MD21/S2 DISK CONTROLLER

TECHNICAL MANUAL

(SCSI-COMPATIBLE)

EMULEX
3545 Harbor Boulevard
Costa Mesa, California 92626
(714) 662-5600 TWX 910-595-2521

MD2151003-00 Rev E
March, 1988

WARNING

This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the technical manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class B computing device pursuant to Subpart J of Part 15 of the Federal Communications Commission (FCC) Rules, which are designed to provide reasonable protection against such interference when operating in a residential installation. However, there is no guarantee that interference will not occur in a particular installation.

Printed in U.S.A.

TABLE OF CONTENTS

FIVE: INSTALLATION

SIX: CONTROLLER INITIALIZATION AND SELF-TEST PROCEDURES

SEVEN: INTERFACES

SEVEN: INTERFACES (continued)

APPENDIX A: TROUBLESHOOTING

APPENDIX B: PROM REMOVAL AND REPLACEMENT

TABLES

TABLES (continued)

FIGURES

PREFACE

This reference manual explains how to install, test, and operate the MD21 Disk Controller. It provides you with the following information:

- Installation instructions
- Disk Controller Specifications
- Compatibility information
- Drive Configuration Parameters
- Initialization and Self-Test Procedures
- Interface information
- A guide to troubleshooting
- PROM Removal and Replacement

This manual has been designed to be used with the Emulex SCSI Disk Controller Programming Reference Manual (manual number MD2352501) and it assumes familiarity with the SCSI standard and the ESDI disk drive interface specification.

The Small Computer System Interface (SCSI) command set for the MD21 Controller is based on the ANSI X3.131-1986 SCSI Specification. Copies of the ANSI SCSI Specification can be obtained from the following publisher:

American National Standard for Information Systems - Small Computer System Interface (SCSI), ANSI X3.131 - 1986
Computer and Business Equipment Manufacturers Association
311 First Street, NW Suite 500
Washington, DC 20001

The ESDI interface standard for 5.25-inch Winchester disk drives is described in the Enhanced Small Device Interface specification, preliminary working document, ANSI X3T9.3/87 -** Revision 1.1 or ESDI Revision F.3A, (26 January 1987). This specification is available from:

Dal Allan
Vice Chairman X3T9.3
ENDL Consulting
14426 Black Walnut Court
Saratoga, CA 95070
(408) 867-6630

EMULEX PRODUCT WARRANTY

CONTROLLER WARRANTY: Emulex warrants for a period of twelve (12) months from the date of shipment that each Emulex controller product supplied shall be free from defects in material and workmanship.

CABLE WARRANTY: All Emulex-provided cables are warranted for ninety (90) days from the time of shipment.

The above warranties shall not apply to expendable components such as fuses, bulbs, and the like, nor to connectors, adapters, and other items not a part of the basic product. Emulex shall have no obligation to make repairs or to cause replacement required through normal wear and tear or necessitated in whole or in part by catastrophe, fault or negligence of the user, improper or unauthorized use of the product, or use of the product in such a manner for which it was not designed, or by causes external to the product, such as but not limited to, power failure or air conditioning. Emulex's sole obligation hereunder shall be to repair or replace any defective product, and, unless otherwise stated, pay return transportation cost for such replacement.

Purchaser shall provide labor for removal of the defective product, shipping charges for return to Emulex, and installation of its replacement. THE EXPRESSED WARRANTIES SET FORTH IN THIS AGREEMENT ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, AND ALL OTHER WARRANTIES ARE HEREBY DISCLAIMED AND EXCLUDED BY EMULEX. THE STATED EXPRESS WARRANTIES ARE IN LIEU OF ALL OBLIGATIONS OR LIABILITIES ON THE PART OF EMULEX FOR DAMAGES, INCLUDING BUT NOT LIMITED TO SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THE PRODUCT.

RETURNED MATERIAL: Warranty claims must be received by Emulex within the applicable warranty period. A replaced product, or part thereof, shall become the property of Emulex and shall be returned to Emulex at Purchaser's expense. All returned material must be accompanied by a RETURN MATERIALS AUTHORIZATION (RMA) number assigned by Emulex.

Section 1
INTRODUCTION

1.1 OVERVIEW

The MD21/S2 Disk Controller is a single-board controller designed to interconnect Small Computer System Interface (SCSI) host adapters and controllers to one or two Enhanced Small Device Interface (ESDI) 5.25-inch Winchester disk drives. The controller features the single-ended SCSI option for drivers and receivers. For brevity, the reference MD21 will be used throughout this manual.

In combination with an independent host adapter, the SCSI bus allows a wide variety of computers to interface with the MD21 Controllers. Compatible computers include IBM Personal Computer systems such as the IBM PC-XT, Q-Bus, VMS Bus, VAX UNIX, and Multibus-based computers. Up to eight bus devices, in any combination of host systems and intelligent controllers, can be supported by the SCSI bus. The MD21 Controller, in combination with one or two ESDI 5.25-inch magnetic disk drives, provides a low-cost, compact storage subsystem.

The MD21 Controller's architecture and SCSI features it supports make it an ideal building block for use by OEMs and system integrators. The MD21 Controller supports a powerful set of SCSI commands. By using those commands, an efficient multiple-Initiator configuration can be constructed with the support of the disconnect function. (The disconnect function allows the MD21 Controller, when it is performing a time-consuming task, to release the SCSI bus temporarily and reconnect at a later time when the task is complete.) The MD21 Controller supports all required SCSI commands and the SCSI Common Command Set (CCS) for direct-access devices described in the CCS standard.

Emulex currently offers other SCSI bus microcontrollers that can be used with SCSI bus subsystems. These include the MT02/MT03 and the MD01. The MT02/MT03 Tape Controller interfaces the SCSI bus to a 5.25-inch streaming cartridge tape drive. The MD01 Disk Controller connects one or two ST506 interface 5.25-inch disk drives to the SCSI bus. Also, the MD23/24 Disk Controller interfaces the SCSI bus to up to four ESDI single-ended/differential drives and the MD32 connects up to four SMD/SMD-E drives to the SCSI bus.

In addition to basic stand-alone controller products, Emulex also offers complete SCSI bus disk and tape packaged subsystems for microcomputer applications.

1.2 FEATURES

The MD21 Controller features are summarized below. More details on these features are given in subsequent sections.

- Industry standard 5.25-inch form factor and mounting
- Operates from single +5 volt source
- 32K byte by 9-bit on-board dynamic RAM
- 8031 microprocessor operating at 12.0 mHz
- Power Fail Detect input
- User Panel Interface which supports:

  -- Write protect switches
  -- Write protect indicators
  -- Ready indicators

- Write protect from the drive
- Support of one or two ESDI Disk Drives
- Provides a transfer rate up to fifteen megabits/sec at the ESDI interface
- Supports physical sector sizes of 256 and 512 bytes
- Supports hard or soft sectoring
- Provides defect skipping, using slip sectoring
- Sequenced drive start up
- Supports embedded servo drives
- Auto configuration during power-up
- Defect management including manufacturer's defect list
- Overlapped Seeks
- Will not destroy manufacturer's defect list
- Provides transfer rate of up to 1.25 Mbytes/sec at the SCSI interface

- Conforms to the latest ANSI Specification (listed on page vii)
- Supports the SCSI Direct Access Device Common Command Set
- Supports SCSI disconnect/reconnect option
- Diagnostic Commands support physical addressing
- Track-to-track and cylinder-to-cylinder format skewing
- Command queuing for each LUN
- Supports logical block sizes of 256, 512, 1024, 2048, and 4096 bytes
- 48-bit ECC correcting up to 17 bits in error
- Supports SCSI bus parity
- ESDI pass-through commands and status

1.3 ORGANIZATION OF THE MANUAL

This manual is designed to help you integrate the MD21 Controller hardware into a subsystem. It provides technical information about the controller and brief overviews of the SCSI and ESDI interfaces. The manual provides no information about the SCSI command set or protocol. For this information, please refer to the Emulex SCSI Disk Controller Programming Reference Manual (manual number MD2352501).

The contents of the seven sections and two appendices of the MD21 Disk Controller manual are briefly described below.

Section 1 Introduction: This section briefly describes the MD21 Controller, provides a list of its features, and describes the organization of this manual. (This section.)

Section 2 General Description: This section contains overviews of the MD21 Controller, the SCSI bus, and the ESDI interface. It also discusses SCSI and ESDI compatibility.

Section 3 MD21 Controller Specifications: This section contains specifications for the major components of the MD21 Controller.

Section 4 Drive Configuration Parameters: This section contains recommended parameters of the ESDI disk drives.

Section 5 Installation: This section contains the information necessary to set up and install the MD21 Controller in your system.

Section 6 Controller Initialization and Self-Test Procedures

This section describes the diagnostic features of the MD21 Controller, including power up and reset tests and online host-initiated diagnostics.

Section 7 Interfaces: This section describes the SCSI bus and ESDI disk drive interfaces. It also describes the user panel and DC power connections.

Appendix A Troubleshooting: This appendix provides information regarding technical support and service.

Appendix B PROM Removal and Replacement: This appendix contains instructions to remove and replace the firmware so that you can upgrade the MD21 Disk Controller in the field.

2.1 INTRODUCTION

This section provides brief overviews of the major components of the MD21 Disk Controller subsystem. For more specific information about the SCSI Bus Interface and about the ESDI Interface, please refer to the ANSI SCSI Specification and the Enhanced Small Device Interface Specification listed on page vii.

For reference convenience, Section 2 is divided into five subsections, as listed in the following table:

Subsection	Title
2.1	Introduction
2.2	Disk Controller Overview
2.3	SCSI Bus Overview
2.4	ESDI Overview
2.5	Compatibility

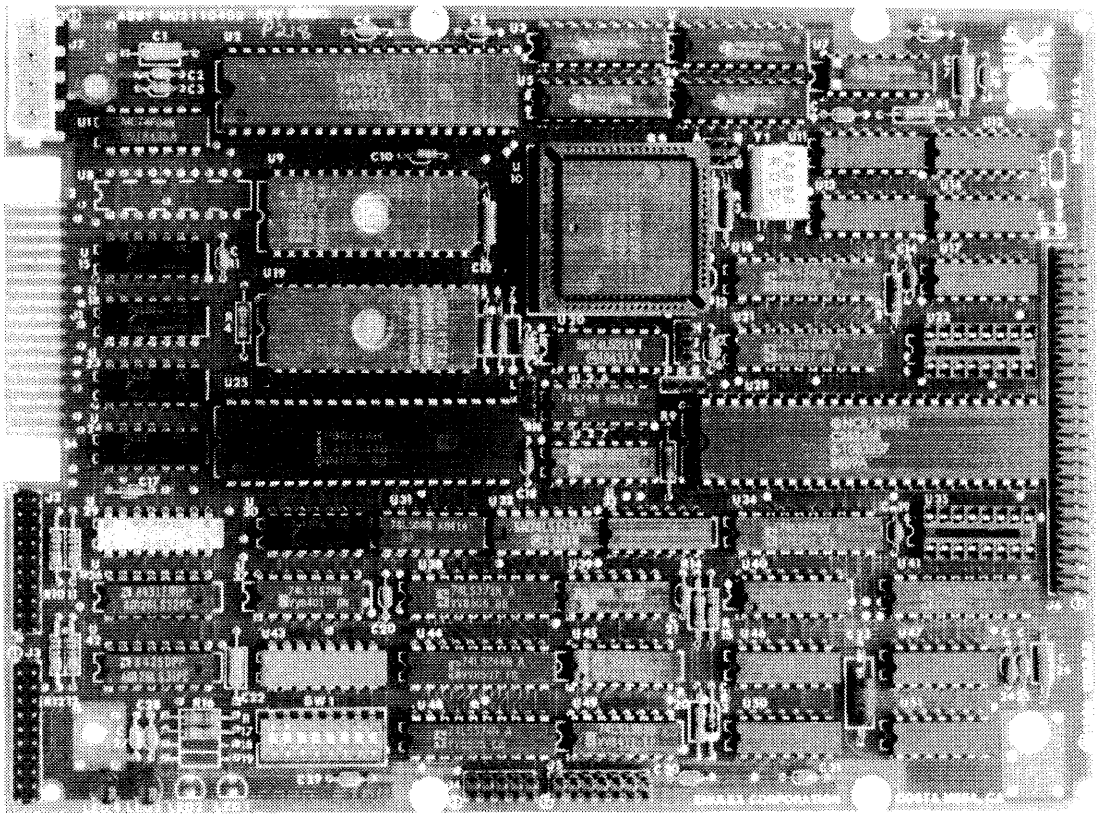
2.2 MD21 DISK CONTROLLER OVERVIEW

2.2.1 PHYSICAL DESCRIPTION

The MD21 Controller, shown in Figure 2-1, is assembled on a single board approximately 14.6 centimeters by 20.3 centimeters (5.25 inches by 7.75 inches). It can be installed directly on a mounting bracket located in the subsystem that contains an ESDI 5.25-inch Winchester disk drive. The MD21 Controller contains the following major components:

- Two Emulex custom Very Large Scale Integrated (VLSI) chips: a Buffer Controller and a disk formatter.
- An 8031 microprocessor chip
- A 32-kilobyte (K byte) Erasable Programmable Read Only Memory (EPROM), and a 32K byte Random Access Memory (RAM) for data buffering.

Figure 2-1 shows the MD21 Disk Controller and its components.



MD2103-0785

Figure 2-1. The MD21 Disk Controller

2.2.2 FUNCTIONAL OVERVIEW

Figure 2-2 is a block diagram that shows the major functional elements of the MD21. The MD21 is organized around the 8031 microprocessor, the SCSI protocol controller, the disk formatter, and the buffer controller. The disk formatter and the buffer controller are custom VLSI chips designed by Emulex.

Two buses are used in the MD21: the data bus and the microprocessor bus.

The data bus is connected directly to the disk formatter, SCSI protocol controller, buffer memory, and buffer controller. The buffer controller is connected directly to the data bus and the microprocessor bus, providing an interface between them. Therefore, the buffer controller provides a data path between the buffer memory, the 8031 microprocessor, disk formatter, and SCSI protocol controller.

The microprocessor bus provides a path for transmission of control and status information between the 8031 microprocessor, EPROM, buffer controller, and disk interface. This bus is completely separate from the data bus. The microprocessor may access the data bus via the buffer controller interface.

The MD21 SCSI Interface is implemented using a single LSI chip on the MD21 Controller. In response to commands from the initiator, the chip establishes and monitors SCSI bus phases appropriate to the command. It performs SCSI signal control and timing functions.

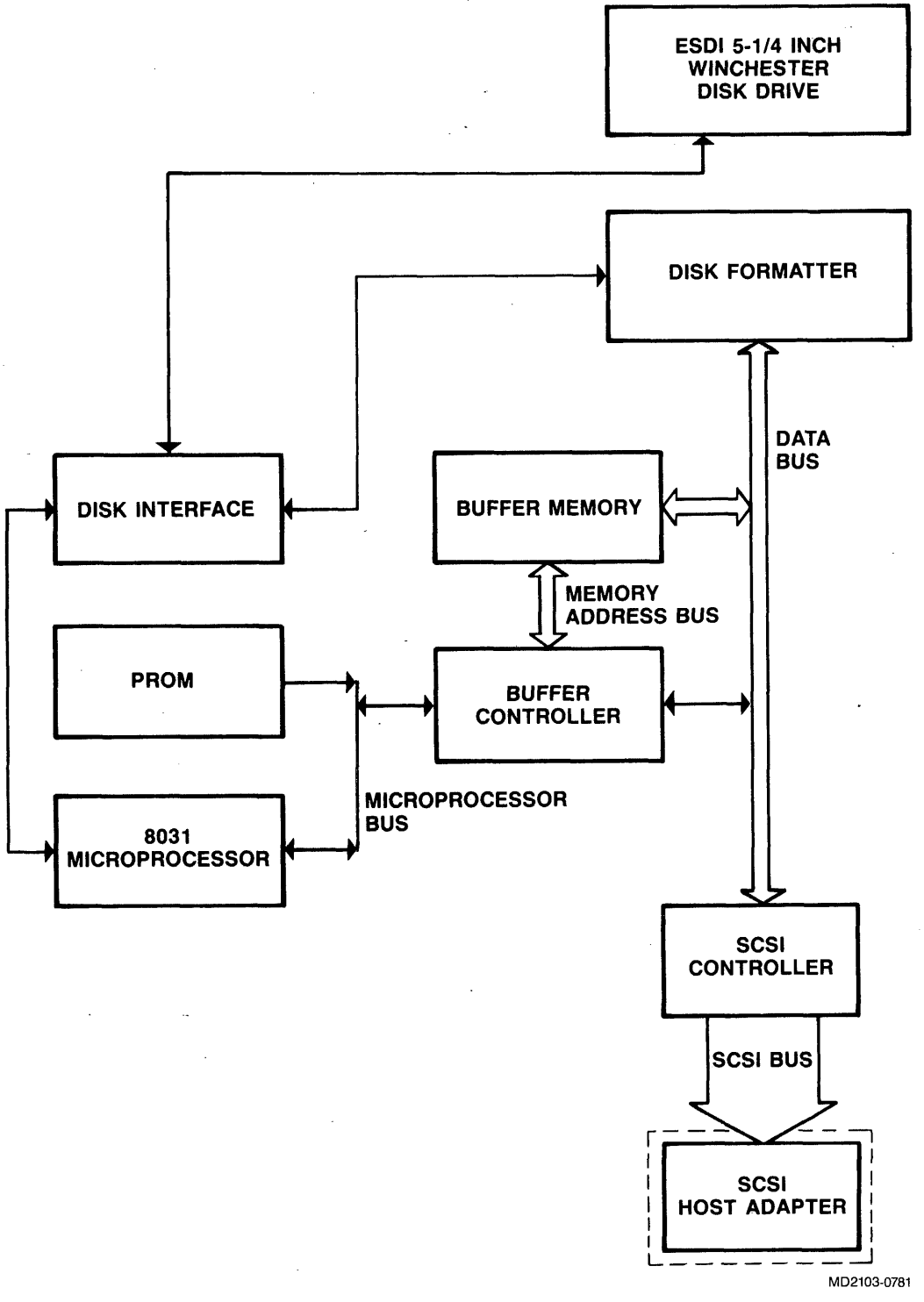


Figure 2-2. MD21 Controller Block Diagram

2.2.2.1 8031 Microprocessor

With the disk formatter, the 8031 microprocessor controls all disk drive operations. These disk operations include drive control, head positioning, and reading drive status.

During disk operations, the disk formatter controls formatting of the data that is written to, and read from, the disk drive. The 8031 microprocessor generates read and write commands that are executed by the disk formatter. All read and write commands involve operations only on a single data block (256 or 512 bytes).

2.2.2.2 Disk Formatter

The disk formatter is a 40-pin VLSI IC fabricated with CMOS gate array technology. This circuit, along with the 8031 microprocessor, handles the read and write operations of the disk drives.

2.2.2.3 Buffer Controller

The buffer controller is a 68-pin VLSI IC fabricated with CMOS gate-array technology. The circuit is basically a three-channel DMA controller. The buffer controller controls data movement in or out of a dynamic buffer memory and provides the connection between the microprocessor bus and the data bus.

The buffer controller circuit provides the address and control for multiple MD21 Controller activities that access a dynamic buffer memory. The buffer controller performs the following operations:

- Handles buffer addressing and control operations for the disk formatter
- Handles buffer addressing and control operations for the SCSI protocol controller
- Handles dynamic memory timing and refresh
- Performs parity checking and generation for the buffer memory
- Connects the microprocessor bus to the data bus
- Decodes the microprocessor address for the buffer memory and the internal input/output (I/O) space in the MD21 Controller
- Determines priority of buffer memory access

2.3 SCSI BUS OVERVIEW

The Small Computer System Interface (SCSI) is a standard interface established to support mass storage, printer output, and network communication for microcomputers and minicomputers. The interface is an eight-port, daisy-chained bus. The SCSI command standard for the MD21 Controller is based on the ANSI SCSI Interface Specification listed on page vii.

The SCSI bus can support up to eight SCSI host adapters and/or controllers. Each controller can be connected to a maximum of eight devices (called Logical Unit Numbers, or LUNs). The MD21 Controller hardware supports any combination of host adapters, intelligent controllers, or intelligent peripherals connected to the SCSI bus. The MD21 Controller supports one or two LUNs (ESDI disk drives). Three basic SCSI configurations are supported with the MD21 Controller and SCSI bus:

- Single initiator, single target
- Single initiator, multi target
- Multi initiator, multi target

Communication on the SCSI bus occurs between a host adapter and a controller. When a host adapter and a controller communicate, one acts as the Initiator and the other acts as the Target. The Initiator (usually the host adapter) originates an operation, and the Target (usually a peripheral controller, such as the MD21 Controller) performs the operation. Sample system configurations supported by MD21 Controller hardware are shown in Figure 2-3.

Some SCSI bus functions are assigned to the Initiator and some functions are assigned to the Target. The Initiator can arbitrate for control of the SCSI bus and select a specific Target. The Target can request the transfer of command, data, status, or other information via the SCSI bus. In some circumstances, the Target can arbitrate for control of the SCSI bus to reselect an Initiator and continue an operation. Sometimes, the Target becomes an Initiator and arbitrates for control of the SCSI bus.

SCSI bus data transfer operations are asynchronous and follow a defined request/acknowledge (REQ/ACK) handshake protocol. (This protocol is defined in the ANSI SCSI specification.) One eight-bit byte of information can be transferred with each handshake.

The SCSI bus consists of 18 signal lines. Nine signal lines are for an eight-bit data bus with parity; the other nine signal lines are for control and status signals that coordinate data transfer operations between the host adapter and SCSI controllers. SCSI bus signals are described in more detail in subsection 7.2.3.1.

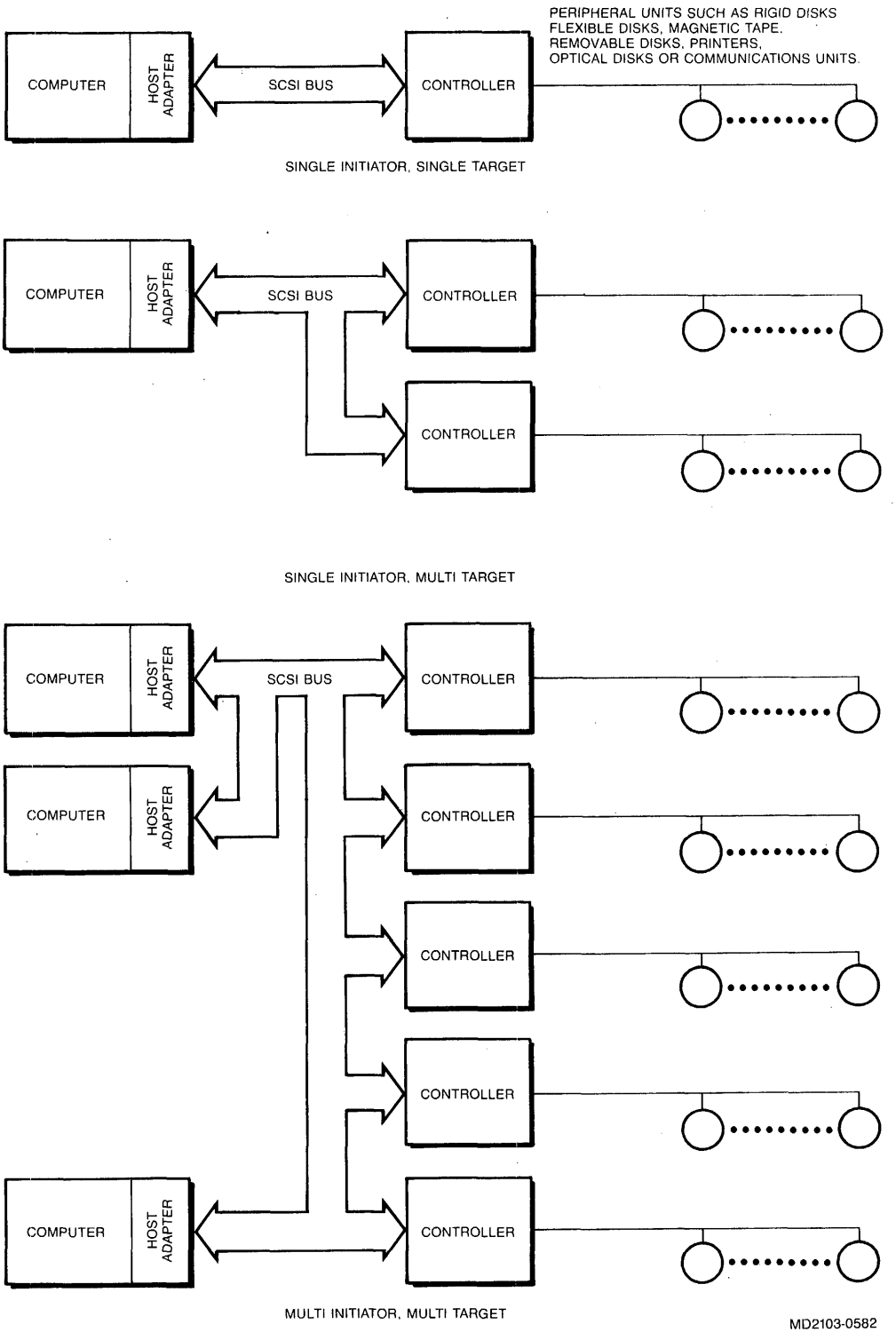


Figure 2-3. Sample SCSI Bus Configuration

2.4 ESDI OVERVIEW

The Enhanced Small Device Interface (ESDI) is a standard interface established to support multiple disk drives on the same controller. ESDI was designed to extend the capabilities of the ST506 interface. The following points regarding the MD21 implementation of the ESDI should be noted:

- The data separator is on the drive (instead of the controller as in ST506 interfaces); therefore, NRZ data can be used between controller and drive.
- The drive, not the controller, provides the reference clock.
- On the data cable, ESDI replicates rotational information from the control cable so that each drive position can be monitored radially. This capability increases performance in multiple-disk configurations.
- ESDI supports higher data transfer rates.

A typical multi-drive ESDI configuration is shown in Figure 2-4.

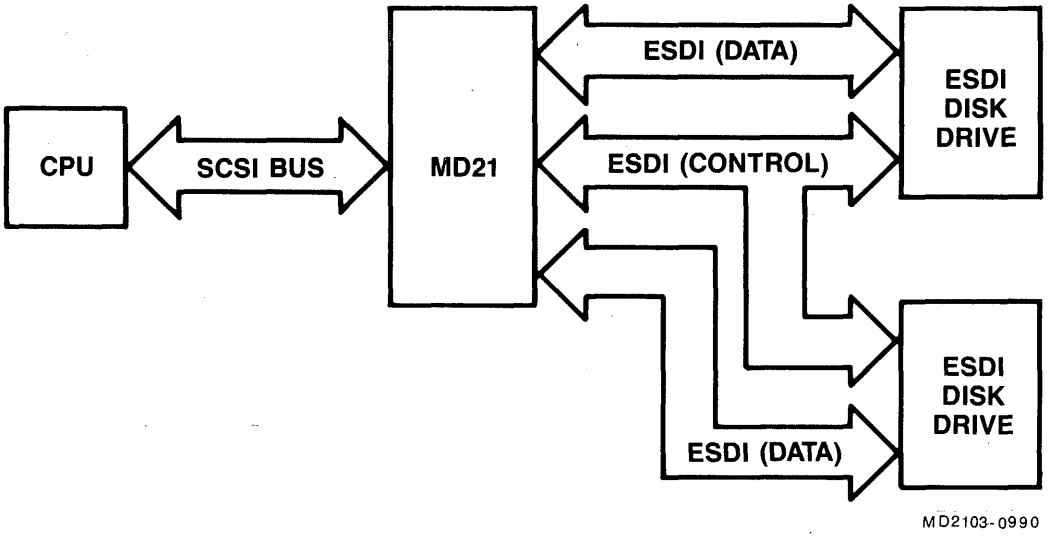


Figure 2-4. Typical Multi-Drive Configuration

2.5 COMPATIBILITY

The following subsections discuss compatibility of the MD21 Controller with specific ESDI disk drives and SCSI host adapter systems and related microcontrollers. For more information about SCSI programming, refer to the Emulex SCSI Disk Controller Programming Reference Manual (part number MD2352501-00, Rev C).

2.5.1 SCSI BUS HARDWARE COMPATIBILITY

A disk drive that is connected to the SCSI bus, and that follows the protocol outlined in the ANSI SCSI Specification, is compatible with the MD21 Controller/disk drive unit. A standard 50-pin male connector, reference designated J6, plugs directly into the SCSI bus cable.

The MD21 Controller supports the SCSI bus single-ended option. The overall length of the cable that connects the SCSI host adapters and controllers in a daisy-chained manner can extend to 6 meters (20 feet). All SCSI bus signals in the cable are terminated at each end by terminating resistors of 220 ohms to +5 VDC, and 330 ohms to ground. Terminators are optionally installed, depending on the physical profile of the SCSI bus. For example, if the host adapter is terminated and no other device except the MD21 is on the SCSI bus, or the MD21 is replacing the last device on the SCSI bus, terminators would be installed in the MD21. The MD21 Controller complies with the FCC limits for a Class B computing device (see subsection 5.6).

2.5.2 ESDI DISK DRIVE COMPATIBILITY

The MD21 Controller connects one or two ESDI 5.25-inch magnetic disk drives via one 34-pin control connector, designated J1, and one or two 20-pin data connectors, designated J2 and J3.

The MD21 supports ESDI disk drives that have clocks up to 15 megahertz. It supports hard-sectored, soft-sectored, and embedded servo disk drives.

See Section 4.2.5 for drives that are supported by the Emulex ESDI-to-SCSI disk controllers.

BLANK

3.1 OVERVIEW

This section contains the specifications for the components on the MD21 Controller. A general description of each component is included under **FUNCTIONAL** in the General and Electrical Specifications table. (For a detailed description of the MD21 Controller's function as a whole, see Section 2, subsection 2.2.2, Functional Description). The specifications for the MD21 Controller are described in separate subsections, as listed in the following table.

Subsection	Title
3.1	Overview
3.2	General and Electrical Specifications
3.3	Physical Specifications
3.4	Environmental Specifications

3.2 GENERAL AND ELECTRICAL SPECIFICATIONS

Table 3-1 lists and describes the general and electrical specifications for the MD21 Controller.

Table 3-1. General and Electrical Specifications

Parameter	Description
FUNCTIONAL	
Design	High-speed microprocessor-based disk controller for integration of one or two ESDI 5.25-inch Winchester disk drives to SCSI bus
SCSI Bus/Controller Interface	Standard SCSI bus interface via a standard 50-pin male connector
Disk Drive Interface	ESDI interface for 5.25-inch Winchester disk drives, via a 34-pin drive control connector and a 20-pin data connector

(continued on next page)

Table 3-1. General and Electrical Specifications (continued)

Parameter	Description
FUNCTIONAL	
Subsystem Configuration	One or two non-intelligent 5.25-inch disk drives and one disk controller per subsystem
Number of Heads	Up to 16 read/write heads
Sector Size	Switch-selectable 256-byte sectors or 512-byte sectors
Data Buffering	32K bytes; approximately 14K bytes for each LUN
Data Burst Rate	1.25 Megabytes/second
Self-Test	Controller automatically executes power-up self-test diagnostic routines
Error Detection/ Correction	48-bit ECC corrects up to 17-bit error bursts. Bad sectors automatically remapped to spare sectors; bad tracks automatically remapped to spare tracks.
INDICATORS	
Fault/Activity Display	Light-emitting diodes (LEDs) indicate detected MD21 Controller fault activity; MD21 Controller provides signals that can be used to control off-board LEDs
Option/Configuration Switches	On-board switch module for burn-in self-test procedures and MD21 Controller configuration
Operator Controls/ Indicators	Panel connector for remote control of write-protect and display of ready/busy and write protect status

(continued on next page)

Table 3-1. General and Electrical Specifications (continued)

Parameter	Description
INTERFACES	
Bus Interface	Standard SCSI bus single-ended option using approved receivers and drivers
Disk Drive Interface	Standard ESDI disk drive interface; supports one or two 5.25-inch disk drives
RELIABILITY	
Mean-Time Between Failures (MTBF)	42,425 hours
Manufacturing Burn-in	96 hours (4 days)
ELECTRICAL	
Power	+5 VDC, ± 5%, 1.5 amperes nominal, 50 millivolts ripple maximum

3.3 PHYSICAL SPECIFICATIONS

Table 3-2 lists and describes the physical specifications for the MD21 Controller. Figure 3-1 shows the physical dimensions of the MD21 Controller.

Table 3-2. Physical Specifications

Parameter	Description
Packaging	Single board, 5.25-inch footprint, 5.75-inches by 8-inches
Cabling	20-pin Drive 1 and 2 data cables; daisy-chained 34-pin drive control cable; daisy-chained 4-pin power connector; 50-pin flat-ribbon cable to SCSI bus
Lengths	20-pin data cable: maximum length of 3 meters (10 feet); 34-pin control cable: maximum length of 3 meters; 50-pin SCSI cable: maximum length of 6 meters (20 feet)
Mounting	Mounts up to 3 meters (10 feet) away from the ESDI 5.25-inch Winchester disk drive using standard #6 screws
Holes (Set 1)	Length = 7.94 centimeters (cm) (3.125 inches) center to center; offset 4.13 cm (1.625 inches) from the front edge of the board (the end that contains the SCSI connector) Width = 13.97 cm (5.5 inches) center to center; offset 0.318 cm (0.125 inches) from the board edge Hole Size = 0.396 cm (0.156 inches) minimum
Holes (Set 2)	Length = 16.764 cm (6.600 inches) center to center; offset 1.27 cm (0.500 inches) from the front edge of the board (the end that contains the SCSI connector) Width = 11.684 cm (4.600 inches) center to center; offset 1.473 cm (0.580 inches) from the board edge Hole Size = 0.422 cm (0.166 inches) minimum

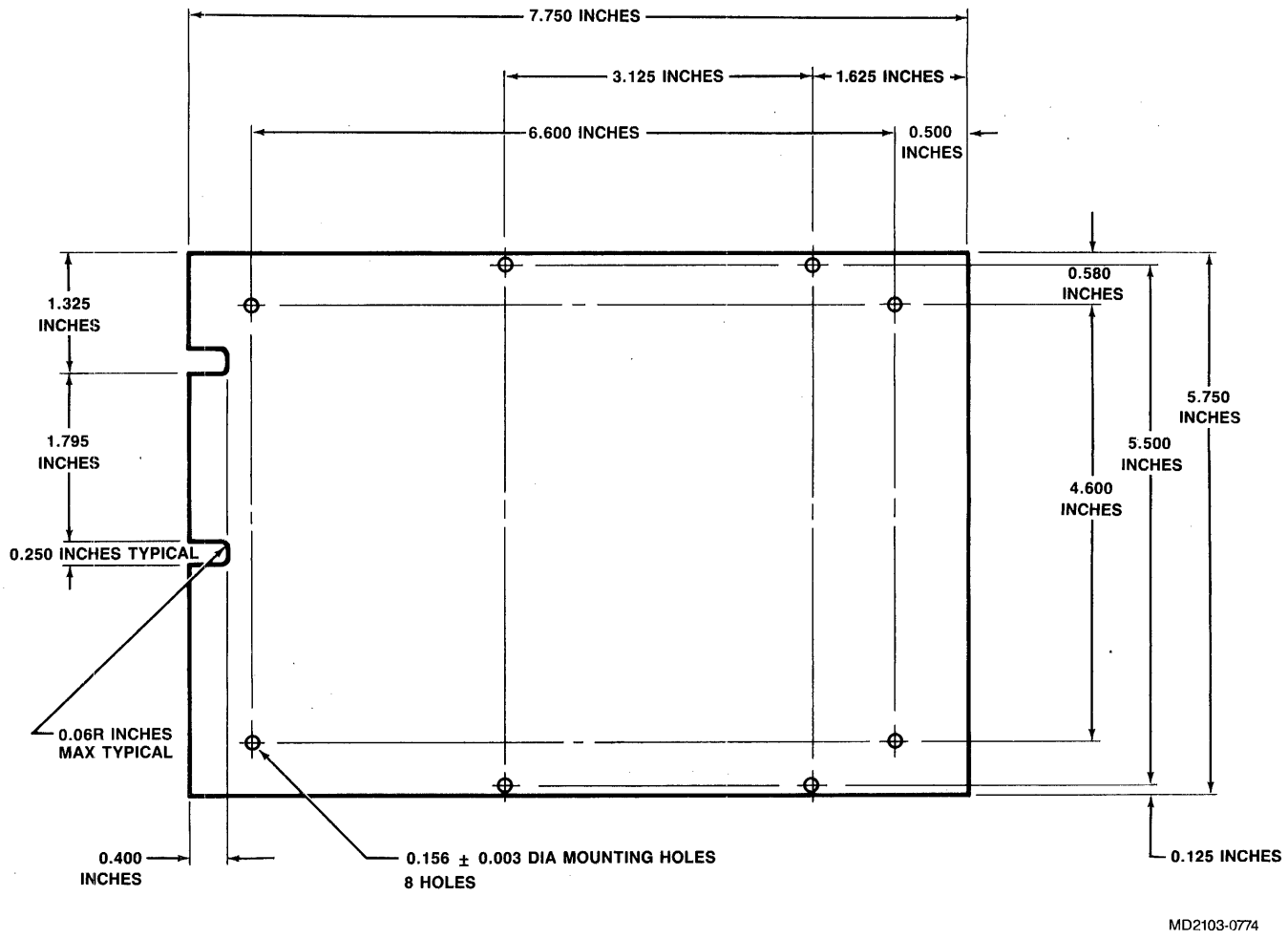


Figure 3-1. MD21 Controller Dimensions

3.4 ENVIRONMENTAL SPECIFICATIONS

Table 3-3 lists and describes the environmental specifications for the MD21 Controller.

Table 3-3. Environmental Specifications

Parameter	Description
Temperature	
Operating	5°C to 50°C (41°F to 122°F)
Storage	-40°C to 66°C (-40°F to 150°F)
Relative Humidity	10% to 95%, noncondensing

BLANK

4.1 OVERVIEW

This section contains the configuration parameters and sector settings for the ESDI disk drives which have been tested by Emulex and are known to be compatible with the MD23 and the MD24. Also included in this section is a discussion of disk operation.

4.2 ESDI DISK DRIVE PREPARATION

4.2.1 DRIVES SUPPORTED

Emulex has tested the MD2X with the following disk drives:

• CAST	10203
• CDC	Wren III 94166-182
• Fujitsu	M2246E
• Hewlett-Packard	97532EA (Coyote)
• Hitachi	DK512
• Maxtor	EXT-4175 Series 2, EXT-4380 Series 3, EST-4380E Series 1
• Micropolis	1350
• NEC	D5652
• Priam	623
• Siemens	Megafile 1300
• Toshiba	MK-156FA-I

4.2.2 DRIVE PLACEMENT

Uncrate and install the disk drives according to the manufacturer's instruction. Position and level the disk drives in the final places before beginning the installation of the MD2X. This positioning allows the I/O cable routing and length to be accurately judged.

4.2.3 DRIVE NUMBERING

The two ESDI disk drives correspond to LUNs 0 and 1. Be careful that the two drives on the same controller are not assigned the same number. (The logical unit number is determined by the address given to the drive.)

4.2.4 SPINDLE CONTROL

Most ESDI drives can be jumpered so that either (1) the drive spins up whenever power is applied or (2) the drive spins up under control of the MD21. Emulex recommends that drives always be jumpered to spin up under control of the MD21.

4.2.5 DRIVE SECTORING AND OTHER OPTIONS

The MD21 supports both hard-sectored and soft-sectored drives. Table 4-1 lists the drives supported by the MD21. This list contains every drive that Emulex has tested to conform to the timing requirements for both the Emulex ESDI-to-SCSI disk controllers and the ESDI specification. Note that specific revision levels are listed for each model of drive. Different revision levels of the same drive can sometimes be significantly different.

The drives in this list have **not** been verified against their own specifications for these parameters: soft/hard error rates, temperature, vibration, humidity, MTBF, MTTR, and others.

Some drives give substantially better performance when they are hard-sectored. These drives are listed in Table 4-1 and Emulex strongly recommends running these drives in hard-sectored mode if possible.

All the parameters listed in Table 4-1 are fully defined in the section following the table.

Table 4-1. Recommended Disk Parameters for Use With MD21

Vendor/Model	Rev	Sectors/Track Size and Type	ISG Size	PLO Size	Bytes per track	Min bytes per sector	Comments
CAST							
10203	86/07	35 / 512 Soft	18	18	20880	592	
		62 / 256 Soft				336	
CDC							
Wren III 94166-182	Lot	36 / 512 Hard	16	11	20880	577	
	8632	65 / 256 Hard				321	
Fujitsu	C4	35 / 512 Hard	20	12	20864	583	Hard-sectors
M2246E		63 / 256 Hard				327	recommended.
Hewlett-Packard							
97532EA (Coyote)	87/04	64 / 256 Imbed	44	13	22400	348	Aggressive Seek & Fast command timing
Hitachi							
DK512	F C/T3	35 / 512 Hard	29	11	20944	590	Hard sectors
		62 / 256 Hard				334	recommended.
Maxtor							
EXT-4175 Series 2	7	34 / 512 Soft	12	26	20808	611	
		58 / 256 Soft				352	
EXT-4380 Series 3	3	34 / 512 Soft	12	26	20808	611	
		58 / 256 Soft				352	
EXT-4380E Series 1	7	34 / 512 Soft	14	24	20940	604	
		60 / 256 Soft				346	
Micropolis							
1350	86/11	36 / 512 Hard	16	11	20833	577	Fast & Normal Seek
		64 / 256 Hard				321	
NEC							
D5652	86/04	35 / 512 Hard	24	11	20992	585	
		63 / 256 Hard				329	
Priam							
623	CCL-D	35 / 512 Hard	26	11	20832	587	
		63 / 256 Hard				330	
Siemens							
Megafile 1300	19 & 16	35 / 512 Imbed	32	16	21280	608	
	64 & 80						
Toshiba							
MK-156FA-I	B	35 / 512 Hard	20	11	20832	581	
		64 / 256 Hard				325	

The parameters shown in Table 4-1 are defined as follows:

Vendor/Model This indicates what company produced the drive and the model of drive that was tested.

Rev This is the Revision number of date of manufacture for the drive that was tested.

Sectors/Track This is the maximum number of sectors that can be used. Note that the drive may not have switch or jumper options capable of selecting this number of sectors. If this is the case, the next smaller value should be used.

Size This is the size in bytes for the data portion of the sector.

Type This is the recommended type of sectoring (Used in calculating this information). In some cases this is also the only sectoring possible. The possible types are:

- **Soft** The controller determines format.
- **Hard** The drive provides the sector pulses.
- **Imbedded** The drive provides sector pulses but the drive uses servo information from between the sectors and not from a separate Servo Track. This also indicates that the Head Switch time will be equal to a single track seek.

ISG This is the minimum length required for the Inter-Sector Gap as specified by the drive via the ESDI request configuration command.

PLO This is the minimum number of bytes required in each of the Phase Lock Oscillator fields as specified by the drive via the ESDI request configuration command. One of these exits before both the Header and Data fields.

Bytes per Track This is the number of bytes guaranteed to be present on a track on one surface (head) of the drive as specified by the ESDI request configuration command.

Min bytes per sector	In the Hard Sector mode this is the minimum number of bytes between sector pulses that is required by the controller. For a soft-sectored drive, this is the sector length the controller will use. This size includes all controller and drive overhead, gaps, sync, and data fields.
Comments	This column mentions any non-standard ESDI features supported by both the controller and drive. Having this information may assist you in setting option jumpers.

4.3 DISK OPERATIONS

The following subsections describe controller functions during operations with the disk drive.

4.3.1 SECTOR AND TRACK FORMAT OPERATIONS

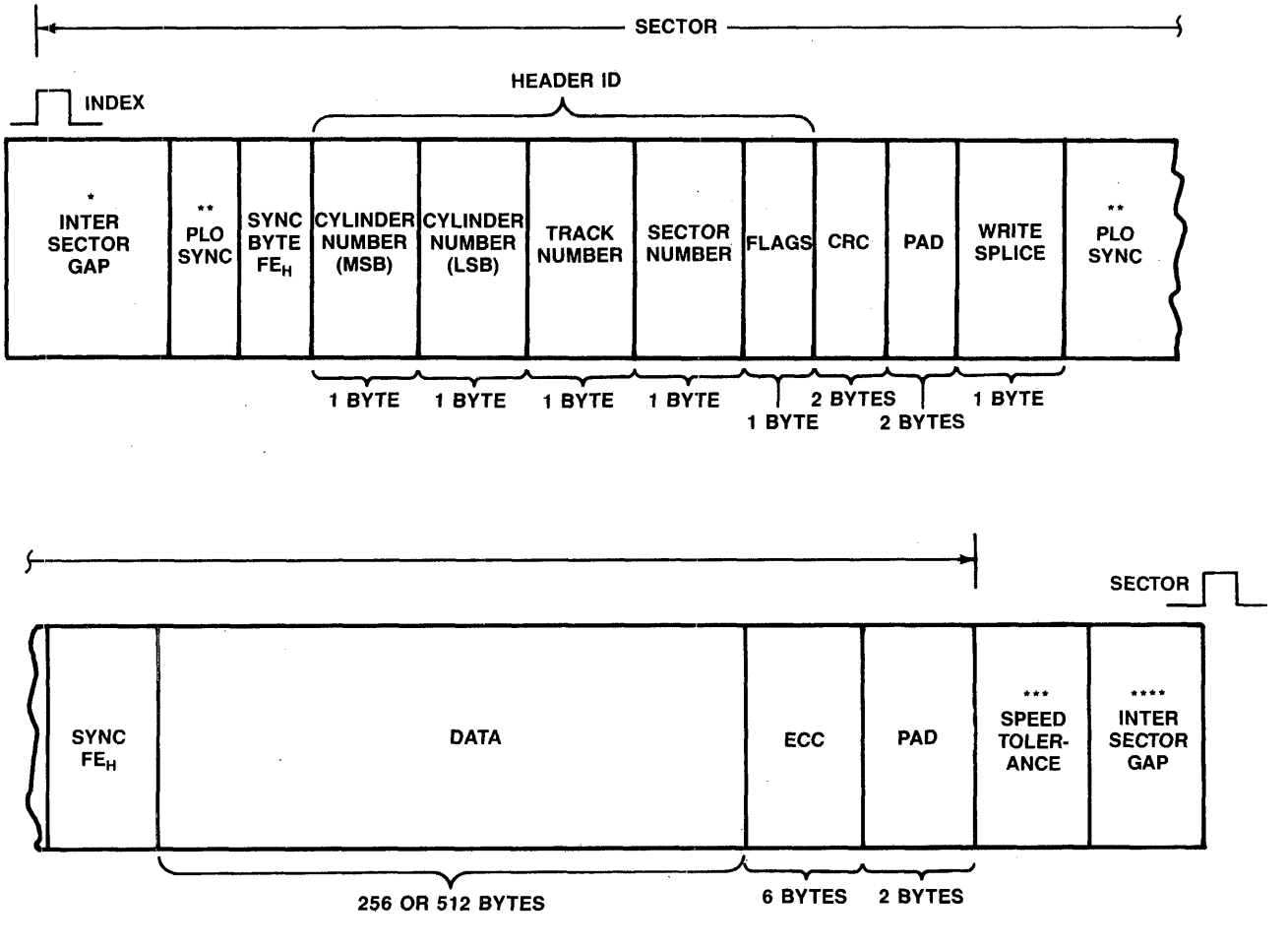
For hard-sectored disk drives, the controller formats each sector as shown in Figure 4-1. For soft-sectored disk drives, the controller formats each sector as shown in Figure 4-2. The Inter Sector Gap (ISG) and PLO Sync fields vary between disks and their sizes are returned by the disk drive over the disk interface (see Figure 4-1 and 4-2). The controller formats each track with a physical address in the header identification (ID) field of each sector. The controller supports a 5-byte header as shown in Figure 4-1 and 4-2. The track address is defined as the cylinder and head address of the specified track. Spare sectors may be allocated on each track. The interleave factor may be specified during a format operation (see the **FORMAT UNIT** command in the Emulex SCSI Disk Controller Programming Reference Manual, manual number MD2352501).

When a data track develops multiple error conditions that cannot be resolved by the use of spare sectors, the controller saves the data from the track and reformats it as a flawed data track. The defective data track is reformatted with the Defective Track bit and the track address of the allocated alternate track in the header of each sector. The data saved from the defective track is written to the alternate track.

An alternate track is a track in the reserved-controller storage area on the disk drive. When an alternate track is so allocated, it is formatted with the sector address of the defective track. The controller considers the interleave factor when it formats an alternate track.

4.3.2 GROWN DEFECT LIST OPERATIONS

The controller maintains the Grown Defect List on one cylinder in an area that is not accessible to the host. The Grown Defect List is duplicated on each track of the Grown Defect List cylinder and may not be larger than one track. The controller returns the contents of the Grown Defect List during the Data Out phase of a **READ DEFECT LIST** command (described in the Emulex SCSI Disk Controller Programming Reference Manual, manual number MD2352501).



*REPORTED BYTES AFTER INDEX FROM THE DRIVE
**REPORTED PLO FIELD FROM THE DRIVE +1
***IF THE DRIVE REQUIRES A SPEED TOLERANCE GAP THIS LENGTH IS THE UNFORMATTED SECTOR SIZE TIMES .01 OR .02 DEPENDING ON WHAT THE DRIVE REPORTS.
****REPORTED INTER SECTOR GAP MINUS REPORTED BYTES AFTER INDEX.

MD2103-0821

Figure 4-1. Sector Format for Hard-Sectored Disk Drives

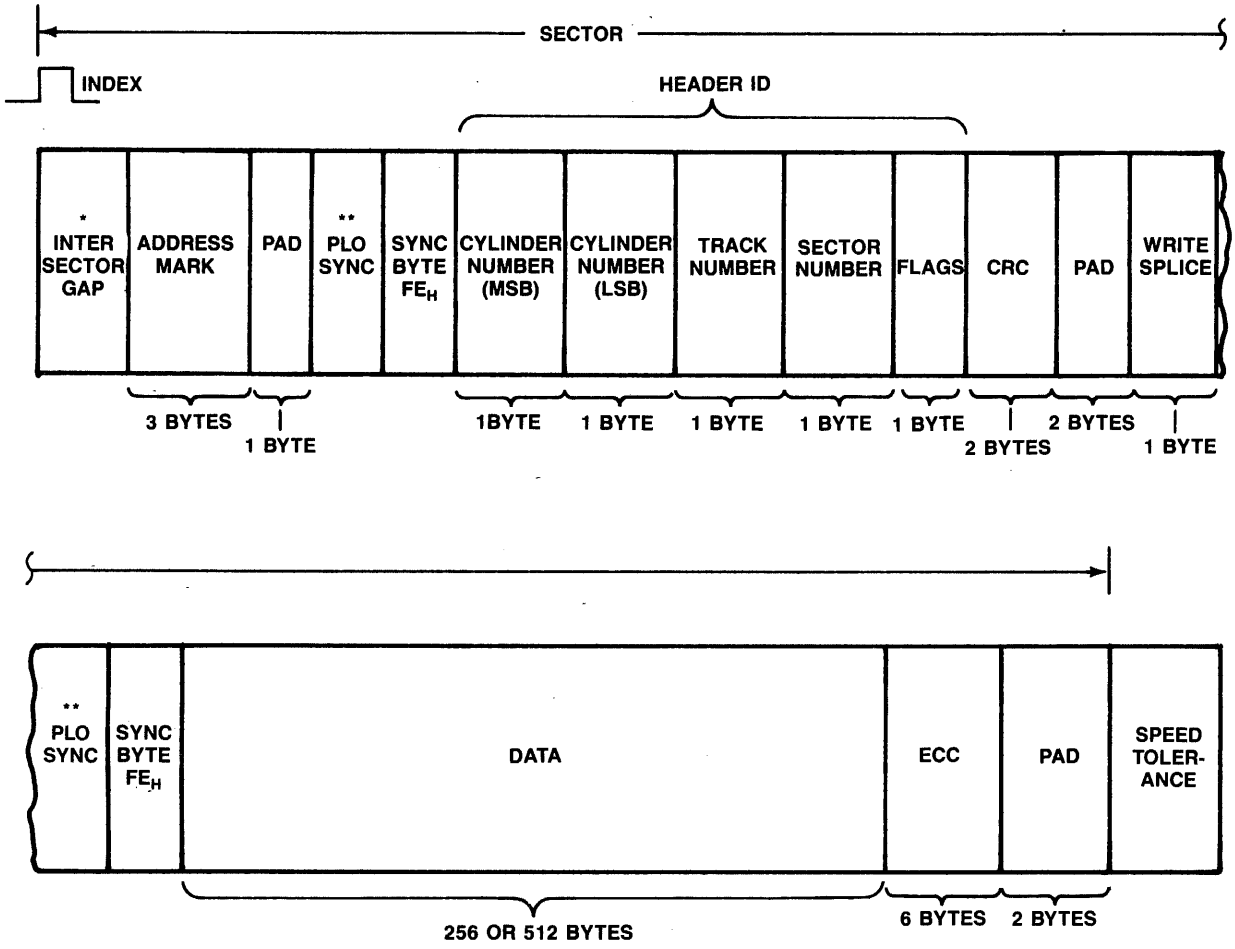


Figure 4-2. Sector Format for Soft-Sectored Disk Drives

5.1 OVERVIEW

This section describes the step-by-step procedure for setting up and installing the MD21 Controller. This section is divided into five subsections, as listed in the following table:

Subsection	Title
5.1	Overview
5.2	Inspection
5.3	MD21 Controller Setup
5.4	MD21 Controller Installation
5.5	FCC Compliance

If you are unfamiliar with the MD21 Controller installation procedure, we recommend reading this Installation Section before beginning.

When you are installing the subsystem, you should make a record of the subsystem configuration and environment. Figure 5-1 is a Configuration Record Sheet that lists the information required. Also, this information will be of help to an Emulex service representative should your subsystem require service.

MD21 CONFIGURATION REFERENCE SHEET

GENERAL INFORMATION

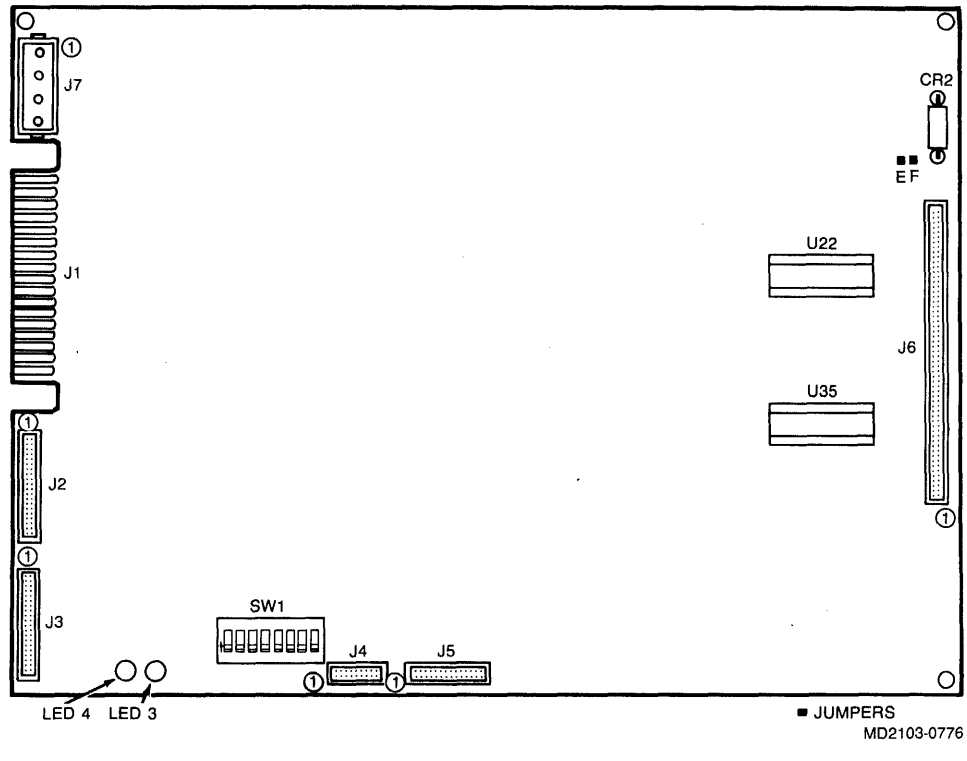
- Host computer Type _____ SCSI Bus Address _____
- Host computer operating system _____
  Version _____
- Other SCSI Controllers: Type _____ , SCSI Bus Address _____
  _____ , _____
  _____ , _____
  _____ , _____

DRIVE CONFIGURATION PARAMETERS

	Drive 1	Drive 2
• Drive Manufacturer(s)	_____	_____
• Model Number	_____	_____
• Parameters:		
Number Units	_____	_____
Sectors/Track	_____	_____
Heads	_____	_____
Cylinders	_____	_____

MD21 CONFIGURATION

- Firmware revision number _____
- Top assembly number _____
- SCSI bus address _____
- Warranty expiration date _____
- Serial number _____



MD2103-1012

Figure 5-1. MD21 Configuration Reference Sheet

5.2 INSPECTION

Emulex products are shipped in special containers designed to provide full protection under normal transit conditions. Immediately upon receipt, please follow this procedure:

1. Inspect the shipping container for evidence of possible damage incurred in transit.

2. Unpack the MD21 Controller and verify that all components listed on the shipping invoice are present.

3. Verify that the model or part number (P/N) designation, revision level, and serial numbers agree with those on the shipping invoice.

   These verifications are important to confirm warranty. If evidence of physical damage or identity mismatch is found, notify an Emulex representative immediately.

4. Check the MD21 Controller after unpacking for bent or broken connector pins, damaged components or any other evidence of physical damage.

5. Carefully examine all socketed components to ensure that they are firmly and completely seated.

Report any obvious damage to the container, or indications of actual or probable equipment damage, to the carrier company in accordance with instructions on the form included in the container.

5.3 MD21 CONTROLLER SETUP

5.3.1 SWITCH SETTINGS

Some of the switches in DIP switch pack SW1 on the MD21 Controller allow configuration of various options available with the MD21. All switches on the MD21 Controller are set to a standard configuration before the MD21 Controller is shipped from the factory. Table 5-1 lists the function and factory settings of all switches on the MD21 Controller. This subsection provides a detailed description of the function of each switch.

NOTE

If the position of a switch on the MD21 is changed, the host must issue a reset before that switch change becomes permanent.

Table 5-1. DIP Switch Settings, MD21 Controller

Switch	Function	Options (Factory Settings in **Boldface**)	Section
SW1-1	SCSI Bus Address (LSB)		5.3.1.1
SW1-2	SCSI Bus Address	**00**, 01 through 07	5.3.1.1
SW1-3	SCSI Bus Address (MSB)		5.3.1.1
SW1-4	Not Used		--
SW1-5	Physical Sector Size*	**0=512 bytes**, 1=256 bytes	5.3.1.2
SW1-6	Disable Drive Spinup	**0=Drives are spun up automatically** 1=Drives are not spun up automatically	5.3.1.3
SW1-7	Disable Soft Error Reporting	**0=Errors reported** 1=Errors not reported	5.3.1.4
SW1-8	SCSI Bus Parity Enable	**0=Parity Check disabled** 1=Parity Check enabled	5.3.1.5
	0 = OFF/OPEN 1 = ON/CLOSED		
	*This switch applies only to soft-sectored drives and is ignored by hard-sectored drives.		

Figure 5-1 shows the location of the configuration switches on the MD21 Controller. The configuration switches should be set before the MD21 Controller and the disk drive are installed in a subsystem, because the switches may not be accessible after the MD21 Controller and the disk drive are installed.

5.3.1.1 SCSI Device Address Selection (SW1-1 through SW1-3)

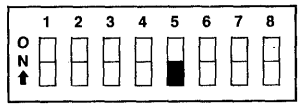
Switches SW1-1, SW1-2, and SW1-3 select the SCSI bus address for the MD21 Controller. The selected address establishes the SCSI bus identity of the MD21 Controller in the system. An Initiator must specify this address to select the MD21 Controller as a Target device. Verify the switch settings with Table 5-2 and be sure that the same SCSI device address is not assigned to another host adapter or controller.

Table 5-2. SCSI Device Address Selection Switches

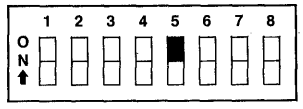
SW1-3 (MSB)	Switch SW1-2	SW1-1 (LSB)	SCSI Device Address
0	0	0	00
0	0	1	01
0	1	0	02
0	1	1	03
1	0	0	04
1	0	1	05
1	1	0	06
1	1	1	07
0 = OFF (OPEN) 1 = ON (CLOSED)			

5.3.1.2 Sector Size (SW1-5)

Switch SW1-5 determines the size of the sector on the disk drive (soft-sectored drives only). Setting this switch to ON (closed) sets the sector size on the disk drive to 256 bytes. Setting this switch to OFF (open) sets the sector size to 512 bytes. The factory setting is OFF, as shown in Figure 5-2.



512 bytes (factory setting)



256 bytes

Figure 5-2. Sector Size Switch Setting

5.3.1.3 Disable Drive Spinup (SW1-6)

Switch SW1-6 indicates whether or not the MD21 Controller automatically spins up the drive during controller power up. When this switch is set to ON (closed), the controller does not spin up the drives during power up. When this switch is set to OFF (open), the controller automatically spins up the drives during power up. The factory setting is OFF, as shown in Figure 5-3.

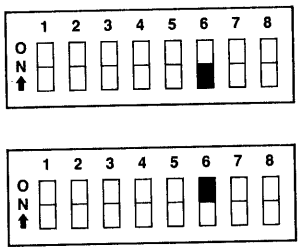


Figure 5-3. Drive Spin Up Switch Setting

NOTE

The disk drive must be configured to only spin up upon a command from the controller or this switch will have no effect.

5.3.1.4 Disable Soft Error Reporting (SW1-7)

Switch SW1-7 indicates whether or not the MD21 Controller reports soft errors that occur during MD21 operations. When switch SW1-7 is left in the OFF (open) position, the MD21 Controller reports soft errors. Setting switch SW1-7 to ON (closed) prevents the MD21 Controller from reporting soft errors. Normally, switch SW1-7 is set to OFF, as shown in Figure 5-4.

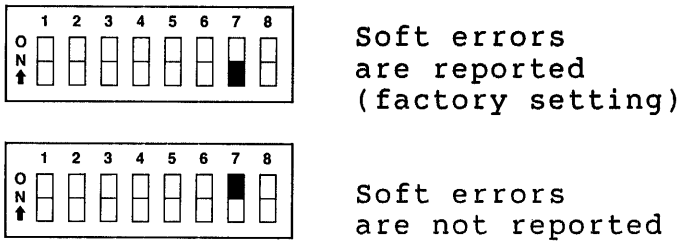


Figure 5-4. Soft Error Reporting Switch Setting

5.3.1.5 SCSI Bus Parity Enable (SW1-8)

Switch (SW1-8) enables the SCSI bus parity check. The factory setting for this switch is OFF (parity check disabled), as shown in Figure 5-5.

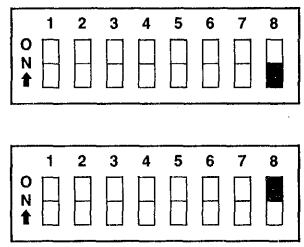


Figure 5-5. Parity Enable Switch Setting

5.3.2 SCSI BUS TERMINATION POWER OPTION

The SCSI termination power option allows the MD21 to supply between +4 and +5 VDC power to the subsystem's external terminators via pin 26 of the SCSI bus. The SCSI Termination Power option is not required if the MD21 is resident in an Emulex subsystem that contains an internal terminator power board. On-board terminators (see subsection 5.3.3) do not require that the SCSI Termination Power option be installed.

- - - - - - - -
C A U T I O N
- - - - - - - -

> When this option is implemented, the voltage supplied on pin 26 is not current limited. If this pin becomes grounded--for example, by a misoriented connector--damage to the MD21 Controller and/or to the system cabling may result.

If the SCSI termination Power option is required, install a #1N5817 diode at reference designator CR2. Also connect a wire-wrap jumper between jumper posts E and F. See Figure 5-1.

CAUTION

If diode leads are reversed so that the anode of the diode is in the wrong hole, the system will not function properly (the cathode end is usually identified by a white line or other unique marking on the diode).

If there are multiple controllers attached to the SCSI bus and power is removed from the MD21 Controller that is configured to supply the terminator power, the other controllers will not function correctly. Under these conditions, the host should supply the power.

5.3.3 SCSI BUS TERMINATION

The MD21 Controller can be configured to terminate the SCSI bus by inserting one 220/330-ohm resistor pack in the sockets located at U22 and U35 on MD21. The resistor packs are available in the Emulex SCSI terminators kit, P/N MD0113002. A SCSI system configuration should contain only two devices that terminate the SCSI bus. Usually these devices are a host adapter and one peripheral device controller (such as the MD21 Controller). Termination should be installed only on the controller that is physically last on the SCSI bus.

5.4 MD21 CONTROLLER INSTALLATION

This subsection describes a sample procedure for installing the MD21 Controller in the disk drive chassis. To install the MD21, see Figures 5-6 and 5-7 and use the following procedure:

NOTE

The installation instructions and figures in this subsection assume the use of an Emulex mounting bracket to install the MD21 on top of the ESDI disk drive. It is necessary to use some kind of intermediary device so that the controller does not sit directly on the disk drive. One mounting bracket for use with the MD21 is available in Emulex kit number MD0113003.

1. Configure the MD21 Controller by setting the switches on switch pack SW1. All switches have been set at the factory; however, you may need to reset some switches for your specific needs.

2. Place the disk drive on a flat surface.

3. Place the MD21 Controller (component side up) on top of the mounting bracket. Align the four screw holes on the MD21 Controller with the four screw holes on the mounting bracket (see Figure 5-6). Secure the MD21 Controller in place with four 4-40 x 1/4-inch screws.

4. Connect the control cable from the disk drive to connector J1 on MD21 Controller. See Figure 5-7.

5. Connect the data cable(s) from the disk drive to connectors J2 and/or J3 on the MD21 Controller. See Figure 5-7.

6. Connect the cable from the power supply to power connector J7 on MD21. See Figure 5-7.

7. Connect the SCSI bus cable to SCSI bus connector J6 on MD21 Controller. See Figure 5-7.

8. If you are going to connect the controller to a user panel, refer to section 7.4.

NOTE

Note that Figure 5-7 shows a SCSI flat-ribbon cable that is used to internally connect the MD21 Controller with a SCSI host adapter. If the MD21 Controller and SCSI host adapter reside in different cabinets, you must use a shielded SCSI cable to connect them to maintain FCC compliance (see subsection 5.5). For more information on shielded cable requirements, see subsection 7.2.1.2.

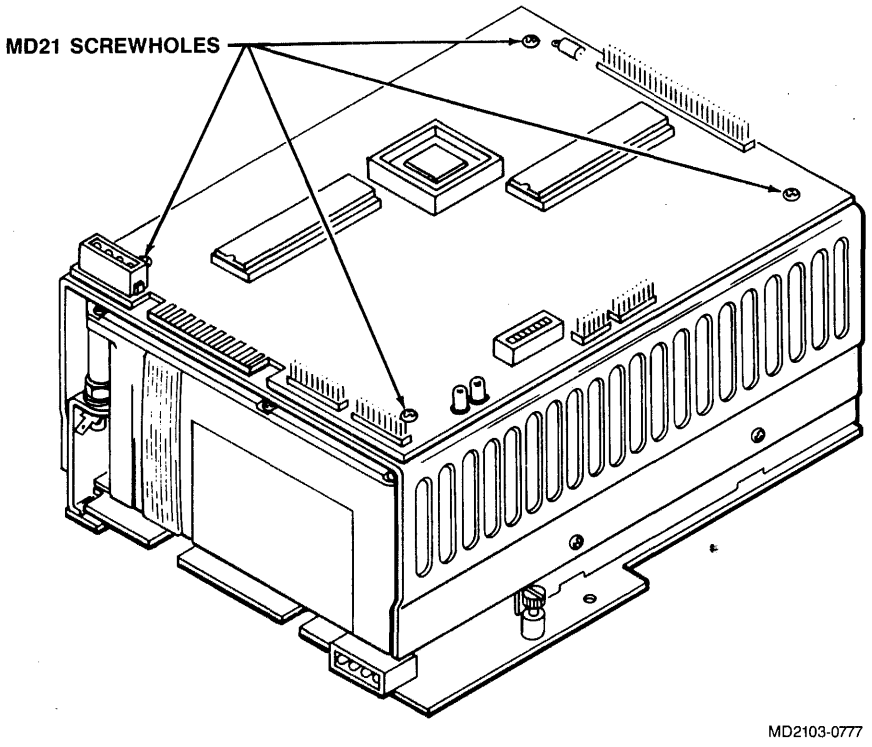


Figure 5-6. Installing the MD21 Controller on the Mounting Bracket

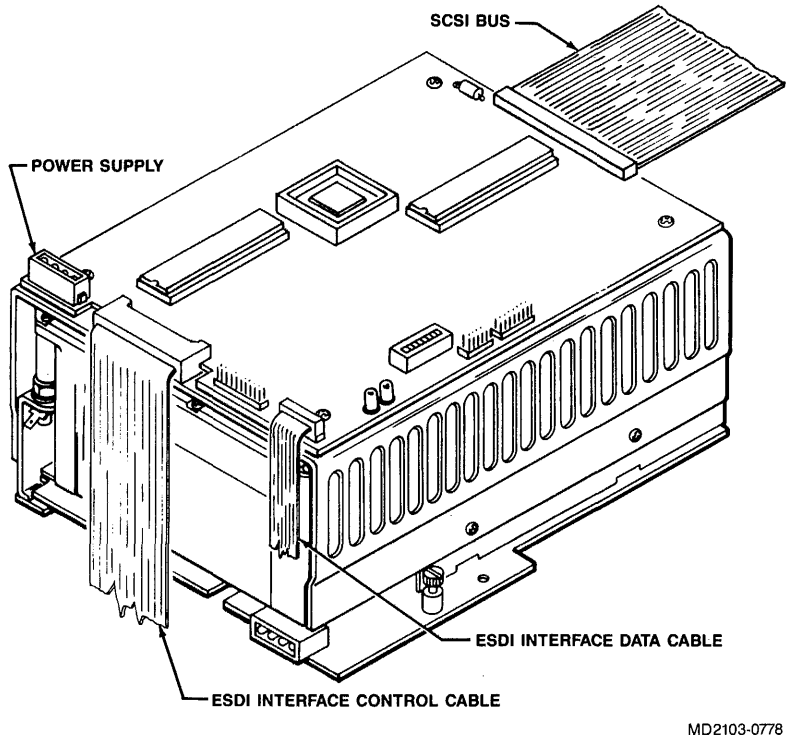


Figure 5-7. Connecting the Disk Drive Data and Control Cables and the SCSI bus to the MD21 Controller

Table 5-3 summarizes the specifications for each type of cable:

Table 5-3. Disk Drive Cable Requirements

	Control Cable (daisy-chained to 1 or 2 drives)	Data Cable (One cable to each drive)
Number of lines	34	20
Maximum cumulative cable length	10 feet (3 meters)	10 feet (3 meters)
Recommended connector	AMP ribbon connector P/N 499560-3 (or equivalent)	AMP ribbon connector P/N 499560-6 (or equivalent)
MD21 cable	J1	J2 and/or J3

5.5 FCC COMPLIANCE

The Federal Communications Commission (FCC) has established technical standards regarding radiation of electromagnetic interference (EMI) emitted by computing devices. The MD21 Controller has been type tested and found to comply with the EMI emission limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules. However, there is no guarantee that interference will not occur in a particular installation.

The MD21 Controller was tested for FCC compliance in a compliant subsystem that was properly shielded (enclosed so that no electromagnetic radiation escapes). The subsystem was connected to other SCSI port devices via a shielded SCSI bus cable. Emulex offers shielded cables, compatible with the MD21 Controller, that are available in various lengths. For information on SCSI bus cable and connector requirements, see subsection 7.2.1.

The MD21 Controller equipment generates and uses radio frequency energy. If it is not installed and used in strict accordance with Emulex's instructions, it may cause EMI with radio and television reception. It is the responsibility of the user to properly install the MD21 and ESDI disk drives in a subsystem.

When installing the MD21 and its disk drives, you must take care that the shield that has been built into equipment cabinets is not defeated.

The routing of the cables that connect the MD21 and its disk drives can have a major impact on the amount of EMI that is radiated by the system, especially if the MD21 and the disk drives are installed in separate cabinets. Emulex is not responsible for any radio or TV interference caused by unauthorized modifications to the MD21 Controller.

If the MD21 Controller causes interference with radio or television reception, as determined by turning the equipment on and off, try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna.
- Relocate the compliant subsystem (that contains the MD21 Controller) with respect to the receiver.
- Move the compliant subsystem away from the receiver.
- Plug the compliant subsystem into a different outlet so that the subsystem and receiver are on different branch circuits.
- Verify that the mounting screws and grounding wires on the compliant subsystem are tightly secured.

If necessary, consult the dealer or an experienced radio/television technician for additional suggestions. You may find the following booklet prepared by the FCC helpful:

Title:	How to Identify and Resolve Radio-TV Interference Problems
Publication Number:	Stock No. 004-000-00345-4
Publisher:	U.S. Government Printing Office Washington, D.C. 20402

Section 6
CONTROLLER INITIALIZATION AND SELF-TEST PROCEDURES

6.1 OVERVIEW

This section describes the diagnostic features with which the MD21 Controller is equipped. MD21 Controller diagnostic modes include power-up (and reset) self-test and online host-initiated diagnostic facilities. The principal function of these tests is to determine MD21 Controller functional integrity and to distinguish failures of the MD21 Controller from those of the disk drive. This section is divided into four subsections, as listed in the following table:

Subsection	Title
6.1	Overview
6.2	Controller Reset/Power Up Initialization
6.3	Self-Test Modes
6.4	Online Diagnostic Commands

6.2 CONTROLLER RESET/POWER UP INITIALIZATION

This section describes the sequence of events during controller initialization and self-test sequences. The self-test sequence occurs before the initialization sequence occurs.

6.2.1 SELF-TEST SEQUENCE

The self-test sequence will be executed only when a controller power-up condition occurs. The self-test sequence verifies the integrity of the hardware. This test is not an exhaustive hardware diagnostic, but simply checks the major components for full functionality. If the self-test fails, the controller will light the Error Indicator and will stop any further initialization. If the self-test fails, only a SCSI Bus Reset or Power On Reset condition will restart the controller. During the self-test, the controller will not respond to a Selection Phase on the SCSI Bus.

The self-test sequence consists of the following events:

- **Hardware Reset Test** - This routine tests the 8031 microprocessor, buffer controller, disk formatter, and SCSI reset latch for the proper power-up condition. If any of these tests fail, the controller can only be reset by a power-up condition.

- **8031 Test** - This routine tests the 8031 internal memory, timers, and register bank switching for proper operation.

- **PROM Checksum Test** - This routine performs a checksum calculation on the controller firmware PROM and compares it against the checksum stored in the PROM.

- **Buffer Controller Test** - This routine tests the buffer controller for proper operation. All the registers are tested and the chip is engaged to access RAM memory. Other portions of the self-test check parts of the buffer controller, which cannot be tested at this time.

- **Dynamic RAM Test** - This routine tests the dynamic RAM memory by writing and reading different patterns to memory. In addition, the buffer controller is tested for proper refresh operation and parity detection. This test also tests the memory parity interrupt.

- **Disk Formatter Test** - This routine tests the disk formatter chip by writing and reading all possible patterns to each of the disk formatter chip registers. After the registers are tested, the interrupts are tested to ensure the formatter chip generates an interrupt when a command completes.

- **SCSI Controller Test** - This routine tests the SCSI controller chip by executing the chip diagnostic command. After the diagnostic test completes, the interrupts are tested to ensure the SCSI chip generates an interrupt when a command completes. Finally, the registers are tested by writing and reading all possible patterns to each of the SCSI controller chip registers.

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

During the self-test, the onboard LEDs will indicate which test(s) are in progress as shown in Table 6-1.

Table 6-1. LED Sequences for Self-Test Procedure

Red LED	Green LED	Description
OFF	OFF	Hardware Reset Test
OFF	ON	8031 Test PROM Checksum Test Buffer Controller Test Dynamic RAM Test
ON	OFF	Disk Formatter Test SCSI Controller Test
ON	ON	Self-Test Passed

If any of the tests fail, the pattern (ON or OFF) displayed by the LEDs indicate which portion of the self-test failed.

NOTE

Due to the large amount of RAM memory on some controllers, the power up self-test may take up to 10 seconds to complete. During this time, the controller **will not** respond to a SCSI Bus Selection Phase.

6.2.2 INITIALIZATION SEQUENCE

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

- Controller Power-Up condition occurs
- SCSI Bus Reset (-RST) signal is asserted
- BUS DEVICE RESET message (on the SCSI bus) is received
- A RESET occurs if the DC voltage drops to 4.5 or less and an INITIALIZATION sequence occurs when the voltage returns to 4.515 or above.

Controller Reset/Power Up Initialization

The initialization sequence consists of the following events:

1. Initialize SCSI firmware

   a. Set status for all LUN's to BUSY

   b. Initialize SCSI interface

   c. Enable SCSI interrupts

2. At this point, the controller responds to a selection phase from the initiator but returns a BUSY status until the initialization sequence is complete.

3. Initialize the disk firmware for each LUN supported by the controller.

   a. If a drive is not connected to this LUN, stop initialization for this LUN and go to the next LUN.

   b. Read the defalt parameters from the drive and/or switches.

   c. If this is a power-up condition and the disable spin up switch is off, a **START UNIT** command is sent to the drive to start the spin up operation. The controller will not wait for the spin up to complete before continuing to the initialization sequence. If this is a SCSI bus reset or bus device message reset, no action is taken.

   d. Turn on the user panel "ready" LED.

4. At this point, the BUSY status is removed from all LUNs and the controller accepts commands from the initiator.

Once the initialization sequence is complete, the controller enters the IDLE state and flashes the green LED. As long as the green LED is flashing, the controller is in its normal state of operation.

NOTE

The green LED may stop flashing momentarily while executing an command.

After this sequence is complete, the first command sent by an Initiator is terminated with a CHECK status and a UNIT ATTENTION Sense Key. For more information, see subsection 5.5, SCSI Error Conditions, in the Emulex SCSI Disk Controller Programming Reference Manual (manual number MD2352501).

Until the drives have been spun up, any command sent by an initiator which accesses the media is terminated with a CHECK status and a DRIVE NOT READY sense key.

After the drive has spun up, the first commmand sent by an initiator which accesses the media loads the SAVED MODE sense parameters. Prior to the drive being spun up, if an initiator requests the current MODE SENSE parameters, the controller returns the default MODE SENSE parameters. An initiator should not request the MODE SENSE parameters until the drive is spun up.

6.3 SELF-TEST MODES

The MD21 Controller performs a self-test procedure when it operates in either of two modes: the normal mode or the burn-in mode. These two modes and their corresponding self-test procedures are described in the following subsections.

6.3.1 NORMAL MODE

The MD21 Controller operates in the normal mode when it performs typical disk controller functions such as a disk format operation or a read operation. When the MD21 Controller is operating in the normal mode and power-up or reset conditions occur, it performs a self-test procedure to determine whether its interface circuits, memory, and on-board microprocessor are operative. The self-test procedure consists of several individual tests that exercise separate components of the MD21 Controller. These tests are performed sequentially; the success of one test enables the next test to be executed. If an individual test fails, the MD21 Controller self-test procedure stops at the location of the failure.

Before the self-test procedure begins, a Power-up Reset Clear code is output to the two on-board LEDs to indicate that the MD21 Controller is ready to perform a self-test. If the MD21 Controller self-test procedure succeeds, a Self-Test Pass code is output to the on-board LEDs. The LED locations on the MD21 Controller are shown in Figure 6-1, and LED Test Code descriptions are listed in Table 6-1.

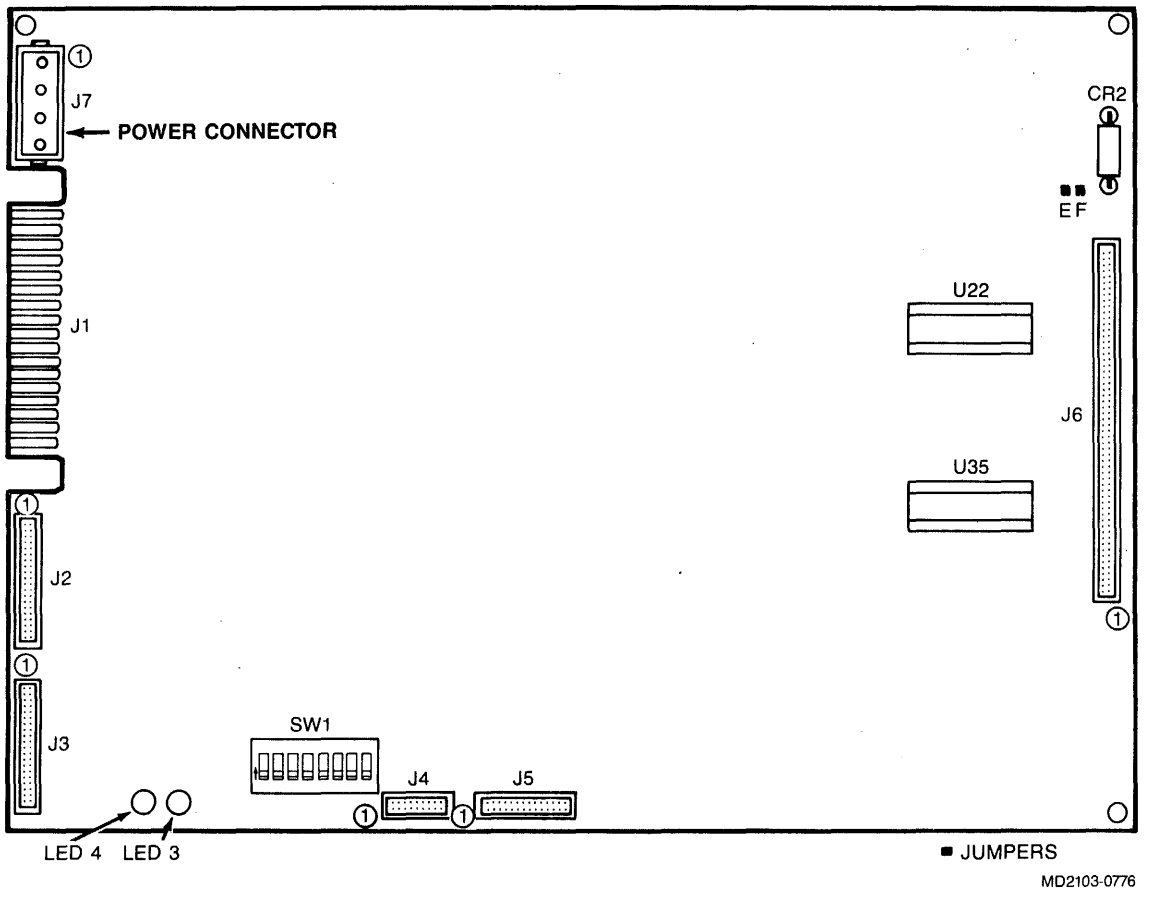


Figure 6-1. Location of LEDs on the MD21 Controller

Table 6-2. LED Test Code Descriptions

LED 2 (Red)	LED 1 (Green)	Test Description
0	0	Power-up Reset Clear
1	1	Power-Up Self-Test Pass Code
0 = OFF (not lit)		1 = ON (lit)

If the MD21 Controller is operative, green LED 1 blinks. If the MD21 Controller fails its self-test procedure, LED 1 does not blink.

After the self-test procedure is successfully completed, the MD21 Controller continues with the initialization routine. If the SCSI interface circuits and the 8031 microprocessor are functioning, the MD21 Controller enters the online mode and is available to the Initiator. At this time, the Power-Up Self-Test Pass code (see Table 6-1) is momentarily displayed by LED 1 and LED 2. Failure of any portion of the self-test result in a selection timeout.

6.3.2 BURN-IN MODE

During the burn-in mode, the MD21 Controller self-test procedure is repeated continuously until a failure is detected. The MD21 Controller contains an eight-bit burn-in connector used to report self-test failures when the MD21 Controller is operating in the burn-in mode. The burn-in connector consists of four pin assignments on the test connector, and four pin assignments on the User Panel connector. The reference designators are as follows (see Figure 6-1):

- MD21 Controller: Test connector: J5
  User panel connector: J4

The burn-in connector pin assignments are shown below:

	Bit							
	07	06	05	04	03	02	01	00
MD21 Connector	J5-9	J5-8	J5-7	J5-12	J4-4	J4-6	J4-7	J4-9

As each individual test is performed during the MD21 Controller burn-in mode, a test code is output to the burn-in connector to indicate which component on the MD21 Controller is currently being tested. If an individual test fails, the corresponding test code is output. The individual tests in the self-test procedure and their corresponding hexadecimal codes are listed in Table 6-2.

To establish the MD21 Controller burn-in mode, ground pin J5-5. Once the burn-in mode has been established, to cause the MD21 Controller to perform its self-test procedure continuously, ground pin J4-8 and reset the MD21 Controller.

Table 6-3. MD21 Controller Test Code Descriptions

Test Code * (hexadecimal)	Test Description
00	Power-up Start Code
01	Buffer Controller Reset Status Test
02	Disk Formatter Reset Status Test
04	SCSI Reset Latch Test
40	8031 Microprocessor Self-Test
41	ROM Checksum Test
42	Buffer Controller LSI Register Test
43	External RAM Data Test
44	External RAM Parity Test
45	Buffer Controller LSI Parity Detection Test
46	Buffer Controller LSI Parity Interrupt Test
80	Disk Formatter LSI Register Test
81	Disk Formatter LSI Interrupt Test
83	SCSI Controller LSI Self-Diagnostic Test
84	SCSI Controller LSI Interrupt Test
85	SCSI Controller LSI Register Test

* Asserted bits are low true.

6.4 ONLINE DIAGNOSTIC COMMANDS

The MD21 Controller supports a set of online diagnostic subcommands, which are used to further delineate peripheral or MD21 Controller failures. These diagnostic subcommands are specified by the **SEND DIAGNOSTIC** command and executed by the **RECEIVE DIAGNOSTIC** command. The diagnostic subcommands are listed in Table 6-3 and described in the **SEND DIAGNOSTIC COMMAND** section of the Emulex SCSI Disk Controller Programming Reference Manual, manual number MD2352501.

Table 6-4. MD21 Controller Diagnostic Subcommands

Diagnostic Subcommand	Description
GET DRIVE STATUS	Causes the MD21 Controller to return unmodified status from the disk drive.
PASS DRIVE COMMAND	Causes the MD21 Controller to pass disk drive commands from the Initiator to the disk drive.
READ DISK PARTITIONS	Causes MD21 Controller to transfer the physical addresses related to the logical partitions on the specified disk drive to the Initiator.
READ HEADER	Causes the MD21 Controller to perform a read operation of the header address field for each block of a track.

BLANK

7.1 OVERVIEW

This section describes the interfaces used by the MD21 Controller. It includes information about how the MD21 implements the SCSI bus interface electrical and mechanical requirements, and how it implements the ESDI interface electrical requirements. It also describes the user panel connection and the DC power connection.

This section is divided into five subsections, as listed in the following table:

Subsection	Title
7.1	Overview
7.2	SCSI Bus Interface
7.3	ESDI Disk Drive Interface
7.4	User Panel Connection
7.5	DC Power Connection

7.2 SCSI BUS INTERFACE

This subsection provides information about MD21 Controller implementation of SCSI bus electrical and mechanical requirements.

7.2.1 SCSI BUS INTERFACE PHYSICAL DESCRIPTION

The following features of the SCSI Bus Interface should be noted:

- SCSI bus devices are daisy-chained with a common cable; both ends of the cable are terminated.
- All signals are common among all SCSI bus devices.
- The MD21 Controller supports the ANSI SCSI specification single-ended option for drivers and receivers.

- The maximum cable length allowed is 6 meters (20 feet).

  The length of the cable located within the FCC compliant subsystem cabinet (that contains the MD21 Controller) is included when calculating the total length of the SCSI bus.

  The SCSI cable that connects the compliant subsystem cabinet (that contains the MD21 Controller) to the host system must be shielded and properly grounded.

To support daisy-chain connections, SCSI devices that use shielded connectors should provide two shielded device connectors on the compliant subsystem cabinet. These two connectors may be wired one-to-one, with a stub going to the SCSI device's drivers and receivers (provided the maximum stub length specified in subsection 7.2.1.1 is not exceeded). Alternatively, two cables may be run from two shielded connectors to the drivers and receivers so that the maximum stub length is not exceeded.

7.2.1.1 Internal Cable Requirements

If the MD21 Controller and the SCSI host adapter reside in the same compliant cabinet, you must use a 50-conductor flat-ribbon cable or a 25-twisted-pair flat cable to connect the MD21 Controller and SCSI host adapter. The maximum cumulative cable length is 6 meters. Each SCSI bus connection should have a stub length (the length of the cable beyond the terminator) of no more than 10 centimeters (4 inches). For information on SCSI bus termination, see subsection 5.3.3.

7.2.1.2 Shielded Cable Requirements

If the MD21 Controller and SCSI host adapter do not reside in the same compliant subsystem, then a shielded SCSI cable must be used to connect the MD21 Controller and the host adapter. The connector for the SCSI bus shielded cable is a 50-pin connector, designated J6, that contains two rows of 25 female contacts on 100 mil centers. The connector shielding system must provide a direct current (DC) resistance of less than 10 milliohms from the cable shield at its termination point to the compliant subsystem cabinet. For information on FCC compliance, see subsection 5.6.

7.2.2 SCSI INTERFACE ELECTRICAL DESCRIPTION

The MD21 interfaces to SCSI host adapters and other controllers via the SCSI bus. A 50-pin male IDC connector, reference designated J6 on the MD21, plugs directly into the SCSI bus. Component locations for the MD21 are shown in Figure 7-1. All signals use open collector drivers.

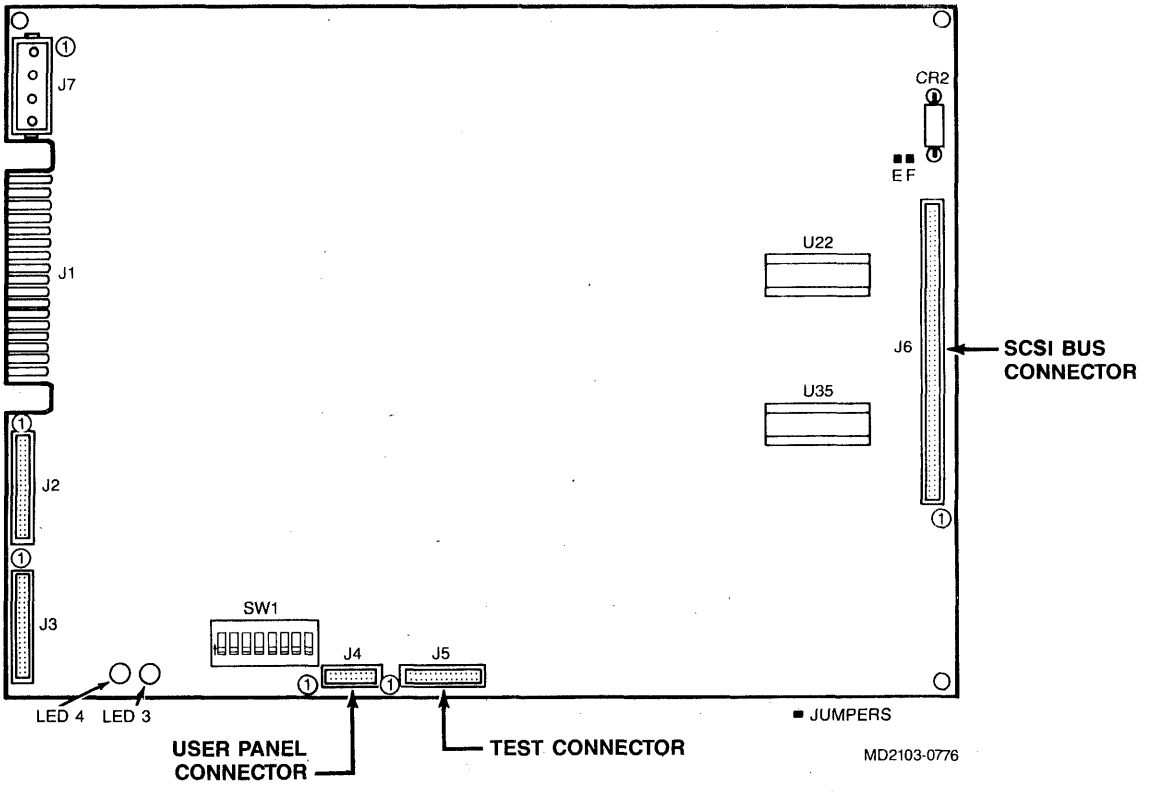


Figure 7-1. MD21 Controller Component Locations

7.2.2.1 Output Signal Characteristics

When measured at the SCSI device's connection, each signal driven by a SCSI device has the following output characteristics:

- Signal assertion = 0.0 VDC to 0.4 VDC
- Minimum driver output capability = 48 milliamperes (sinking) at 0.5 VDC
- Signal negation = 2.5 VDC to 5.25 VDC

All assigned signals are terminated with 220 ohms to +5 VDC, or 180 ohms to 4.3 VDC (nominal) and 330 ohms to ground at each end of the SCSI cable as shown in Figure 7-2.

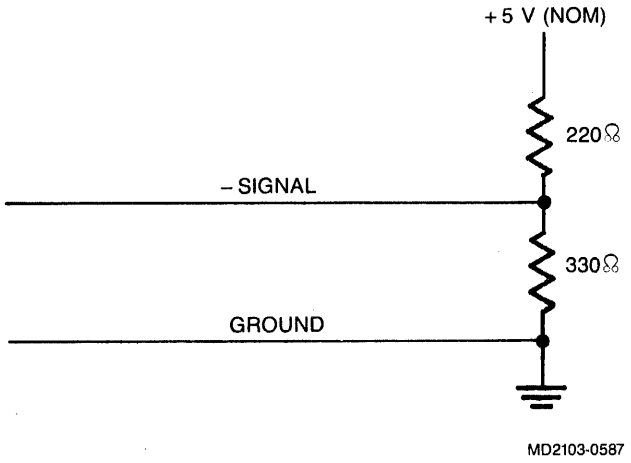


Figure 7-2. SCSI Bus Signals Termination

7.2.2.2 Input Signal Characteristics

When measured at the SCSI device's connection, each signal received by a SCSI device has the following input characteristics:

- Signal true = 0.0 VDC to 0.8 VDC
- Maximum total input load = -0.4 milliamps at 0.4 VDC
- Signal false = 2.0 VDC to 5.25 VDC
- Minimum input hysteresis = 0.2 VDC

7.2.2.3 Terminator Power (Optional)

The MD21 supports the single-ended SCSI option which provides pin 26 with termination power that has the following characteristics:

V_{CC} = 4.0 VDC to 5.25 VDC (through diode)
800 milliamps maximum source drive capability

For information on implementing the SCSI termination power option, see subsection 5.3.2.

7.2.3 SCSI BUS SIGNALS AND TIMING

SCSI bus activities involve one or more of the following SCSI phases of operation:

- Arbitration Phase
- Selection Phase
- Reselection Phase
- Command Phase
- Data Phase
- Status Phase
- Message Phase

These phases are described in more detail in Subsection 5.1 of the Emulex SCSI Disk Controller Programming Reference Manual (manual number MD2352501). When the SCSI bus is not involved in one of the above phases, it is in the Bus Free Phase. SCSI phase sequencing is accomplished by asserting or de-asserting the SCSI bus signals; the signals are described in Subsection 7.2.3.1.

7.2.3.1 SCSI Bus Signals

There are 18 signals on the SCSI bus. Nine signals are control signals that coordinate transfer of data between SCSI bus host adapters and controllers; the other nine signals are for an eight-bit data bus with parity. The signals are listed and described in Table 7-1.

In Table 7-1, the eight data bit signals are represented by DB0 through DB7, where DB7 is the most significant bit and has the highest priority during the Arbitration Phase. Bit number, significance, and priority decrease downward to DB0. The parity, represented by the DBP signal, is always odd. Host adapters and controllers on the SCSI bus can generate parity and have parity detection enabled. During the Arbitration Phase, parity is not guaranteed to be valid.

Pin/signal assignments for the MD21 SCSI bus interface are listed in Table 7-2; they support the SCSI single-ended option.

Table 7-1. SCSI Bus Signals

Mnemonic Name	Signal	Description
DB0	Data Bus	Data Bus Bit 0
DB1	Data Bus	Data Bus Bit 1
DB2	Data Bus	Data Bus Bit 2
DB3	Data Bus	Data Bus Bit 3
DB4	Data Bus	Data Bus Bit 4
DB5	Data Bus	Data Bus Bit 5
DB6	Data Bus	Data Bus Bit 6
DB7	Data Bus	Data Bus Bit 7
DBP	Data Bus	Data Bus Parity
ACK	Acknowledge	Indicates acknowledgment for a REQ/ACK data transfer handshake operation.
REQ	Request	Indicates a request for a REQ/ACK data transfer handshake operation.
ATN	Attention*	Indicates ATTENTION condition (i.e., the Initiator has a message to send to the Target).
RST	Reset*	Indicates RESET condition (i.e., clears the SCSI bus of all activity).
SEL	Select	Used to select and/or reselect a SCSI bus device.
BSY	Busy	Indicates the SCSI bus is being used.
C/D	Control/Data	Indicates command, status information transfer, or data in and/or data out transfer.
I/O	Input/Output	Indicates direction of data movement on the data bus with respect to an Initiator.
MSG	Message	Indicates the SCSI bus is in the Message Phase.

*This condition is described in Section 5 of the Emulex SCSI Disk Controller Programming Reference Manual (manual number MD2352501).

Table 7-2. Single-Ended Pin/Signal Assignments at SCSI Bus Interface

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

7.2.3.2 SCSI Bus Timings

Except where noted, the delay time measurements for each SCSI device (host adapter or controller) is calculated from signal conditions existing at the SCSI bus connection for that device. Normally these measurements do not consider delays in the SCSI bus cable. The SCSI command timings are listed and described in Subsection 5.3 of the Emulex SCSI Disk Controller Programming Reference Manual (manual number MD2352501).

The timing diagram shown in Figure 7-3, shows the typical relationship between SCSI bus signals and SCSI bus phase sequencing.

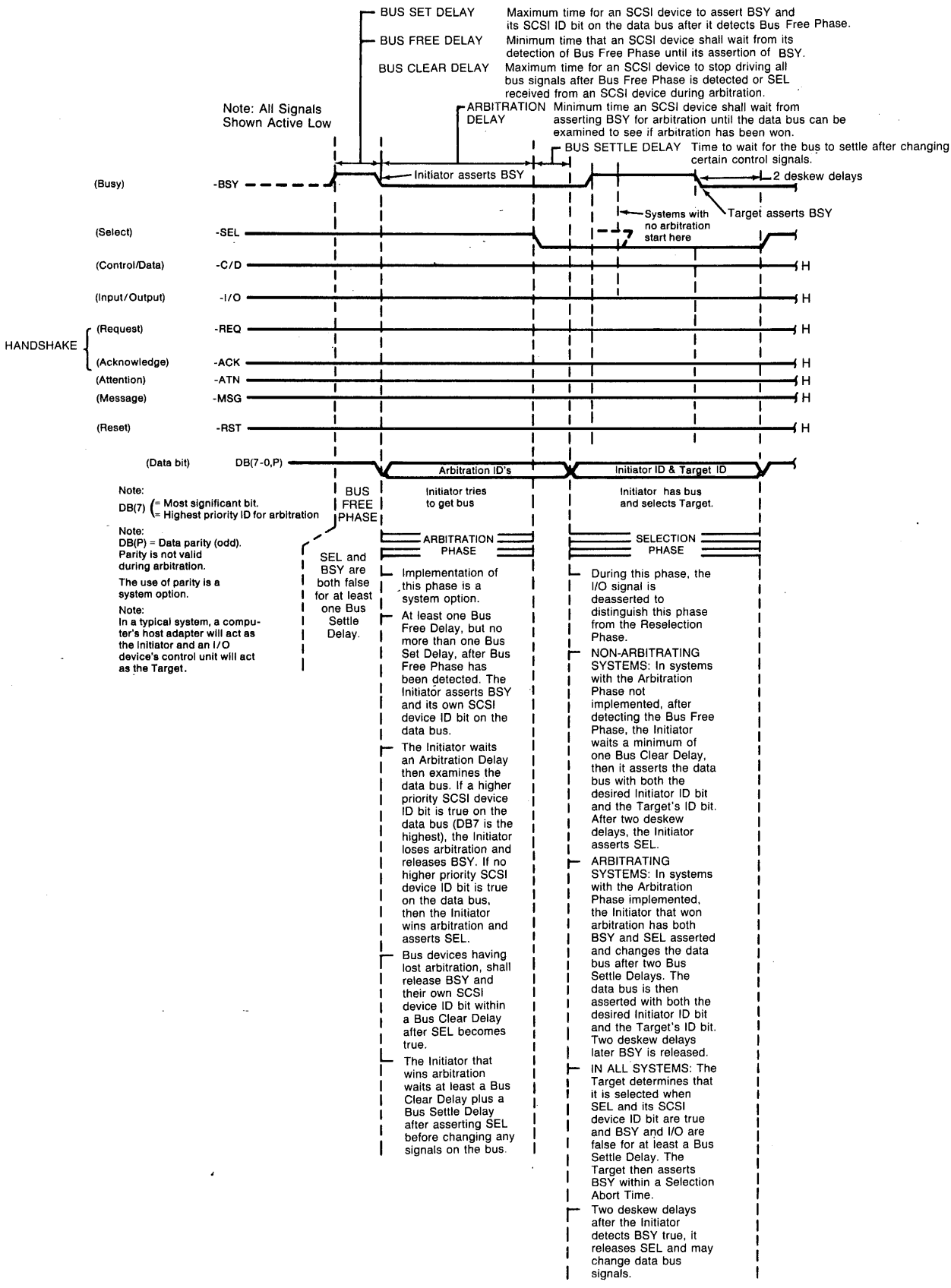


Figure 7-3. SCSI Bus Timing Diagram (Sheet 1 of 3)

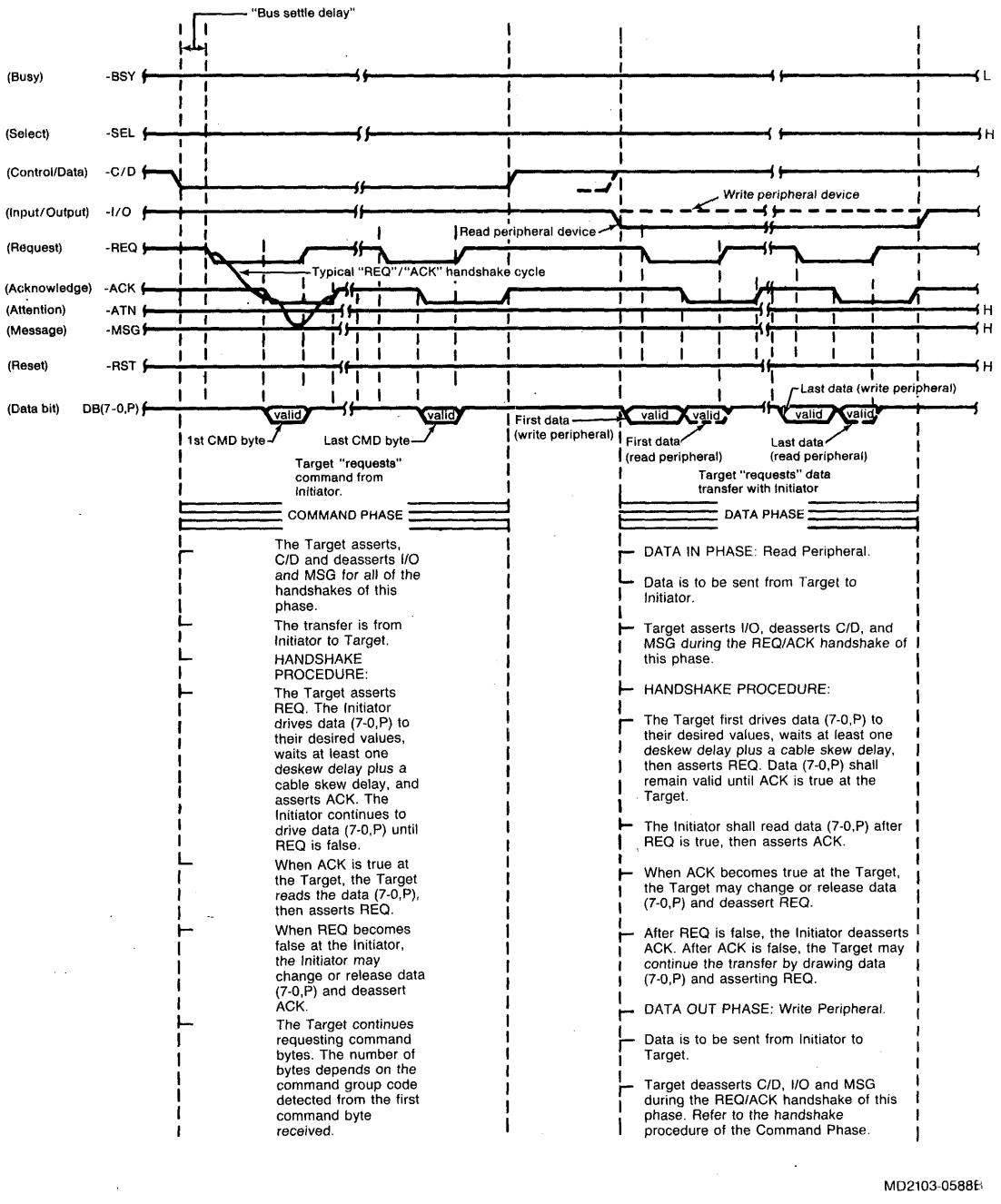


Figure 7-3. SCSI Bus Timing Diagram (Sheet 2 of 3)

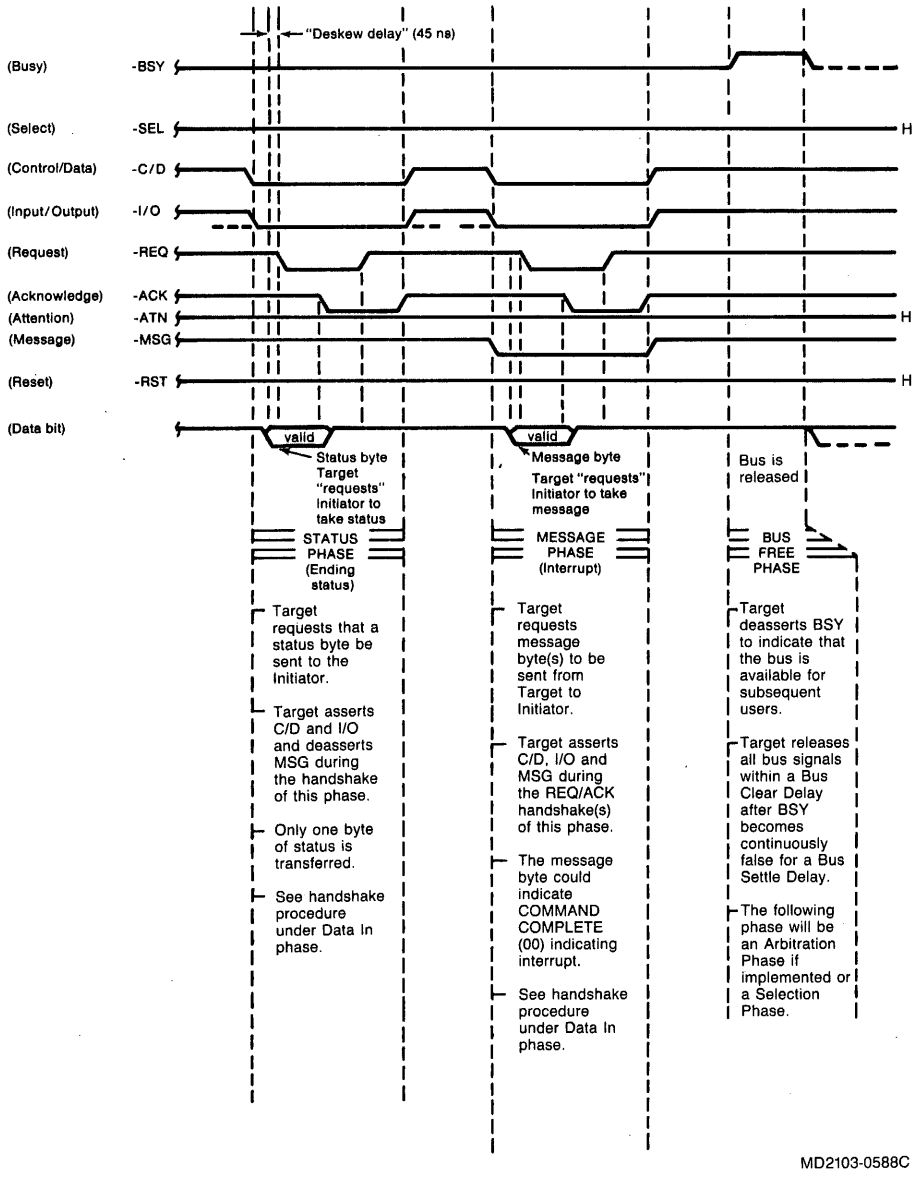


Figure 7-3. SCSI Bus Timing Diagram (Sheet 3 of 3)

7.3 ESDI DISK DRIVE INTERFACE

The MD21 Disk Controller interfaces with ESDI disk drives via one 34-line control cable, which is daisy-chained, and one or two 20-line data cables. Table 7-3 lists specifications for each type of cable:

Table 7-3. Disk Drive Cable Requirements

	Control Cable (daisy-chained to 1 or 2 drives)	Data Cable (One cable to each drive)
Number of pins	34	20
Maximum cumulative cable length	10 feet (3 meters)	10 feet (3 meters)
Recommended connector	AMP ribbon connector P/N 499560-3 (or equivalent)	AMP ribbon connector P/N 499560-6 (or equivalent)
MD21 cable	J1	J2 and/or J3

7.3.1 ESDI INTERFACE ELECTRICAL DESCRIPTION

7.3.1.1 Output Signal Characteristics

When measured at the ESDI device's connection, each signal driven by an ESDI device has the following output characteristics:

- Signal assertion = 0.0 VDC to 0.4 VDC
- Minimum driver output capability = 48 milliamperes (mA) (sinking) at 0.4 VDC
- Signal negation = 2.5 VDC to 5.25 VDC

7.3.1.2 Input Signal Characteristics

When measured at the ESDI device's connection, each signal received by an ESDI device has the following input characteristics:

- Signal true = 0.0 VDC to 0.5 VDC
- Signal false = 1.4 VDC minimum

7.3.1.3 Termination

All assigned signals are terminated with 220 ohms to +5 VDC and 330 ohms to ground at each end of the cable.

7.3.1.4 ESDI Signals

The pin/signal assignments for control signal interface between the MD21 Controller and an ESDI disk drive are shown in Figure 7-4 and Table 7-4.

The pin/signal assignments for data signal interface between the MD21 Controller and an ESDI disk drive are shown in Figure 7-5 and Table 7-5. As indicated in the figure, lines 2, 5, 9, and 20 are connected to ground at the MD21 data interface. The MD21 does not use lines 2 and 20 to report the sector and index positions from each drive (as indicated in the ESDI specification), but uses the sector and index lines on the control cable for the selected drive.

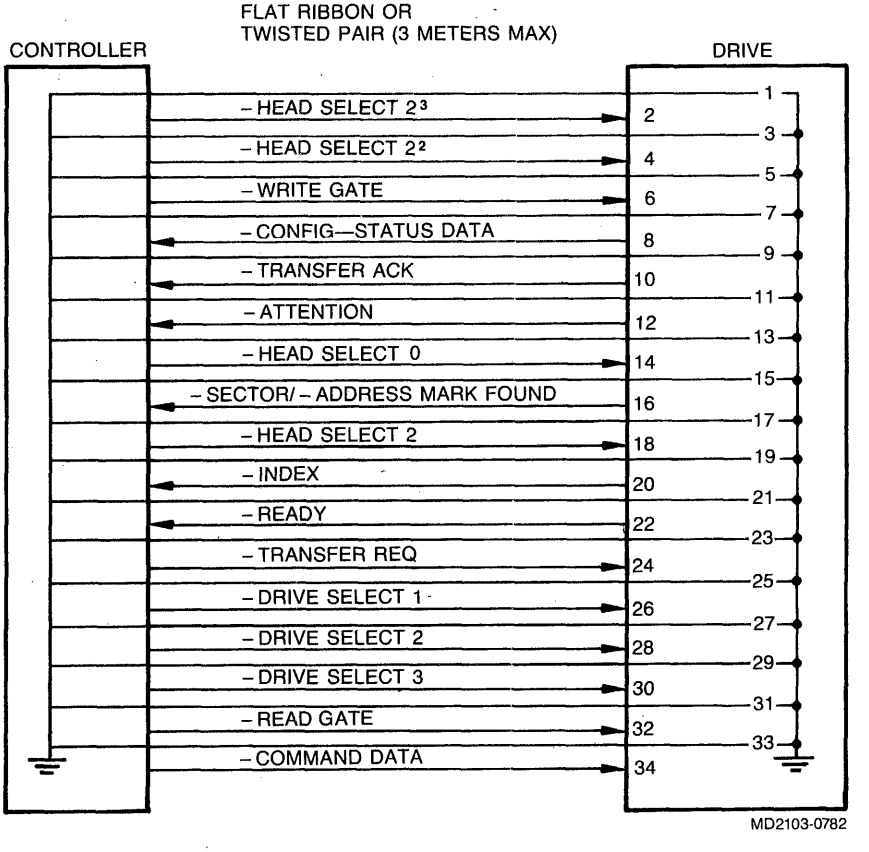


Figure 7-4. ESDI Control Cable Pin/Signal Assignments (Connector J1)

Table 7-4. Control Cable Pin Assignments

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

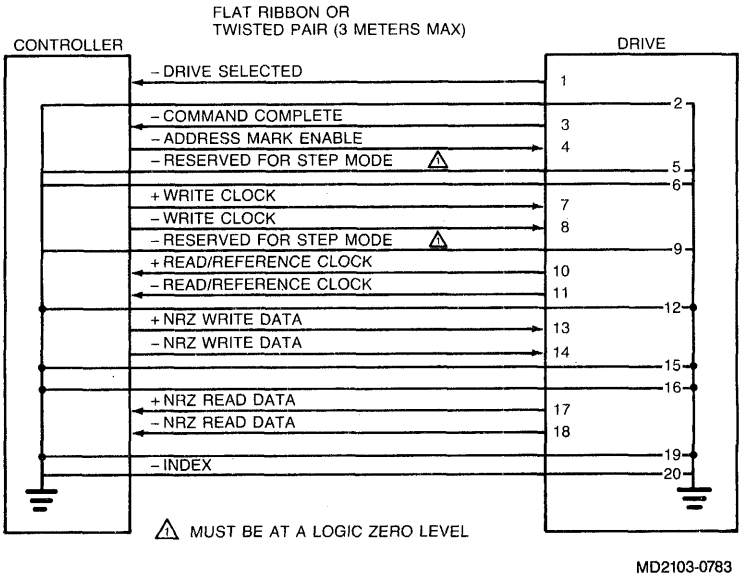


Figure 7-5. ESDI Data Pin/Signal Assignments (Connectors J2 and J3)

Table 7-5. Data Cable Pin Assignments

Pin	Signal Name	Input/Output
1	-DRIVE SELECTED	Input
2	GND	--
3	-COMMAND COMPLETE	Input
4	-ADDRESS MARK ENABLE	Output
5	GND	--
6	GND	--
7	+WRITE CLOCK	Output
8	-WRITE CLOCK	Output
9	GND	--
10	+READ REFERENCE CLOCK	Input
11	-READ REFERENCE CLOCK	Input
12	GND	--
13	+NRZ WRITE DATA	Output
14	-NRZ WRITE DATA	Output
15	GND	--
16	GND	--
17	+NRZ READ DATA	Input
18	-NRZ READ DATA	Input
19	GND	--
20	GND	--

7.4 USER PANEL CONNECTION

Connector J4 on the MD21 (see Figure 7-8) is used to connect the controller to external LEDs and switches that indicate ready and write-protect conditions for each disk drive. On Emulex subsystems, these external LEDs and switches are on a user panel located on the subsystem bezel, as shown in Figure 7-6.

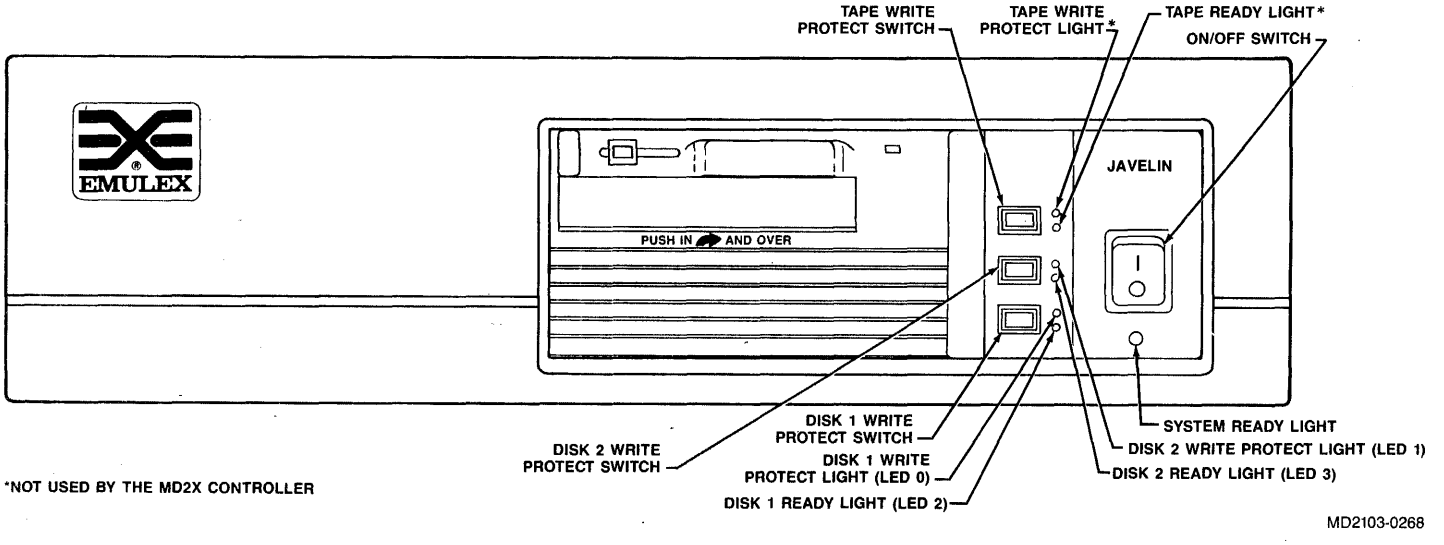


Figure 7-6. Sample User Panel

The user panel connectors is a 10-pin 3M P/N 3473-XXXX. The pin descriptions for connector J4 are listed in Table 7-6.

Table 7-6. Connector J4 Pin Description

Pin	Connection	True	Function
1	Ground	--	--
2	Power Fail	Low	Detects DC Power Fail
3	SW3	High	Drive 2 Write Protect
4	LED 3	Low	Drive 2 Ready
5	SW2	High	Drive 1 Write Protect
6	LED 2	Low	Drive 1 Ready
7	LED 1	Low	Drive 2 Write Protect
8	None	--	Not Used
9	LED 0	Low	Drive 1 Write Protect
10	+5 volts	--	

7.4.1 OUTPUTS FROM THE MD21

These output signals are driven by a 74LS374-type register. When a low level is applied to any of these signal lines, the LED is lit to indicate that the disk drive is either write-protected or on-line.

7.4.2 WRITE-PROTECT INPUTS TO THE MD21

These inputs are pulled up with 4.7K ohms to +5 volts, and go to 74LS244-type receivers. When a low level is applied to any signal line, the MD21 inhibits write operations to its respective drive. Figure 7-7 illustrates the write-protect input signal.

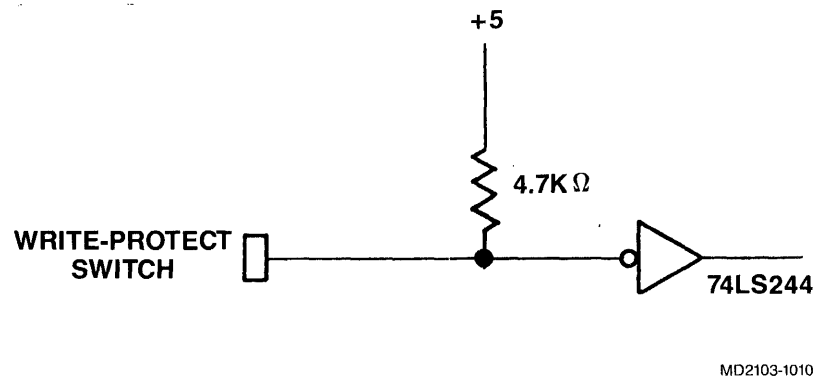


Figure 7-7. Write-Protect Input Signal

7.4.3 POWER FAIL DETECT SIGNAL

Pin 2 on connector J4 is an optional power fail detect signal. This signal allows the MD21 to detect failing DC power. When the signal is asserted (active low), a latch is set. When the MD21 microprocessor senses the latch, it inhibits disk drive activity. The signal must be asserted at least 2 milliseconds before the +5 VDC power falls below +4.75 VDC.

To use this power fail detect option, the power supply used in the subsystem in which the MD21 resides must contain a power fail signal. Connect pin 2 to the power fail signal in the power supply.

7.5 DC POWER CONNECTION

The MD21 Controller power supply, designated J7, (see Figure 7-8) is an AMP P/N 641737-1. Table 7-7 lists the power connections for this connector.

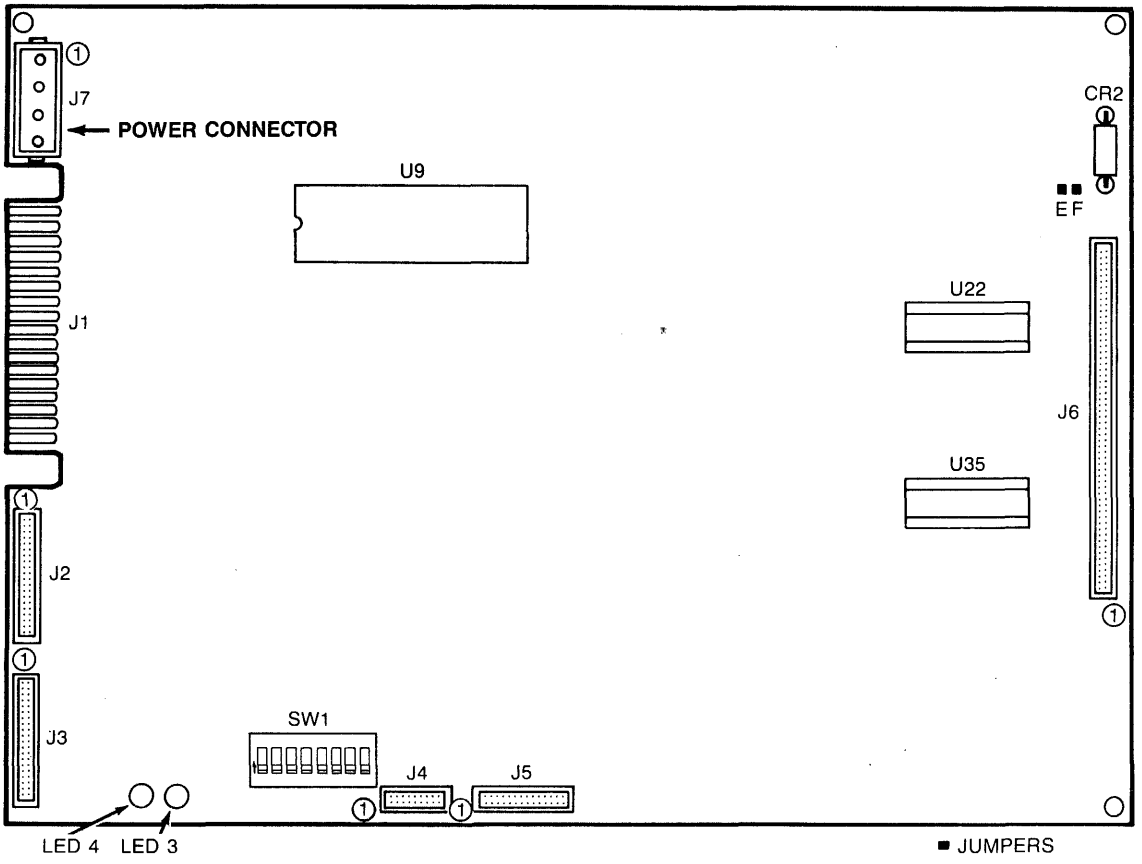


Figure 7-8. Pin Locations for Power Connector

Table 7-7. Power Supply Connections

Pin	Description
1	No Connection
2	Ground
3	Ground
4*	+5 VDC, ± 5%, 1.5 amperes nominal

* A RESET occurs if the DC voltage drops to 4.5 or less and an INITIALIZATION sequence occurs when the voltage returns to 4.515 or above.

BLANK

A.1 OVERVIEW

The installation of the MD21/S2 Controller, when used with the recommended devices, should run smoothly and problem-free. The diagnostic procedures described in this manual are intended to help you identify and resolve any problems you may encounter. However, because of the wide variety of host adapters, disk drives and other devices to which the MD21/S2 could be connected, diagnostic procedures cannot be specific or all-inclusive. The following subsections explain how to obtain technical assistance or service for problems you cannot resolve.

A.2 PROBLEM IDENTIFICATION

The self-test, described in Section Six, diagnoses problems within the MD21/S2 itself. It does not diagnose problems with the host adapter, disk drive, or other devices to which the MD21/S2 is connected.

If the MD21/S2 does not pass the self-test when it is connected to the other devices in your system, remove the devices and try the self-test again. If the controller passes the self-test, the problem may be elsewhere in the system. See directions for obtaining help from Emulex's technical support personnel in the subsection on Technical Assistance.

If the controller does not pass the self-test when it is tested apart from the devices, it may be defective and should be returned to the factory for replacement. See directions for returning the unit in the subsection on Service.

A.3 TECHNICAL ASSISTANCE

If the MD21/S2 controller passed the self-test, but you believe it is not performing as expected, you can obtain assistance from Emulex's technical support personnel. The SCSI Product Performance Report (see last two pages of Appendix A) allows you to gather all the required information. Complete the form and mail it to Emulex at the address on the form. A technical support representative will contact you within five days of receipt of the form.

Note that this form is required in order for you to receive technical assistance regarding your MD21/S2 controller. Please do not attempt to contact Technical Support by any other means. (If you have not heard from Emulex after five days, you may call in to check the status of your report.)

It is suggested that you use a photocopy of this form, so that the form will be available should you need to use it again.

A.4 SERVICE

The components of your Emulex MD21/S2 Controller have been designed to give years of trouble-free service, and they were thoroughly tested before leaving the factory.

If one of the diagnostic procedures described in this manual indicates that a component is not working properly, the MD21/S2 Controller must be returned to the factory, or to an Emulex authorized repair center, for service. Emulex products are not designed to be repaired in the field.

Before returning the component to Emulex, whether the product is or is not under warranty, you must contact Emulex's Repair Center for instructions and a Return Materials Authorization (RMA) number.

DO NOT RETURN AN MD21/S2 CONTROLLER TO EMULEX WITHOUT AUTHORIZATION. An MD21/S2 Controller returned for service without an authorization will be returned to the owner at the owner's expense.

In the continental United States, Alaska, and Hawaii contact:

Emulex Repair Center
3545 Harbor Boulevard
Costa Mesa, CA 92626
(714) 662-5600 TWX 910-595-2521

Outside the United States, contact the distributor from whom the MD21/S2 Controller was initially purchased.

B.1 OVERVIEW

This appendix provides instructions for replacing the MD21 firmware PROM.

B.2 EXCHANGING PROMS

The MD21 firmware PROM is located in the socket at U9. Pry the existing PROM from its socket using an IC puller or an equivalent tool.

The MD21 PROM is identified by the part numbers on top of the PROMs. Place the MD21 PROM in socket U9. See Figure 7-8 for the location of the U9 socket. Make certain that the PROM is firmly seated and that no pins are bent or misaligned. (If the two rows of PROM pins are too far apart to fit in the socket, grasp the PROM at its ends using your thumb and forefinger and bend one of the pin rows inward by pressing it against a table top or other flat surface.

PROM Number	PCBA Location
A98	U9

BLANK

Reader's Comments

Your comments and suggestions will help us in our continuous effort to improve the quality and usefulness of our publication.

Manual Part Number _____ **Rev.** _____

What is your general reaction to this manual? In your judgment is it complete, accurate, well organized, well written, etc.? Is it easy to use? _____

What features are most useful? _____

What faults or errors have you found in the manual? _____

Does this manual satisfy the need you think it was intended to satisfy? _____

Does it satisfy *your* needs? _____ Why? _____

☐ Please send me the current copy of the *Controller Handbook*, which contains the information on the remainder of EMULEX's controller products.

Name _____ Street _____

Title _____ City _____

Company _____ State/Country _____

Department _____ Zip _____

Additional copies of this document are available from:

Emulex Corporation
3545 Harbor Boulevard
P.O. Box 6725
Costa Mesa, CA 92626
Attention: Customer Services

Fold Here and Staple

Do Not Tear — Fold Here

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 202 COSTA MESA, CA

POSTAGE WILL BE PAID BY ADDRESSEE

EMULEX CORPORATION
3545 HARBOR BOULEVARD
P.O. BOX 6725
COSTA MESA, CALIFORNIA 92626
ATTN: TECHNICAL PUBLICATIONS

SCSI PRODUCT PERFORMANCE REPORT

Please provide all information requested.

CUSTOMER INFORMATION

Name _____ Phone No. _____ Ext. _____
Position/Title _____
Company Name _____
Address _____
City _____ State _____ Zip _____

PRODUCT INFORMATION

EMULEX Product in Use: MD _____ MT _____ IB _____ UC _____
Top Assembly Number _____
Serial Number _____ Date of Purchase _____
Purchased From _____ Sales Engineer _____

PERIPHERAL INFORMATION

DISK

Manufacturer _____
Model Number _____
Interface: ST506 _____ ESDI _____
Geometry: No. of Cylinders _____
Number of Heads _____ Sectors _____
Number of Bytes/Track _____
Number of Drives _____

TAPE

Drive Interface: QIC36 _____ QIC44 _____
Media Interface: QIC11 _____ QIC24 _____
QIC120 _____ QIC150 _____

Tape Type: 300 _____ 450 _____ 600 _____
Tape Manufacturer: 3M _____ DEI _____
DYSAN _____ CARTREX _____ SCOTCH _____

SYSTEM CONFIGURATION

Bus Type: IBM _____ DEC _____ VME _____
MULTIBUS _____ OTHER _____
Software: Diagnostics _____
Utilities _____

Amount of Memory _____
Host Adapter _____
Formatter _____
Operating System _____

GRAPHIC REPRESENTATION OF YOUR SYSTEM

PROBLEM DESCRIPTION

Give a complete description of the problem you are encountering. Provide details of the command packet and/or test loop/routine that you are using to troubleshoot the problem. Include a copy of the program(s) that demonstrates the problem on either hard copy or magnetic media (DOS or FILES 11 format).

Please mail the completed form to:

EMULEX CORPORATION
National Technical Support
3545 Harbor Boulevard
Costa Mesa, CA 92626

Attn: SCSI Support