions

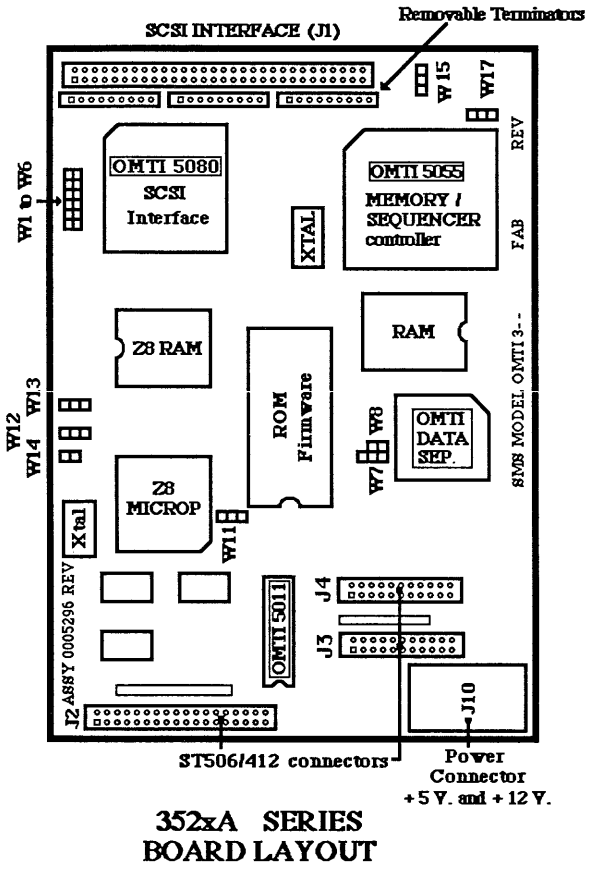
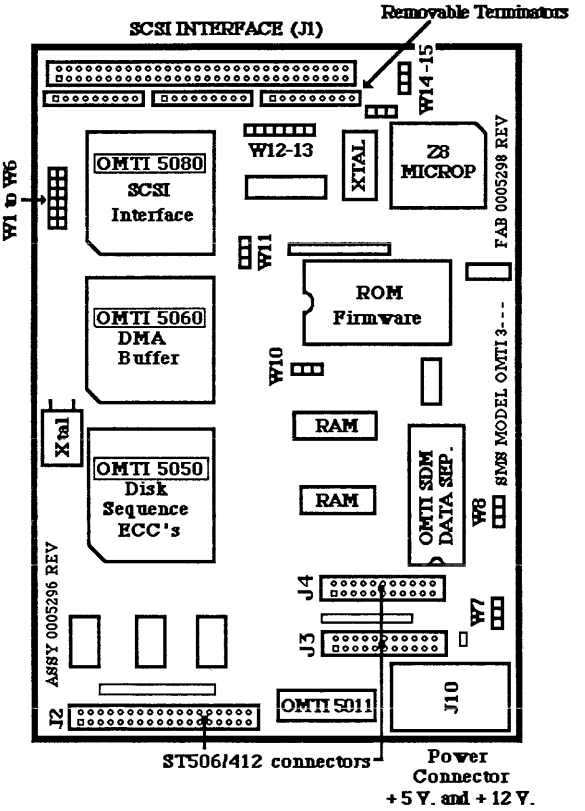
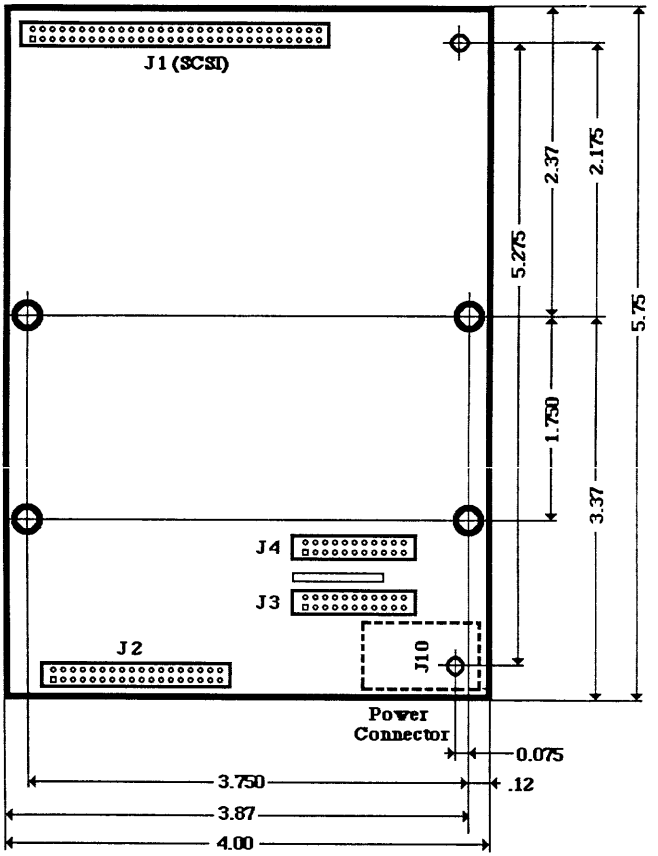


Figure 3-3 OMTI 352XA Series Board Layout



352x SERIES BOARD LAYOUT

Figure 3-4 OMTI 352X Series Board Layout



3.5 inch CONTROLLER BOARD DIMENSIONS

Figure 3-5 3.5 inch Controller Board Dimensions

SECTION 4

SYSTEM CONFIGURATION
for the OMTI 7X00

4.1 GENERAL

SCSI bus :
The interface between the host computer and the controller is a 50-pin cable. This cable isconnected to J1 connector 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.

The recommended mating connector for J1 is :
J1 AMP P/N 499956-0

Winchester Disks
The Winchester Disk drive's interface to controllers is via connectors J2, J3, and J4.
J2 is a 34-pin header type connector that connects all 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 length of the cables should not exceed 20 feet (6 meters) or drive manufacturer's limit, whichever is less.

The recommended mating connectors for J2, J3, J4 are:
J2 AMP P/N 499956-7
J3 and J4 AMP P/N 499956-4

Flexible Disks :
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. Eight inch Flexible Disk drives (50 pin connector) are to be connected to the 34-pin controller connector, through an 34-pin to 50-pin adaptor (OMTI 528).

The recommended mating connector for J7 is :
J7 AMP P/N 499956-7

QIC 02 Tape drive :
The QIC-02 interface compatible Streaming Tape Drive's connection to the controller is via J8, a 50-pin header type connector. The length of this cable should not exceed 20 feet (6 meters) or the drive manufacturer's limit, whichever is less.

The recommended mating connector for J8 is :
J8 AMP P/N 499956-0

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

The recommended mating connector for J10 is :
J10 AMP P/N 480424-0

4.2 PIN ASSIGNMENTS

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

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

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

PINS			FIXED DISKS	REMOVABLE DISKS
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 DISKS
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	

NOTE: When connecting an ESDI type drive and an ST type drive to the same controller, Pin 7 of the Radial cable (J3 or J4) for the ST type drive must be cut.

4.2.2 ESDI Winchester Disk Drive Interface (7X00 Series)

ESDI DISK CONTROL SIGNAL CONNECTOR (J2). CHAINED (7X00 Series)

	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 (7X00 Series)

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

4.2.3 Flexible Disk Drive Interface (7000, 7200 and 7400 models)

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	READY/DISK CHANGE

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

Note: Pin 1 - OMTI 7000-1A, 7200-1D and 7400-1D REV C Printed Circuit Boards, or later, provide disk change reset for Sony flexible disk drives on pin 1.

OPTIONAL ADAPTOR BOARD (OMTI 528 Paddle Board) CONNECTIONS (7000, 7200 and 7400 models)

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

4.2.4 QIC-02 1/4 Inch Cartridge Streaming Tape Interface (7400 models)

The following table defines the pin assignments for QIC-02 1/4 inch Cartridge Streaming Tape drive.

TAPE DRIVE CONNECTOR (J8)

GROUND	1	2	Not Used
	3	4	Not Used
	5	6	Not Used
	7	8	Not Used
	9	10	-PARITY
	11	12	-DATA BIT 7
	13	14	-DATA BIT 6
	15	16	-DATA BIT 5
	17	18	-DATA BIT 4
	19	20	-DATA BIT 3
	21	22	-DATA BIT 2
	23	24	-DATA BIT 1
	25	26	-DATA BIT 0
	27	28	-ON LINE
	29	30	-REQUEST
	31	32	-RESET
	33	34	-TRANSFER
	35	36	-ACKNOWLEDGE
	37	38	-READY
	39	40	-EXCEPTION
	41	42	-DIRECTION
	43	44	Not Used
	45	46	Not Used
	47	48	Not Used
GROUND	49	50	Not Used

4.2.5 Power Connector

Power is applied to the controller via J10 which is a 4-pin AMP connector. The recommended mating connector, P10, is an AMP P/N 1-480424-0 using AMP pins, P/N 60617-4, or equivalent.

J10 POWER CONNECTOR

+12 VDC	PIN 1	with 3500 series models
+12 RTN	PIN 2	
+5 RTN	PIN 3	
+5 VDC	PIN 4	

4.3 DEFAULT LOGICAL UNIT NUMBER (LUN) and DEVICE ID ASSIGNMENT

The LUN affectation and device assignments are recorded on the System Device, and are automatically configured during each Power-On. The defaults are only applicable if the parameters cannot be read from the System Device. These parameters can be modified by the initiator by issuing a MODE SELECT command with the Page Code 22h.

DEFAULT LUN and DEVICE ID ASSIGNMENTS

LUN	DRIVE SELECT	W6	W7	DEVICE	
0	1	0		**ST506/412** WINCHESTER DISK	
		1		**ESDI** WINCHESTER DISK	(7X00 series)
1	2		0	**ST506/412** WINCHESTER DISK	
			1	**ESDI** WINCHESTER DISK	(7X00 series)
2	1			**FLEXIBLE** DISK DRIVE	(7X00 series)
3				**QIC 02** TAPE DRIVE	(7X00 series)
4	2			**FLEXIBLE** DISK DRIVE	(7X00 series)
5	3			**FLEXIBLE** DISK DRIVE	(7X00 series)
6	4			**FLEXIBLE** DISK DRIVE	(7X00 series)
7				Reserved	

The Drive Select time out is set to 50 seconds.

Note: Except OMTI 7x00 - See Jumper W5 configuration Page 4-9.

4.4 DEFAULT PARAMETERS

4.4.1 ST506/412 Winchester Disk Drives

See MODE SENSE Page 4 Default values for both LUNs.

4.4.2 ESDI Winchester Disk Drives (7X00 series)

These drives are auto configurable.

4.4.3 Flexible Disk Drives (7X00 series)

See MODE SENSE Page 5 Default values for all LUNs.

4.5 OMTI 7X00 SERIES JUMPER ALLOCATION

The OMTI 7X00 Series Controllers allow the user to select the various controller functions listed below :

OMTI 7X00 Series Jumper Allocation

W1, W2, W3 **SCSI CONTROLLER ID.** Defines the SCSI device priority. ID 7 is the highest priority in a multi SCSI device 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 **7000 (Flexible disk only controller)**
Device to LUN association.
* Shorted = Flexible disk to LUN association matches the 7200/7400. LUN 2 = Device select 1, LUN 4 = Device select 2, LUN 5 = Device select 3 & LUN 6 = Device select 4.

Open = Flexible disk to LUN default association is: LUN 0 = Device select 1, LUN 1 = Device select 2, LUN 2 = Device select 3 & LUN 3 = Device select 4.

W5 **7100, 7200 & 7400**
Used with **ESDI drives supporting the Start Spindle option.**
* Shorted = Spin Up on controller Power On assuming the drive is powered on.
Open = Spin Up when receiving the START/STOP UNIT command with the Start bit set to one.

(On OMTI 7100, 7200 and 7400 only)The jumper W5 allows the user to control the power up cycle of an ESDI drive. The spindle may either be turned on on power up when W5 is shorted, or when receiving the START/STOP UNIT command with W5 open.

If W5 is open, the first command to be issued by the system host after power on is the START/STOP UNIT command to Winchester DS1 then to Winchester DS2. This will start both drives and configure the system.

Until the spindle is turned on, the controller responds to all commands with a CHECK CONDITION status for a NOT READY Sense Key except for the following commands: START/STOP UNIT, REQUEST SENSE, INQUIRY, RESERVE/RELEASE, READ & WRITE BUFFER, MODE SENSE, SEND DIAGNOSTIC and commands to invalid LUNs.
The MODE SENSE command returns default or changeable values to requests for default or changeable values. The CHECK CONDITION status is created with NOT READY Sense key to MODE SENSE command requests for the current or saved values.

At Power On, to avoid drive power supply overload, with those ESDI drives supporting the Start Spindle option, each OMTI 7X00 series controller of the configuration automatically starts its ESDI drive(s) (if enabled by the W5 jumper), after a delay of 13 seconds multiplied by its own SCSI ID (0 to 7). As an example, assuming that all devices would be powered up at the same time, the ESDI drive(s) on OMTI 7X00 controller ID0 will start first without any delay, followed 13 seconds later by the ESDI drive(s) on the controller ID 1, followed 13 seconds later by the ESDI drive(s) on SCSI controller ID 2 etc... until reaching controller ID 7. If a second ESDI drive is installed on a controller, it will be turned on after the first drive is up to speed and ready and the self-configuration information has been read.

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.	
W8, W9, W10 ,W11, W12, W13		Reserved. Not used.
W14	**SCSI POWER TERMINATION**	
	* **W14**	1-2 = TERMINATION POWER FROM BOARD
	W14	2-3 = TERMINATION POWER FROM SCSI BUS

* As shipped or default settings.

FLEXIBLE DISK JUMPERS
Valid for OMTI 7000, 7200 and 7400 only

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.

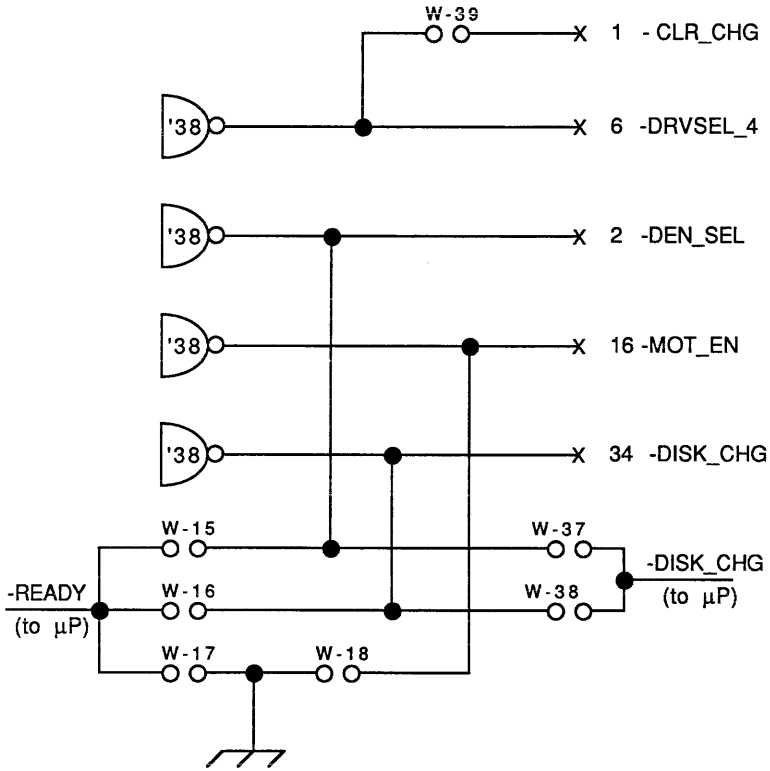


Figure 4.1 USAGE OF FLOPPY JUMPERS

Tape Jumper
Valid for OMTI 7400 Only

W25	**QIC 02 TAPE PARITY**
	* **Installed:** Enabled
	Removed: Disabled

4.6 OMTI 3500 SERIES JUMPER ALLOCATION

The OMTI 3500 Series Controllers allow the user to select the various controller functions listed below :

Jumper Allocation

W1, W2, W3 **SCSI CONTROLLER ID.** Defines the SCSI device priority. ID 7 is the highest priority in a multi SCSI device 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 through W13 Reserved

W14 SCSI POWER TERMINATION

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

* As shipped or default settings.

SECTION 5

SYSTEM CONFIGURATION
for the OMTI 3500 Series

5.1 GENERAL

SCSI bus :
The interface between the host computer and the controller is a 50-pin cable. This cable is connected to the J1 connector 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.

The recommended mating connector for J1 is :
J1 AMP P/N 499956-0

Winchester Disks
The Winchester Disk drive's interface to controllers is via connectors J2, J3, and J4.
J2 is a 34-pin header type connector that connects all 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 length of the cables should not exceed 20 feet (6 meters) or drive manufacturer's limit, whichever is less.

The recommended mating connectors for J2, J3, J4 are:
J2 AMP P/N 499956-7
J3 and J4 AMP P/N 499956-4

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

The recommended mating connector for J10 is :
J10 AMP P/N 480424-0

5.2 PIN ASSIGNMENTS

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

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

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

PINS			FIXED DISKS	REMOVABLE DISKS
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 DISKS
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	

5.3 OMTI 3500 SERIES JUMPER ALLOCATION

The OMTI 3500 Series Controllers allow the user to select the various controller functions listed below :

Jumper Allocation

W1, W2, W3 **SCSI CONTROLLER ID.** Defines the SCSI device priority. ID 7 is the highest priority in a multi SCSI device 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 through W13 Reserved

W14 SCSI POWER TERMINATION

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

* As shipped or default settings.

SECTION 6

FUNCTIONAL DESCRIPTION

6.1 GENERAL

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

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

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 send completion status to the host. Sense Status information is provided through the REQUEST SENSE command.

6.2 ELECTRICAL/ PHYSICAL INTERFACE

The controller includes single-ended drivers and receivers (built into the OMTI 5080 chip), which allow a maximum cable length of six meters (primarily for connection within a cabinet).

A minimum conductor size of 28 AWG shall be employed to minimize noise effects and ensure proper distribution of terminator power.

The non-shielded SCSI device connector shall be a 50-conductor connector consisting of two rows of 25 male pins with adjacent pins 2.54 mm (0.1 in) apart.

All assigned signals shall be terminated with 220 ohms to +5 volts (nominal) and 330 ohms to ground at each end of the cable. All signals shall use open-collector or three state drivers.

OUTPUT CHARACTERISTICS. Each signal driven have the following output characteristics when measured at the connector.

Signal assertion = 0.0 volts dc to 0.4 volts.

Minimum driver output capability = 48 milliamps (sinking) at 0.5 volts dc (7438 or equivalent).

Signal negation = 2. volts dc to 5.25 volts dc.

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.

INPUT CHARACTERISTICS:
Each signal received by the controller shall have the following input characteristics when measured at the SCSI device's connector:
Signal true = 0.0 volts dc to 0.8 volts dc
Maximum total input load = -0.4 milliamps at 0.4 volts dc
Signal false = 2.0 volts dc to 5.25 volts dc
Minimum input hysteresis = 0.2 volts dc

TERMINATOR POWER (PIN 26):
Usually, only the initiators shall provide termination power. On the controller this power is supplied through a diode that prevents backflow of power to the controller.
VTerm. = 4.25 volts dc to 5.25 volts dc
600 milliamps minimum source drive capability
1.0 milliamp maximum sink capability

TERMINATORS:
As shipped, all assigned received interface signal lines are terminated with a removable 220/330 ohm resistor network. The daisy-chain SCSI bus must be terminated. The terminators from the devices in between shall be removed. For instance, if the controller is in the middle of the string, remove its terminators. The host adapters should be terminated in a similar fashion.

6.3 SCSI SIGNAL INTERFACE

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

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	Ground		
	21	22	Ground		
GND	23	24	Ground		
OPEN	25	26	POWER TERMINATION		The Controller or another SCSI device.
GND	27	28	Ground		
	29	30	Ground		
	31	32	- ATTENTION	(- ATN)	The Host(s)
	33	34	Ground		
	35	36	- BUSY	(- BSY)	Bidirectional
	37	38	- ACKNOWLEDGE	(- ACK)	The Host(s)
	39	40	- RESET	(- RST)	The Host(s)
	41	42	- MESSAGE	(- MSG)	The Controller
	43	44	- SELECT	(- SEL)	The Host(s)
	45	46	- CONTROL / DATA	(- C/D)	The Controller
	47	48	- REQUEST	(- REQ)	The Controller
GND	49	50	- INPUT / OUTPUT	(- I/O)	The Controller

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

6.4 SIGNAL DEFINITION

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 (25) microseconds wide to allow the controller's microprocessor to execute this function properly.

SELECT (- SEL) — Asserted by the host, along with a single data bit (0 through 7), causes the addressed target to be selected. The SELECT line must be de-asserted by the host after the controller asserts the BUSY line in response to a proper selection. See NOTE in paragraph 6.7.

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

CONTROL/DATA (- C/D) — Signal asserted by the controller indicating that control information is to be transferred on the data bus. De-assertion 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. De-assertion indicates that information will be transferred to the controller from the host. This signal is also used to distinguish between SELECTION and RESELECTION phases.

REQUEST (- 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 from the host. REQ and ACK control the handshaking.

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. The direction depends on the I/O signal.

ATTENTION (- ATN) — A signal driven by the host to indicate the Attention Condition. See paragraph 6.11.

MESSAGE (- MSG) — A signal asserted by the controller to indicate the Message phase. The I/O signal when MSG is asserted, indicates MESSAGE IN or MESSAGE OUT.

DATA BITS 0-7 (- DB0-7)
PARITY (- DBP) — 8 bi-directional 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 and has the highest priority during the ARBITRATION phase. Parity is not valid during the ARBITRATION phase.

6.5 BUS TIMINGS

The controller fully complies to the timing requirements as described in the ANSI document (refer to this document for detailed information).

Arbitration Delay (2.2 microseconds)
Bus Clear Delay (800 nanoseconds)
Bus Free Delay (800 nanoseconds)
Bus Set Delay (1.8 microseconds)
Bus Settle Delay (400 nanoseconds)
Data Release Delay (400 nanoseconds)
Reset Hold Delay (25 microseconds)
Selection Abort Delay (200 microseconds)
Selection Timeout Delay (250 milliseconds)

6.6 INTERNAL DIAGNOSTICS

6.6.1 At Power On or Bus Reset

The controller performs a hard reset after each Power-On or Bus Reset. After power-up, the controller executes the following tests :

TEST #	DEVICE TESTED	COMMENTS
	Z8	Includes tests of the control functions and registers. Blinks the on-board LED if the Z8 test fails.
0	Program ROM	Uses the ROM checksum to verify the ROM.
1	Micro RAM	Uses a moving inversion test to test the RAM. Leaves the RAM filled with zeros.
2	Buffer RAM	Determines the size of the buffer RAM then tests it. Leaves the buffer filled with zeros. Uses the path through the Sequencer chip and the DMA channel 3 (or 1 on the products that use the KOMBO chip).
3	SCSI chip	Tests the SCSI chip including the interrupt.
4	DMA	Tests the DMA including the interrupt.
5	Sequencer	Tests the Sequencer chip, including the interrupt.
6	Sequencer State	Tests, then initializes the State controller RAM.
7	Disk Bus	Tests the disk bus control chip (OMTI 5080), only valid with the 7X00 series.
8	NEC 765 chip	Interface tests (only valid with the 7000, 7200 and 7400).
9	Tape Interface tests	Only valid with the 7400

After a Bus Reset the controller executes tests 3 - 9.

6.6.2 Self Test Failure Status

If tests 0 through 4 fail, this is considered a fatal controller error. The controller will still respond to host selects, if possible, but will not execute any commands, except REQUEST SENSE, INQUIRY, and SEND DIAGNOSTIC. If any other he self tests fail, this is still a controller error, but, if the component that failed does not affect another path, commands for the unaffected path will be executed. Also, if the failure is in the winchester path, the self configuration will not be completed so the host must use the MODE SENSE and MODE SELECT commands to set up the parameters unless the default parameters are acceptable.

TEST	SENSE KEY	ADDITIONAL SENSE CODE	ALLOWED COMMANDS
0	04	A0	03h, 12h, 1Dh. - Only after power-up
1	04	A1	same as above. - Only after power-up
2	04	A2	same as above. - Only after power-up
3	04	A3	same as above.
4	04	A4	same as above.
5	04	A5	03h, 12h, 1Dh, 25h, 16h, 17h, 3Bh 3Ch and all Tape and Flexible Disk commands.
6	04	A6	same as above.
7	04	A7	same as above.
8	04	A8	All disk and Tape commands.
9	04	A9	All disk and Flexible disk commands.

6.6.3 Self Configuration
(Not Applicable for OMTI 7000 controllers)

The parameters that determine the operating mode for the controller and each device on the controller are maintained in the controller EPROM, in the controller micro-processor RAM, in the micro-processor registers and on track zero of each winchester disk.

During power up and after each bus reset this information is used to configure the controller.

After power up or reset the default parameters are loaded from EPROM into the micro processor RAM for each device. The parameters for the winchester device select 1 are loaded into the Z8 and the firmware attemps to read track 0 from the disk. If the read is successfull the parameters that are saved on the disk are used instead of the default parameters. If a second winchester is connected its track 0 is read. If the read from the first disk failed then the parameters from device select 2 are used for all devices. If the read from device select 1 did not fail then only device select 2's parameters are updated.

The Mode Sense command can be used to read the parameters from the microprocessor RAM (Current parameters), from the EPROM (Default parameters) or from the disk (Saved parameters).

The Mode Select is used to update the current parameters (in RAM and the Z8) and if the Save Parameters bit is set to update the parameters on track 0 of the winchesters. If the Save Parameters bit (SP) is set, then the current parameters for all LUN's are written to track 0 of the selected winchester device.

Self-configuration error: If the system is not able to read the self-configuraiton parameters from winchester device select 1 on power on/bus reset the Sense Key/Error Code for all LUN's will be set to (06h/90h) Unit Attention/Self Configuration error. If the read from device select 1 works correctly but the system is not able to read device select 2's parameters the status for device select 2 will be set to 06h/90h.

It is highly recommended that the host test for this error code.

W5 not installed:
If Jumper W5 is not installed, for ESDI drives that support the start spindle option, the self configuration is not done until the winchester drives are started.

When the first winchester drives spindle motor is started, device select 1 or 2, the current parameters for all LUN's are updated. Then when the second winchesters spindle motor is started its current parameters are updated.

After all of the controllers parameters are updated the Sense Key/Error Code will be set to Unit Attention/Power Up Reset except for the drive that has not been started which will be set to Unit Attention/Self Configuration error (06H/90h).

After the next drive is started and its parameters updated its Sense Key/Error Code will be set to Unit Attention/Power Up Reset.

SECTION 7

TRACK AND SECTOR FORMAT

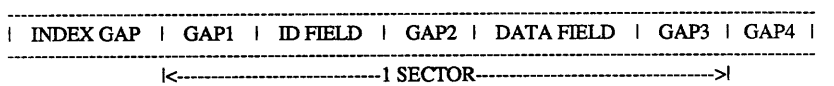
7.1 WINCHESTER DISK TRACK FORMAT

The standard track format for hard and soft sectored Winchester Disk drives is organized into numbered data segments, or sectors (See Figure 6-1 and 6-2).

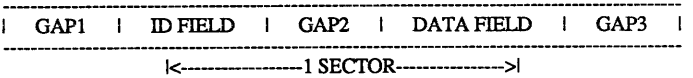
The nominal ST506/412 Winchester Disk capacity is 10,416 Bytes. The minimum track capacity is based on a one percent speed variation. The method of encoding used is Modified Frequency Modulation (MFM).

The nominal ESDI Winchester Disk capacity is 20,832 Bytes. Refer to the ESDI drive specification for more details.

OMTI 3527: The nominal ST412R Winchester Disk capacity is 15,624 Bytes. The miminum track capacity is based on a one percent speed variation. The method of encoding used is 2,7 RLL.



Winchester Disk Soft Sector Track Format



Winchester Disk Hard Sector Track Format

7.2 WINCHESTER VOLUME FORMAT

During the FORMAT UNIT command the controller de-allocates some tracks from the user addressable blocks. They are:

		ONLY FOR ESDI DRIVES:	
Maximum cylinder (for ESDI Drives only)		Head 0 (Manufactures Defect list)	
		Head N (Manufactures Defect list)	
Maximum Track		DIAGNOSTIC TRACK	
Maximum Track	-1	OMTI P LIST	
Maximum Track	-2	BACKUP OF OMTI P LIST	
		ONLY IF MAPPING ENABLED:	
Maximum Track	-3	COPY OF OMTI P LIST	
Maximum Track	-4	BACKUP OF COPY OF OMTI P LIST	
Maximum Track	-5	G LIST	
Maximum Track	-6	BACKUP OF G LIST	
Maximum Track	-7	REASSIGN BLOCK	
Maximum Track	-8	BACKUP OF REASSIGN BLOCK	
Maximum Track	-9	SPARE	
Maximum Track	-10	SPARE	
		USER AREA:	
Track 0		SELF CONFIGURATION	

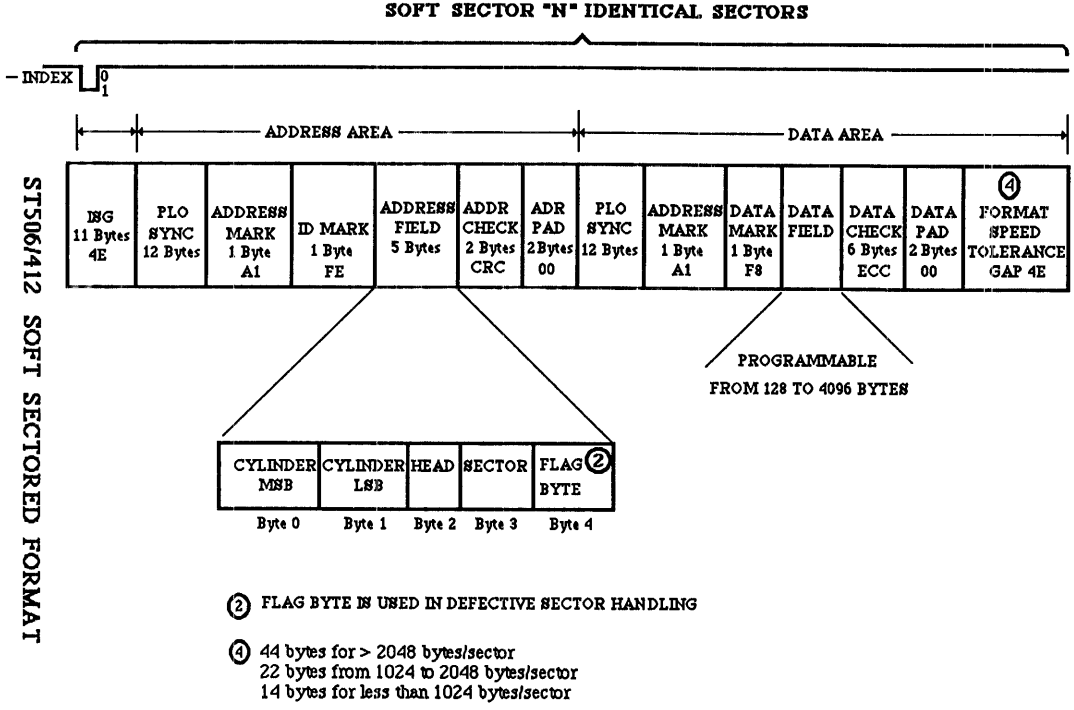
Track zero :	Used for Self or Auto Configuration information. Provides device independence to the LUNs connected (Winchesters, Flexible disks and Tape if model permits and connected). The Block Length of this track is the same as the other tracks. This track is formatted during the FORMAT UNIT command. It is written during the format command after all tracks are formatted and is written during the MODE SELECT command if the Save Parameters bit, SP bit, is set. Track zero contains the saved parameters for each LUN. The contents of track zero can be read by the host by issuing a READ BUFFER command immediately after powering up or resetting the system. Track zero information is read into the buffer when the system is configured.
Manufacturers Defect List :	On ESDI drives the last cylinder is reserved for the Manufacturers Defect List. This area is only read by the controller. When an ESDI drive is initially formatted, if P list is enabled, the controller reads the Manufacturers Defect list and converts it to the OMTI P list format and, after formatting the OMTI P list tracks, writes to the OMTI P list. If the controller detects an error while reading the Manufacturers Defect list on the last cylinder it tries to read the list on the maximum cylinder -8.
OMTI P List :	Primary defect list. All lists are duplicated on a second track in case one has a defect.
Copy of OMTI P list:	This list is the same as the OMTI P list but contains the address where the defects are mapped to in addition to the defect address. This list is written during formats and Reassign Blocks, when the P list is enabled.
G List :	Grown list track. All lists are duplicated on a second track in case one has a defect.
Reassign Block Track :	This track is used during the REASSIGN BLOCK command to contain the data from the tracks that contain the defective sector while these tracks are being re-formatted. A backup of this track is used in case there is a defect on the first track.
Spare Tracks:	These tracks are used to spare any defective sectors that overflow the spares contained on the last zone in the user area.

Spare tracks per volume in Page 3 of the MODE SENSE command is reported with a value of zero or two.

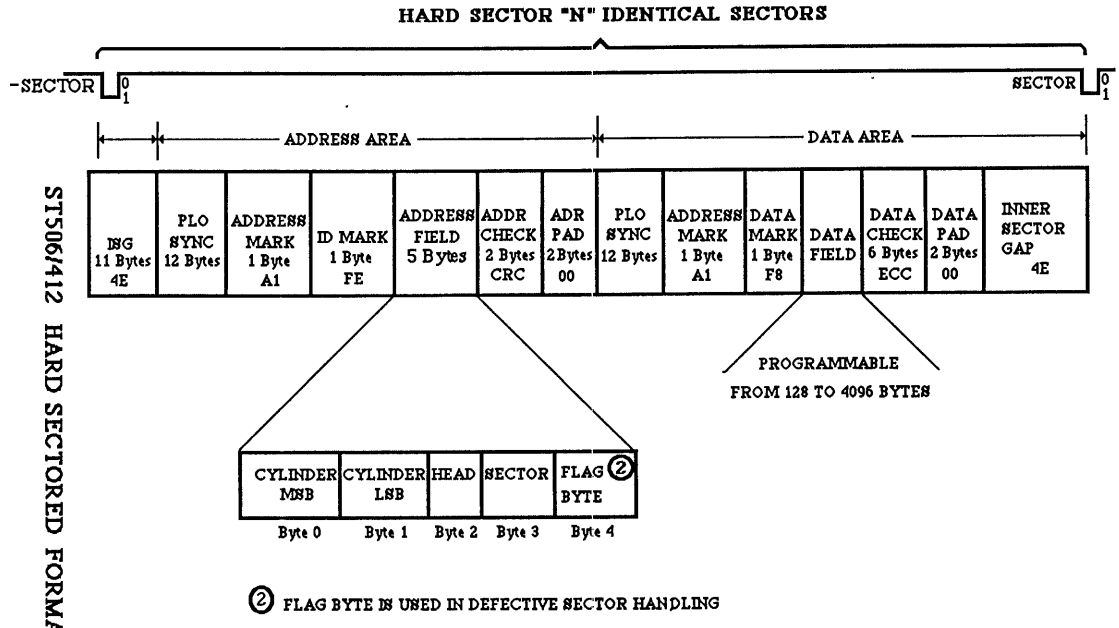
REDUNDANCY:

There are two P and G and Reassign Block tracks so if a defect exists on any single track the controller will continue to operate normally. If both tracks are bad the function supported by those tracks will be unusable.

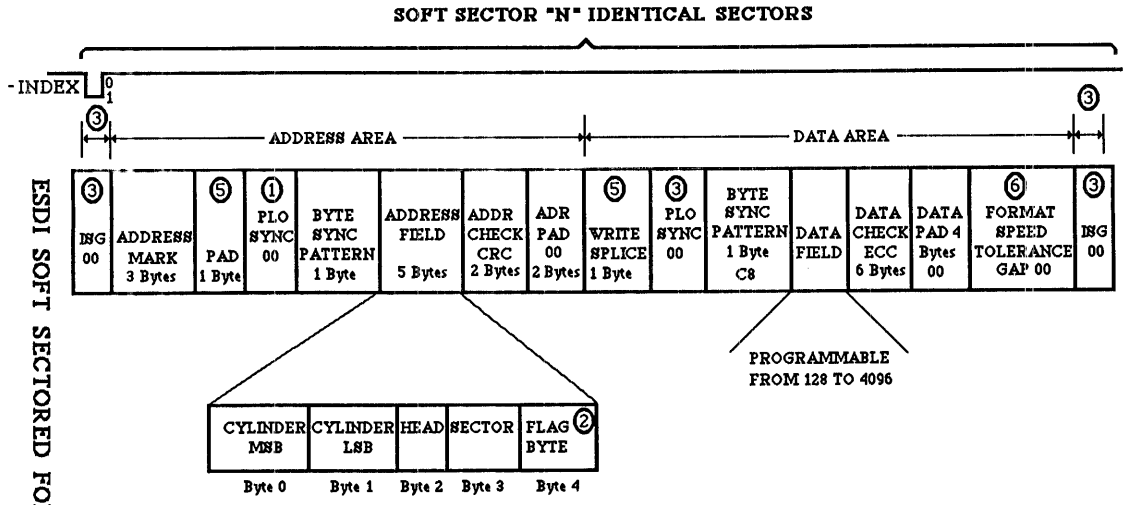
ST506/412 SOFT SECTORED FORMAT



ST506/412 HARD SECTORED FORMAT



ESDI SOFT SECTORED FORMAT



① AS REPORTED TO ESDI REQUEST CONFIGURATION CMD -1.

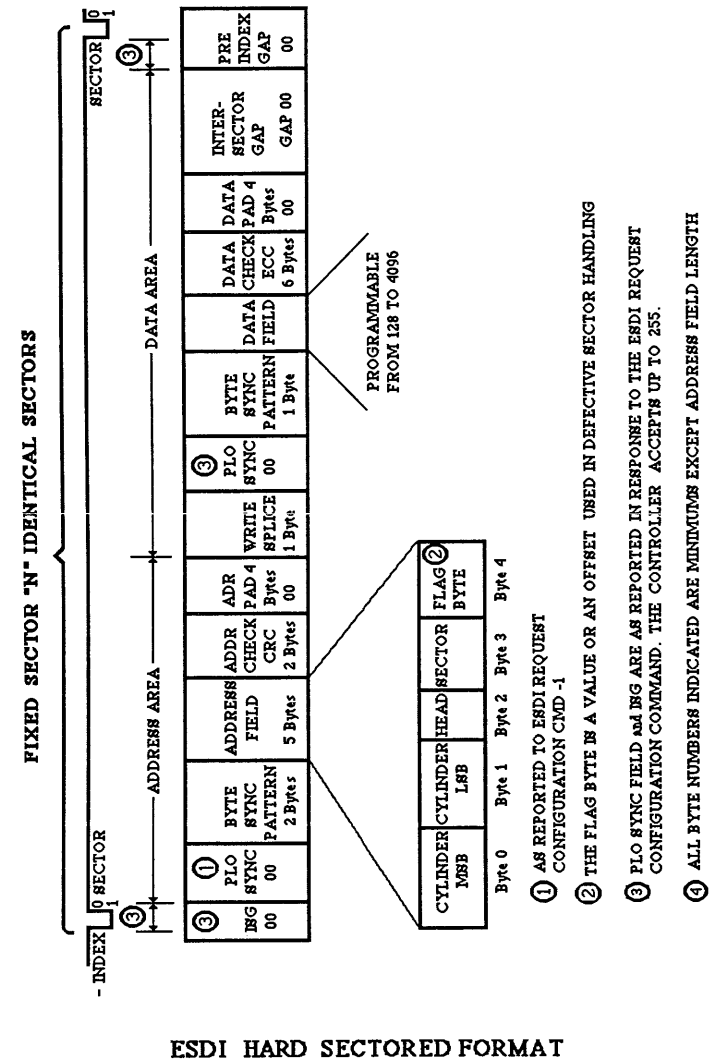
② SEE HARD SECTOR COMMENTS

③ PLO SYNC FIELD and ING ARE AS REPORTED IN RESPONSE TO THE ESDI REQUEST CONFIGURATION COMMAND. THE CONTROLLER ACCEPTS UP TO 255.

④ ALL BYTE NUMBERS INDICATED ARE MININUMS 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 HARD SECTORED FORMAT

7.3 FLEXIBLE DISK TRACK FORMAT (Valid for 7000, 7200 and 7400 models)

The flexible disk format is very flexible and can be changed to match most any standard flexible disk by issuing Mode Select commands. For example, the number of sectors per track, the number of cylinders, the number of heads, the transfer rate (250/300/500Kbit), the starting sector number and if the data is FM or MFM, or if Track 0 is FM and all other tracks are MFM, are all programmable. The sector sizes are also selectable and the allowed selections are 128 (FM only), 256, 512, 1024, 2048 and 2048 bytes per sector.

Refer to the Mode Select command for the details.

REQUEST FOR FEEDBACK

Scientific Micro Systems welcomes your comments on the accuracy and usability of its technical manuals. I interest of assisting us in the on-going process of manual improvement and updating, please answer the following questions:

1. How easy is this manual to use?

2. What would you like to see in this manual that is not currently included?

3. What parts of this manual could, in your opinion, be omitted without impacting the accuracy and effectiveness of the manual?

4. Indicate any faults or errors you may have found in the manual.

5. What is your general evaluation of this manual.

THANK YOU FOR YOUR ASSISTANCE!

Please send your comments on this sheet (and your name and company address, if you wish a reply) to:

SCIENTIFIC MICRO SYSTEMS
ATTN: OMTI TECHNICAL PUBLICATIONS DEPARTMENT
P.O. Box 7777
339 North Bernardo Avenue
Mt. View, CA 94039 U.S.A.