UC14/MO INTELLIGENT HOST ADAPTER TECHNICAL MANUAL (MSCP COMPATIBLE)

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

UC1451004-00 Rev E
February, 1989

EMULEX PRODUCT/MANUAL REVISION HISTORY

PROM A26x[1], Location U38

PROM A26x REVISION	DESCRIPTION	MANUAL P/N
A,B,C,D	UC14/MO with optional diagnostics	UC1451002-00
E and above	UC14/MO with firmware-resident diagnostics	UC1451004-00

This manual has been extensively revised to incorporate changes to support the Firmware-Resident Diagnostics (F.R.D.) that have been added to the Revision E controller firmware PROM. Due to the nature of these firmware changes, a UC14/MO with a Revision E and above firmware PROM will no longer operate with previously supplied diagnostic software. In addition, some of the ODT functions (NOVRAM loading commands and Format Drive command) previously available are no longer available.

All of the functionality that was provided by software diagnostics and ODT commands for magnetic discs has been incorporated in F.R.D. In addition, F.R.D. allows the user to write valid RCTs on an optical disk pack. No other diagnostic capability is provided by F.R.D. for optical drives. Be certain that your manual is appropriate for the revision level of your controller firmware, as noted in the table above. This firmware is easily identified by the label on integrated circuit U38 on the UC14/MO.

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 A computing device pursuant to Subpart J of Part 15 of Federal Communications Commission (FCC) Rules, which are designed to provide reasonable protection against such interference when operating in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

Printed in U.S.A.

[1] The small x indicates the PROM's revision level letter: A, B, C, etc.

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES

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 of shipment.

The above warranties shall not apply to expendable components such as fuses, bulbs, and the like, nor to connectors, adaptors, 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 is 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
GENERAL DESCRIPTION

1.1 Introduction

This manual is designed to help you install and use your UC14/MO Intelligent Host Adapter. It assumes that you have some knowledge of hardware configuration, UNIBUS architecture and terminology, and interpretations of error messages and device register contents. The contents of the nine sections and four appendices are described as follows:

- **Section 1 (General Description):** This section contains an overview of the UC14/MO Intelligent Host Adapter.
- **Section 2 (Controller Specification):** This section contains the specification for the UC14/MO Host Adapter.
- **Section 3 (Planning the Installation):** This section contains the operating system considerations and other pre-installation instructions.
- **Section 4 (Installation):** This section contains the information needed to set up and physically install the controller, including switch settings and cabling. It also describes the firmware-resident diagnostics and contains instructions for loading drive configuration parameters into the NOVRAM.
- **Section 5 (Troubleshooting):** This section describes fault isolation procedures that can be used to pinpoint trouble spots.
- **Section 6 (Registers and Programming):** This section describes the UC14/MO's UNIBUS registers and presents an overview of the Mass Storage Control Protocol (MSCP).
- **Section 7 (Functional Description):** This section describes the controller architecture.
- **Section 8 (Interfaces):** This section describes the controller UNIBUS and SCSI interfaces.
- **Section 9 (SCSI Protocol):** This section describes the protocol used on the SCSI bus.

- **Appendix A (Autoconfigure):** This appendix describes the DEC algorithm for the assignment of CSR addresses and vector addresses.
- **Appendix B (PROM Removal and Replacement):** This appendix contains instructions to remove and replace the firmware so that the user can upgrade the UC14/MO Host Adapter in the field.
- **Appendix C (Subsystem Configuration Selection):** This appendix explains how to set the switches that define the drive configuration.
- **Appendix D (Disk Drive Configuration Parameters):** This appendix contains configuration parameters for supported disk drives.

1.2 Subsystem Overview

The UC14/MO Host Adapter connects high-capacity SCSI-compatible storage devices (including both magnetic and optical disks) to the PDP-11 and VAX-11 computers manufactured by Digital Equipment Corporation (DEC). The UC14/MO implements DEC's Mass Storage Control Protocol (MSCP) to provide a software-transparent interface for the host DEC computer. The Small Computer System Interface (SCSI) peripheral interface provides traditional Emulex flexibility in peripheral selection.

1.2.1 Mass Storage Control Protocol (MSCP)

MSCP is a software interface designed to lower the host computer's mass storage overhead by offloading much of the work associated with file management into an intelligent mass storage subsystem. In concert with SCSI-compatible peripherals, the UC14/MO provides just such a subsystem. The UC14/MO relieves the host CPU of many file maintenance tasks. The UC14/MO Host Adapter performs these MSCP functions: error checking and correction, bad block replacement, seek optimization, command prioritizing and ordering, and data mapping.

This last feature is, perhaps, the most important. This feature allows the host computer's operating system software to store data in logical blocks that are identified by simple logical block numbers (LBNs). Thus, the host does not need to have detailed knowledge of the peripheral's geometry (cylinders, tracks, sectors, etc.). This feature also makes autoconfiguration a simple matter. During system start-up, the host operating system queries the subsystem to find its capacity (the number of logical blocks that the subsystem can store).

Because the host operating system does not need to have detailed knowledge of its mass storage subsystem, the complexity of the operating system itself has been reduced. This reduction comes about because only one or two software modules are required to allow many different subsystems to be connected to a host.

1.2.2 Small Computer System Interface (SCSI)

The Small Computer System Interface, which is used as the UC14/MO Host Adapter's peripheral interface, complements the MSCP protocol well. SCSI architecture is designed to allow up to eight host adapters and intelligent peripheral controllers to be connected together on an eight-bit data bus (the SCSI bus; see Figure 1-1). Host adapters, such as the UC14/MO, connect computers to the SCSI bus. Intelligent peripheral controllers support mass-storage peripherals such as mini-Winchester disk drives. The devices communicate over the SCSI bus using a device-independent protocol that largely masks the data structure of the peripheral. Thus, SCSI architecture allows the host computer to become device independent within certain classes of devices.

SCSI also provides for a large volume of data storage that can be configured in many ways. The bus is fast enough to support modern Winchester-technology disks, and the interface allows seeks and other types of positioning to be overlapped if there is more than one peripheral controller on the bus.

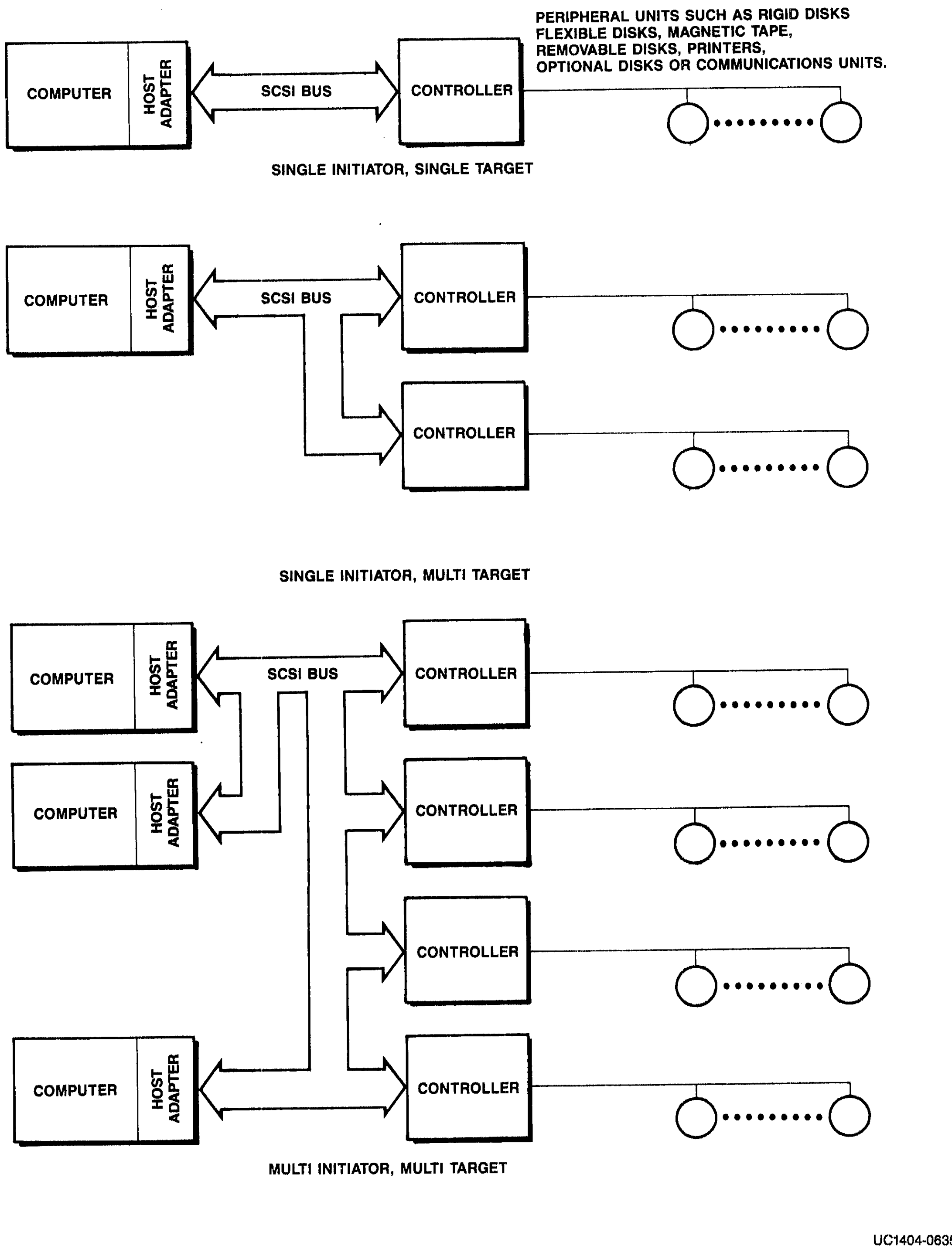


Figure 1-1. SCSI Bus Overview

1.3 Physical Organization Overview

The UC14/MO Intelligent Host Adapter is a modular, microprocessor-based host adapter that connects directly to the host computer's UNIBUS backplane. The microprocessor architecture ensures excellent reliability and compactness.

The UC14/MO is contained on a single quad-wide printed circuit board assembly (PCBA) that plugs directly into a UNIBUS backplane slot.

The UC14/MO supports up to eight peripherals. All of these devices may be supported by the same controller, or each may be attached to its own controller, up to a maximum of seven controllers. See subsection 3.2 for more details on the configurations allowed by the UC14/MO.

Aggregate data storage capacities are limited only by the capacities of the peripherals. Currently, drives are available that can be combined to provide more than one gigabyte of online storage with high-speed back-up capability. Figure 1-2 shows one possible SCSI configuration.

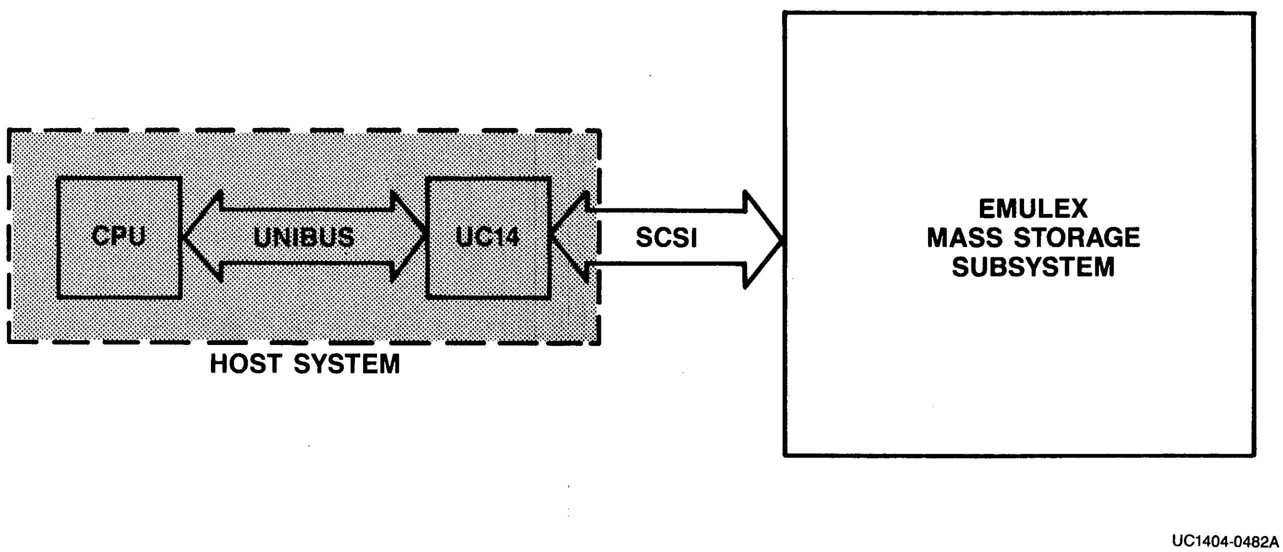


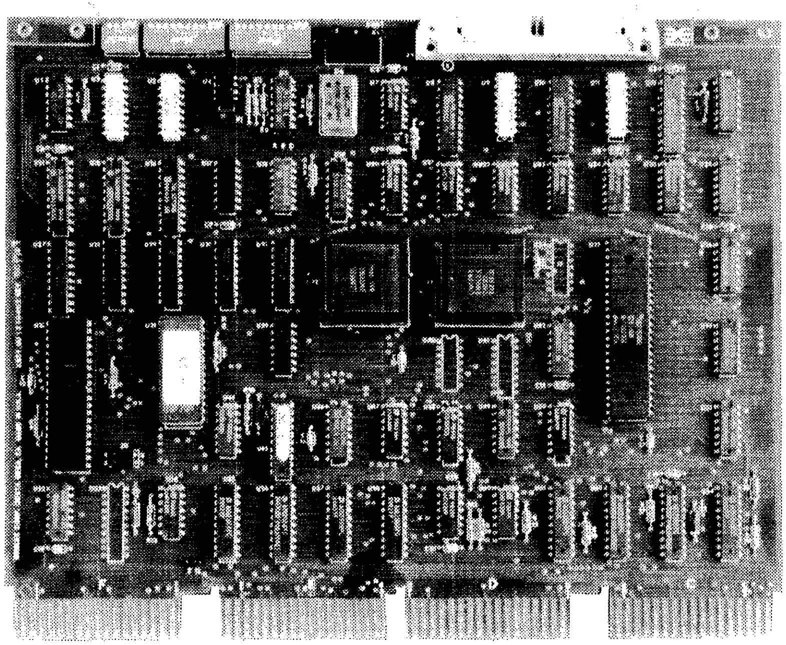
Figure 1-2. UC14/MO Subsystem Configuration

1.4 Subsystem Models and Options

The UC14/MO Intelligent Host Adapter, with appropriate peripherals, provides a DEC MSCP-compatible mass storage subsystem. The UC14/MO is pictured in Figure 1-3. Two models of the UC14 are offered: the UC14/M and UC14/MO. The UC14/M supports only magnetic disk subsystems. The UC14/MO supports both optical and magnetic disk subsystems. This manual describes only the UC14/MO. Please see Emulex publication UC1451003 for a description of the UC14/M. The UC14/MO is identified by a top level assembly tag that is glued to the 8031 microprocessor chip on the PWB. The UC14/MO top level assembly number is given in Table 1-1 along with the part numbers of the items that are delivered with the UC14/MO.

Table 1-1. Basic Contents

Itm	Qty	Description	Part Number
1	1	UC14/MO Host Adapter	UC1410201-02
2	1	UC14/MO Technical Manual	UC1451004-00



UC1401-0828

Figure 1-3. UC14/MO Host Adapter

1.4.1 Subsystem Options

Table 1-2 lists the options that can be ordered to tailor your UC14/MO to your particular application.

Table 1-2. UC14/MO Options

Option	Description
PD9951802-xx	Backup and Restore Program (BRP). For PDP-11s only. Allows image backup and restoration of disk. Compatible with TS11, SCSI tape, and the following DEC disk formats: RK06/07, RL01/02, RM02/03/05, RP04/05/06, and MSCP. Media per customer order. (xx= 01 for .5″ tape/1600 bpi or 02 for .25″ tape/TKQ25 format)
PD9951801	SCSI Tape Utility (STU). For PDP-11s only. Includes BRP and MSCP/SCSI Disk Formatter Program. Distributed on 0.25-inch DC600A tape cartridge, Titleist format.
PX9951806-xx	Optical disk reliability software for PDP-11. (xx depends on the media and boot type desired; consult Emulex Sales Support.)
VX9951807-01	Optical disk reliability software for VAX-11/730 and 750.
VX9951807-02	Optical disk reliability software for VAX-11/780 and 785.
VX9951808	Optical disk reliability software for VAX 8600.
1090xxx	Perceptics optical disk driver for VAX-11. (xxx depends on the media desired; consult Emulex Sales Support.)
PU0113003	Rack Mount Cable Kit for universal RETMA rack mount applications. Converts UC14/MO J1 to AMP connector. Includes SCSI cable, rack mount, adapter, and hardware. Fully compatible with Decathlon, Javelin, and SABRE Emulex SCSI subsystems.
PU0213003	Rack Mount Cable Kit for universal RETMA rack mount applications. Converts UC14/MO J1 to AMP connector. Includes SCSI cable, rack mount, adapter, and hardware. Compatible with Medley disk subsystems.
PU0213002	Same as PU0213003 but for Medley disk and tape subsystems.
PU0213004	Same as PU0213003 but for Medley tape subsystems.

Options are specified as separate line items on a sales order.

1.5 Features

The following features enhance the usefulness of the UC14/MO Host Adapter.

1.5.1 Microprocessor Design

The UC14/MO design incorporates an eight-bit, high-performance CMOS microprocessor to perform all controller functions. The microprocessor approach provides a reduced component count, high reliability, easy maintainability, and the microprogramming flexibility that allows MSCP to be implemented without expensive, dedicated hardware.

1.5.2 Improved Throughput

By using our custom-designed Buffer Controller (BC) chip and Host Adapter Controller (HAC) chip, the UC14/MO can perform DMA transfers on the host UNIBUS in excess of 2M bytes per second with a peak rate of 950 nanoseconds per word.

1.5.3 Firmware-resident Diagnostics

The UC14/MO host adapter firmware incorporates a self-contained set of disk preparation and diagnostic utilities. These utilities are contained in UC14/MO Revision E and above firmware. Controllers with this firmware are easily identified by a label on the PROM in location U38.

These utilities allow the user to communicate directly with the UC14/MO via a firmware-resident terminal driver that is compatible with either CRT or hardcopy devices connected to a UNIBUS or VAX console port. These firmware-resident diagnostics (F.R.D.), also called onboard diagnostics, provide several important disk preparation functions, including the ability to:

- Configure the controller NOVRAM
- Format the drive
- Test the disk surface and replace defective blocks, and
- Perform reliability testing of the magnetic devices in the attached disk subsystem.

1.5.4 Custom Configuration Capability

An onboard NOVRAM can be programmed to support as many as seven SCSI-compatible controllers with disk drives of varying capacities. The user can specify many different drive configurations. Using the firmware-resident utilities, you can control drive parameters such as the number of sectors per track.

1.5.5 Optical Disk Support

The UC14/MO supports both magnetic and optical disks in a variety of configurations. See subsection 3.5 for details on optical disk support.

1.5.6 Self-test

The UC14/MO incorporates an internal self-test routine which exercises all parts of the microprocessor, the onboard memory, the Buffer Controller, and the Host Adapter Controller. Although this test does not completely test all circuitry, successful execution indicates a very high probability that the host adapter is operational. If the UC14/MO fails the self-test, it leaves three light-emitting diodes (LEDs) ON and sets an error bit in the Status and Address (SA) register (base address plus two).

1.5.7 Error Control

The UC14/MO, in conjunction with the operating system software, presents error-free media to the host. The host adapter corrects soft errors and performs retry operations, and allows the operating system to dynamically replace uncorrectable errors. **(Does not apply to optical.)**

1.5.8 Host-Initiated Bad Block Replacement

The UC14/MO uses DEC-compatible host-initiated bad block replacement to dynamically replace any defective blocks that occur during the life of the system. For maximum reliability, the UC14/MO reports errors that cannot be corrected by the attached SCSI device controller as candidates for replacement. **(Does not apply to optical.)**

1.5.9 Media Defect List Management

The firmware-resident diagnostics allow the user to manually enter bad blocks found in the manufacturer's defect list in Logical Block Number (LBN) format. **(Does not apply to optical drives.)**

1.5.10 Seek Optimization

The UC14/MO is able to pool the various seeks that need to be performed and determine the most efficient order in which to do them. This is an especially important feature in heavily loaded systems. The host adapter's ability to arrange seeks in the optimal order saves a great deal of time and makes the entire system more efficient.

1.5.11 Disconnect/Reconnect

The UC14/MO fully supports standard SCSI arbitration, including disconnect/reconnect. Using this feature, drives that are performing time-consuming tasks (e.g., seeks) release the SCSI bus temporarily and reconnect when the seek is complete. Support of this feature permits the UC14/MO to initiate four commands simultaneously on four controllers; thus, several operations can be performed at once. The disconnect/reconnect option ensures efficient use of the SCSI bus and provides maximum overall subsystem throughput.

1.5.12 Command Buffer

The UC14/MO contains a buffer that is able to store 13 MSCP commands. This large buffer allows the subsystem to achieve a higher throughput and to operate at a very efficient level.

1.5.13 Adaptive DMA

During each DMA data transfer burst, the UC14/MO monitors the UNIBUS for other pending DMA requests and suspends its own DMA activity to permit other DMA transfers to occur. The host processor programs the DMA burst length during the MSCP initialization sequence or the UC14/MO defaults to 16 words per burst. In addition, the UC14/MO firmware design includes a switch selectable DMA burst delay to avoid data-late conditions on other slower devices that may be on a given system. Because of these adaptive DMA techniques, the UC14/MO ensures that CPU functions, including interrupt servicing, are not locked out for excessive periods of time by high-speed disk transfers.

1.6 Compatibility

This section describes the operating systems and hardware components that are compatible with the UC14/MO.

1.6.1 Operating Systems

The UC14/MO implements MSCP. Emulex supports its implementation of MSCP beginning with the indicated version of the following DEC operating systems:

Operating System	Version
VMS	4.0
RSTS/E	9.1
RSX-11M	4.1
RSX-11M-PLUS	2.1
RT-11	5.1
Ultrix-11	3.0
Ultrix-32m	1.1

1.6.2 Hardware

The UC14/MO Host Adapter complies with DEC UNIBUS protocol.

The disk drives supported by the UC14/MO are not media compatible with comparable DEC MSCP products. The fixed nature of DEC's disk media, however, makes this an unimportant consideration.

2.1 Overview

This section contains the general, environmental, physical, and electrical specifications for the UC14/MO Host Adapter.

2.2 General Specification

Table 2-1 contains a general specification for the UC14/MO Host Adapter.

Table 2-1. UC14/MO General Specifications

Parameter	Description
FUNCTION	Providing mass data storage to Digital Equipment Corporation (DEC) computers that use the UNIBUS
Logical CPU Interface	Emulates DEC's Mass Storage Control Protocol (MSCP)
Diagnostics	Embedded diagnostics; Emulex Optical Disk Reliability: U1M09 Rev. F and above for PDP-11; RVD04M Rev. 2.1 and above for VAX
Operating System Compatibility	VMS V4.0 and above RSTS/E V9.1 and above RSX-11M V4.1 and above RSX-11M PLUS V2.1 and above RT-11 V5.1 and above Ultrix-11 V3.0 and above Ultrix-32m V1.1 and above

(continued on next page)

Table 2-1. UC14/MO General Specifications (continued)

Parameter	Description
CPU I/O Technique	Direct Memory Access (DMA)
INTERFACE	
CPU Interface	Standard UNIBUS interface
Device Base Address	Standard 772150_8 Alternates 772154_8 760334_8 760340_8 760344_8 760350_8 760354_8 760360_8
Vector Address	Programmable
Priority Level	BR5
Bus Loading	1 dc Load, 2.5 ac Loads
Peripheral Interface	Small Computer System Interface (SCSI)
Driver Option	Single ended
Maximum Length	20 ft. (6 m.)
SCSI Commands used with MSCP Implementation	00 Test Unit Ready 03 Request Sense 04 Format Unit (extended)* 07 Reassign Block 08 Read 0A Write 12 Inquiry** 15 Mode Select** 28 Read (extended) 2A Write (extended) 2E Write and Verify 2F Verify 68 Read Long*** 6A Write Long***

* = Formatting only
** = Used by Emulex MSCP/SCSI Disk Formatter Program only
*** = Vendor-unique commands on Emulex disk drive controllers

(continued on next page)

Table 2-1. UC14/MO General Specifications (continued)

Parameter	Description
Firmware Diagnostic Access Path	
VAX	Standard console terminal

2.3 Environmental Specification

Table 2-2 contains the environmental specifications for the UC14/MO Host Adapter.

Table 2-2. UC14/MO Environmental Specifications

Parameter	Description
OPERATING TEMPERATURE	10°C (50°F) to 40°C (104°F), where maximum temperature is reduced 1.8°C per 1000 meters (1°F per 1000 feet) altitude
RELATIVE HUMIDITY	10% to 90% with a maximum wet bulb of 28°C (82°F) and a minimum dewpoint of 2°C (3.6°F)
COOLING	6 cubic feet per minute
HEAT DISSIPATION	82 BTU per hour

2.4 Physical Specification

Table 2-3 contains the physical specifications for the UC14/MO Host Adapter.

Table 2-3. UC14/MO Physical Specifications

Parameter	Description
PACKAGING	Single, quad-wide, four-layer PCBA
Dimensions	10.436 by 8.70 inches 26.507 by 22.09 centimeters (see Figure 2-1)
Shipping Weight	4 pounds

2.5 Electrical Specification

Table 2-4 lists and describes the electrical specification for the UC14/MO Host Adapter.

Table 2-4. UC14/MO Electrical Specification

Parameter	Description
POWER	+5 Vdc $\pm$ 5%, 2.6 amperes (A) MAX

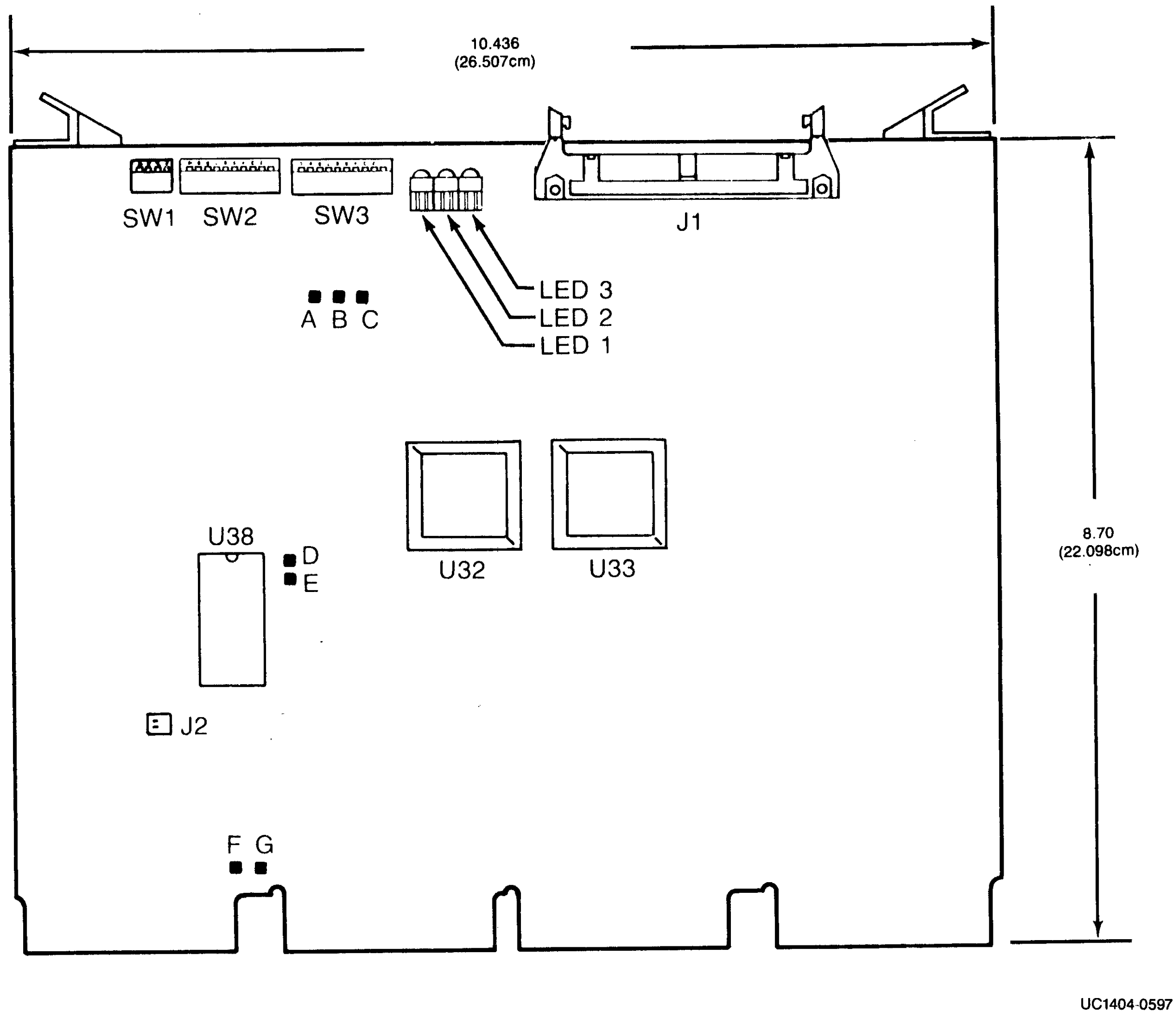


Figure 2-1. UC14/MO Host Adapter Dimensions

Section 3
PLANNING THE INSTALLATION

3.1 Overview

This section is designed to help you plan the installation of your UC14/MO Host Adapter. Taking a few minutes to plan the configuration of your subsystem before beginning its installation should result in a smoother installation with less system downtime. This section contains UC14/MO application examples and configuration procedures. The subsections are listed in the following table:

Subsection	Title
3.1	Overview
3.2	Configuring the Subsystem
3.3	Generating the Operating System
3.4	Performance Considerations

3.2 Configuring the Subsystem

This section explains how to decide on a suitable configuration for your disk subsystem. Once you have decided, the configuration can be set in one of two ways:

- **Via switches.** More than 40 common configurations are preconfigured in the firmware. If one of these configurations meets your needs, you can select it by setting switches on the UC14/MO PCBA.

- **Via NOVRAM.** If you can't find a suitable configuration, you can set your own configuration and save it in the nonvolatile RAM (NOVRAM) on the UC14/MO. ESDI drives used with an MD21 controller must be set via NOVRAM.

  Note that this section is concerned only with working out a configuration on paper. The details of setting switches or loading the NOVRAM are left for Section 4, INSTALLATION.

3.2.1 SCSI Address and LUN

The UC14/MO can work with a wide variety of SCSI controllers and peripherals. These devices are identified on the SCSI bus by means of their SCSI Address and SCSI LUN (Logical Unit Number), as follows:

- **SCSI Address.** Every controller attached to the UC14/MO is assigned a SCSI Address. These controllers are connected to the UC14/MO and to each other via the SCSI bus. A single SCSI bus supports up to eight addresses and the UC14/MO itself uses one SCSI Address, so each UC14/MO can support up to seven SCSI controllers.
- **SCSI LUN.** Each peripheral device on a single controller is assigned a unique SCSI LUN. The UC14/MO supports a maximum of eight physical devices, or eight LUNs.

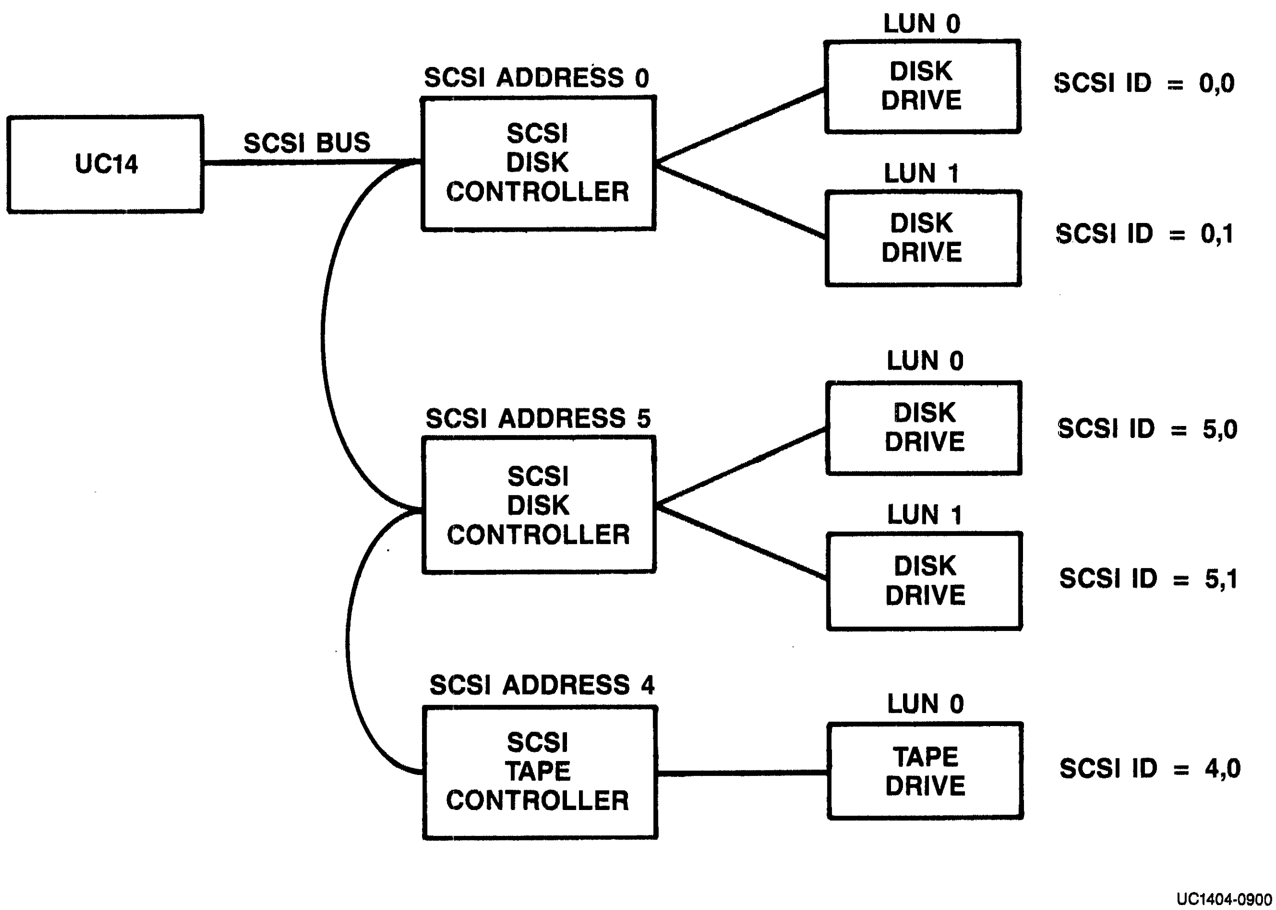


Figure 3-1. SCSI Bus Device Numbering Example

Figure 3-1 shows a typical configuration of a single UC14/MO with three controllers supporting a total of five LUNs. As you can see, although LUNs are repeated on different controllers, every device has a separate SCSI ID. Devices on the SCSI bus are referred to by both their SCSI Address and SCSI LUN, so the first drive on the first controller is 0,0, followed by 0,1. The first drive on the second controller (which has a SCSI Address of 5 in the example) is 5,0, and so forth.

All SCSI devices must have their address or LUN programmed into them, usually with switches or jumpers, and these addresses and LUNs must match the configuration you choose with the UC14/MO. The next section discusses strategies for choosing a suitable SCSI configuration.

3.2.2 Choosing a Configuration

The UC14/MO must know the SCSI Addresses and LUNs of every device attached to it. This information is available to it in one of two ways: through the configuration switches or the NOVRAM. Which method you use to configure the system depends on your requirements.

- **Configuration switches.** The UC14/MO has a large number of configurations already stored in its firmware. These configurations are listed and explained in Appendix C.

Each configuration supports a certain combination of controllers and peripherals with specified SCSI Addresses and LUNs. Therefore, if you choose one of the switch configurations, the SCSI Addresses and LUNs of your devices must match those shown in the configuration.

By Emulex convention, the first controller on a UC14/MO is assigned SCSI Address 0, the second is SCSI Address 5, and a tape controller is SCSI Address 4. You are bound by these conventions if you use a switch configuration. The NOVRAM, however, allows you more freedom.

- **NOVRAM.** If you are unable to find a configuration that fits your requirements, you can make up your own configuration and store it permanently in the UC14/MO's NOVRAM.

If you choose to use this method, all you have to do is decide on SCSI Addresses and LUNs for each of your devices. You may choose any numbers that are convenient, as long as every device has a separate SCSI ID. Instructions for loading the NOVRAM are presented in Section 4, INSTALLATION.

NOTE

If your configuration includes optical disks, you may use either switches or NOVRAM to specify the configuration. If you use the NOVRAM to identify a device as optical, however, be aware that the configuration will default to Optimem parameters.

3.2.3 MSCP Numbers

The operating system identifies drives attached to MSCP controllers via sequential numbers that have nothing to do with SCSI ID numbers (the operating system is completely unaware of the SCSI bus). The following table shows the numbers assigned by various operating systems. Two controller names and two drive names are given to indicate the numbering scheme.

Table 3-1. Device Names

Operating System	Controller First, Second	Drives Supported by First Controller
RSTS/E	RU0, RU1	DU0, DU1
RSX-11M	----, ----	DU0, DU1
RSX-11M-PLUS	DUA, DUB	DU0, DU1
RT-11	Port0, Port1	DU0, DU1
VAX/VMS	PUA, PUB	DUA0, DUA1
Ultrix-11	uda0, uda1	ra0, ra1
Ultrix-32m	uda0, uda1	ra0, ra1

In general, MSCP numbers are assigned sequentially across controller boundaries (although it is actually a host adapter, the UC14/MO is considered an MSCP controller by the operating system). For example, if there are three drives (DU0, DU1, and DU2) on the first MSCP controller in the system (at address 772150), then the first drive on the second controller (in floating address space) is numbered DU3. However, there are exceptions:

- **RSTS/E** requires that the first drive on the second controller be DU4, regardless of how many drives (up to a maximum of four) are on the first controller.
- **VAX/VMS** allows you to repeat MSCP numbers on different controllers. The first drive on the first controller is DUA0, the first drive on the second controller is DUB0, and so forth.

The UC14/MO has a set of switches that allows you to designate an offset value if you are using the UC14/MO as an alternate MSCP controller. These switches must be set to the proper value for the operating system you are using. They should always be set to 4 for an alternate controller under RSTS/E. For the other operating systems, the switches should be set so that the first drive attached to the UC14/MO has a number one higher than the highest numbered drive on previous MSCP controllers. The setting of the switches does not matter under VAX/VMS.

3.2.4 Logical vs. Physical Drives

There is one more factor in the configuration process: logical splitting of physical drives. The UC14/MO allows the **first drive** in any single configuration to be split into two logical drives. If a switch configuration is used, the first drive is defined by the configuration table. If NOVRAM is used, the first drive is defined by the first NOVRAM parameter.

If splitting is done, the two logical drives are treated as separate drives for nearly all purposes (although the physical drive has only a single SCSI LUN). For the purposes of MSCP numbering, these two logical drives are treated as two separate drives and are assigned separate MSCP numbers. This limits the number of devices you can attach to the UC14/MO, since a single UC14/MO supports a maximum of eight logical devices (i.e., eight separate MSCP numbers).

Two different splits are available: 1:1 (each logical is half the size of the physical) and 7:1 (one drive is 7/8 the size of the physical and the other is 1/8 the size). Dividing a physical drive into two logical drives usually slows performance, especially when both logicals are active. Therefore, we do not recommend splitting a physical drive unless it is necessary to allow for convenient file backup when only one drive is present.

3.2.5 Bus Address

Like any other controller on a DEC computer, the UC14/MO must be assigned a bus address. Therefore, before the UC14/MO is installed, you must calculate a bus address for the UC14/MO and that address must be programmed into the UC14/MO via switches.

As an MSCP device, the UC14/MO emulates the DEC UDA50 and must be assigned a bus address accordingly. Normally, the first MSCP controller in a system is assigned an address of 772150_8 and subsequent controllers are assigned addresses in floating address space. If you are using autoconfigure to assign addresses, see Appendix A for details on how autoconfigure works. If you are not using autoconfigure, you may use any bus address that is convenient.

If your system contains both a DEC RQDX1 and one or more UC14/MOs, we recommend assigning the standard address to the RQDX1 and floating addresses to the UC14/MOs.

3.3 Generating the Operating System

Before the installation of the UC14/MO is completed, the operating system must be modified to add the appropriate number of UDA50 controllers. Although it is beyond the scope of this manual to include detailed instructions for adding devices under DEC operating systems, this section outlines the procedure for RSTS/E, RT-11, RSX-11M, RSX-11M-PLUS, VAX/VMS, Ultrix-11 and Ultrix 32-m. Read only the section that applies to you.

In the discussions that follow, the following assumptions are made:

- This is the first pass that is being made through SYSGEN. Therefore, no saved answer file exists. Answer NO to questions such as "Use as input saved answer file?"
- Your host system configuration conforms to the standard UNIBUS device configuration algorithm (otherwise autoconfigure results are not reliable). Read Appendix A if you are not familiar with the DEC autoconfigure algorithm.
- You are generating a mapped version of the operating system on the appropriate hardware (unless you are using RT-11).

3.3.1 RSTS/E Operating Systems (V9.1 and above)

RSTS/E scans the hardware to determine configuration each time the system is bootstrapped. The scanning program is called INIT.SYS and it relies on the same hardware configuration conventions as do the other DEC operating systems.

RSTS/E versions 9.0 and below support two MSCP controllers; versions 9.1 and above support up to four MSCP controllers. The first MSCP controller must be located at the standard address, 772150_8. The second unit should be located in floating address space. For an alternate UC14/MO, Emulex suggests specifying a UNIBUS address of 760334_8 using the HARDWARE option of the INIT.SYS program.

The INIT.SYS program uses a user-specified table, located in the currently installed monitor, to make exceptions to the autoconfigure algorithm. This table is modified by the HARDWARE option of the INIT.SYS program. Use of this table allows an MSCP controller to be placed at virtually any address on the I/O page. Note that this table must be reset any time a new monitor is installed. An MSCP controller must be located at the standard address to be a bootstrap device.

Interrupt vector addresses are assigned to the MSCP controllers by INIT.SYS and programmed into the devices during initialization.

3.3.1.1 Adding MSCP Support

Support for an MSCP controller must be included in a monitor at SYSGEN time. To include support for an MSCP controller in a RSTS/E monitor, respond to the SYSGEN question "number of MSCP controllers" with the number of MSCP controllers on the system.

Units connected to MSCP controllers will be accessible to an on-line RSTS/E system only after the monitor is successfully SYSGENed and installed with the INSTALL sub-option of the INIT.SYS program, and the units have been successfully initialized with the DSKINT sub-option of INIT.SYS.

3.3.2 RT-11 Operating Systems (V5.1 and above)

The RT-11 Operating System supports up to four MSCP controllers with up to 256 devices (total) on the four controllers. The following paragraphs discuss the CSR and vector addresses for MSCP controllers under RT-11 in host systems with only one MSCP controller and in those with more than one controller. Disk partitioning, a unique feature of RT-11 that is applicable regardless of the number of controllers, is also discussed.

3.3.2.1 Installing a Single MSCP Controller

If your host system includes only one MSCP controller, install it with a CSR address of 772150_8. RT-11 will find and install the handler (driver) for that controller. In single MSCP controller configurations, it is not necessary to run SYSGEN. You may use one of the pregenerated monitors that are provided with the RT-11 Distribution. Emulex recommends that you modify the system start-up command file, STARTx.COM, to properly partition the disk drives.

3.3.2.2 Installing Multiple MSCP Controllers

If your host system includes more than one MSCP controller, you may either modify the MSCP handler as described in the *RT-11 Software Support Manual* or perform a SYSGEN. The following procedure describes the SYSGEN technique (user input is in **boldface** print):

1. Initiate SYSGEN:

   IND SYSGEN<return>

   Answer the next group of questions appropriately.

2. Indicate that you want the system to use the start-up command file when booting:

   ```
   Do you want the start-up indirect
   file (Y)? Y<return>
   ```

The start-up command file is required to allow additional CSR addresses to be specified and to partition the disks consistently when the system is bootstrapped. Answer the next set of questions appropriately.

3. Indicate that you want MSCP support when the Disk Options question appears:

    `Enter the device name you want support for`
    `[dd]:` **`DU<return>`**

4. Indicate the number of MSCP controllers on your system in response to this question:

    `How many ports are to be`
    `supported (1)?` **`2<return>`**

    RT-11 refers to individual MSCP controllers or controllers as ports. Each port has its own CSR and vector addresses.

5. Specify support for all other devices in your host system configuration as well. Indicate that there are no more devices by entering a period:

    `Enter the device name you want support for`
    `[dd]: .<return>`

6. You must specify the addresses of all MSCP controllers (ports) using the SET CSR keyboard command. To ensure that this is done consistently and automatically on power-up, you must add the commands to the system start-up command file, STARTx.COM. The **x** stands for the monitor that is being used, where **x** is S, F, or X for single-job, foreground/ background, or extended memory, respectively. Edit the command file to include the following statements:

    SET DU CSR=772150 (Default)
    SET DU CSR2=760334_8 (Floating)
    SET DU VECTOR=154 (Default)
    SET DU VEC2=300

    The CSR address for the second device can be any unused address in the I/O page which is supported by UC14/MO address switch settings; the vector address can be any unused address in the vector page. Default statements are not required.

7. Complete SYSGEN according to the DEC documentation.

3.3.2.3 Disk Partitioning

RT-11 is unable to handle drives with a capacity of more than 65,535 blocks (33.5M bytes). To allow drives with larger capacities to be used, RT-11 allows individual physical drives to be partitioned into multiple logical drives. This is done by assigning as many logical drive names (DU0, DU1, etc.) to a physical drive as that drive can support. The statements that make that assignment should be placed in the system start-up command file. This ensures that the drives are automatically partitioned every time the system is bootstrapped and that the partitions are always the same. Use the following procedure to determine the total number of logical drives to be assigned to each physical drive.

1. Determine the drive configuration(s) that you intend to use. You need to know the LUN of each logical drive and the data storage capacity (in logical blocks) of each logical unit. If the UC14/MO is at an alternate UNIBUS address (not 772150_8), then you must specify an MSCP device number by using switches SW2-1 through SW2-3.

2. Divide the capacity for each MSCP Unit by 65,535. If the result is a number greater than 1, then that MSCP Unit should be partitioned into multiple logical units. (The last partition on a disk may be smaller than 65,535 blocks.) Round the result up to the nearest whole number. That whole number (up to eight) equals the number of logical disks into which that MSCP unit should be partitioned.

3. You must then include a series of statements in the system start-up command file, STARTx.COM, that assigns logical names to each partition. Each statement has the following format:

```
SET DUn UNIT=y PART=x PORT=z
```

   where **n** is the logical device name, **y** is the physical MSCP unit number, **x** is the partition number, and **z** is the controller number (specify the controller number when two or more controllers are present; do not specify the port when only one controller is present). If you partition any drives, you must do this for each partition on each drive, including drives that can hold only one partition.

Example 3-1. *You have selected configuration number 02 from Table C-4 (see Appendix C). MSCP Unit 0 has a capacity of 218,432 blocks; Unit 1 has a capacity of 20,301 blocks (using a Medalist disk controller).*

Unit 0

$$\frac{218{,}432}{65{,}535} = 3.33 \text{ (4 logical units)}$$

Unit 1

$$\frac{20{,}301}{65{,}535} = 0.31 \text{ (1 logical units)}$$

Dividing the unit capacities by 65,535 and rounding the result up to the nearest whole number gives the number of logical units into which each should be partitioned. (Note that RT-11 allows only a maximum of 8 addressable units.)

You assign logical names to the partitions, beginning with DU0. For the previous example, the assignments are made as follows:

```
SET DU0 UNIT=0 PART=0 PORT=0
SET DU1 UNIT=0 PART=1 PORT=0
SET DU2 UNIT=0 PART=2 PORT=0
SET DU3 UNIT=0 PART=3 PORT=0

SET DU4 UNIT=1 PART=0 PORT=1
```

NOTE

The port command must be removed if only one controller is present. If two controllers are present, then the command is valid.

Modify the system start-up command file to include the disk partitioning statements.

4. Complete the SYSGEN as outlined in the *RT-11 Software Support Manual.*

3.3.3 RSX-11M Operating Systems (V4.0 and above)

RSX-11M SYSGEN is an interrogative program that allows a complete, running RSX-11M system to be configured for a particular hardware environment. SYSGEN is well documented in the *RSX-11M System Generation and Installation Guide*, and you are expected to rely primarily on that manual. This explanation is provided only to remove some ambiguities that the installation of the UC14/MO may present.

SYSGEN supports autoconfigure, and MSCP controllers are detected by autoconfigure. However, autoconfigure detects only the MSCP controller that is located at the standard CSR address. Additional MSCP controllers at alternate addresses must be attached to the operating system manually.

3.3.3.1 Installing a Single MSCP Controller

If you have only one UC14/MO, install it at the standard address (772150_8) and use autoconfigure to connect your peripherals. The procedure given in the *RSX-11M System Generation and Configuration Guide* is adequate for this purpose.

3.3.3.2 Installing Multiple MSCP Controllers

If you have two MSCP controllers, say a DEC MSCP controller and a UC14/MO, you must perform a complete manual initialization. We recommend that the DEC MSCP controller be installed at the standard CSR address. Locating the UC14/MO at the alternate address does not prevent its being used as the system device. Both MSCP controllers are connected to the operating system by using the following procedure.

1. Invoke SYSGEN.

   ```
   > SET /UIC=[200,200]<return>
   > @SYSGEN<return>
   ```

2. To indicate that you want to use autoconfigure, answer **Y** (yes) to the following question:

   ```
   * Autoconfigure the host system hardware?
     [Y/N]: Y<return>
   ```

3. To indicate that you do not want to override autoconfigure results, answer **N** (no) to this question:

   ```
   * Do you want to override Autoconfigure
     results? [Y/N]: N<return>
   ```

   Answer the rest of the questions in the SETUP section appropriately, and continue to the next section, TARGET CONFIGURATION. In TARGET CONFIGURATION, the defaults presented for the first group of questions should be accurate for your system because autoconfigure was requested.

4. In response to the question regarding devices, indicate that you have two MSCP-type controllers:

   ```
   * Devices: DU=2<return>
     Devices: .<return>
   ```

   This entry supersedes the value of 1 that autoconfigure has determined. Typing a period (.) terminates device input.

   Continue through the next four sections, HOST CONFIGURATION, EXECUTIVE OPTIONS, TERMINAL DRIVER OPTIONS, and SYSTEM OPTIONS, answering questions appropriately.

5. When you reach the PERIPHERAL OPTIONS section, SYSGEN asks you questions that pertain only to the MSCP devices on your system. (Unless you indicated that you wished to override other autoconfigure results when you responded to the Devices question, SYSGEN asks questions on those devices.)

The first question requests information about the controller's interrupt vector address, CSR address, the number of DU-type disk drives (there is no default value for this parameter), the number of command rings, and the number of response rings. The question is asked twice, once for controller 0 and once for controller 1, because we have specified two DU-type controllers. The dialogue uses the abbreviation contr to indicate controller.

```
* DU contr 0 [D:154,172150,,4,4]
154,772150,3,4,4<return>
```

The standard vector address for MSCP controllers is 154_8. The vector for a second unit should be allocated from floating vector address space. Any unused vector between 300_8 and 774_8 can be allocated.

The standard CSR address for MSCP controllers is 772150_8. Emulex recommends that second unit be located in floating address space.

The number of DU-type disk drives depends on the configuration that you have selected for the UC14/MO, or on the number of drives that are attached to a DEC MSCP controller.

For the UC14/MO, the number of DU-type drives is equal to the number of physical drives it is suporting or, if the first drive is logically split, to that number plus one. If a Titleist .25-inch cartridge tape drive is included in the configuration, do not count it as an MSCP disk when you answer this question. Tape drives are not supported by MSCP. You determine the configuration of each disk drive when you program the UC14/MO's NOVRAM; see subsections 4.7, 4.8 and 4.9.

The following types of disk drives can be attached to DEC MSCP controllers:

- RX50
- RD52
- RD53
- RC25
- RA60
- RA80
- RA81

The RX50 drive contains two 5.25-inch floppy diskettes; count an RX50 as two drives. The RC25 has both fixed and removable hard media; count an RC25 as two drives.

RSX-11M supports up to eight command and eight response rings; the number of command and response rings that you specify depends on your application. Four command and four response rings are reasonable and adequate for most applications.

6. SYSGEN then asks you to specify the type of disk drive(s) on each controller:

```
* DU contr 0 unit 0 is an RA60/80/81/RC25/RD51/RX50
[D:RA81]RA81<return>
```

For the DEC MSCP controller, indicate the appropriate peripherals.

For the UC14/MO, indicate that you have one RD51 for each logical disk drive (the tape drive is excluded).

RSX-11M does not tolerate gaps in sequence; the unit numbers must be contiguous. In addition, the unit numbers specified for each controller must be the same as those reported by the controller during initialization.

7. Complete the SYSGEN procedure according to DEC documentation.

3.3.4 RSX-11M-PLUS Operating Systems (V2.1 and above)

RSX-11M-PLUS SYSGEN is an interrogative program that allows a complete, running RSX-11M-PLUS system to be configured for a particular hardware environment. SYSGEN is well documented in the *RSX-11M-PLUS System Generation and Installation Guide,* and you are expected to rely primarily on that manual. This explanation is provided only to remove some ambiguities that the installation of the UC14/MO may involve.

SYSGEN supports autoconfigure, and MSCP controllers are detected by autoconfigure. However, autoconfigure detects only the MSCP controller that is located at the standard CSR address. Additional MSCP controllers at alternate addresses must be attached to the operating system manually.

3.3.4.1 Installing a Single MSCP Controller

If you have only one UC14/MO, install it at the standard address (772150_8) and use autoconfigure to connect your peripherals. The procedure given in the *RSX-11M-PLUS System Generation and Configuration Guide* is adequate for this purpose.

3.3.4.2 Installing Multiple MSCP Controllers

If your initial system configuration includes two MSCP controllers, connect the alternate MSCP controller to the operating system during the initial SYSGEN. We recommend that you use autoconfigure to connect the first controller at the standard address (772150_8). We recommend that the DEC MSCP controller be installed at the standard CSR address; locating the UC14/MO at the alternate CSR address does not prevent its being used as the system device.

If you are adding the second MSCP controller to the system configuration, use the Add a Device option of SYSGEN or a complete SYSGEN. The following procedure describes the Add a Device process (user input is in **boldface** print):

1. Invoke SYSGEN.

   ```
   > SET /UIC=[200,200]<return>
   > @SYSGEN<return>
   ```

2. To indicate that you want to do a subset of the SYSGEN procedure, answer **N** (no) to the following questions:

   ```
   * Do you want to do a complete SYSGEN?
     [Y/N D:Y]: N<return>

   * Do you want to continue a previous SYSGEN
     from some point? [Y/N D:Y]: N<return>
   ```

3. To indicate that you want to execute a specific module of the SYSGEN procedure, answer **Y** (yes) to this question:

   ```
   * Do you want to do any individual sections
     of SYSGEN? [Y/N D:Y]: Y<return>
   ```

4. Select the Add a Device section of SYSGEN:

   ```
   * Which sections would you like to do?
     [S R:0.-15.]: H<return>
   ```

   Type the letter H to select the Add a Device section. SYSGEN now asks you all of the questions in the Choosing Peripheral Configuration section.

   The questions that SYSGEN asks pertain to the type and number of controllers that are installed on your system. There is one question for each type of controller that RSX-11M-PLUS can support. Answer 0 (zero) for all types of controllers until you are prompted for the number of MSCP-type devices.

5. When you are asked to specify the number of MSCP-type devices, answer appropriately:

   ```
   * How many MSCP disk controllers do you
     have? [D R:0.-63. D:0.] 2<return>
   ```

6. Give the total number of MSCP disk drive (on all controllers) installed on the system.

   ```
   * How many MSCP disk drives do you have?
     [D R:0.-n. D:1.] 5<return>
   ```

   The answer to this question depends on the configuration that you have selected for the UC14/MO and on the number of drives that are attached to any DEC MSCP controllers.

For the UC14/MO, the number of DU-type drives is equal to the number of physical drives it is supporting or, if the first drive is logically split, to that number plus one. If a Titleist .25-inch cartridge tape drive is included in the configuration, do not count it as an MSCP disk drive when you answer this question. Tape drives are not supported by MSCP.

The following types of disk drives can be attached to DEC MSCP controllers:

- RX50
- RD52
- RD53
- RC25
- RA60
- RA80
- RA81

The RX50 drive contains two 5.25-inch floppy diskettes; count an RX50 as two drives. The RC25 drive has both fixed and removable hard media; count an RC25 as two drives.

7. SYSGEN then asks you to specify controllers per disk drives.

```
* To which DU controller is DU0: connected?
  [S R:1-1]: A<return>
```

This question is asked as many times as the number of MSCP drives that you have indicated are on the system. RSX-11M-PLUS does not tolerate gaps in sequence; the MSCP unit numbers must be contiguous. In addition, the unit numbers specified for each controller must be the same as those reported by the controller during initialization. Use A for the primary controller and B for the alternate controller.

8. Enter the vector address for each MSCP controller:

```
* Enter the vector address of DUA
  [O R:60-774 D:154]
```

The standard vector address for MSCP controllers is 154_8. The vector for a second unit should be allocated from floating vector address space. Any unused vector between 300_8 and 774_8 can be allocated.

9. Enter the CSR address for each MSCP controller:

```
* What is its CSR address?
  [O R:160000-177700 D:172150]
```

The standard CSR address for MSCP controllers is 772150_8. Emulex recommends that the second unit be located in floating CSR address space.

10. Specify the number of command rings for each MSCP controller:

```
* Enter the number of command rings for DUA
  [D R:1.-8. D:4.] 4<return>
```

RSX-11M-PLUS supports up to eight command rings. The value you specify depends on your application. Four command rings are reasonable and adequate for most applications.

11. Specify the number of response rings for each MSCP controller:

```
* Enter the number of response rings for DUA
  [D R:1.-8. D:4.] 4<return>
```

12. Complete SYSGEN as outlined in the *RSX-11M-PLUS System Generation and Installation Guide.*

3.3.5 VAX/VMS Operating Systems

VAX/VMS supports MSCP controllers at the standard address, 772150_8, and in floating address space. VAX/VMS has a software utility called SYSGEN which can be used to determine the UNIBUS address and interrupt vector address for any I/O devices to be installed on the computer's UNIBUS. A running VAX/VMS computer system is required in order to use this utility.

If you do not have access to a running system, you must determine the UNIBUS addresses and vector addresses manually (although autoconfigure can still be used to connect the devices to the computer automatically on power-up).

The following procedure tells how to use VAX/VMS SYSGEN to determine UNIBUS addresses and interrupt vectors.

1. Login to the system manager's account. Run the SYSGEN utility:

```
$ RUN SYS$SYSTEM:SYSGEN<return>
SYSGEN>
```

The SYSGEN> prompt indicates that the utility is ready to accept commands.

2. Obtain a list of devices already installed by typing:

```
SYSGEN> SHOW/CONFIGURATION<return>
```

SYSGEN lists by logical name the devices already installed, shown in Figure 3-2. Make a note of these other devices with floating addresses (greater than 760000_8) or floating vectors (greater than 300_8) that you plan to re-install with your UC14/MO.

Name: PUA	Units: 1	Nexus: 0	CSR: 772150	Vector1: 154	Vector2: 000
Name: TTA	Units: 1	Nexus: 0	CSR: 760100*	Vector1: 300*	Vector2: 304*
Name: TXA	Units: 1	Nexus: 0	CSR: 760500*	Vector1: 310*	Vector2: 000

*Floating address or vector
Note: All addresses and vectors are expressed in octal notation.

Figure 3-2. Sample SHOW CONFIGURATION

3. To determine the UNIBUS addresses and vectors that autoconfigure expects for a particular device type, execute the CONFIGURE command:

```
SYSGEN> CONFIGURE<return>
DEVICE>
```

Specify the UNIBUS devices to be installed by typing their UNIBUS names at the DEVICE prompt (the device name for MSCP controllers under VAX/VMS is UDA).

```
DEVICE> UDA,2<return>
DEVICE> DHV11<return>
DEVICE> DZ11<return>
```

A comma separates the device name from the number of devices of that type to be installed. The number of devices is specified in decimal.

In addition to the UC14/MO, you need only specify devices that have floating addresses or vectors. Devices with fixed addresses or vectors do not affect the address or vector assignments of devices with floating addresses and vectors.

4. Indicate that all devices have been entered by pressing the <ctrl> and Z keys simultaneously:

```
DEVICE> ^Z
```

SYSGEN lists the addresses and vectors of the devices entered in the format shown in Figure 3-3.

5. Note the CSR addresses listed for the UNIBUS devices in floating address space. Program the listed addresses into non-Emulex devices as instructed by the manufacturer's documentation. For the UC14/MO, program the address given for the UC14/MO (lowest numerical address) into the board as described in subsection 4.5.1.

6. Complete SYSGEN according to the DEC documentation.

```
SYSGEN>   CONFIGURE
DEVICE>  DZ11
DEVICE>  DHV11
DEVICE>  UDA,2
DEVICE>  ^Z
Device:  UDA      Name: PUA     CSR: 772150      Vector: 154     Support: yes
Device:  DZ11     Name: TTA     CSR: 760100*     Vector: 300*    Support: yes
Device:  UDA      Name: PUB     CSR: 760354*     Vector: 310     Support: yes
Device:  DHV11    Name: TXA     CSR: 760500*     Vector: 320     Support: yes

*Floating address or vector
Note: All addresses and vectors are expressed in octal notation.
```

Figure 3-3. CONFIGURE Command Listing

3.3.6 Ultrix-11 Operating Systems (V3.0 and above)

The Ultrix-11 Version 3.0 system supports up to a total of four MSCP disk controllers, **but only one of each type of controller**. Therefore, to add support for two MSCP controllers, the system generation procedure must be told that there is, for example, one UDA50 controller and one RQDX1 controller. The choices are:

Controller name	device name	disk name
UDA50	ra	ra??
KLESI	rc	rc??
RQDX1, RQDX2, or RQDX3	rq	rd??
RUX1	rx	rx??

NOTE

A bug exists in version 3.0 that prevents actually using more than three controllers. When an RQDX1, RQDX2, or RQDX3 is specified, the sysgen program will not allow specifying an RUX1 controller, and vice versa.

3.3.6.1 Sysgen

To add a device to an Ultrix-11 kernel, the sysgen program must be run to create and make a new kernel. Creating a kernel involves the creation of a configuration file and then "making" the kernel from this configuration file.

A dialogue mode is used to enter various system parameters. The question:

```
Disk controller type:

<rh11 rh70 rp11 rk611 rk711 rl11 rx211 rk11
 uda50 kda50 rqdx1 rqdx2 rqdx3 klesi rux1> ?
```

asks for the specification of a disk controller. You must choose a different controller type for each MSCP controller on your system, even if they are all UC14/MOs.

NOTE

> The order in which you enter each controller is very important. The order becomes the controller number. The same order must also be used when creating the special files (see below).

For each MSCP controller specified, one of the following statements will be typed:

```
First MSCP controller type:
Second MSCP controller type:
Third MSCP controller type:
```

Depending on the controller name specified previously, the next question will differ. See the appropriate correlation below:

Disk Controller Type	Next Sysgen Question
uda50 or kda50	Drive 0 type <ra60 ra80 ra81> ?
klesi	Drive 0 type <rc25> ?
rqdx1/2/3 or rux1	Drive 0 type <rx50 rd51 rd52 rd53> ?

Note that it doesn't matter which drive type you choose. Just enter one of the supplied names for each drive you have connected to each controller.

The next two questions refer to the controller's CSR and vector addresses:

```
CSR address <172150> ?
Vector address <154> ?
```

The defaults for the CSR and Vector address will always be 172150_8 and 154_8, respectively. Be sure to enter the correct CSR value. Since the MSCP controller accepts a software-defined vector, an unused vector from the floating address space should be used for all nonstandard address controllers. Emulex suggests that you use a decrementing (by 4) vector address starting at 700_8. This will prevent you from using a vector address that is already in use.

3.3.6.2 Special Files

The Ultrix operating system communicates with devices on the system by the use of special files. These files contain pointers into a system table that lists the entry points for a corresponding driver for that device. There must be a special file for each device (and each partition for disks) on the system in order for Ultrix to communicate with that device. Some devices will have two special files associated with a device: one for use with character mode, and the other for block mode. These special files exist in the account "/dev".

The special files for Ultrix-11 are created with the 'msf' program (make special file). If no options are supplied, this program enters a dialogue mode:

```
# /etc/msf
```

The "msf" program will issue the prompt:

```
Command <create exit help remove table>:
```

Use the "c" command to create the special files.

```
Device name (? for help) <rp06,dz11,lp11,etc>:
```

The "msf" program does not understand the notations for different controller types. Instead, it uses the device name and controller number in order to create the special files. For example, the special files for ra60, ra80, and ra81 would be "ra", the special file for an rc25 would be "rc", and the special files for an rd51/2/3 would be "rd". Therefore, you must enter a unique device name for each controller. It is suggested that you use the same device names used previously with the sysgen program.

The next two questions are:

```
MSCP controller number <0 1 2 3>:
Unit number <0 -> 7 or all>:
```

The MSCP controller number assigned to each controller is determined by the order in which you entered the devices to the sysgen program; that is, the number for the first controller is 0.

The unit number for each drive (as it is identified by SW2-1 through SW2-3) must match the drive's specification in the configuration file. In addition, the drive to be booted from must be 0, regardless of whether the controller is at the standard or an alternate address.

For ra, rc, and rd type devices, the next question will be asked:

```
  Assume standard disk partitions (? for help) <y
or n> ?
```

If you answer "no", the next question will be asked:

```
Create partitions <0 -> 7 or all>?
```

You should always answer "all".

3.3.6.3 Newfs

The "newfs" program is used to create file systems on specified partitions. The newfs program requires no arguments and immediately enters a dialogue mode. See the *Ultrix-11 System Manager's Guide* for more information on newfs.

3.3.6.4 Volcopy

Once a device is configured into your current kernel, you can copy an existing file system onto a new partition with the 'volcopy' program. The new partition will be created with the identical size parameters of the original file system. See the *Ultrix-11 System Manager's Guide* for more information on volcopy.

3.3.6.5 Copying a Bootstrap

A new bootstrap can be copied onto a new system disk with the "dd" program. The command:

```
# dd if=/mdec/rauboot of=/dev/ra00
```

will copy the bootstrap file onto block zero of ra0.

NOTE

V7M-11 V1.0 and Ultrix-11 V2.0 did not support self-sizing disks and are unusable with the Emulex MSCP controllers.

3.3.7 Ultrix-32m Operating Systems

The Emulex MSCP class disk subsystems emulate the DEC DSA UDA-50/KDA-50/RA81 (MSCP) disk subsystem. They report that they are of controller type "DU" and of device type "RA81". However, when asked for the number of logical blocks, they do not return a size value that matches that of a "real" DEC RA81.

3.3.7.1 The Kernel

Support for MSCP controllers must be included in a monitor when rebuilding the kernel. The configuration file is edited to reflect the number of controllers and the number of drives connected to each controller. The Ultrix-32m system supports two MSCP disk controllers.

Ultrix-32m does not require that MSCP device numbers be assigned to the units in sequential order. However, the MSCP device number for the drive to be booted from **MUST** be 0 regardless of the controller's UNIBUS address. Further, be certain that the MSCP device number of each drive (as it is identified by SW2-1 through SW2-3) matches the drive's specification in the configuration file.

The following example of a configuration file shows two controllers, the first with two drives, the second with one:

```
controller  uda0  at uba0 csr 0172150  vector
                                       udintr
disk        ra0   at uda0 drive 0
disk        ra1   at uda0 drive 1
controller  uda1  at uba0 csr 0160334  vector
                                       udintr
disk        ra2   at uda1 drive 2
```

In this example, the first unit on the second controller must be MSCP device number two regardless of the units on the first controller.

3.3.7.2 Special Files

The Ultrix operating system communicates with devices on the system by the use of special files. These files contain pointers into a system table that lists the entry points for a corresponding driver for that device. There must be a special file for each device (and each partition for disks) on the system in order for Ultrix to communicate with that device. Some devices will have two special files associated with a device: one for use with character mode, and the other for block mode. These special files exist in the account '/dev'.

There is a shell script, called "MAKEDEV" (uppercase important), on the Ultrix-32m system to help build these special files. The format of this command is:

```
% /dev/MAKEDEV device ...
```

This script passes your input to the program "mknod" to create the special files. You should use this command file to create the special files for each disk you wish to connect to the system. An example for two disks is:

```
% /dev/MAKEDEV ra4 ra5
```

This example assumes that you have already added the device into the configuration file, and you chose the logical names ra4 and ra5 for your disks.

3.3.7.3 Autoconfigure

At boot time, Ultrix-32m attempts to autoconfigure the devices included in the booted monitor's configuration file. If the device was not included in the configuration files, it will not be configured into the running system. If the device is not present, Ultrix will skip it.

When Ultrix-32m finds a device at autoconfigure time it prints a message as follows:

```
rqd0 at csr 172150 vec 774, ipl 17
ra0 at rqd0 slave 0
ra1 at rqd0 slave 1
rqd1 at csr 160334 vec 770, ipl 17
ra2 at rqd1 slave 0
```

The CSR addresses were set in the configuration file. The vectors are assigned sequentially in reverse order by the operating system. If the CSR or unit numbers don't match the configuration file, the device will be skipped (and no message will be printed).

3.3.7.4 Disk Partitions

Ultrix allows a user to logically subdivide a disk into sections called "partitions". Disk partitions were created because the first Unix operating systems could access only a limited amount of space on large disks. Disk partitioning lets several Unix file systems reside on the same disk, one file system per partition. This allows the operating system to use the entire disk.

Each disk has a partition table that defines the starting location and size (both in blocks) of each partition on that disk. When a disk is opened by the operating system (for the first time), it writes the partition size table into the super block of partition "a" (the first partition) on the disk.

3.3.7.5 Disk Partition Modifications

Modifications to a disk's partition table is done with the "chpt" command each time a disk is initialized or reinitialized. The "chpt" command allows a system manager to alter a particular partition's location and size characteristic.

The operating system initializes the disk's partition table with that of a real DEC RA81's size table (found in the disk driver) on its very first opening. The system manager should then edit these sizes (with "chpt" command) to match system needs.

3.3.7.6 Default Partition Modifications

It is also possible to modify the default RA81 partition size table, which is stored in the device driver; this would eliminate the need for editing the partition table each time the disk is initialized.

When DEC reorganized the Berkeley 4.2 Unix system to create Ultrix-32(m) they set it up to allow the distribution of the operating system in a binary format. This allowed them to distribute a minimum amount of source code to binary license holders. They separated each of the drivers and system kernel modules into two sections: a code portion and a data portion. The code portion does not require recompilation depending on the selected options at sysgen time; this is supplied in object format (xx.**o**). The data portion requires selection parameters based on sysgen answers; this is supplied in source code format (xx_**data.c**). Making changes to this table will alter the default partition size characteristics for new disks. An example of the changes to the 'uda' driver is included here.

/usr/sys/data/uda_data.c:

```
}, ra81_sizes[8] ={
    15884,    0,          /* A=blk 0 thru 15883 */
    66880,    15884,      /* B=blk 15884 thru 82763 */
    -1,       0,          /* C=blk 0 thru end */
    0,        0,          /* D= not used */
    0,        0,          /* E= not used */
    0,        0,          /* F= not used */
    -1,       82764,      /* G=blk 82764 thru end */
    0,        0,          /* H= not used */
};
```

The -1 above indicates the end of the disk.

3.3.7.7 Newfs

The newfs program speeds up the creating of a file system on a partition. It looks up information, in the file /etc/disktab, on the disk specified by the system manager and creates the file system according to those default values. An example of the changes to the /etc/disktab file have been included here.

/etc/disktab:

```
qd32|UC14/MO|Emulex UC14/MO Fujitsu Eagle M2351A Winchester:\
        :ty=winchester:ns#47:nt#20:nc#840:\
        :pa#15884:ba#4096:fa#512:\
        :pb#66880:bb#4096:fb#512:\
        :pc#789600:bc#4096:fc#1024:\
        :pg#706836:bg#4096:fg#1024:
```

3.3.7.8 Suggestions/Warnings

There is a maximum of eight partitions per disk. The partitions form logical boundaries on the disk, separating each file system from all others. These logical divisions are useful for disk management because you can put similar types of users, files, directories or projects all on the same file system. Because a file system can never exceed its partition in size, you can use partitions to regulate disk use.

There are certain areas of the disk which, by default, are reserved for the operating system. By mounting the swap space, for example, on its own partition, important data can not be overwritten when data from memory is swapped to the disk. The Ultrix-32m systems use partition "b" for the swap file. If you plan to use your own partition values, be sure to allocate an area on your system disk for a swap file.

For more information on disk partitioning and modifications to the partition sizes, see the *Ultrix-32m System Manager's Guide.*

The program "diskpart" is used to create entries for the disk driver or for the "disktab" file. It creates a template based on the default rules used at Berkeley. The following is a table defining the Berkeley defaults:

Partition	**20-60 MB**	**61-205MB**	**206-355 MB**	**356+ MB**
a	15884	15884	15884	15884
b	10032	33440	33440	66880
c *	all	all	all	all
d	15884	15884	15884	15884
e	unused	55936	55936	307200
f *	unused	end	end	end
g *	end	end	end	end

* The 'c' partition is, by convention, used to access the entire disk. In normal operation, either the 'g' partition is used, or the 'd', 'e', and 'f' partitions are used. The 'f' and 'g' partitions are variable sized, occupying whatever space remains after allocation of the fixed sized partitions.

NOTE

Ultrix-32m V1.0 did not support self-sizing disks and is unusable with the Emulex MSCP controllers. The "diskpart" program was not included on the Ultrix-32m V1.1 distribution kit.

3.4 Performance Considerations

The only performance consideration on the UC14/MO involves the sector interleave ratio of disk-type devices that are connected to the UC14/MO. Table 3-2 lists the sector interleave ratios recommended by Emulex to achieve the best performance from the subsystem.

Table 3-2. Recommended Sector Interleave Ratios

Drive Model	Interleave Ratio
Atasi 3064	1:1
IOMEGA Alpha-10.5	2:1
Maxtor XT1140	1:1
Rodime	1:1
Fujitsu	1:1

3.5 Optical Disk Preparation

This section discusses some things to consider if you are installing a subsystem that includes optical disks.

3.5.1 Optical Disk Drivers

Optical disks will not function properly under standard DEC operating systems that are designed for magnetic disk applications. In order to work under DEC operating systems, a special software driver must be installed that takes into account the limitations of reading and writing optical disks.

There are three ways of supplying a driver:

- Write your own. If you plan to do this, see section 3.5.3 for a discussion of some programming details.
- Buy a driver from a third party.
- Buy a driver from Emulex.

At the present time, Emulex offers one driver, the Perceptics Laserware driver for use under VMS. Complete instructions for installing the driver are contained in the Perceptics manual that comes with the driver. The Perceptics driver may be ordered directly from Emulex at the time you purchase your subsystem.

3.5.1.1 Limitations of Perceptics Driver

In addition to the restrictions listed in the Perceptics manual, the following qualifiers to the VMS BACKUP command cannot be used when the Perceptics driver is installed:

- /FAST
- /IMAGE
- /PHYSICAL

Each of these operations fails because they require direct access to the index file on the disk. This cannot be done because the disk is not in the Files-11 format. All backup operations with the optical disk should be performed on a SAVE SET basis. This allows the optical disk to contain many different disk volumes.

3.5.2 Supported Devices

Emulex offers an optical disk subsystem that has been completely tested and certified with the UC14/MO when used with the Perceptics optical disk driver.

In addition, the following models of optical disk drives are supported by Emulex on the UC14/MO:

- Optimem 1000
- OSI Laserdrive 1200

3.5.3 Programming

The UC14/MO is designed to interface optical disks with the DEC MSCP device driver. Driver transparency is achieved by translating standard MSCP commands and responses used for magnetic disks into those unique to optical disks.

Because optical disks can be written only once, however, the DEC MSCP driver will not work without modification. Users who wish to either modify the DEC driver or write a pseudo-driver that works with the DEC driver must be aware of the limitations of optical disks and the UC14/MO. The following subsections discuss some of these limitations.

3.5.3.1 Write Operations

The following limitations apply to write operations:

1. Any sector on the disk pack may be written only once. An attempt to overwrite a previously written sector can result in several different types of errors, depending on the drive vendor. Most vendors return a SCSI CHECK CONDITION with a Sense Key of BLANK CHECK (8H). The UC14/MO translates this into the MSCP error "Read Data Sync Error." User-written software must be capable of detecting and handling this error.

   Some optical disks do not check for overwrites and give no error indication when an overwrite is performed. In such a case, not only is the previous data destroyed but the sector is undreadable from that point on. Therefore, it is the software's responsibility to keep track of previously used sectors.

2. User-written application software must provide file and directory updating utilities.

3. On optical disks, the UC14/MO translates Write/Datacheck into a SCSI Group 1 WRITE AND VERIFY command. This results in the fastest possible throughput while taking advantage of the extensive ECC correction capability of the optical disk controller. In this mode, all data is written to the disk and then read back and checked for ECC by the drive controller.

   Users who wish to check the integrity of the data path from the host CPU to the disk can issue a WRITE followed by a READ and allow the host to compare data in memory.

   Users who are primarily concerned with speed and are using a drive with "Direct Read After Write" capability (for example, the OSI Laserdrive 1200) can issue a simple WRITE command. If this is done, Emulex recommends using Write/Datacheck as a minimum.

3.5.3.2 Read Operations

Read operations are performed transparently. The only exception occurs when a read is attempted on a blank sector. Most drive controllers return a SCSI CHECK CONDITION when this is done and the UC14/MO translates this into the MSCP error message "Read Data Sync Fail." In general, the message displayed to the user will be "Parity Error" and the application software must be capable of handling this error condition.

3.5.3.3 Bad Block Replacement

The UC14/MO reports all optical drives as nonblock-replaceable devices. This means that the application software is responsible for the management of uncorrectable data errors. There are two possible ways to handle uncorrectable write errors:

1. If the drive is capable of "Direct Read After Write" operations, it will usually transparently revector and rewrite any sectors with uncorrectable errors. This operation is vendor dependent and should be determined before the application software is written.

2. If the drive is not capable of "Direct Read After Write" operation, the application software should issue a Write/Datacheck. This causes the UC14/MO to issue a SCSI WRITE AND VERIFY command. It is the responsibility of the application software to revector and rewrite any sectors with uncorrectable errors. The application is also responsible for updating its own file directory to account for the revectoring.

Uncorrectable read errors must also be handled by the application software. This can usually be handled as described in situation 2 above.

3.5.3.4 VMS Command Support

In general, transparent use of VMS commands is not supported without the use of special utilities such as the Perceptics software. The following VMS commands (with the stated limitations) are supported:

- MOUNT/FOREIGN. This operation works only if the optical disk contains a valid RCT. An attempt to mount an optical disk without a valid RCT will return an "INVALID MEDIA FORMAT ERROR."

- DUMP. The VMS DUMP utility will work transparently in most cases. When attempting to dump a blank sector the utility returns a "PARITY ERROR." The data displayed in this case is unreliable.

Attempts to user other VMS commands transparently cause undefined error conditions that can include system hangs, machine checks, and loss of data on the disk. For example, initializing an optical disk with the VMS Files-11 format renders the disk pack unusable.

Attempts to mount an uninitialized disk causes the hardware error "Read Data Sync Error" and will hang the mount process for an undefined time because it will continually retry the operation. In the same situation on a formatted but uninitialized magnetic disk, the mount operation will return a "No Files-11 Home Block Found" error.

4.1 Overview

The procedure for installing the UC14/MO Host Adapter is described in this section. The subsection titles are listed below to serve as an outline of the procedure.

Subsection	Title
4.1	Overview
4.2	Inspection
4.3	SCSI Controller Setup
4.4	UC14/MO Host Adapter Setup
4.5	Physical Installation
4.6	Cabling
4.7	NOVRAM Loading, Disk Formatting, and Testing
4.8	F.R.D. Options
4.9	Drive Configuration Parameters
4.10	Operation

If you are unfamiliar with the subsystem installation procedure, Emulex recommends reading this Installation Section before beginning.

4.1.1 Subsystem Configurations

This section is limited to switch setting data and physical installation instructions. No attempt is made to describe the many subsystem configurations that are possible. **If you are not familiar with the possible configurations, we strongly recommend reading Section 3, PLANNING THE INSTALLATION, before attempting to install this subsystem.**

When you are installing the subsystem, you should make a record of the subsystem configuration and environment. Figure 4-1 is a Configuration Record Sheet that lists the information required and shows where the data can be found. This information will be of help to an Emulex service representative should your subsystem require service.

UC14/MO CONFIGURATION REFERENCE SHEET

GENERAL INFORMATION

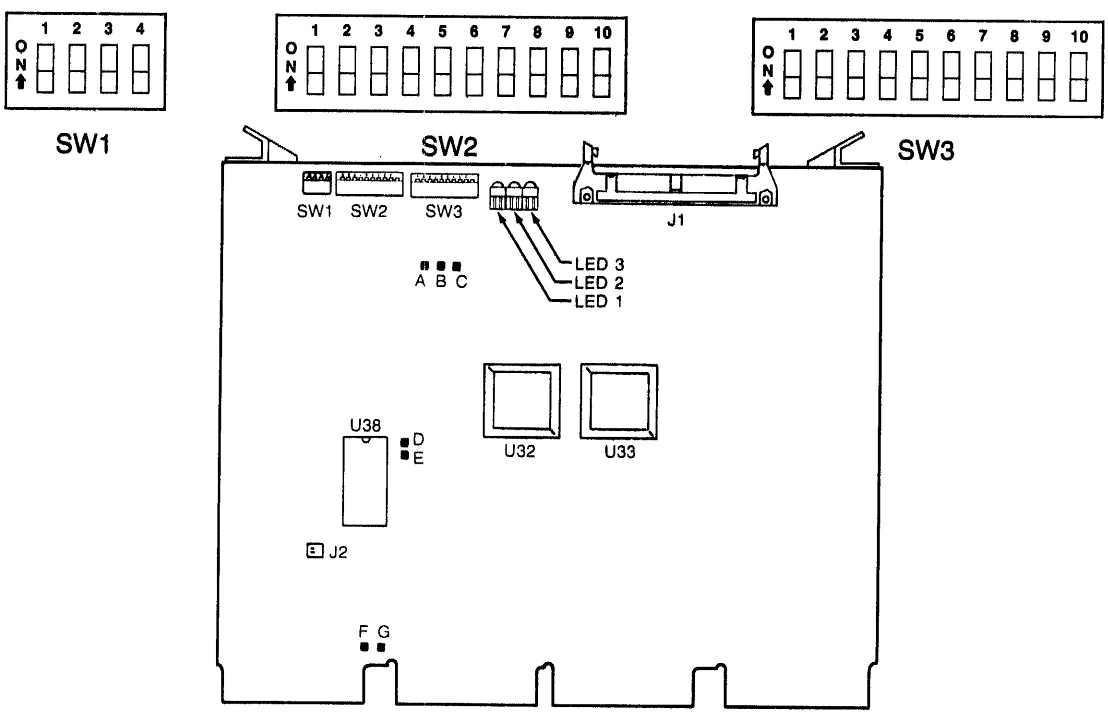
1. Host computer type ____________________
2. Host computer operating system ____________________
   Version ____________
3. Subsystem Model ____________________
   Controller(s) ____________________

   Disk drive(s) ____________________

   Tape drive(s) ____________________

UC14/MO INTELLIGENT HOST ADAPTER

1. Firmware revision number____________________
2. Warranty expiration date ____________________
3. Top assembly number ____________________
   Serial number ____________________
4. Unibus address____________________
5. Interrupt vector address ____________________
6. Switch settings (☐ = OFF ■ = ON)



U37 label identifies top assembly and serial numbers.
U38 label identifies firmware revision.

Use Pencil

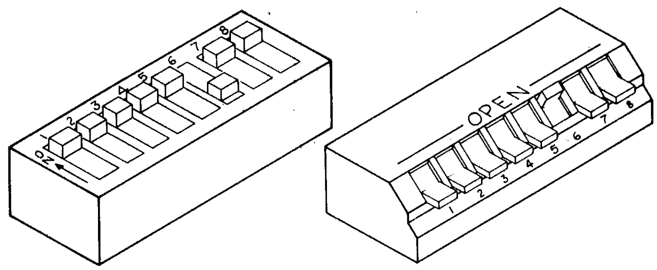
Figure 4-1. UC14/MO Configuration Reference Sheet

UC1404-0680

4.1.2 Dip Switch Types

Switch-setting tables in this manual use the numeral one (1) to indicate the ON (closed) position and the numeral zero (0) to indicate the OFF (open) position.

The two DIP switch types used in this product are shown in Figure 4-2. Each is set to the code shown in the switch setting example.



------------ SW1 ------------							
1	2	3	4	5	6	7	8
1	1	1	1	1	0	1	1

Figure 4-2. Switch Setting Example

4.1.3 Maintaining FCC Class A Compliance

Emulex has tested the UC14/MO Intelligent Host Adapter with DEC computers that comply with FCC Class A limits for radiated and conducted interference. When properly installed, the UC14/MO does not cause compliant computers to exceed Class A limits.

There are two possible configurations in which the UC14/MO and its associated SCSI peripherals can be installed:

- With both the UC14/MO Host Adapter and the SCSI disk drives mounted in the same cabinet, and
- With the UC14/MO mounted in the CPU cabinet and the SCSI drives mounted in a separate cabinet.

To limit radiated interference, DEC completely encloses the components of its computers that generate or could conduct radio-frequency interference (RFI) with a grounded metal shield (earth ground). During installation of the UC14/MO, nothing must be done that would reduce this shield's effectiveness. That is, when the UC14/MO installation is complete, no gap in the shield that would allow RFI to escape can be allowed.

Conducted interference is generally prevented by installing a filter in the ac line between the computer and the ac outlet. Most power distribution panels that are of current manufacture contain suitable filters.

The steps that must be taken to maintain the integrity of the shield and to limit conducted interference are explained fully in subsection 4.6.

4.2 Inspection

Emulex products are shipped in special containers designed to provide full protection under normal transit conditions. Immediately upon receipt, the shipping container should be inspected for evidence of possible damage incurred in transit. Any obvious damage to the container, or indications of actual or probable equipment damage, should be reported to the carrier company in accordance with instructions on the form included in the container.

Unpack the UC14/MO subsystem and, using the shipping invoice, verify that all equipment is present. Verify also that model or part numbers (P/N), revision levels, 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. If the equipment must be returned to Emulex, it should be shipped in the original container.

Visually inspect the UC14/MO Host Adapter after unpacking. Check for such items as bent or broken connector pins, damaged components, or any other evidence of physical damage.

Examine all socketed components carefully to ensure that they are properly seated.

4.2.1 UC14/MO Host Adapter Inspection

Visually inspect the UC14/MO Host Adapter after unpacking. Check for such items as bent or broken connector pins, damaged components, or any other evidence of physical damage.

Examine all socketed components carefully to ensure that they are properly seated.

4.3 SCSI Controller Setup

All SCSI mass-storage subsystems, which usually include a SCSI controller, its associated drives or transports, and a power supply in a single chassis, must be configured to operate with the UC14/MO. Configuration items that must be taken into consideration include drive and controller placement, controller SCSI address, SCSI bus termination, and drive or transport unit number.

4.3.1 SCSI Mass Storage Subsystem Placement

Unpack and install the SCSI subsystem according to the manufacturer's instructions. Position the subsystem in its final location before beginning the installation of the UC14/MO. This placement allows the SCSI cable routing and length to be judged accurately. The maximum recommended length of the SCSI cable is 20 feet (6 meters).

4.3.2 Controller Addressing

An address must be selected for each SCSI controller (some subsystems may contain more than one controller). If you are configuring the UC14/MO with the NOVRAM, you must calculate the SCSI address for each controller. If you are configuring the UC14/MO with switches, the SCSI address is determined by which configuration you choose. After selecting a configuration, assign the SCSI address specified for that configuration to the controller(s). The address is specified in the SCSI Addr column of Table C-4. Take care that no two controllers are assigned the same address.

4.3.3 Peripheral (Drive) Unit Numbers

Some peripherals must have unit numbers assigned to them during installation. If you are configuring the UC14/MO with the NOVRAM, you must calculate the unit number yourself. If you are configuring the UC14/MO with switches, check the Drive LUN (logical unit number) column of Table C-4. Use the row that corresponds to the configuration that you are using. Check the manual supplied with the drive for instructions on how to program the unit number into the drive.

4.3.4 SCSI Termination

The last controller on the SCSI bus must electrically terminate the bus. The last controller should have termination enabled; all others should have it disabled. See your controller or subsystem manual for instructions on enabling and disabling the termination option.

4.4 Host Adapter Setup

Several configuration setups must be made on the UC14/MO Host Adapter before inserting it into the chassis. These are made by option switches SW1, SW2, and SW3.

Figure 4-3 shows the locations of the configuration switches referenced in the paragraphs below.

NOTE

If a switch position is changed on the UC14/MO, either reset the unit by toggling switch SW1-1 and then issuing a host bus init, or remove and restore the unit's power. This reset is required because the switches are read by the host operating system's initialization routine.

Table 4-1 defines the functions and factory configuration of all switches on the UC14/MO controller. The factory configuration switch settings are representative of most UC14/MO Host Adapter applications.

There are also several jumpers on the UC14/MO PCBA. Although none of these control configuration options, you may want to check to make sure they are in their factory configuration. Figure 4-3 shows the location of the jumpers on the PCBA; Table 4-2 lists the function and factory configuration of each jumper.

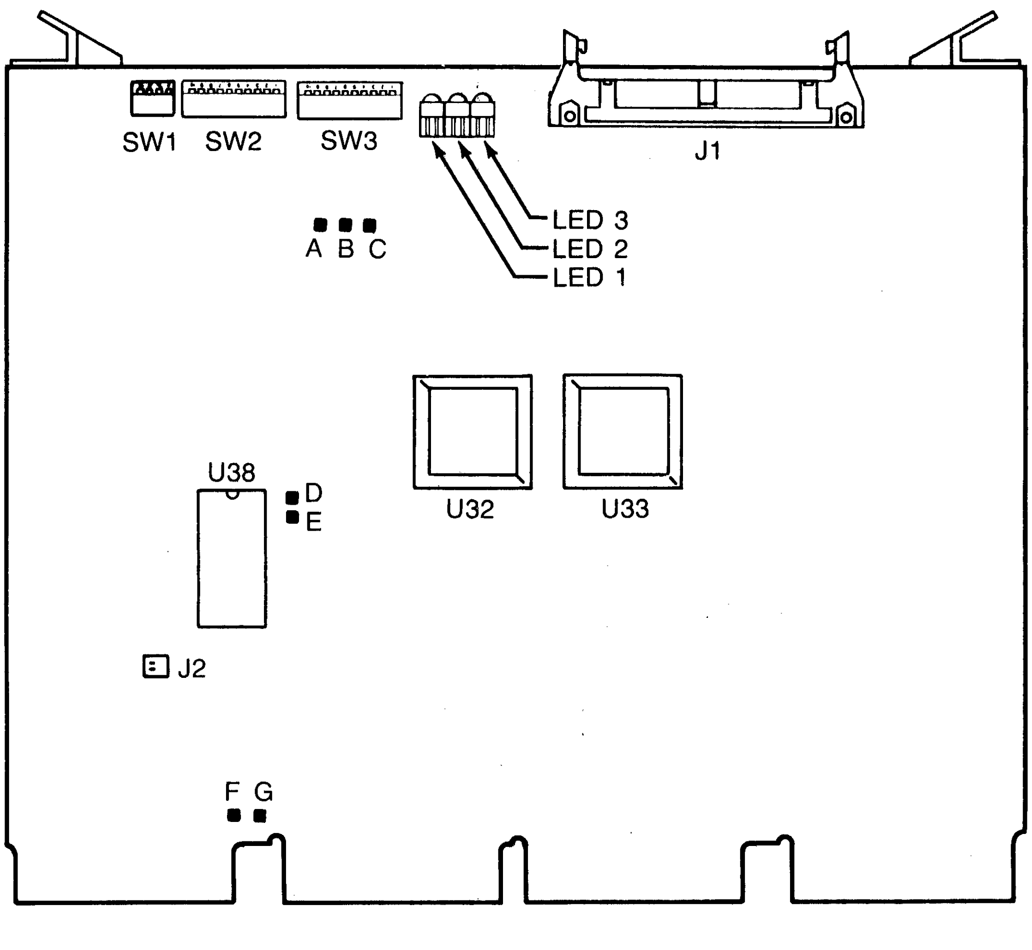


Figure 4-3. UC14/MO Host Adapter Assembly

NOTE

If you change a switch position on the UC14/MO or change configuration values in NOVRAM, you must also reset the UC14/MO so that the host operating system's initialization sequence reads the codes established by the switch settings and/or NOVRAM. To reset the UC14/MO, either toggle switch SW1-1 (ON then OFF), or power-down and power-up the system.

Table 4-1 defines the function and factory configuration of all switches on the UC14/MO host adapter. The factory configuration switch settings are representative of most UC14/MO Host Adapter applications.

Table 4-1. UC14/MO Switch Definitions and Factory Configuration

Switch	OFF(0)	ON(1)	Fact	Function	Section
SW1-1	Run	Reset/Halt	OFF(0)	Run vs. Reset/Halt	
SW1-2	Disable	Enable	OFF(0)	Ultrix Compatibility	4.4.5.5
SW1-3	4,0	0,4	OFF(0)	Subsystem Tape Configuration	4.4.5.3
SW1-4	4 us	8 us	OFF(0)	DMA Burst Delay	4.4.5.4
SW2-1	-	-	OFF(0)	MSCP Device Number	4.4.5.1
SW2-2	-	-	OFF(0)	MSCP Device Number	4.4.5.1
SW2-3	-	-	OFF(0)	MSCP Device Number	4.4.5.1
SW2-4	-	-	OFF(0)	Host Adapter UNIBUS Address	4.4.1
SW2-5	Disable	Enable	OFF(0)	Self-test Error Reporting	5.4
SW2-6	-	-	OFF(0)	Not Used	
SW2-7			ON(1)	Host Adapter SCSI Address	4.4.3
SW2-8			ON(1)	Host Adapter SCSI Address	4.4.3
SW2-9			ON(1)	Host Adapter SCSI Address	4.4.3
SW2-10	-	-	OFF(0)	Reserved	
SW3-1	-	-	NS	Subsystem Configuration	4.4.4
SW3-2	-	-	OFF(0)	Not Used	
SW3-3	-	-	NS	Subsystem Controller Type	4.4.5.2
SW3-4	-	-	NS	Host Adapter UNIBUS Address	4.4.1
SW3-5	-	-	NS	Host Adapter UNIBUS Address	4.4.1
SW3-6	-	-	NS	Subsystem Configuration	4.4.4
SW3-7	-	-	NS	Subsystem Configuration	4.4.4
SW3-8	-	-	NS	Subsystem Configuration	4.4.4
SW3-9	-	-	NS	Subsystem Configuration	4.4.4
SW3-10	-	-	NS	Subsystem Configuration	4.4.4

ON(1) = Closed
OFF(0) = Open
NS = No Standard
Fact = Factory switch setting

Table 4-2 lists the function and factory configuration of all jumpers on the host adapter.

Table 4-2. UC14/MO Jumper Definitions and Factory Configuration

Jumper[1]	OUT	IN	FACT	Comment
A-C	Disable Clock	Enable Clock	IN	Must be IN
B	Not used	Not used	OUT	Ground test point
D-E	16K PROM	32K PROM	IN OUT	Rev. E and up Rev. D and below
F-G	Not Installed	Not Installed	OUT	Burn-in Testing

FACT = Factory Setting

[1]These are not options. They should be set as indicated at the factory. Do not reconfigure these jumpers.

4.4.1 Host Adapter Bus Address

Every UNIBUS I/O device has a block of several registers through which the system can command and monitor that device. The registers are addressed sequentially from a starting address assigned to that controller, in this case an MSCP-class host adapter.

The address for the first of the UC14/MO's two UNIBUS registers is selected by DIP switches SW3-4, SW3-5, and SW2-4. See Table 4-3 for register address switch settings. For more information on determining the UNIBUS address, see Section 3 and Appendix A.

Table 4-3. Adapter Address Switch Settings

Bus Address	SW Factory Setting (in octal) SW3-4	SW3-5	SW2-4
772150	0	0	0
772154	0	0	1
760334	1	0	0
760340	1	0	1
760344	0	1	0
760350	0	1	1
760354	1	1	0
760360	1	1	1

4.4.2 Interrupt Vector Address

The interrupt vector address for the UC14/MO is programmed into the device by the operating system during power-up.

4.4.3 Host Adapter SCSI Address

The UC14/MO must be assigned a SCSI address, as noted in Table 4-4. This address is programmed into the UC14/MO using switches SW2-7 through SW2-9.

Table 4-4. UC14/MO SCSI Address Selection

SCSI Address	-- SW2 -- 7 8 9	Fact	SCSI Address	-- SW2 -- 7 8 9	Factory
0	0 0 0		4	0 0 1	
1	1 0 0		5	1 0 1	
2	0 1 0		6	0 1 1	
3	1 1 0		7	1 1 1	1 1 1

Fact = Factory (factory setting is SCSI address 7)

4.4.4 Subsystem Configuration Selection

The characteristics of the disk or tape subsystem(s) attached to the UC14/MO must be specified in one of two ways: with the configuration switches on the UC14/MO PCBA or by using the NOVRAM to specify the parameters of the disk drives. ESDI drives used with an MD21 controller must be set up via NOVRAM.

If you use the configuration switches, you are limited to only the configurations supported by the UC14/MO firmware. The NOVRAM is more flexible, since it allows you to specify the parameters for any type of disk drive. This may be important if you are planning to expand your system at a later date. If you use the configuration switches to define the subsystem and later add a drive that is not supported by the switches, you will have to reconfigure the UC14/MO using the NOVRAM, and this requires that you reformat all disk drives attached to the UC14/MO.

Switches SW3-1 and SW3-6 through SW3-10 are used for configuring the subsystem. If you will be using the NOVRAM, these switches should all be OFF and the configuration itself will not be done until the UC14/MO is installed and you are running the formatter program (see subsection 4.8).

If you wish to use the switches to configure the subsystem, they must be set before the UC14/MO is installed. Instructions for setting these switches, along with a list of all supported drive configurations, is contained in Appendix C. Read this appendix now if you plan to select the drive configuration with switches.

4.4.5 Options

There are other UC14/MO options that can be implemented by the user. These features are selected by physically installing the option on the PCBA or by enabling the option using a switch.

4.4.5.1 MSCP Device Number

If the UC14/MO is installed at the primary UNIBUS address (772150_8), switches SW2-1 through SW2-3 select the logical unit to boot from, as shown below. This applies only to PDP-11 systems.

Logical Unit	--- SW2 --- 1 (LSB)	2	3 (MSB)	Factory
0	0	0	0	•
1	1	0	0	
2	0	1	0	
3	1	1	0	
4	0	0	1	
5	1	0	1	
6	0	1	1	
7	1	1	1	

If the UC14/MO is installed as a second MSCP controller at an alternate address, these switches have a different function. Some operating systems require that no two MSCP drives have the same MSCP Unit number, even though the units may be attached to different controllers at different CSR addresses.

Switches SW2-1 through SW2-3 allow you to specify the MSCP Unit number of the first drive on the UC14/MO when your UC14/MO is being installed as a second MSCP controller (at an alternate UNIBUS address). You may specify a unit number that is contiguous with the highest unit number on the MSCP controller at the primary UNIBUS address, or you may leave a gap. See Table 4-5 for switch settings.

Example 4-1: *Your system operates under RSX-11M-PLUS and has two UC14/MO Host Adapters. The first UC14/MO is at the primary address for MSCP controllers, 772150_8, and it is supporting two drives, DU0 and DU1. The second UC14/MO is at an alternate (floating) address, and it also is supporting two drives. RSX-11M-PLUS requires that the drives be numbered in sequence: 0, 1, 2, and 3, in this case.*

This example would also apply if the first MSCP controller were a DEC RQDX1 with two logical drives.

Table 4-5. MSCP Device Number for the First Drive Supported by a UC14/MO at an Alternate Address

Starting MSCP Unit Number	--- SW2 --- 1 (LSB)	2	3 (MSB)	Factory
0	0	0	0	•
1	1	0	0	
2	0	1	0	
3	1	1	0	
4	0	0	1	
5	1	0	1	
6	0	1	1	
7	1	1	1	

4.4.5.2 Controller Type

If you are using the configuration switches to configure the UC14/MO, this switch selects the type of disk controller attached to the UC14/MO. When the UC14/MO is attached to an Emulex controller, SW3-3 must be ON. When a non-Emulex controller is used, SW3-3 must be OFF. This switch is meaningless if you are using the NOVRAM to configure the system.

Switch	OFF	ON	Factory
SW3-3	non-Emulex	Emulex	NS

4.4.5.3 Tape Drive Address Selection

This switch controls the SCSI address and SCSI LUN of the tape drive if the subsystem configuration is chosen with switches. It is meaningless if you are using NOVRAM to configure the system.

On all of the switch configurations that include a tape drive, the tape is assigned a SCSI Address of 4 and an LUN of 0. However, combination disk/tape controllers (such as the Emulex MS51), place the tape controller at SCSI Address 0 and the tape drive is assigned LUN 4. Switch SW1-3 is used with combination boards to allow use of the standard UC14/MO configurations (tape drive = 4,0) when the tape drive actually has a SCSI ID of 0,4.

If switch SW1-3 is OFF, the tape is assigned SCSI address 4, LUN 0 (standard configuration); if switch SW1-3 is ON it is assigned SCSI address 0, LUN 4 (for use with combination controllers).

Switch	OFF	ON	Factory
SW1-3	Address 4 LUN 0	Address 0 LUN 4	OFF

4.4.5.4 DMA Burst Delay

The UC14/MO firmware design includes a switch-selectable DMA burst delay to avoid data-late conditions. Switch SW1-4 selects either a 4-microsecond or 8-microsecond delay between DMA bursts. Even with the UC14/MO adaptive DMA, some applications may require a longer burst delay to allow other devices adequate time on the bus.

Switch	OFF	ON	Function
SW1-4	4 usec	8 usec	DMA Burst Delay

4.4.5.5 Ultrix Compatibility

Switch SW1-2 allows the UC14/MO to operate under Ultrix-32m, V1.1 or above, or Ultrix 11, V3.0 or above. When this switch is ON, it forces all media to be identified as RA81 devices, regardless of the actual drive type. However, to format disks using the Emulex formatter programs, SW1-2 must be OFF. If you are working under an Ultrix operating system and need to format disks, first format them with the switch OFF, then set the switch ON for operation. This switch must always be OFF for VAX/VMS operation.

Switch	OFF	ON	Function
SW1-2	Normal or Formatting	Ultrix	Ultrix Compatibility

4.4.5.6 Adaptive DMA/Default Burst

Depending on the other devices on the bus and their priority, the UC14/MO may use more or less bus time than optimal for your application. The UC14/MO allows you to modify its DMA operations by disabling adaptive DMA.

When adaptive DMA is enabled, the UC14/MO monitors the UNIBUS for other pending DMA requests and suspends its own DMA activity to permit other DMA transfers to occur. If the UC14/MO is not getting the bus time your application requires, you may want to disable the adaptive DMA. When adaptive DMA is disabled, the UC14/MO performs a burst transfer of 8 words or fewer, relinquishes the bus, then performs another DMA burst transfer unless overridden by the host processor.

Switch	OFF	ON	Function
SW2-8	Enable	Disable	Adaptive DMA/Default Burst

When adaptive DMA is disabled, the default DMA burst length is 8 words instead of 16 words. This shorter burst length is more appropriate when adaptive DMA is disabled because the shorter bursts give other devices more frequent opportunities to get the bus. In either case, the burst length is programmable per MSCP port requirements (i.e., the defaults are in effect until the operating system gives the UC14/MO another value).

4.5 Physical Installation

4.5.1 System Preparation

Power down the system and switch OFF the main ac breaker at the rear of the cabinet (the ac power indicator will remain lighted). Slide the UNIBUS box out of the cabinet and remove the top cover. Remove the card cage shield to obtain access to the UNIBUS and other modules.

4.5.2 Slot Selection

The UC14/MO can be inserted into any small peripheral controller (SPC) slot in either the DEC computer chassis or UNIBUS expansion chassis. The closer a module is to the CPU, the higher its interrupt priority. The UC14/MO can be placed fairly far from the CPU because of its large buffer capacity.

Each CPU slot should contain a module. Card slots that would otherwise remain unoccupied should contain Bus Grant (flip-chip) modules to provide interrupt acknowledge continuity.

NOTE

> The nonprocessor grant (NPG) jumper on the SPC card slot in which the controller is being installed **must be removed** to allow the controller to trap the NPG signal during DMA requests.

4.5.3 NPG Signal Jumper

The NPG jumper on the SPC card slot must be removed to allow the trapping of the NPG signal during DMA requests. Therefore, remove the NPG signal jumper between pins CA1 and CB1 on the backplane so that the NPG signal passes through the UC14/MO module.

Figure 4-4 shows a DD11-DK nine-slot backplane, with the enlargement depicting the layout of a typical socket as seen from the rear. (The enlargement is valid for each of the sockets on the backplane.) The figure of the backplane includes letters and numbers that are not actually on the backplane; they are included to help identify pin locations. Also, the numbers shown in the enlargement do not appear in the same location on the backplane; rather, they are located in about the center of the backplane.

Jumper locations are defined by a series of numbers and letters that show pin locations by socket, column, and row. To find the NPG signal jumper on the DD11-DK backplane, use the following procedure:

1. Find the appropriate socket (in this case C). The sockets of pins are lettered sequentially in the illustration, beginning with A and proceeding to F.

2. Find the appropriate card slot. In Figure 4-4, the card slots are numbered 1 through 9 from right to left. The column of pins shown in the socket enlargement corresponds to card slot 7. Note that each card slot is four pins wide, as the enlargement shows.

3. Find the appropriate row of pins. As the enlargement shows, each number is labeled A through V, excluding G, I, O, and Q. Also, each row of pins is offset from the row on either side.

4. Find the appropriate number corresponding to the desired pin. As the enlargement shows, each number differentiates between two pins on the same row that correspond to the same card slot. A number 1 indicates the component side; a number 2 indicates the solder side.

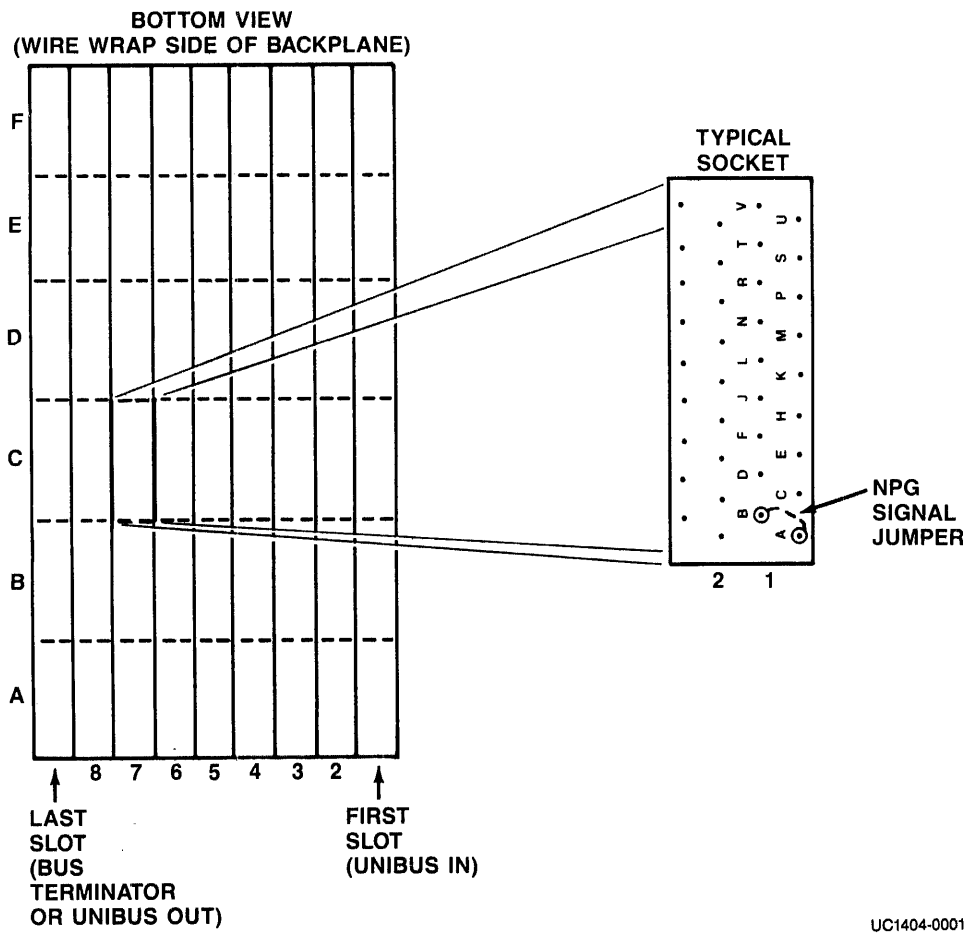


Figure 4-4. NPG Jumper Location

In summary: For the seventh card slot, pin CA1 refers to the fourth socket from the top of the backplane drawing (C), the top pin of the left-hand set (A1). CB1 is one pin to the right and slightly down. An arrow shows the wire between the two pins.

The wire-wrap jumper between CA1-CB1 is the bottom-most wrap on the pair. Once you have located the jumper, cut it. Slipping a small piece of insulation over the end of the pin facilitates later location.

If the UC14/MO is removed from the backplane, either reconnect the NPG jumper, or insert a dual-width grant continuity module into connectors C and D of the slot vacated by the module. The dual-width grant continuity module (DEC part number G7273) jumpers all grant signals (interrupt grants and nonprocessor grants).

4.5.4 Mounting

The UC14/MO Host Adapter PWB should be plugged into connectors C, D, E, and F of the UNIBUS backplane, with components oriented in the same direction as the CPU and other modules. Always insert and remove the boards with the computer power OFF to avoid possible damage to the circuitry. Be sure that the board is properly positioned in the throat of the board guides before attempting to seat the board by means of the extractor handle.

4.6 Cabling

The UC14/MO Host Adapter interfaces with the SCSI Bus through J1, a 50-pin flat connector located on the outside edge of the PWB. You may make a custom cable to connect your SCSI subsystem to the UC14/MO, or you may use one of the three cabling kits manufactured by Emulex. The cabling kits are designed to ease the installation of the UC14/MO in common DEC CPU cabinets, and to keep the radiation of electromagnetic interference (EMI) within the limits specified by FCC regulations.

As noted in subsection 4.1.3, the UC14/MO and SCSI subsystem can be installed in either of two configurations:

1. With both the UC14/MO Host Adapter and the SCSI subsystem that it supports mounted in the same cabinet, or

2. With the UC14/MO mounted in the CPU cabinet and the SCSI subsystem mounted in a separate cabinet.

The following paragraphs describe the cabling of the UC14/MO and subsystem on that basis: same cabinet vs. separate cabinet. The separate cabinet installations rely on Emulex cabling kits to limit EMI and thus the procedures for installing the kits are described there.

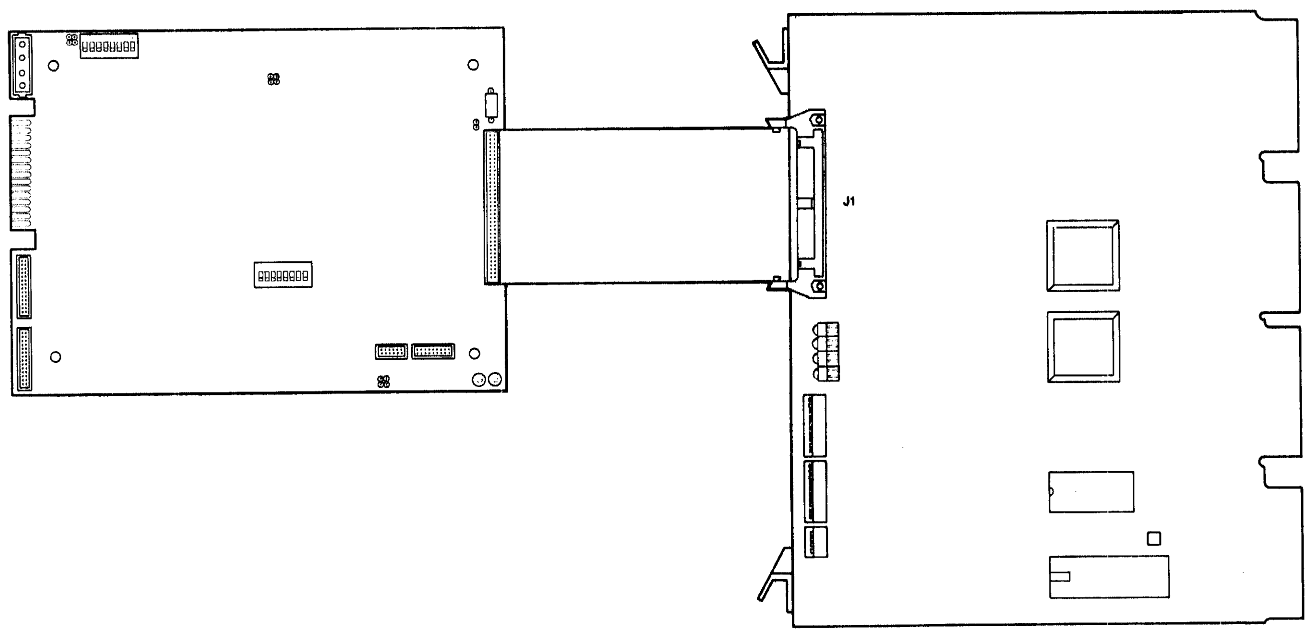
4.6.1 Same Cabinet Installation

When the UC14/MO and the SCSI subsystem are installed in the same cabinet, it is possible that the cabinet itself provides sufficient shielding. In such cases, it is not necessary to shield the cable that carries the SCSI bus between the UC14/MO and the SCSI peripherals.

A custom 50-wire flat cable can be constructed to connect J1 to the SCSI peripherals. See Table 8-1 for J1 pin assignments; Figure 4-5 is an illustration of a common installation. Make sure that the last, and only the last, SCSI controller in the daisy chain provides proper termination for the SCSI bus.

NOTE

If the cabinet in which the UC14/MO and PDP-11 CPU are installed was manufactured before 1 October 1983, it may not provide sufficient shielding or filtering to prevent excessive RFI radiation or conduction. In case of complaint, it is the operator's responsibility to take whatever steps are necessary to correct the interference.



UC1404-0477

Figure 4-5. UC14/MO Cabling Diagram

4.6.2 Separate Cabinet Installation

If the SCSI peripheral subsystem is mounted in a separate cabinet from the UC14/MO Host Adapter, then the cable that connects the SCSI peripheral to the UC14/MO must be shielded, as it runs outside of the shielded cabinet environment.

Emulex makes three cabling kits that adapt shielded cables to the SCSI interface of the UC14/MO and that preserve the shield built into some DEC CPU cabinets. These kits also include a shielded SCSI cable that is fully compatible with the SCSI peripheral subsystems manufactured by Emulex. Each kit contains the all of the hardware necessary to complete an installation.

The cable kits are listed in Table 4-6 and illustrated in Figures 4-6, 4-7, and 4-8. Note that each kit can be ordered with SCSI cables in various lengths; in the Universal RETMA mount kit, the flat cables can also be ordered in a variety of lengths.

Table 4-6. Cabling Kits

Cabling Kit	Top Assembly Part Number	Subsystem Supported
Universal RETMA Rack-mount	PU0113003-XX	Decathlon Javelin SABRE
	PU0213003-XX	Medley, disk
	PU0213002-XX	Medley, disk and tape
	PU0213004-XX	Medley, tape

The items listed in Table 4-6 can be ordered from your Emulex sales representative or directly from the factory. Contact:

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

The cabling kit includes a transadapter plate and a rack mounting frame. The transadapter plate can fit either in the mounting frame or directly in a DEC CPU cabinet with removable I/O panels.

4.6.2.1 The Universal RETMA Rack Mount Cabling Kit

The Universal RETMA Rack Mount Cabling Kit can be used in any CPU cabinet that is based on the standard 19-inch RETMA rack. To install the kit, see Figures 4-6 and 4-7, and use the following procedure.

1. Mount the CU22 Mounting Frame at the rear of the CPU cabinet using the supplied hardware. Make sure that the frame is mounted close enough to the CPU so that the flat cable from the transadapter can reach the UC14/MO. Transadapters are available with flat cables in four different lengths. See Table 4-5.) The rack should be wired to a good earth ground.
2. Install the transadapter in the mounting frame using the eight captive screws. See Figure 4-7.
3. Align the header of the connector on the flat-ribbon cable with connector J1 on the UC14/MO. Match the triangle marking on the header with the triangle marking on the J1 connector, as shown in Figure 4-7.
4. Seat the header in the J1 connector using the latches as shown in Figure 4-7.

NOTE

The connector is not keyed and can be physically reversed in the header. No damage should result, but the system will not operate.

5. Connect one end of the SCSI round shielded cable to the 50-pin opening in the transadapter plate. See Figure 4-6.
6. Thread the round shielded cable through the opening in the rear of the CPU chassis.
7. Connect the other end of the SCSI round shielded cable to the 50-pin opening in the rear panel of the subsystem. For additional cabling instructions, refer to your subsystem manual.

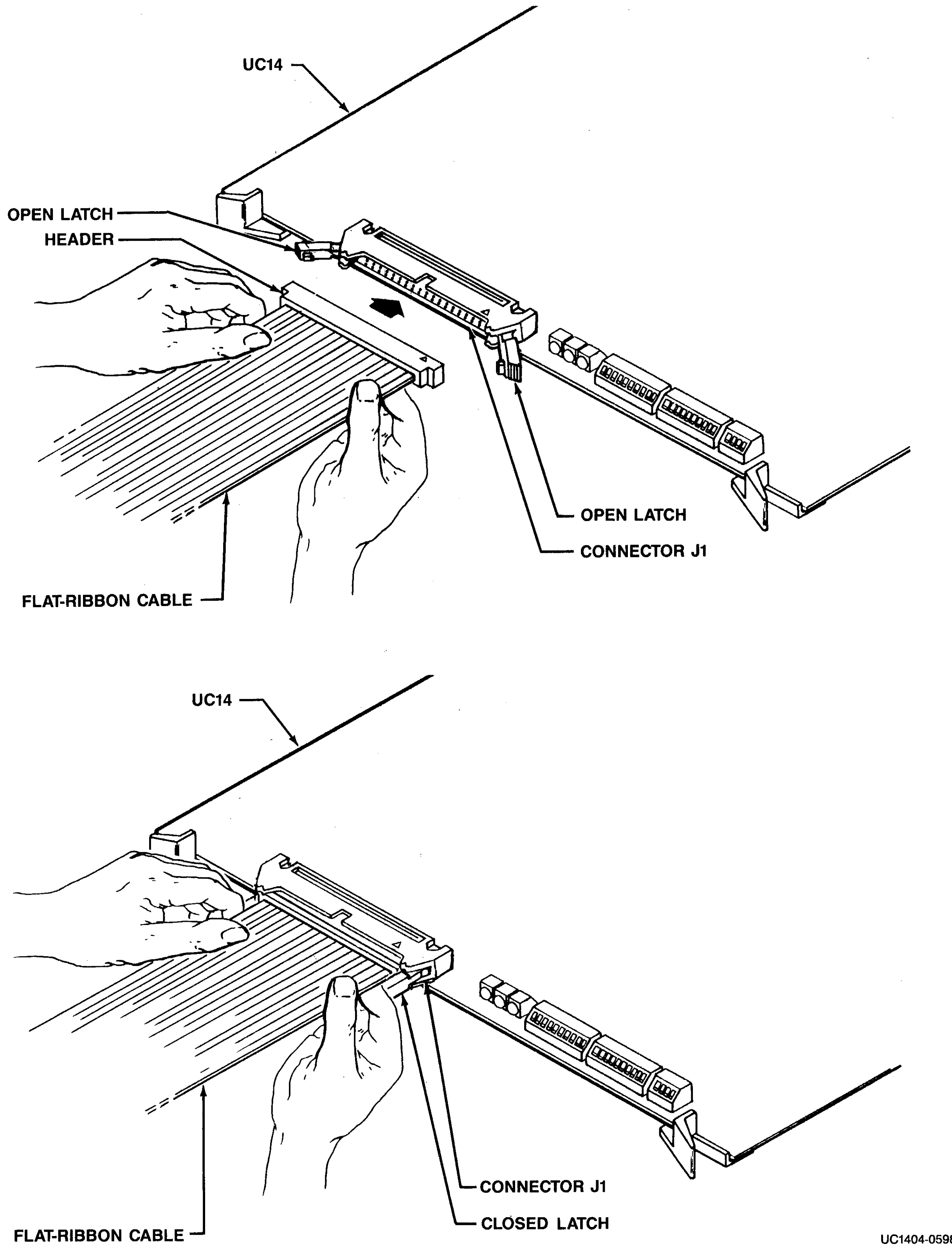


Figure 4-6. Plugging the Transadapter Flat Cable into J1.

4.6.2.2 Installation in a DEC CPU Cabinet

Many DEC FCC-compatible cabinets have bulkheads (usually at the rear of the cabinet) with removable panels. Those panels can be replaced by applications panels such as the transadapter plate provided in the cabling kit. To install the kit directly in a DEC CPU cabinet, see Figures 4-6 and 4-8, and use the following procedure:

1. Remove a blank panel from the bulkhead at the rear of the CPU cabinet. The blank panels are often made up of interleaved segments. It may be necessary to remove four segments to make room for the transadapter plate in this kit. Choose an area on the bulkhead that is close enough to the CPU card cage to allow the transadapter plate flat cable to reach the UC14/MO.

2. Install the transadapter plate in the bulkhead using the eight captive screws. See Figure 4-8.

3. Align the header of the connector on the flat-ribbon cable with connector J1 on the UC14/MO. Match the triangle marking on the header with the triangle marking on the J1 connector, as shown in Figure 4-6.

4. Seat the header in the J1 connector using the latches as shown in Figure 4-6.

NOTE

> The connector is not keyed and can be physically reversed in the header. No damage should result, but the system will not operate.

5. Connect one end of the SCSI round shielded cable to the 50-pin opening in the transadapter plate. See Figure 4-8.

6. Thread the round shielded cable toward the bottom of the chassis.

7. Connect the other end of the SCSI round shielded cable to the 50-pin opening in the rear panel of the subsystem. For additional cabling instructions, refer to your subsystem manual.

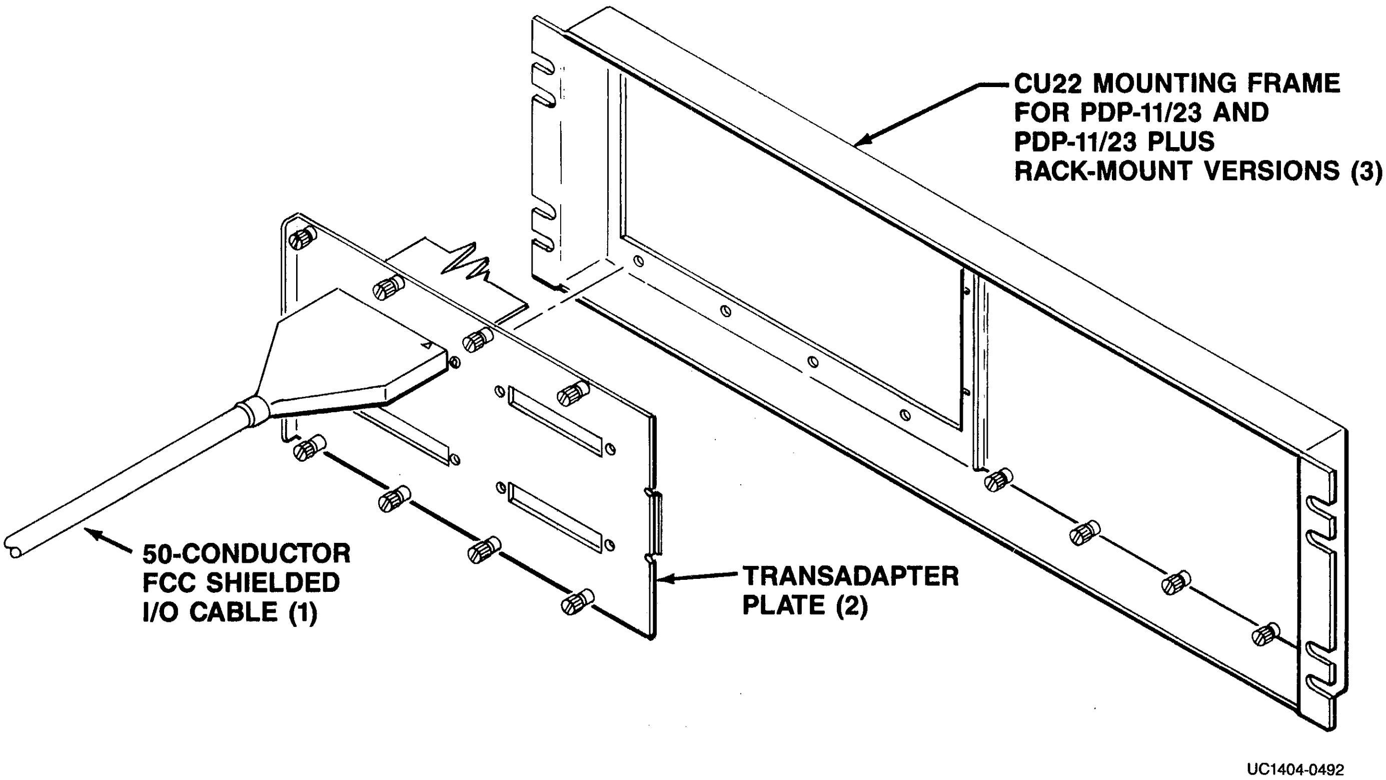


Figure 4-7. Installing the Universal Rack Mount Cabling Kit

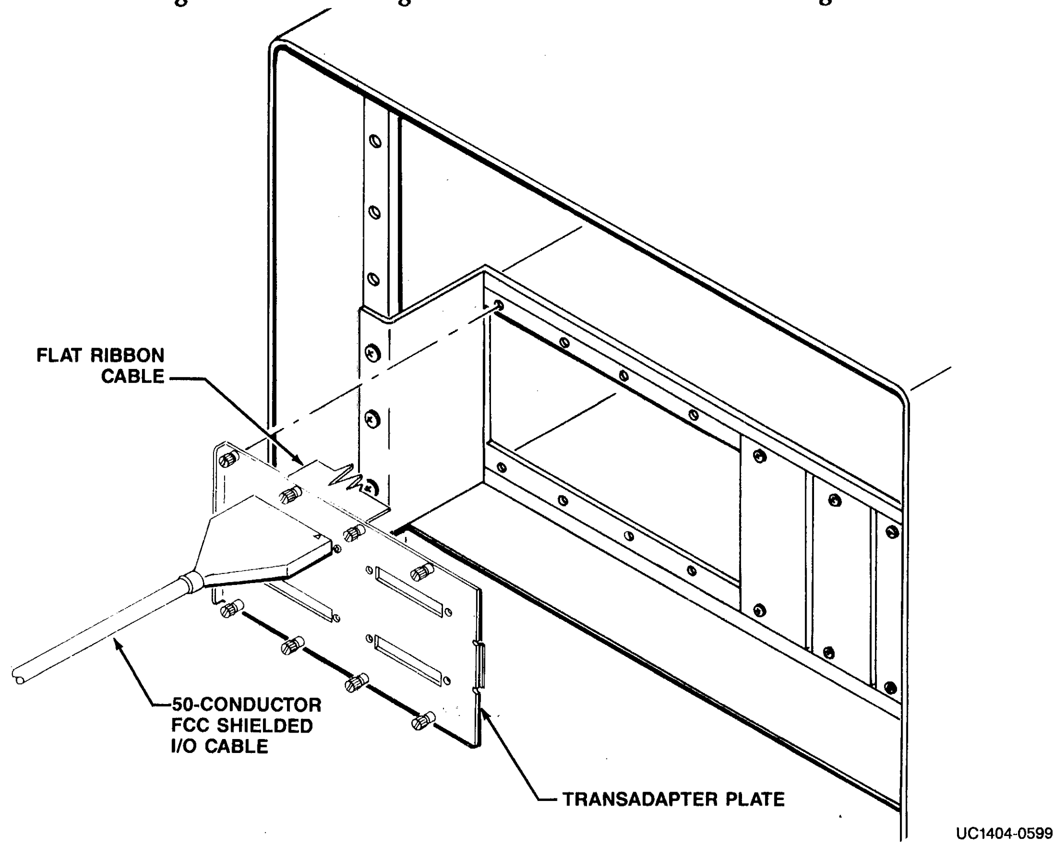


Figure 4-8. Installing the UC14/MO in a DEC CPU Cabinet

4.7 NOVRAM Loading, Disk Formatting, and Testing

After physically installing the UC14/MO, several steps are required to prepare the subsystem for operation. They are:

- Loading the drive configuration into the NOVRAM
- Formatting and verifying the media
- Testing the subsystem

The UC14/MO host adapter firmware incorporates a self-contained set of disk preparation and diagnostic utilities, called firmware-resident diagnostics (F.R.D.). **(Not all options are supported with optical drives; optical users should refer to subsection 4.7.1.)** F.R.D. provides several important disk preparation functions, including the ability to configure the adapter NOVRAM, format the drive, test the disk surface and, for magnetic disks only, replace defective blocks, and perform reliability testing of the attached disk subsystem. These utilities allow you to communicate directly with either CRT or hardcopy devices connected to a UNIBUS or VAX console port.

The basic application of F.R.D. is in preparing MSCP disk drives for use in your subsystem. Before data can be stored on a drive, the disk must be formatted and any bad blocks identified. F.R.D. provides options that allow you to perform these functions. You use NOVRAM configuration options to set and review your drive parameter values.

The steps involved in magnetic disk preparation are formatting the drive and then verifying that each logical block is good. F.R.D. supports both automatic and manual block replacement operations to allow for replacing defective and pattern-sensitive blocks.

For magnetic disks, automatic replacement, or blanket bad block replacement, is a feature of several F.R.D. options. With this feature, you can format a drive, verify, and replace any bad blocks in one step. During this format/verify operation, bad blocks are displayed in logical block number (LBN) format. If replacement is enabled, the blocks are replaced automatically.

Manual bad block replacement for magnetic disks is a separate option. This option allows you to identify specific bad blocks to be replaced. In addition, you can identify the blocks in LBN format.

There are several ways you can use F.R.D. options to format and verify your disk. The method you choose depends on whether you:

- have formatted this disk
- want to replace blocks using LBN information
- want to preserve data on this disk

Each method is described below. The options listed are on the F.R.D. main menu. Use them in the order they are listed. (F.R.D. options are described in section 4.8.)

If this is the initial format of a disk and you want to replace only those defects that F.R.D. finds with the four worst-case data patterns, use:

- Option 2, Format and Verify (with replacement enabled)

If this is the initial format of a disk and you want to replace manufacturer's detected defects from the hardcopy list, use:

- Option 1, Format
- Option 7, Replace Block (using LBN format)
- Option 3, Verify (with replacement enabled)

If this disk is formatted and you want to preserve data and obtain a list of bad blocks, use:

- Option 4, Read Only Test (with replacement disabled)

4.7.1 Preparing Optical Disks

Optical disks come preformatted from the factory and should not be formatted using the standard Emulex magnetic disk utilities. Optical disks must contain a valid RCT (Replacement Caching Table) before they can be used. This can be accomplished by one of two methods:

1. Use the Format option of F.R.D. (Refer to subsection 4.8.1.)

CAUTION

> Be sure to specify type code 5 to the NOVRAM first in order to identify the drive as optical; this will permit the RCT to be created properly. Otherwise, the F.R.D. will proceed with the optical drive as if it were magnetic.

2. Use an Emulex-supplied utility designed to initialize the RCT and perform other diagnostic operations that F.R.D. does not support on optical devices.

Emulex supplies two separate utilities for diagnostic purposes:

- U1M09A for the PDP-11
- RVD04M for the VAX

Both utilities come with their own manuals: *U1M09A Emulex PDP-11 UCxx Optical Disk Reliability Diagnostic User's Guide for the PDP-11* (part number PX9950923) and *RVD04M Emulex VAX UCxx Optical Disk Reliability Diagnostic User's Guide for the VAX* (part number VX9950923).

CAUTION

Once a disk pack has been initialized, any attempt to reinitialize it will render the disk pack useless. Make sure you mark disk packs as initialized for future reference.

Before you start the initialization procedure, read all the appropriate documentation carefully. Be sure the UC14/MO is properly configured for operation with optical drives and the drives are configured for the correct SCSI addresses. If you mistakenly format an optical disk that the UC14/MO thinks is a magnetic disk, you will ruin an expensive disk pack.

NOTE

With the introduction of revision C firmware on the UC13, Emulex started reserving the last 20 cylinders of the disk pack for future diagnostic use. If you have written an RCT to a disk pack with a UC13 prior to firmware revision C, you will have to reformat it if you wish to use it with the UC14/MO. If you have UC13 disk packs that are unusable because of improperly written RCTs, you can reformat them and use them again since the old RCT now falls in the diagnostic section of the pack.

4.7.2 Optical Disk Driver

Optical disks can be used under standard DEC operating systems only if a special driver is installed. Emulex offers a driver for use under VMS and other drivers are available from other vendors. See Section 1 for part numbers of the Emulex driver.

If you are planning to write your own driver, refer to section 3.5 for a discussion of some optical disk programming requirements.

4.7.3 F.R.D. Conventions

F.R.D. uses the following keyboard conventions:

<CR>	required to terminate operator inputs
<Ctrl C>	aborts the current operation and returns to the main menu

A delay of 10 seconds may occur between the <Ctrl C> and the next display. During some verify operations, the delay may be considerably longer because the abort is delayed until the successful completion of the current command.

In this section, operator responses to F.R.D. prompts appear in **bold** print. The symbols used in this section are listed below with their meanings:

<CR>	carriage return key
<LF>	line feed key
<Ctrl C>	Ctrl key and the letter C pressed at the same time

4.7.4 Starting F.R.D. on a VAX

F.R.D. is started by issuing a special command sequence via console ODT. The sequence to use is illustrated by the following example; specific commands are contained in the tables noted in parentheses. The example pertains to a VAX 750 with UNIBUS Adapter (UBA) #0 and a UC14/MO base address of 772150 (octal) or 3F468 (hex).

1. Initialize the VAX by applying power to the system and entering the console I/O mode. The initialization command is:

   >>>**D/I 37 1<CR>** (Table 4-8)

2. Enable the map registers for two pages (must be longword aligned):

   >>>**D/L/P F30800 80000000<CR>** (Table 4-9)
   >>>**D/L/P F30804 80000001<CR>**

3. Deposit the UC14/MO "backdoor enable" code in the SA register:

   >>>D/W/P FFF46A 3003<CR> (Tables 4-10, 4-11)

   The SA register is arrived at by the following:

UBA Base Address	+ UC14/MO Base Address	+ 2 = UC14/MO SA Register
FC0000	+ 3F468	+ 2 = FFF46A

4. Wait for 100 to appear in the SA Register:

   >>>E/W/P FFF46A 100

5. Deposit UC14/MO F.R.D. code in the SA register:

   >>>D/W/P FFF46A 44xx<CR> (Table 4-12)

   The value of xx is 01 for the VAX 750 UBA #0.

6. Wait for 400 to appear in the SA Register:

   >>>E/W/P FFF46A<CR> 400

   A value other than 400 may indicate one of the following vendor-unique errors:

SA Register	Type of Error
100111	Timeout
100121	Driver upload failure

7. Start the F.R.D.

   S 80<CR>

Table 4-7. VAX Initialization Command Sequences

VAX Model	Initialization Command(s)
VAX 730	**I<CR>**
VAX 750[1]	**D/I 37 1<CR>**
VAX 780,[1] 8600/8650[1]	**UNJAM<CR>**
VAX 8200[1]	**20000000+720 20000[16]<CR>**

1 Console mode I/O command " I " initializes only the CPU, not the UNIBUS, for some VAX systems.

2 The format of this sequence is Node Space Address + DWUBA Control and Status Register, followed by the Data in the UPI bit. See Table 4-8.

Table 4-8. VAX and UBA Memory Map Register Addresses

VAX Model	Address	Data	Bit Definition
730	F26800 F26804	80000000 80000001	Validity bit, PFN = 0 Validity bit, PFN = 1
750	F30800 F30804 F32800 F32804	80000000 80000001 80000000 80000001	Validity bit, DDP, PFN = 0 at UBA #0 Validity bit, DDP, PFN = 1 at UBA #0 Validity bit, DDP, PFN = 0 at UBA #1 Validity bit, DDP, PFN = 1 at UBA #1
780 and 8600/8650 on SBIA #0	20006800 20006804 20008800 20008804 2000A800 2000A804 2000C800 2000C804	80000000 80000001 80000000 80000001 80000000 80000001 80000000 80000001	Validity bit, DDP, PFN = 0 at TR #3, UBA #0 Validity bit, DDP, PFN = 1 at TR #3, UBA #0 Validity bit, DDP, PFN = 0 at TR #4, UBA #1 Validity bit, DDP, PFN = 1 at TR #4, UBA #1 Validity bit, DDP, PFN = 0 at TR #5, UBA #2 Validity bit, DDP, PFN = 1 at TR #5, UBA #2 Validity bit, DDP, PFN = 0 at TR #6, UBA #3 Validity bit, DDP, PFN = 1 at TR #6, UBA #3
8600/8650 on SBIA #1	22006800 22006804 22008800 22008804 2200A800 2200A804 2200C800 2200C804	80000000 80000001 80000000 80000001 80000000 80000001 80000000 80000001	Validity bit, DDP, PFN = 0 at TR #3, UBA #0 Validity bit, DDP, PFN = 1 at TR #3, UBA #0 Validity bit, DDP, PFN = 0 at TR #4, UBA #1 Validity bit, DDP, PFN = 1 at TR #4, UBA #1 Validity bit, DDP, PFN = 0 at TR #5, UBA #2 Validity bit, DDP, PFN = 1 at TR #5, UBA #2 Validity bit, DDP, PFN = 0 at TR #6, UBA #3 Validity bit, DDP, PFN = 1 at TR #6, UBA #3

(continued on next page)

NOTE

TR levels and UBAs listed for the VAX 780/8600/8650 are standard but may vary depending on your configuration.

Table 4-8. VAX and UBA Memory Map Register Addresses (continued)

VAX Model 8200

Data to be deposited in selected Node and Map Register:

Map Addr. Offset	Data	Bit Definition
800	80000000	Validity, DDP, PFN = 0
804	80000001	Validity, DDP, PFN = 1

Node #	Bus #0	Bus #1	Bus #2	Bus #3
0	20000000	22000000	24000000	26000000
1	20002000	22002000	24002000	26002000
2	20004000	22004000	24004000	26004000
3	20006000	22006000	24006000	26006000
4	20008000	22008000	24008000	26008000
5	2000A000	2200A000	2400A000	2600A000
6	2000C000	2200C000	2400C000	2600C000
7	2000E000	2200E000	2400E000	2600E000
8	20010000	22010000	24010000	26010000
9	20012000	22012000	24012000	26012000
10	20014000	22014000	24014000	26014000
11	20016000	22016000	24016000	26016000
12	20018000	22018000	24018000	26018000
13	2001A000	2201A000	2401A000	2601A000
14	2001C000	2201C000	2401C000	2601C000
15	2001E000	2201E000	2401E000	2601E000

Table 4-9. VAX and UBA I/O Base Addresses

VAX Model 730 I/O Address
UBA Base Address
FC0000

VAX Model 750 I/O Address
UBA Base Address
FC0000 UBA #0
F80000 UBA #1

VAX Models 780 and 8600/8650 on SBIA #0 I/O Address
UBA Address

20100000	TR #3	UBA #0
20140000	TR #4	UBA #1
20180000	TR #5	UBA #2
201C0000	TR #6	UBA #3

VAX Models 8600/8650 I/O Address on SBIA #1
UBA Base Address

22100000	TR #3	UBA #0
22140000	TR #4	UBA #1
22180000	TR #5	UBA #2
221C0000	TR #6	UBA #3

VAX Model 8200 I/O Address Window Space Assignments
(Window space offset values are 0 through 3FFFF)

Node #	Bus #0	Bus #1	Bus #2	Bus #3
0	20400000	22400000	24400000	26400000
1	20440000	22440000	24440000	26440000
2	20480000	22480000	24480000	26480000
3	204C0000	224C0000	244C0000	264C0000
4	20500000	22500000	24500000	26500000
5	20540000	22540000	24540000	26540000
6	20580000	22580000	24580000	26580000
7	205C0000	225C0000	245C0000	265C0000
8	20600000	22600000	24600000	26600000
9	20640000	22640000	24640000	26640000
10	20680000	22680000	24680000	26680000
11	206C0000	226C0000	246C0000	266C0000
12	20700000	22700000	24700000	26700000
13	20740000	22740000	24740000	26740000
14	20780000	22780000	24780000	26780000
15	207C0000	227C0000	247C0000	267C0000

Table 4-10. UC14/MO Base Address Offsets (IP Register)

Octal	Hex
772150	3F468
772154	3F46C
760334	3E0DC
760340	3E0E0
760344	3E0E4
760350	3E0E8
760354	3E0EC
760360	3E0F0

Table 4-11. Available F.R.D. Upload Codes

(44xx) xx value	VAX and UBA Number
01	730 and 750 UBA #0
02	750 UBA #1
03	780 UBA #0 and 8600/8650 UBA #0 on SBIA #0
04	780 UBA #1 and 8600/8650 UBA #1 on SBIA #0
05	780 UBA #2 and 8600/8650 UBA #2 on SBIA #0
06	780 UBA #3 and 8600/8650 UBA #3 on SBIA #0
07	8600/8650 UBA #0 on SBIA #1
08	8600/8650 UBA #1 on SBIA #1
09	8600/8650 UBA #2 on SBIA #1
0A	8600/8650 UBA #3 on SBIA #1
10	8200 Node #0 VAXBI Bus #0
11	8200 Node #1 VAXBI Bus #0
12	8200 Node #2 VAXBI Bus #0
13	8200 Node #3 VAXBI Bus #0
14	8200 Node #4 VAXBI Bus #0
15	8200 Node #5 VAXBI Bus #0
16	8200 Node #6 VAXBI Bus #0
17	8200 Node #7 VAXBI Bus #0
18	8200 Node #8 VAXBI Bus #0
19	8200 Node #9 VAXBI Bus #0
1A	8200 Node #10 VAXBI Bus #0
1B	8200 Node #11 VAXBI Bus #0
1C	8200 Node #12 VAXBI Bus #0
1D	8200 Node #13 VAXBI Bus #0
1E	8200 Node #14 VAXBI Bus #0
1F	8200 Node #15 VAXBI Bus #0

(continued on next page)

Table 4-11. Available F.R.D. Upload Codes (continued)

(44xx) xx value	VAX and UBA Number
20	8200 Node #0 VAXBI Bus #1
21	8200 Node #1 VAXBI Bus #1
22	8200 Node #2 VAXBI Bus #1
23	8200 Node #3 VAXBI Bus #1
24	8200 Node #4 VAXBI Bus #1
25	8200 Node #5 VAXBI Bus #1
26	8200 Node #6 VAXBI Bus #1
27	8200 Node #7 VAXBI Bus #1
28	8200 Node #8 VAXBI Bus #1
29	8200 Node #9 VAXBI Bus #1
2A	8200 Node #10 VAXBI Bus #1
2B	8200 Node #11 VAXBI Bus #1
2C	8200 Node #12 VAXBI Bus #1
2D	8200 Node #13 VAXBI Bus #1
2E	8200 Node #14 VAXBI Bus #1
2F	8200 Node #15 VAXBI Bus #1
30	8200 Node #0 VAXBI Bus #2
31	8200 Node #1 VAXBI Bus #2
32	8200 Node #2 VAXBI Bus #2
33	8200 Node #3 VAXBI Bus #2
34	8200 Node #4 VAXBI Bus #2
35	8200 Node #5 VAXBI Bus #2
36	8200 Node #6 VAXBI Bus #2
37	8200 Node #7 VAXBI Bus #2
38	8200 Node #8 VAXBI Bus #2
39	8200 Node #9 VAXBI Bus #2
3A	8200 Node #10 VAXBI Bus #2
3B	8200 Node #11 VAXBI Bus #2
3C	8200 Node #12 VAXBI Bus #2
3D	8200 Node #13 VAXBI Bus #2
3E	8200 Node #14 VAXBI Bus #2
3F	8200 Node #15 VAXBI Bus #2
40	8200 Node #0 VAXBI Bus #3
41	8200 Node #1 VAXBI Bus #3
42	8200 Node #2 VAXBI Bus #3
43	8200 Node #3 VAXBI Bus #3
44	8200 Node #4 VAXBI Bus #3
45	8200 Node #5 VAXBI Bus #3
46	8200 Node #6 VAXBI Bus #3
47	8200 Node #7 VAXBI Bus #3
48	8200 Node #8 VAXBI Bus #3
49	8200 Node #9 VAXBI Bus #3
4A	8200 Node #10 VAXBI Bus #3
4B	8200 Node #11 VAXBI Bus #3
4C	8200 Node #12 VAXBI Bus #3
4D	8200 Node #13 VAXBI Bus #3
4E	8200 Node #14 VAXBI Bus #3
4F	8200 Node #15 VAXBI Bus #3

4.7.5 Starting F.R.D. on a PDP-11 System

To start F.R.D. on a PDP-11 system, first halt the processor. Then enter the following commands in response to the ODT prompt (@):

@ **177xxxxx/** 000000 **1 <LF>**
@ 177yyyyy/ 4400 **30003 <CR>**
@/000400 **42000<CR>**
@ **177yyyyy/** 2000 **<CR>** !TEST FOR 2000
@ **200G**

NOTE: XXXX and YYYY are offsets dependent on the address of the UC14/MO controller. See Table 4-12 for the available values.

Table 4-12. PDP-11 Offsets

CONTROLLER BUS ADDRESS	XXXXX	YYYYY
772150	72150	72152
772154	72154	72156
760334	60334	60336
760340	60340	60342
760344	60344	60366
760350	60350	60352
760354	60354	60356
760360	60360	60362

When the appropriate start procedure is completed, F.R.D. identifies itself by displaying the controller type and firmware revision. Then, it displays the menu options. See subsection 4.8 for more information on F.R.D. options.

4.7.6 Terminating F.R.D.

To terminate F.R.D., choose one of the following:

- Press the BREAK key
- Reinitialize the system, or
- Halt the CPU.

You can restart the diagnostics from a halted condition if you have not changed the memory contents. On a PDP-11 system, enter **200G** at the ODT prompt. On a VAX system, enter **S 80**.

4.8 F.R.D. Options

F.R.D. is an interactive, menu-driven utility. When invoked, F.R.D. displays the type of controller, firmware revision level, and the IP address at which the controller resides. F.R.D. then displays a main, option menu, as shown below:

```
Option Menu

1 - Format
2 - Format and verify
3 - Verify
4 - Read only test
5 - Data reliability test
6 - List known units
7 - Replace block
8 - Display Novram
9 - Edit / Load Novram

Enter option number:
```

Configuration parameters can be selected in one of two ways:

- switches on the UC14/MO module
- NOVRAM (ESDI drives must be set up via NOVRAM)

If you elected at the time of setup (subsection 4.4.4) to use the switches, when you invoke the onboard diagnostics you will find the NOVRAM disabled and options 8 and 9 are not displayed. This is because all drive information will be read from the hard configuration data contained in the UC14/MO firmware PROM.

Not all the options listed above in the main menu are supported on all device types used with the UC14/MO. In these cases, depending on the type of device, F.R.D. either does not display the option on the screen or returns an "option not supported" message when an unsupported operation is attempted. Unsupported devices are noted in subsequent paragraphs.

The main menu and each submenu prompt for required input. When you enter a valid selection, the next menu displays or F.R.D. performs the selected option. If you make an invalid entry, F.R.D. rejects it and reprompts.

Based on the nature of the MSCP emulation being performed, some operations may produce an observable delay when performed on previously unformatted drives. This delay is approximately 30 seconds.

When an option is finished, F.R.D. displays the prompt "Hit any key to continue" and waits for you to do so before returning to the main menu.

4.8.1 Option 1 - Format

The Format option is used to initially format a drive. The operation writes sector headers and initializes the drive's replacement caching tables (RCT). It is used to format a virgin drive, a drive that has been determined to contain unusable data, or a drive with a format that is improper to use with a particular controller.

After formatting, the drive contains a valid RCT with a serial number you specified.

Tape drives are not supported by Format.

Iomega: These cartridges are preformatted. The format operation is used to write control information on a special track. If the format option is selected, F.R.D. will ask for interleave; 2:1 is recommended. F.R.D. also will allow the user to enable full-track ECC or post-write CRC check. While ECC can be used on older Iomega drives, it must be disabled on the newer, half-height models. Post-write CRC may be enabled on any Iomega; doing so will cause an extra revolution on each write operation. Emulex recommends disabling both ECC and post-write CRC during normal operations.

Optical drives: The format operation creates a valid RCT area only. No other areas of the optical disk are accessed.

CAUTION

1. To use this option with optical drives, be certain that you have specified a type code of 5 in the NOVRAM first.

2. For optical drives, this option does **not** check for the presence of valid data before it writes. A rewrite will destroy the RCT area and render the optical disk unusable.

4.8.2 Option 2 - Format and Verify

This option formats a drive, then tests the surface to replace pattern-sensitive and defective sectors. It performs both of the operations that are available separately with options 1 (Format) and 3 (Verify). This option also offers a bad block replacement feature which, when enabled, replaces any bad blocks found during the verify operation.

Tape drives are not supported by Format and Verify.

Optical drives are not supported by Format and Verify.

Adaptec: This device controller does not support the replace operation. If replacements are enabled, the UC14/MO will collect any bad blocks found during the Verify phase, then reformat the drive with the defect list. This action will occur until the verify runs error-free.

4.8.3 Option 3 - Verify

The Verify option Write/Read exercises all user-available blocks. F.R.D. uses four worst-case data patterns to find and replace pattern-sensitive blocks. It asks for the logical unit number (LUN) of the drive to be verified. After you enter the LUN, F.R.D. prompts for the number of write/read passes.

Verify operations are performed on 120 logical blocks at a time. Logical blocks are referenced by logical block number (LBN).

During Verify operations, F.R.D. disables all controller error recovery capabilities so that a sector is replaced for any repeatable single bit error. Each data pattern is run until error-free for a single pass, ensuring that replacement blocks are also verified.

When a block is encountered that cannot be accessed because of header or data field errors, the Logical Block Number in error displays. Because the failing pattern may not be the first pattern, it is possible that replacement blocks may not be tested with all patterns. For this reason, Emulex recommends running at least two Verify passes over all 4 data patterns.

The Verify option also offers a bad block replacement feature which, when enabled, replaces any bad blocks using the appropriate technique.

Use this option if you plan to manually replace the bad blocks identified in the manufacturer's defect list.

Tape drives are not supported by Verify.

Optical drives are not supported by Verify.

Adaptec: Replacement is not supported. Block replacement must be done using Option 2, Format and Verify.

4.8.4 Option 4 - Read Only Test

This option causes all the user-available blocks on the selected drive to be Read-only, not Write/Read, during the Verify pass. When a block is encountered that cannot be accessed because of header or data field errors, the utility displays the Logical Block Number.

The Read Only Test option also offers a bad block replacement feature, which, when enabled, replaces any bad blocks. Because F.R.D. runs with ECC disabled and does not cache any read data, no corrected data is available to put in the replacement block. This means that even though the defective block is replaced and no forced error flag is set in the replacement sector, the data is nonvalid.

CAUTION

This may cause problems if the replaced blocks contain executable program files. For this reason, you should back up sensitive data before running this option with the replacement feature enabled.

This option is usually used after the drive is formatted. However, if you plan to manually replace the bad blocks identified in the manufacturer's defect list, be certain to do so before using Option 4 with replace enabled.

Tape drives are not supported by Read Only Test.

Optical drives are not supported by Read Only Test.

Adaptec: Replacement is not supported.

4.8.5 Option 5 - Data Reliability Test

This option allows you to thoroughly test your subsystem. The reliability test uses Write, Write/Check, and Read functions to test the controller-to-drive portion of the subsystem. In addition, an independent DMA operation between the host memory and the controller tests the host/controller interface.

The test defaults to two reserved diagnostic cylinders so that user data will be protected; a test of the full pack is your option. To run the reliability test indefinitely, select 0 (zero) passes.

If the test encounters errors, F.R.D. displays text error messages. These messages are primarily for use by Emulex technical support personnel.

Optical drives are not supported by Data Reliability Test. To perform a Data Reliability Test using reserved diagnostic cylinders, you must use one of two software utilities designed by Emulex for this purpose. They are version 1.13 RVD04M (VAX) and version 1.5 U1M09A (PDP)[1].

Adaptec: Replacement is not supported.

[1] The U1M09A diagnostic will not be able to identify itself to the Emulex controller with the new F.R.D. firmware. Use option C to change the base address, then input the base address of the UCxx optical subsystem controller in order to continue the diagnostic.

4.8.6 Option 6 - List Known Units

This option causes the program to list all the drives that are configured in the NOVRAM. Only those units that can be selected by the controller and are ready are listed as available.

A user size (in 512-byte blocks) is listed with all drives found by this option. The user size does not include RCT area, diagnostic cylinders, designated or hidden spare tracks or blocks, etc.

In addition, this option displays the attached drive's physical geometry. This display includes all areas of the disk. If the device size in logical blocks is calculated from this data, the number will be larger than the displayed user size. The difference is the number of LBNs used for RCT, diagnostic cylinders, spares, etc.

Tape: Displays unit ID and a dummy unit size.

4.8.7 Option 7 - Replace Block

This option allows you to replace a specific bad block or group of blocks without using the blanket replacement feature found in the Verify and Read Only options. You identify logical blocks (entered in decimal MSCP Logical Block Number format), then enter the block to be replaced.

LBN replacement allows you to replace blocks identified as bad during the verify operation, when they are identified in LBN format by older versions of DEC operating systems which do not support host-initiated replacement.

Emulex recommends that you run the Verify option after the replacement option is complete. The Verify option runs test patterns that may detect any pattern-sensitive blocks.

Tape drives, optical drives, and Adaptec controllers are not supported.

4.8.8 Option 8 - Display NOVRAM

This option displays the current contents of the NOVRAM for your drives. It is displayed only if the NOVRAM configuration method was chosen.

4.8.9 Option 9 - Edit/Load NOVRAM

This option allows you to enter the drive configuration parameters into the controller. It is displayed only if the NOVRAM configuration method was chosen. If a drive type code of 1 is specified, F.R.D. prompts you for the required drive parameters. (NOVRAM parameters are described in section 4.9.)

4.9 Drive Configuration Parameters

When you edit or load NOVRAM configuration parameters, you are asked to enter the values required for your configuration. This section describes each parameter and states the range of valid entries for each. The required values for each drive supported by Emulex are listed in Appendix D.

You begin loading NOVRAM parameter values by selecting Option 9 from the F.R.D. main menu. F.R.D. then displays each parameter, one at a time. The parameter displays with a range of valid entries and a default value. Enter the appropriate value (in decimal) or simply press the return key to accept the default value (the last value entered). The next parameter then displays.

4.9.1 Disable Disconnect Flag

This parameter is used to disable or enable SCSI disconnect. When enabled, drives performing time-consuming tasks release the SCSI bus temporarily and reconnect when the task is complete; thus, several operations can be performed at once. Timing considerations of unique software applications may dictate that you disable the disconnect.

The choices are:

0 = enable SCSI disconnect
1 = disable SCSI disconnect

Default is 0.

4.9.2 Type Code

The type code you use determines which of the available configuration parameters (subsections 4.9.3 through 4.9.14) will be presented by F.R.D.

Type code parameter indicates the type of disk drive. The valid values are shown below.

Code	Controller
1	Medalist (MD01 -- ST506 interface)
2	Adaptec 4000
3	Iomega
4	Tape (Titleist)
5	Optical (Optimem)
6	Champion (MD21 -- ESDI interface)

In addition, two of the type codes (4,5) do not ask any device parameter question but instead default to load the NOVRAM with data from hard configurations contained in the firmware PROM.

Iomega: This type code (3) prompts for only four parameter questions: Number of Units of this Type, ECC, Post-write CRC Check, and Timer Count.

4.9.3 Number of Units of this Type

This parameter specifies the quantity of attached physical disk drives that use the NOVRAM parameters that follow. Valid values are 1 through 8.

4.9.4 Error Correction Code (ECC)

This value specifies whether ECC is enabled on Iomega drives. It works **only** with old style, full height Iomega drives. Emulex recommends that ECC be disabled.

4.9.5 Post-write CRC Check

This value specifies whether the post-write CRC check is enabled on Iomega drives. Emulex recommends disabling the CRC check.

4.9.6 Timer Count

This value specifies the amount of time that an Iomega drive remains spinning if no access is made to it. Emulex recommends a dwell period of five minutes which is specified by a count of two. The range is from two to 12 counts, with each count representing 2.5 minutes.

Default is two.

4.9.7 Number of Sectors per Track

This parameter specifies the total number of physical sectors per track, including spares. The valid range is from 1 through 127.

4.9.8 Number of Heads

This parameter specifies the number of data heads per physical drive. The valid range is from 1 through 31.

4.9.9 Number of Cylinders

This parameter specifies the total number of physical cylinders per drive, including spares.

4.9.10 Number of Spare Sectors per Track

This parameter specifies the number of spare sectors to reserve per track. The valid range is 0 through 3. If 0 is specified, no spare sectors are reserved.

4.9.11 Number of Alternate Cylinders

This parameter specifies the number of spare cylinders per physical drive. The valid range is from 2 through 255. At least two cylinders must be specified as alternates, as the sector replacement algorithm needs tracks for working space.

If there are no spare sectors, this question will not be asked.

4.9.12 Split Code

This parameter allows the drive(s) defined by this parameter block to be split into two logical disk units (two each, if more than one drive is defined by this block). Only the first physical drive may be split. The relative sizes of the logical drives are defined as follows:

Code	Drive 0	Drive 1
0	8/8	0
1	4/8	4/8
2	7/8	1/8

The split codes are:

Code 0: No split.

Code 1: The cylinders are divided equally between the two logical drives.

Code 2: The capacity of the disk is divided by 8. The first drive contains seven-eighths of the total, and the second contains one-eighth. Note that each drive has fixed and variable overhead areas (such as RCTs and alternate cylinders) which consume some of the user area, so the resulting sizes of the two logical drives only approximate one-eighth and seven-eighths.

Use of the split option disables seek-ordering and overlapped seek processing in the MSCP Controller, which reduces performance, particularly when both logicals of a split physical drive are active.

4.9.13 Removable Media

This parameter indicates whether the disk media is fixed or removable. If you are defining one physical/logical drive, this parameter uses a 1-bit field with valid values of 0 and 1, where 0 indicates fixed media and 1 indicates removable media.

4.9.14 Reduced Write Current Cylinder

ST-506 drives: This parameter specifies the physical cylinder at which the write current to the data heads is reduced. Some drives require that the write current to the heads be reduced above a certain cylinder to reduce the strength of the flux transition. This reduction prevents adjacent flux transitions in the higher cylinders (where they are closer together) from displacing one another to such an extent as to force data bits out of their data clock windows. Valid range is from 0 through 4095. If no reduction is required, specify the total number of physical cylinders.

4.9.15 Write Precompensation Cylinder

ST-506 drives (Medalist or Adaptec controller): This parameter specifies the physical cylinder at which the timing of write data transmitted to the disk drive must be advanced or retarded (with reference to the disk data clock). This timing shift compensates for timing shifts that are caused by adjacent flux transitions in the higher cylinders (where they are closer together). Shifting the write data with respect to the data clock ensures that, when the data is read back, the data will fall within the clock window, despite the tendency of one transition to affect the apparent position of the adjacent transition. This shifting is called precompensation.

The valid range is from 0 through 4095. If no precompensation is required, specify the total number of physical cylinders.

4.9.16 Step Code

ST-506 Drives (Medalist or Adaptec controller): This parameter specifies the stepping mode of the disk drive, as follows:

Step Code	Stepping Mode
0	Unbuffered, 3 msec
1	Buffered, 11 usec (Medalist), 28 usec (Adaptec)
2	Buffered, 12 usec (Adaptec only)

For most drives, Emulex recommends the fastest buffered step code available (1 for Medalist, 2 for Adaptec). Use a slower buffered step code or the unbuffered step code if your drive requires it.

ESDI drives (Champion controller): This parameter specifies the number of sectors by which sector 0 is offset from sector 0 of the previous track. Offsetting sector 0 from one track to the next is a technique that is used to reduce latency when performing write or read operations that cross a track boundary. When the drive is formatted, sector 0 of a track is offset a certain number of sectors from the position of sector 0 on the previous track. When this is done, spiral write and read operations are more efficient because the drive has time to switch from track to track before encountering sector 0. The valid range is from 0 through 255.

After the appropriate parameter questions have been answered, you will be prompted for the answers to these questions on the screen:

Do you want to configure another unit (Y or N, def=N)?

Do you want to change any parameter (Y or N, def=N)?

4.9.17 Defining Addresses for Physical Drives

A SCSI address and SCSI LUN must be defined for every drive in the system. Two values are written for each physical drive: the first value is the SCSI address of the controller and the second value is the drive's SCSI LUN. These values must be entered in the same order as the units have been entered in NOVRAM (see subsection 4.9.2).

The SCSI controller address range is 0 to 6. The SCSI LUN range is 0 to 7. You will be prompted to specify both values for each physical unit.

4.10 Operation

There are no operational instructions. The UC14/MO is ready for MSCP initialization as soon as its drives are formatted and tested.

4.10.1 Indicators

There are three light emitting diodes (LEDs) on the UC14/MO PWB. These LEDs are used for both diagnostics and for normal operations.

If switch SW2-1 is OFF, the UC14/MO executes a preliminary test at the following times:

- On power-up
- After a reset condition
- After a bus initialization
- After a write operation to the Initialization and Polling (IP) register (base address)

The self-test routine consists of two test sequences: preliminary and self-test. The preliminary test sequence exercises the 8031 microprocessor chip and the Disk Formatter chip. When the UC14/MO successfully completes the preliminary test, LED3 illuminates indicating that the UC14/MO is waiting for the MSCP initialization sequence.

During the MSCP initialization sequence, initiated by host software control, the UC14/MO executes a self-test that exercises the buffer controller chip, the Host Adapter Controller (HAC) chip and its associated circuitry, the onboard RAM, and the control memory PROM. If the UC14/MO passes this sequence of its self-test successfully, all the LED indicators on the edge of the UC14/MO are OFF.

If a fatal error is detected either during self-test or while the system is running, all three of the edge-mounted LED indicators are ON (illuminated). If the UC14/MO fails to pass its power-up self-tests, you can select a special diagnostic mode (switch SW2-1 ON) which causes the LED indicators to display an error code. See Self-Test Error Reporting, in Section 5, TROUBLESHOOTING.

During normal operation, LED1 and LED2 flicker occasionally. These LEDs are used to indicate UNIBUS activity and SCSI activity, respectively.

5.1 Overview

This section describes the several diagnostic features with which the UC14/MO Host Adapter is equipped, and outlines fault isolation procedures that use these diagnostic features.

Subsection	Title
5.1	Overview
5.2	Service
5.3	Fault Isolation Procedure
5.4	Power-Up Self-Diagnostics
5.5	Fatal Error Codes

5.2 Service

Your Emulex UC14/MO Host Adapter was designed to give years of trouble-free service, and it was thoroughly tested before leaving the factory. Should one of the fault isolation procedures indicate that the UC14/MO is not working properly, the product must be returned to the factory or to one of Emulex's authorized repair centers for service. Emulex products are not designed to be repaired in the field.

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

Do not return a component to EMULEX without authorization. A component returned for service without an authorization will be returned to the owner at the owner's expense. To receive an RMA number, contact Customer Service at (714) 662-5600.

For technical help in the continental United States, Alaska, and Hawaii contact:

Emulex Technical Support
3545 Harbor Boulevard
Costa Mesa, CA 92626
(714)662-5600 TWX 910-595-2521
Outside California: (800) 854-7112

After 5 p.m. Pacific Time, call (800) 638-7243. When answered, you will be prompted to key in 37115, followed by a # symbol, then to leave a phone number where you can be reached.

Outside the United States, contact the distributor from whom the subsystem was initially purchased.

To help you efficiently, Emulex or its representative requires certain information about the product and the environment in which it is installed. During installation, a record of the switch setting should have been made on the Configuration Reference Sheet. This sheet is contained in the Installation Section, Figure 4-1.

After you have contacted Emulex and received an RMA, package the component (preferably using the original packing material) and send the component **postage paid** to the address given you by the Emulex representative. The sender must also insure the package.

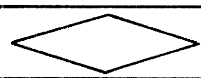
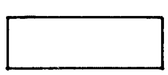
5.3 Fault Isolation Procedure

This fault isolation procedure is provided in flow chart format. The procedure is based on the self-diagnostics incorporated into the UC14/MO. The procedure is designed to be used if the product's self-diagnostic fails or if many errors are flagged by the subsystem during normal operation. If neither of these events happens, it is not necessary to follow these procedures.

The Fault Isolation Chart is shown in Figure 5-1. The chart symbols are defined in Table 5-1.

If the fault isolation procedure indicates that a component needs to be returned to Emulex, see subsection 5.2 for instructions on how to do so.

Table 5-1. Flow Chart Symbol Definitions

Symbol	Description
	Start point, ending point.
	Decision, go ahead according with YES or NO.
	Connector, go to same-numbered symbol on another sheet.
	Process.

UC1404-106

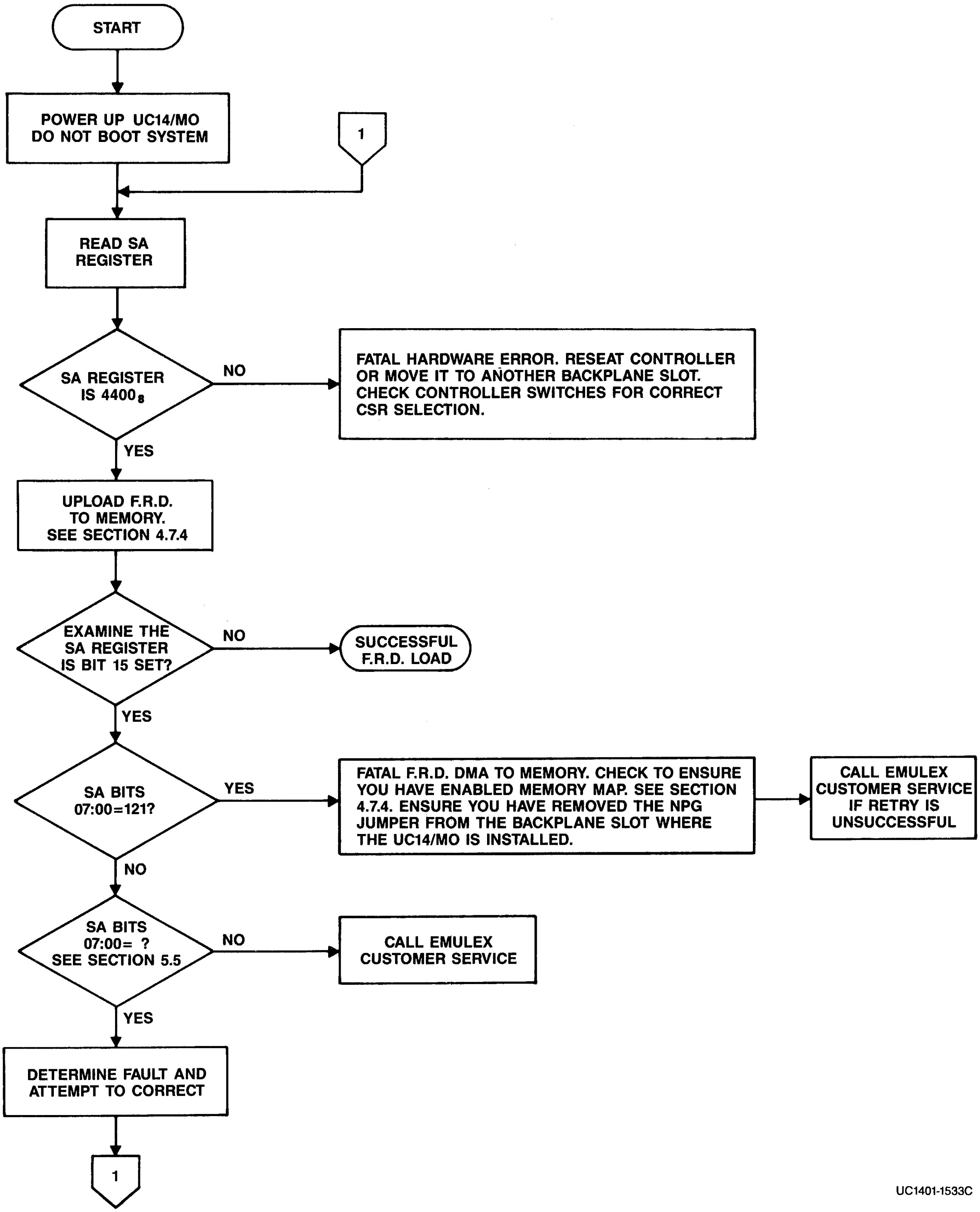


Figure 5-1. Fault Isolation Chart

5.4 Power-Up Self-Diagnostic

The UC14/MO executes an extensive self-diagnostic to ensure that the host adapter is in good working order. The self-diagnostic is divided into several parts. Table 5-2 indicates the order in which the tests are performed.

The first two tests are executed immediately after power-up, a reset, a bus INIT, or a write to the IP register (base address). The other tests are executed as the controller interacts with the MSCP initialization routine. If the UC14/MO fails any of the tests, it posts an MSCP fatal error code in the low-byte of the SA register (base address plus 2) and turns on three LEDs which are located on the outside edge of the PWB. The MSCP fatal error codes used by the UC14/MO are listed in Table 5-3.

To help determine the location of the problem, the operator can select a special diagnostic mode that causes the LEDs to display an error code. To enable this diagnostic mode, place the CPU halt switch in the ON position and set UC14/MO switch SW2-5 ON (1). After setting SW2-5 ON, the host computer must be powered down or UC14/MO switch SW1-1 must be toggled (turned ON and then OFF) to cause the UC14/MO to again perform its self-test.

Upon encountering an error, the host microprocessor halts and the LEDs display an error code. The error codes are listed and described in Table 5-2.

If the UC14/MO completes the diagnostic mode without errors, all three LEDs are OFF. Set switch SW2-5 in the OFF position and reset the UC14/MO controller before using.

Table 5-2. LED Error Codes

LED 3	LED 2	LED 1	Error Description
0	0	0	Self-diagnostic complete without errors
0	0	1	CPU Chip Test failed
0	1	0	SCSI Chip Test failed
1	0	0	Controller idle, waiting for initialization
0	1	1	Buffer Controller or External Memory Test failed
1	0	1	HAC Test failed
1	1	0	Emulation PROM Checksum Test failed

5.5 Fatal Error Codes

If the UC14/MO encounters a fatal error anytime during operation, all three LEDs are illuminated and an error code is posted in the low byte of the SA register (base address plus 2). Table 5-3 lists the MSCP fatal error codes used by the UC14/MO.

Table 5-3. MSCP Fatal Error Codes used by the UC14/MO

Octal Code	Hex Code	Description
0	0	No information in message packet.
1	1	Possible parity or timeout error when the UC14/MO attempted to read data from a message packet.
2	2	Possible parity or timeout error when the UC14/MO attempted to write data to a message packet.
4	4	UC14/MO diagnostic self-test indicated a controller RAM error.
5	5	UC14/MO diagnostic self-test indicated a firmware checksum error.
6	6	Possible parity or timeout error when the UC14/MO attempted to read an envelope address from a command ring.
7	7	Possible parity or timeout error when the UC14/MO attempted to write an envelope address to a command ring.
11	9	Host did not communicate with UC14/MO within the time frame established while bringing the controller online.
12	A	Operating system sent more commands to the UC14/MO than the controller can accept.
13	B	Controller unable to perform DMA transfer operation correctly.
14	C	UC14/MO diagnostic self-test indicated controller fatal error.
16	E	The MSCP connection identifier is invalid.
23	13	An error occurred during the MSCP initialization sequence.

Additional fatal error messages may appear. These error codes are listed in Table 5-4.

Table 5-4. Fatal Error Codes

Octal Code	Hex Code	Description
004	04	RAM error
005	05	Firmware checksum error
014	0C	Fatal error during self-test
111	49	Autoboot timeout
121	51	F.R.D. load to memory failed

Section 6
DEVICE REGISTERS AND PROGRAMMING

6.1 Overview

This section contains an overview of the UC14/MO device registers that are accessible to the UNIBUS and that are used to monitor and control the UC14/MO Host Adapter. The registers are functionally compatible with DEC implementations of MSCP controllers.

The following table outlines the contents of this section.

Subsection	Title
6.1	Overview
6.2	Overview of MSCP Subsystem
6.3	Programming
6.4	Registers
6.5	Bootstrap Command

6.2 Overview of MSCP Subsystem

Mass Storage Control Protocol (MSCP) is the protocol used by a family of mass storage controllers and devices designed and built by Digital Equipment Corporation. MSCP allows a host system to be connected to subsystems with a variety of capacities and geometries. This flexibility is possible because MSCP defines data locations in terms of sequential, logical blocks, not in terms of a physical description of the data's location (i.e., cylinder, track, and sector). This scheme gives the MSCP subsystem the responsibility for converting MSCP logical block numbers into physical addresses that the peripheral device can understand.

This technique has several implications. First, the MSCP subsystem must have detailed knowledge of the peripheral's capacity, geometry, and status. Second, the ability to make the translation between logical and physical addresses implies considerable intelligence on the part of the subsystem. Finally, the host is relieved of responsibility for error detection and correction because its knowledge of the media is insufficient to allow error control to be done efficiently.

There are several advantages to this type of architecture. First, it provides the host with an "error-free" media. Second, it provides for exceptional operating system software portability because, with the exception of capacity, the characteristics of all MSCP subsystems are the same from the operating system's point of view.

In terms of implementation, this protocol requires a high degree of intelligence on the part of the subsystem. Essentially, this intelligence is a process that runs on a microprocessor and is referred to as an MSCP controller. The MSCP controller has all of the responsibilities outlined above.

The host computer runs corresponding software processes which take calls from the operating system, convert them into MSCP commands, and cause the resulting command to be transferred to the MSCP controller.

In summary, an MSCP subsystem is characterized by an intelligent controller that provides the host with the view of a perfect media. It is further characterized by host independence from a specific bus, controller, or device type.

6.3 Programming

A complete description of MSCP commands and the corresponding status responses which the UC14/MO Host Adapter posts is beyond the scope of this manual.

6.3.1 Command Support

No currently available MSCP Controller supports the entire range of MSCP commands. The following subsections describe the extent of MSCP command support by the UC14/MO.

6.3.1.1 Minimal Disk Subset

The UC14/MO Host Adapter supports the entire minimal disk subset of MSCP commands.

6.3.1.2 Diagnostic and Utility Protocol (DUP)

The UC14/MO Host Adapter does not support any of the DUP commands or maintenance read/write commands. Therefore, the UC14/MO is not compatible with DEC diagnostics that use the MSCP DUP commands.

6.4 Registers

During normal operation, the UC14/MO Host Adapter is controlled and monitored using the command and status packets that are exchanged by the Class Driver (host) and the MSCP Controller. The UC14/MO has two 16-bit registers in the UNIBUS I/O page that are used primarily to initialize the subsystem. During normal operation, the registers are used only to initiate polling or to reset the subsystem. These registers are always read as words. The register pair begins on a longword boundary. Table 6-1 lists the octal and hexadecimal values for the Initialization and Polling (IP) register (base address) and the Status and Address (SA) register (base address plus 2) supported by the UC14/MO.

The IP register (base address) has two functions as detailed below:

- When written with any value, it causes a hard initialization of the MSCP Controller.
- When read while the port is operating, it causes the controller to initiate polling.

The SA register (base address plus 2) has four functions as listed below:

- When read by the host during initialization, it communicates data and error information relating to the initialization process.
- When written by the host during initialization, it communicates certain host-specific parameters to the port.
- When read by the host during normal operation, it communicates status information including port and controller-detected fatal errors.
- When zeroed by the host during either initialization or normal operation, it signals the port that the host has successfully completed a bus adapter purge in response to a port-initiated purge request.

Table 6-1. UC14/MO IP and SA Registers

UC14/MO Address Octal	UC14/MO Address Hex	VAX-11/730 VAX-11/750 Hex Address With Offset	------------ VAX-11/780 ------------ Hex Address with Offset UBA #0	UBA #1	UBA #2	UBA #3
772150 772152	F468 F46A	FFF468 FFF46A	2013F468 2013F46A	2017F468 2017F46A	201BF468 201BF46A	201FF468 201FF46A
772154 772156	F46C F46E	FFF46C FFF46E	2013F46C 2013F46E	2017F46C 2017F46E	201BF46C 201BF46E	201FF46C 201FF46E
760334 760336	E0DC E0DE	FFE0DC FFE0DE	2013E0DC 2013E0DE	2017E0DC 2017E0DE	201BE0DC 201BE0DE	201FE0DC 201FE0DE
760340 760342	E0E0 E0E2	FFE0E0 FFE0E2	2013E0E0 2013E0E2	2017E0E0 2017E0E2	201BE0E0 201BE0E2	201FE0E0 201FE0E2
760344 760346	E0E4 E0E6	FFE0E4 FFE0E6	2013E0E4 2013E0E6	2017E0E4 2017E0E6	201BE0E4 201BE0E6	201FE0E4 201FE0E6
760350 760352	E0E8 E0EA	FFE0E8 FFE0EA	2013E0E8 2013E0EA	2017E0E8 2017E0EA	201BE0E8 201BE0EA	201FE0E8 201FE0EA
760354 760356	E0EC E0EE	FFE0EC FFE0EE	2013E0EC 2013E0EE	2017E0EC 2017EOEE	201BE0EC 201BEOEE	201FE0EC 201FEOEE
760360 760362	E0F0 E0F2	FFE0F0 FFE0F2	2013E0F0 2013E0F2	2017E0F0 2017E0F2	201BE0F0 201BE0F2	201FE0F0 201FE0F2

For more information on the VAX 8600/8650/8200 addresses, refer to Table 4-9 on page 4-31.

6.5 Bootstrap Command

To allow the system to be easily bootstrapped from peripherals attached to the UC14/MO Host Adapter, Emulex has incorporated a Bootstrap Command into the controller. This feature is not part of the standard MSCP command set nor is it supported on the VAX.

The Bootstrap Command can be issued from the console after the system is powered up, or it may be incorporated into a firmware routine that is located in a Bootstrap ROM. (The ROM would not be located on the UC14/MO PWB, but on some other module in the system.) The Bootstrap Command causes the UC14/MO to load the first logical block from the selected peripheral into host memory starting at location 00000.

To issue the Bootstrap Command to the UC14/MO:

1. Initialize the UC14/MO by writing any value into the IP register (base address). The UC14/MO performs self-test and begins the initialization dialogue.

Register	Octal
IP: Write	000001

2. The UC14/MO indicates that initialization step 1 has begun by setting bit 11 in the SA register (base address plus 2). The host must poll the register for this value (no interrupt is generated). Bit 8 should also be set.

Register	Octal	Addressing
SA: Read	004400	18-Bit

3. When the controller indicates that step 1 of the initialization dialogue is begun, load the SA register (base address plus 2) with the "special initialization code:"

Register	Octal
SA: Write	030003

4. The controller acknowledges the initialization code with 00400.

Register	Octal
SA: Read	000400

5. Load the SA register (base address plus 2) with $04000n_8$ or $400n_{16}$, where n is the MSCP logical unit number of the unit to bootstrap from. In this example, the unit is 0.

Register	Octal
SA: Write	040000

6. Load R0 with the unit number. Load R1 with the UC14/MO base address, then enter 0G to begin:
   @0G

7.1 Overview

This section contains a description of the UC14/MO Host Adapter's architecture.

7.2 UC14/MO Host Adapter Architecture

The UC14/MO is a microprocessor-based emulating host adapter that is contained on a single quad-wide PCBA. The UC14/MO's major functional blocks are shown in Figure 7-1. The host adapter is organized around the eight-bit 8031 microprocessor. The board has an eight-bit internal data bus with 16-bit addressing capability. Both of the interface controllers and the buffer controller are addressed as memory (memory-mapped I/O).

The 8031's primary task is to decode and implement commands from the host. At command completion, the microprocessor is also responsible for generating status and transmitting it to the host. A large part of the microprocessor's job while performing those duties involves setting up the Host Adapter Controller and the Buffer Controller for the large data transfers which are their specialties.

The UC14/MO uses a 27256 erasable programmable read-only memory (EPROM), which contains the control program, and 32K bytes of random access memory (RAM), which is used for data buffering and working storage.

The UNIBUS interface consists of a 16-bit bidirectional set of data lines and an 18-bit set of address lines. The Host Adapter Controller is used for programmed I/O, CPU interrupts, and NPR data transfers. The microprocessor responds to all programmed I/O and carries out the I/O functions required for the addressed host adapter register. The Interface Controller has automatic UNIBUS address generation capability that, in conjunction with a byte counter, allows the Interface to conduct UNIBUS nonprocessor request (NPR) transfers without direct microprocessor intervention. This auto NPR capability is used with the UC14/MO buffer controller to transfer large blocks of data directly between host memory and the UC14/MO's RAM.

The SCSI Interface and Control is implemented using a single LSI chip. In response to commands from the microprocessor, the chip establishes and monitors SCSI bus phases appropriate to the command, and thus relieves the microprocessor of signal control and timing duties.

The buffer controller is implemented on a single chip. This four-channel controller is responsible for moving large blocks of data between the 32K RAM buffer and the SCSI interface, and between the UNIBUS interface and the 32K RAM buffer. After being set up for an operation by the microprocessor, either interface requests DMA service from the buffer controller logic by driving an individual request signal active. The transfer then proceeds without direct intervention by the microprocessor. This allows high-speed data transfers to occur while the microprocessor is focused on other processes.

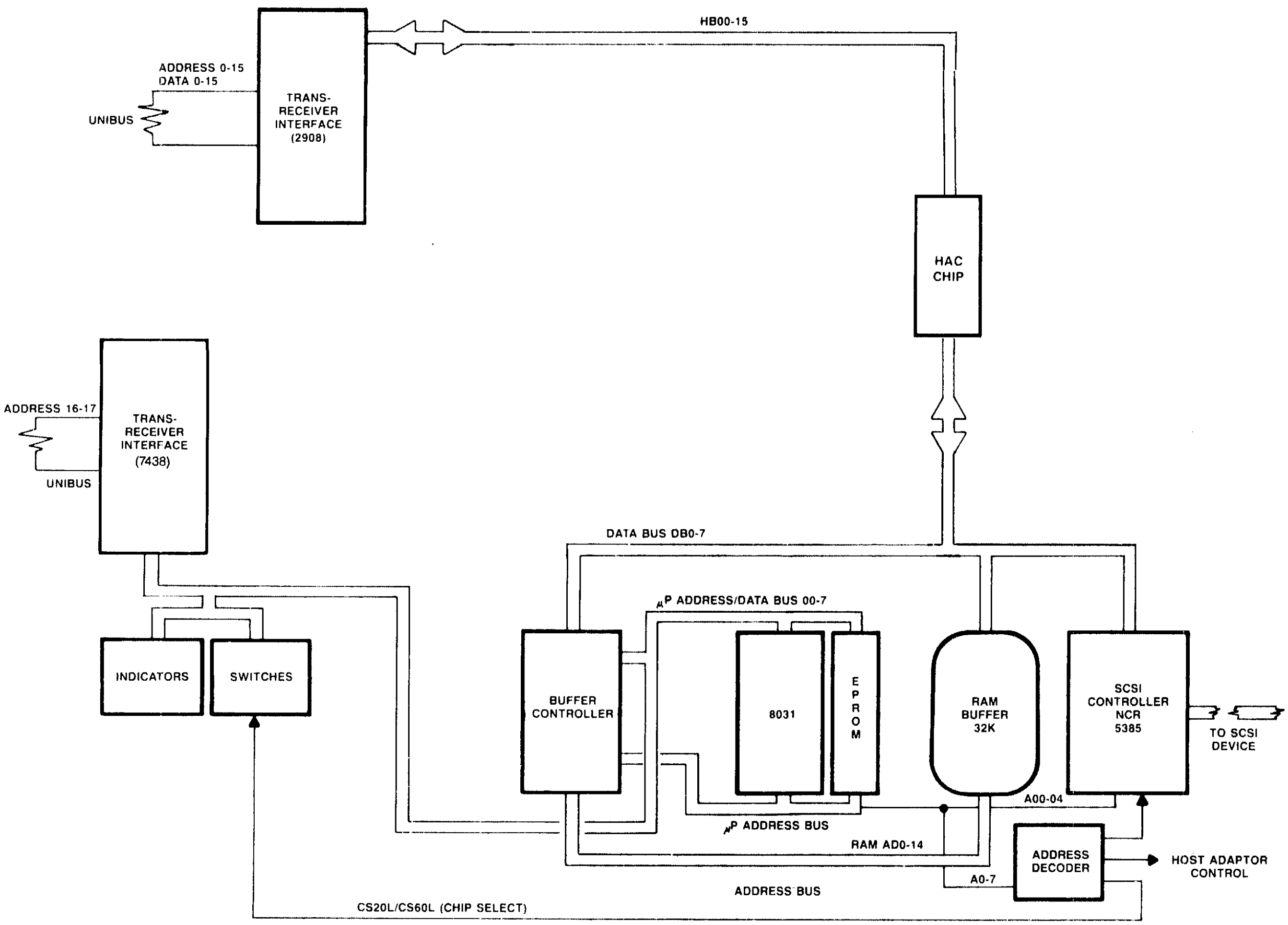


Figure 7-1. UC14/MO Block Diagram

8.1 Overview

This section describes the interfaces that the UC14/MO Host Adapter incorporates. It includes information on the UC14/MO implementation of SCSI bus specification electrical and mechanical requirements. Including this overview, the section is divided into the following subsections.

Subsection	Title
8.1	Overview
8.2	UC14/MO UNIBUS Interface
8.3	UC14/MO SCSI Bus Interface

8.2 UNIBUS Interface

The UNIBUS between the CPU and the UC14/MO Host Adapter contains 18 address lines and 16 bidirectional data lines, plus control signals for data and interrupt vector address transfer and for becoming bus master. UNIBUS interface pin assignments are listed and described in Table 8-1. These signal lines provide the means by which the CPU and the UC14/MO Host Adapter communicate with each other.

Table 8-1. UNIBUS Interface Pin Assignments

Connector C			Connector D		
Component Side 1	**Pin**	**Solder Side 2**	**Component Side 1**	**Pin**	**Solder Side 2**
NPGIN H	A	+5V		A	+5V
NPG H	B			B	
PA L	C	GND		C	GND
	D	D15 H		D	
	E	D14 H		E	
BRN TST H	F	D13 H		F	BR5 L
D11 H	H	D12 H		H	
	J	D10 H		J	
	K	D09 H		K	BG7 H
	L	D08 H	INIT L	L	BG7 H
	M	D07 H		M	BG6 H
DCLO L	N	D04 H		N	BG6 H
	P	D05 H		P	BG5IN H
	R	D01 H		R	BG5 H
PB L	S	D00 H		S	BG4 H
GND	T	D03 H	GND	T	BG4 H
	U	D02 H		U	
ACLO L	V	D06 H		V	

Connector E			Connector F		
Component Side 1	**Pin**	**Solder Side 2**	**Component Side 1**	**Pin**	**Solder Side 2**
	A	+5V		A	+5V
	B			B	
UA12 H	C	GND		C	GND
A17 L	D	UA15 H	BBSY L	D	
MSYN L	E	A16 L		E	
UA02 H	F	C1 L		F	
UA01 H	H	UA00 H		H	
SSYN L	J	C0 L	NPR L	J	
UA14 H	K	UA13 H		K	
UA11 H	L			L	
	M		INTR L	M	
	N	UA08 H		N	
UA10 H	P	UA07 H		P	
UA09 H	R			R	
	S			S	
GND	T		GND	T	SACK L
UA06 H	U	UA04 H		U	
UA05 H	V	UA03 H		V	

8.2.1 Interrupt Priority Level

The UC14/MO is hardwired to issue level 5 interrupt requests and monitor level 6.

8.2.2 Register Address

The UC14/MO Host Adapter has two registers visible to the UNIBUS. Their addresses are determined by DIP switches SW2-4, SW3-4, and SW3-5. See Section 4 for detailed address and switch setting information.

8.2.3 Scatter/Gather

The UC14/MO Host Adapter supports the VAX I/O technique of scatter-write and gather-read operations.

8.3 UC14/MO SCSI Bus Interface

Information on the UC14/MO implementation of SCSI bus electrical and mechanical requirements is provided in this subsection.

8.3.1 SCSI Interface Physical Description

SCSI bus devices are daisy-chained together using a common cable. Both ends of the cable are terminated. All signals are common between all bus devices. The UC14/MO supports the SCSI specification single-ended option for drivers and receivers. The maximum cable length allowed is 20 feet (six meters). This cabling is primarily for interconnection outside the subsystem cabinet in which the UC14/MO resides.

8.3.1.1 Cable Requirements

A 50-conductor flat cable or 25-twisted-pair flat cable must be used to connect SCSI bus hosts and controllers. The maximum cable length is 20 feet (six meters). The maximum length of the cable past the terminator is 0.1 meter. SCSI bus termination can be internal to the SCSI devices that are located at the ends of the bus cable (such as the subsystem that contains the SCSI device controller and its peripheral). The UC14/MO single-ended pin assignments are shown in Table 8-1.

8.3.1.2 Shielded Connector Requirement

The SCSI bus shielded connector is a 50-conductor cable connector that consists of two rows of 25 female contacts on 100 mil centers. The connector shielding system must provide a dc resistance of less than 10 milliohms from the cable shield at its termination point to the SCSI device enclosure.

8.3.2 SCSI Interface Electrical Description

The UC14/MO SCSI Host Adapter interfaces to SCSI controllers via the SCSI bus. A 50-pin male IDC connector at location J1 on the UC14/MO board plugs directly into the SCSI bus (refer to Figure 4-3). All signals use open collector or three-state drivers. Each signal driven by a SCSI device has the following output characteristics when measured at the SCSI device's connection:

- 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 volts (nominal) and 330 ohms to ground at each end of the SCSI cable as shown in Figure 8-2.

Each signal received by a SCSI device has the following input characteristics when measured at the SCSI device's connection:

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

Table 8-2. UC14/MO SCSI Bus Pin Assignments

Pin	Signal Name	Input/Output
1	GND	--
2	-D0	Input/Output
3	GND	--
4	-D1	Input/Output
5	GND	--
6	-D2	Input/Output
7	GND	--
8	-D3	Input/Output
9	GND	--
10	-D4	Input/Output
11	GND	--
12	-D5	Input/Output
13	GND	--
14	-D6	Input/Output
15	GND	--
16	-D7	Input/Output
17	GND	--
18	-DP (Data parity)	Input/Output
19	GND	--
20	GND	--
21	GND	--
22	GND	--
23	GND	--
24	GND	--
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

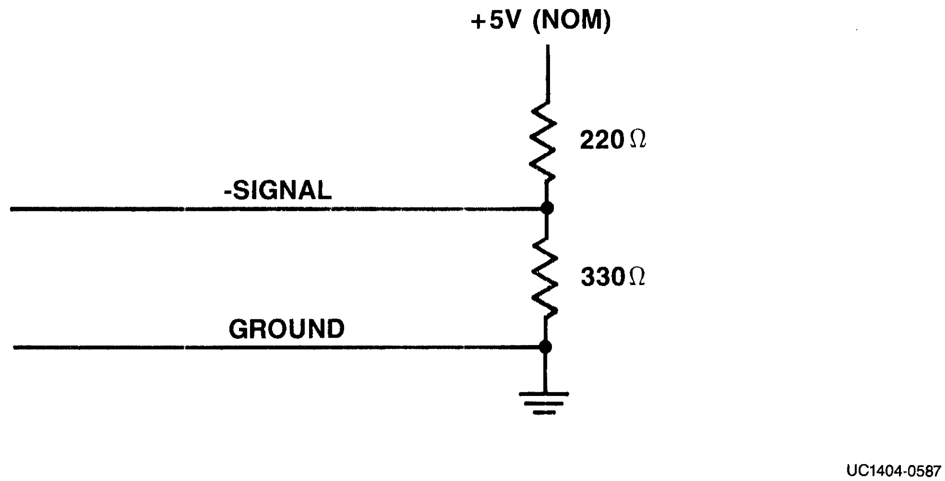


Figure 8-1. UC14/MO SCSI Bus Signals Termination

8.3.3 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

The phases are described in Subsection 9.3. 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 signals; the signals are described in Subsection 8.3.3.1.

8.3.3.1 SCSI Bus Signals

There are 18 signals on the SCSI bus. Nine signals are control signals that coordinate transfer of data between SCSI hosts/ controllers; nine signals are for an eight-bit data bus with parity. The signals are defined in Table 8-2.

In Table 8-2, the eight data bit signals are represented by DB0 through DB7; 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 bit, represented by DBP, is odd. The UC14/MO generates parity but does not have parity detection enabled. Parity is not guaranteed valid during the Arbitration Phase.

The UC14/MO SCSI bus pin assignments are listed in Table 8-2; the UC14/MO supports only the SCSI single-ended option.

Table 8-3. 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 acknowledgement for a REQ/ACK data transfer handshake.
REQ	Request	Indicates a request for a REQ/ACK data transfer handshake.
ATN	Attention	Indicates the ATTENTION condition (i.e., the Initiator has a message to send to the Target). The ATTENTION condition is described in subsection 9.5.2.
RST	Reset	Indicates the RESET condition (i.e., clears the SCSI bus of all activity). The RESET condition is described in subsection 9.5.1.

(continued next page)

Table 8-3. SCSI Bus Signals (continued)

Mnemonic Name	Signal	Description
SEL	Select	Used to select/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/data out transfer.
I/O	Input/Output	Indicates the direction of data movement on the data bus with respect to an Initiator.
MSG	Message	Indicates the SCSI bus is in the Message Phase.

8.3.3.2 SCSI Bus Timing

Except where noted, the delay time measurements for each SCSI device (host or controller) are calculated from signal conditions existing at that device's SCSI bus connection. Normally, these measurements do not consider delays in the SCSI cable. The SCSI timings are listed in Table 8-3.

The timing diagram shown in Figure 8-3 indicates the typical relationship between SCSI bus signals and SCSI phase sequencing.

Table 8-4. SCSI Bus Timings

Timing	Duration	Description
Arbitration Delay	2.2 us	The minimum time a SCSI host or controller waits from asserting the BSY signal for arbitration until the data bus can be examined to see if arbitration has been won. There is no maximum time.
Bus Clear Delay*	800 ns	The maximum time for a SCSI host or controller to stop driving all bus signals after 1) a Bus Free Phase is detected, 2) the SEL signal is received from another SCSI host or controller during the Arbitration Phase.
Bus Free Delay	800 ns	The minimum time a SCSI host or controller waits from its detection of the Bus Free Phase until it asserts the BSY signal when going to the Arbitration Phase.
Bus Set Delay	1.8 us	The maximum time for a SCSI host or controller to assert the BSY signal and its SCSI ID bit on the data bus after it detects a Bus Free Phase for entering the Arbitration Phase.
Bus Settle Delay	400 ns	The time to wait for the SCSI bus to settle after changing certain control signals.
Cable Skew Delay	10 ns	The maximum difference in propagation time allowed between any two SCSI bus signals when measured between any two SCSI devices.
Deskew Delay	45 ns	This time is used to calculate the minimum time required for deskew of signals.
Reset Hold Time	25 us	The minimum time for which the RST signal is asserted. There is no maximum time.

* In the Bus Clear Delay, for condition 1) the maximum time for a SCSI device to clear the bus is 1200 ns from the BSY and SEL signals both first becoming false. If a SCSI device requires more than a Bus Settle Delay to detect the Bus Free Phase, it clears the bus within a Bus Clear Delay minus the excess time.

(continued on next page)

Table 8-4. SCSI Bus Timings (continued)

Timing	Duration	Description
Selection Abort Time	200 us	The maximum time a Target (or Initiator) takes from its most recent detection of being selected (or reselected) until it asserts the BSY signal. This timeout is required to ensure that a Target (or Initiator) does not assert the BSY signal after a Selection (or Reselection) Phase has been aborted. This is not the Selection timeout.
Selection Timeout Delay	250 ms	The minimum recommended time that an Initiator (or Target) should wait for a BSY response during the Selection or Reselection Phase before starting the timeout procedure.
ms = milliseconds us = microseconds ns = nanoseconds		

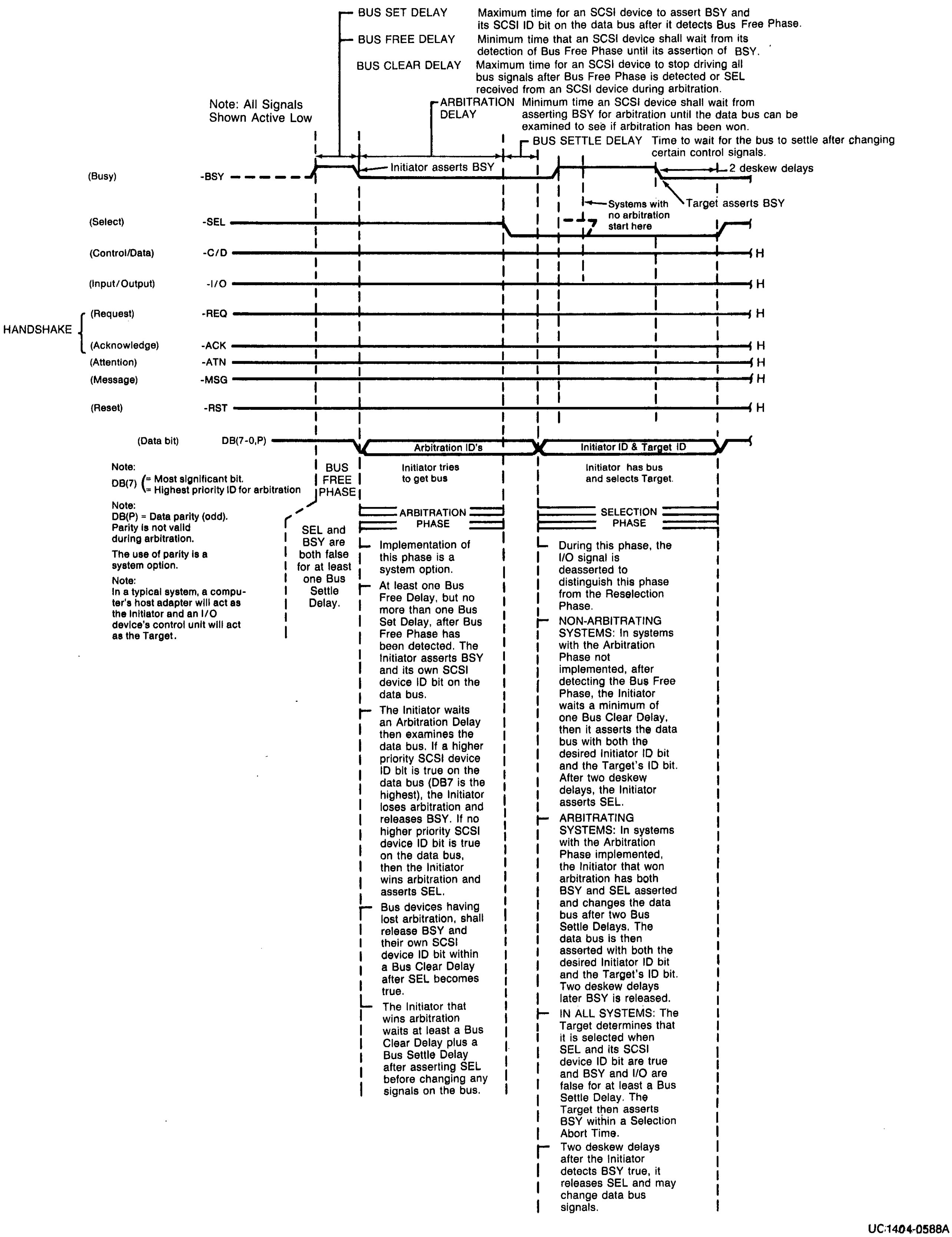


Figure 8-2. SCSI Bus Timing Diagram (Sheet 1 of 3)

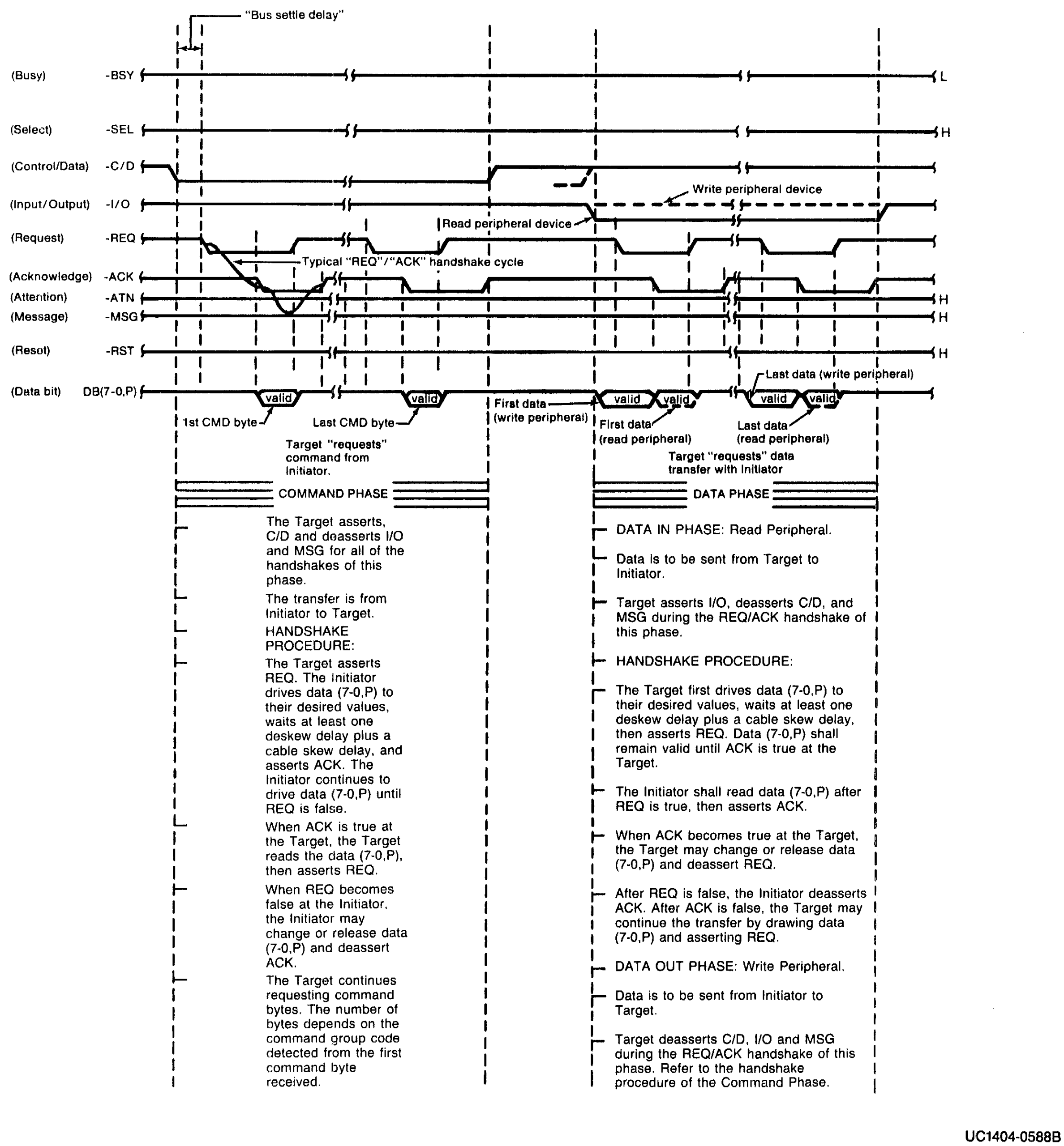


Figure 8-3. SCSI Bus Timing Diagram (Sheet 2 of 3)

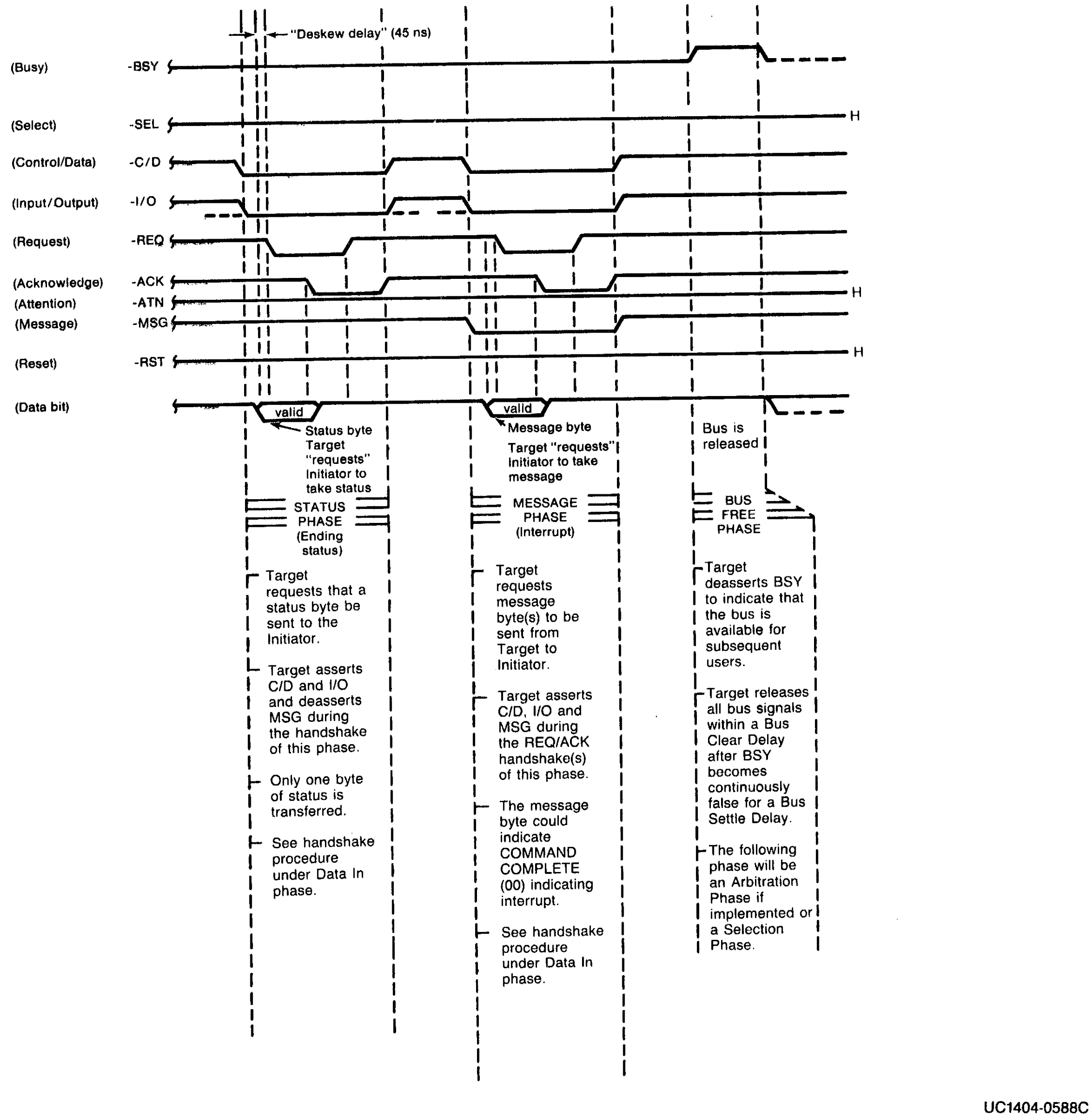


Figure 8-3. SCSI Bus Timing Diagram (Sheet 3 of 3)

Section 9
SCSI PROTOCOL DESCRIPTION

9.1 Overview

This section describes the SCSI bus; it includes information on SCSI bus phases and phase sequencing, as well as the procedures for passing control and status information between SCSI bus hosts and controllers using SCSI memory address pointers. Finally, it also describes in detail the SCSI commands issued by the UC14/MO. This section is divided into the following subsections:

Subsection	Title
9.1	Overview
9.2	SCSI Bus Overview
9.3	SCSI Bus Phases
9.4	SCSI Bus Phase Sequencing
9.5	SCSI Bus Conditions
9.6	SCSI Commands
9.7	SCSI Group 0 Command Descriptions
9.8	SCSI Group 1 Command Descriptions
9.9	SCSI Group 7 Command Descriptions

9.2 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 UC14/MO SCSI command standard is based on the ANSI X3T9.2/82-2 Revision 17B (16 Dec. 85) SCSI Interface Specification.

Up to eight SCSI hosts and/or controllers can be supported by the SCSI bus. Each controller can be connected to a maximum of eight devices (called Logical Unit Numbers, or LUNs). The UC14/MO hardware supports any combination of host systems, intelligent controllers or intelligent peripherals. Three basic SCSI configurations are supported with the UC14/MO and the SCSI bus; they are listed below:

- single initiator, single target,
- single initiator, multi-target,
- multi-initiator, multi-target.

Communication on the SCSI bus occurs between a host and a controller. (The UC14/MO also supports communication between two controllers, as in a copy operation.) When a host and a controller communicate, one acts as the Initiator and one as the Target. The Initiator (usually the host, the UC14/MO) originates an operation and the Target (usually a peripheral controller) performs the operation. Sample system configurations supported by UC14/MO hardware are shown in Figure 9-1.

Some SCSI bus functions are assigned to the Initiator and some functions 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 on the SCSI data bus. In some cases, 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, e.g., when it performs a copy operation.

SCSI bus data transfers are asynchronous and follow a defined REQ/ACK (request/acknowledge) 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 signals. Nine signals are for an eight-bit data bus with parity; the other nine signals are for control signals that coordinate data transfer between the host and SCSI controllers. SCSI bus signals are described in detail in subsection 8.3.

9.2.1 Technical Manual Conventions

To avoid possible confusion with other uses of the same words, throughout this section we use the following conventions:

- All SCSI commands (such as **READ, MODE SELECT,** and **INQUIRY)** and diagnostic subcommands (such as **READ BAD SECTOR FILE** and **WRITE LONG**) are printed in uppercase boldface.
- All SCSI status and error messages (such as CHECK CONDITION and DRIVE NOT READY) are printed in uppercase.
- All SCSI bus phases and conditions (such as Arbitration Phase) and SCSI Command Descriptor Block names (such as Extended Sense Byte) are printed in initial caps.
- All SCSI command and message codes are given in their hexadecimal values.

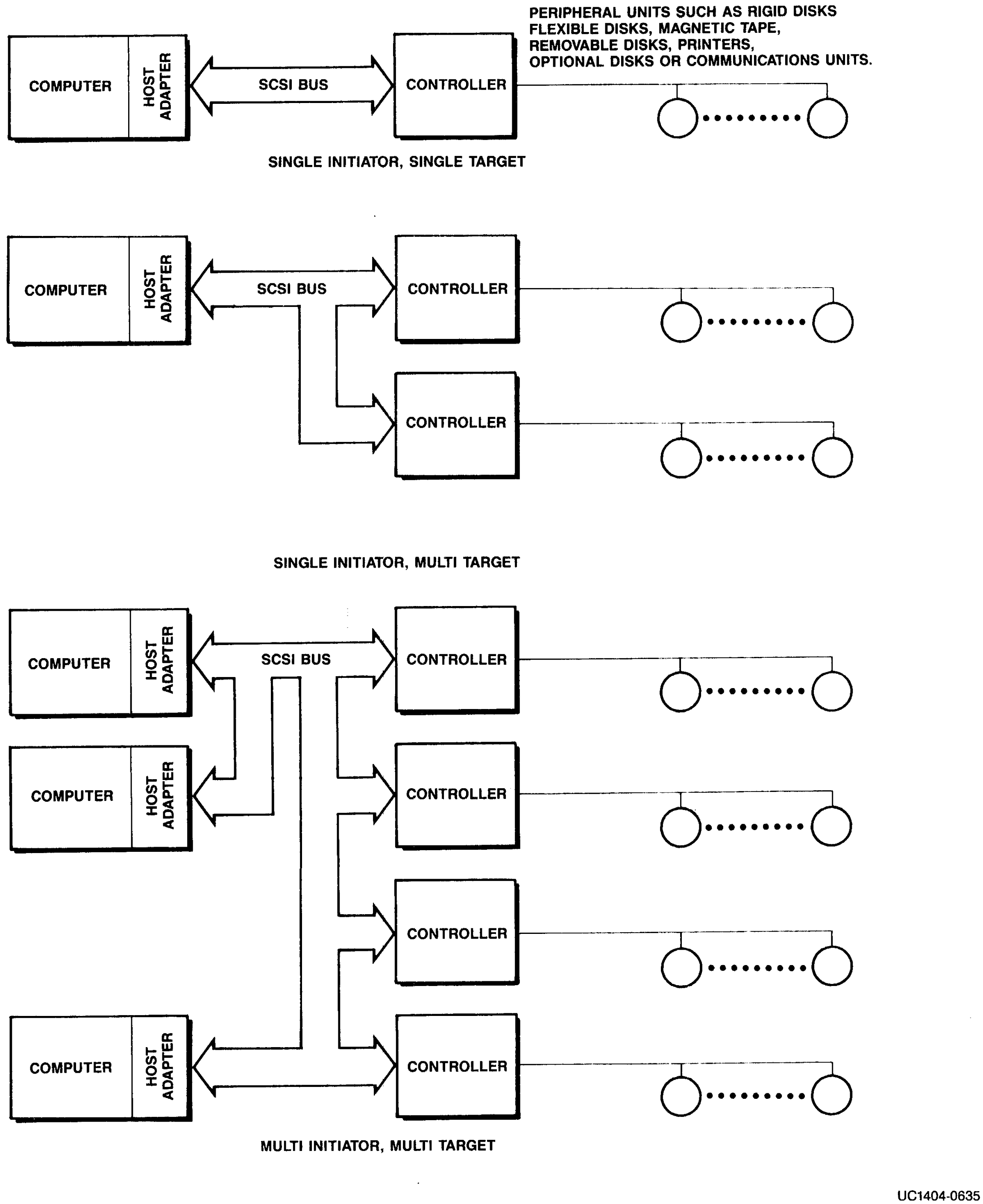


Figure 9-1. Sample SCSI Bus Configurations

9.3 SCSI Bus Phases

The activities on the SCSI bus can be divided into the following phases of operation:

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

These phases are supported as specified by the ANSI SCSI specification. The phases are individually discussed in subsequent subsections. The last four phases (Command, Data, Status, and Message) are grouped together as Information Transfer Phases.

When the SCSI bus is not involved in one of the SCSI bus phases, it is in a Bus Free Phase. The Bus Free Phase indicates that no host adapter or controller is actively using the SCSI bus and the SCSI bus is available for subsequent users.

The SCSI bus activities, implemented by the UC14/MO, include the disconnect function and reselection function (see subsection 9.3.2). Overlapped operations on multiple controllers and multiple logical units are supported.

In the following subsections, no attempt is made to detail the SCSI bus signal sequences; the signals and timing are listed in subsection 8.3.3.

9.3.1 Arbitration Phase

The Arbitration Phase is an optional implementation on the SCSI bus. This phase is used when multiple controllers or processors vie for SCSI bus ownership. Since multiple host adapters and/or controllers may desire control of the SCSI bus concurrently, arbitration for the SCSI bus is a requirement for controllers attached to the UC14/MO.

9.3.2 Selection and Reselection Phases

The SCSI bus Selection and Reselection phases provide methods for establishing a link between the Initiator and a desired Target.

After the UC14/MO selects a target to perform some function (e.g., read or write data), the target has the option of disconnecting from the SCSI bus. When the target needs to re-establish the link to its original Initiator, it reselects that Initiator.

The SCSI Selection and Reselection Phases can be terminated for any one of three conditions:

1. The preceding Selection or Reselection Phase is successfully completed by using the Selection/Reselection handshake protocol.

2. A Selection/Reselection timeout occurs. The timeout results if any Target or Initiator does not respond to the Selection/Reselection Phase within a timeout period of two seconds.

3. A Reset (-RST) signal occurs on the SCSI bus. When this signal is asserted, all SCSI bus sequences are immediately terminated and the SCSI bus signals are released by all Initiators and Targets.

The Initiator uses the Attention (-ATN) signal to notify the target that a message is ready. To guarantee that the Target recognizes the Attention condition before the Command Phase is entered, the -ATN signal level is held true before the Selection or Reselection Phase is completed.

If an IDENTIFY message is used during the Selection Phase sequence, the specified Logical Unit Number (LUN) has precedence over the LUN field in the Command Descriptor Block (CDB). (CDBs are described in detail in subsection 9.7.) The IDENTIFY message also informs the Target if the Initiator supports the disconnect function.

9.3.3 Information Transfer Phases

The Command, Data, Status, and Message Phases are grouped together as Information Transfer Phases because they are all used to transfer data or control information via the SCSI data bus. The Information Transfer Phases are described in the following subsections.

9.3.3.1 Command Phase

The Command Phase allows the Target to request command information from the Initiator. An Initiator issues SCSI commands to a Target by transferring a command packet, called a Command Descriptor Block (CDB). The length of the SCSI command and the meaning of the information in the command packet depends on which command is being transferred. (See subsection 9.6 for definitions of SCSI commands and all SCSI CDBs supported by the UC14/MO.)

The Command Phase is interrupted only for the following exception conditions:

- **Reset Condition.** This condition can occur when the SCSI Reset (-RST) signal is asserted or a power fail or power-off condition in the Target occurs. In this case, the Command Phase and the connection established during the Selection/Reselection Phase is terminated by the Target with the release of the -BSY signal.

- **Parity Error Condition.** The Target detects a parity error on the SCSI bus during the command transfer operation. At this time, the target controller releases the -BSY signal, terminates the connection, and the SCSI bus returns to the Bus Free phase.

9.3.3.2 Data Phase

The Data Phase of a connection controls the transfer of data between the Initiator and Target devices. The Data Phase includes both the Data In Phase and the Data Out Phase. The Data In Phase allows the Target to request sending of data to the Initiator from the Target. The Data Out Phase allows the Target to request sending of data to the Target from the Initiator. The direction of the data transfer operation depends on the command being processed. Some commands may have no data to be transferred and therefore have a null Data Phase. Only the asynchronous data transfer mode is supported by the UC14/MO.

The Data Phase is interrupted only for the following exception conditions:

- **Reset Condition.** This condition can occur when the SCSI Reset (-RST) signal is asserted or when a power fail or power-off condition in the Target occurs. In this condition, the Data Phase and the connection established during the Selection/Reselection Phase are terminated by the Target with the release of the -BSY signal.

- **Data Out Parity Error Condition.** The Target detects a parity error on the SCSI bus during the data transfer operation from the Initiator to the Target.

- **Data In Parity Error Condition.** The Initiator detects a parity error on the SCSI bus during the data transfer operation from the Target to the Initiator. The Initiator can then assert the -ATN signal along with the Acknowledge (-ACK) signal. The Target detects this condition and enters the message out phase to receive a message. The Initiator sends an Initiator-detected error message in response.

9.3.3.3 Status Phase

The Status Phase is used by the Target to send completion information to the Initiator. The status is sent in a single byte, the format of which is defined in subsection 9.3.3.3.1.

The Target can initiate the Status Phase when any one of the following conditions occur:

- **Busy Status.** The Selection Phase is completed and the Target is in a BUSY state and unable to process any commands for an extended period of time. The Target can initiate the Status Phase immediately after this condition occurs. The Status Byte transferred has the BUSY status code set.

- **Reservation Conflict Status.** The Command or Reselection Phase is completed and the specified LUN is reserved for another Initiator. The Status Byte transferred has the RESERVATION CONFLICT status code set.

- **Terminated Status.** At the termination of a command, the Status Byte transferred has the GOOD STATUS code set to indicate the success of the command.

NOTE

In multi-Initiator environments, the Initiator delays a minimum of 200 microseconds before attempting another selection of a Target if a BUSY status code for that Target is received.

9.3.3.3.1 Status Byte Format

The format of the Status Byte used by the Target to send completion information to the Initiator is defined below.

Byte	Bit	07	06	05	04	03	02	01	00
00		0	0	0	Status Code				NED

Status Code - Bits <04:01>

These bits are used to specify the status code. Table 9-1 lists and describes the status codes that are recognized by the UC14/MO.

Nonexistent Device (NED) - Bit 00

When the NED bit is set to one, the Initiator selected a LUN that is not configured in the system.

Table 9-1. Status Codes

Bits 04	03	02	01	Status	Description
X	0	0	0	GOOD STATUS	The target controller successfully completed the command.
0	0	0	1	CHECK CONDITION	An error, exception, or abnormal condition occurred.
0	1	0	0	BUSY	The target controller is busy.
1 = Set				0 = Cleared	X = Don't Care

9.3.3.4 Message Phase

The Message Phase is used to transfer information about exception conditions between the Initiator and the Target. The Message Phase includes both the Message In and the Message Out Phases. The Message In Phase allows a Target to request that messages be sent to the Initiator from the Target. The Message Out Phase allows a Target to request that messages be sent from the Initiator to the Target. Messages from the target controller are a single byte in length. Table 9-2 lists the error messages that are supported by the UC14/MO. Unsupported messages will cause the UC14/MO to abort and restart the command.

Table 9-2. UC14/MO SCSI Messages

Code	Message	Description
00	COMMAND COMPLETE	Issued by the Target just before releasing the -BSY signal at the end of a command execution. This message is generally sent immediately after a Status Phase.
02	SAVE DATA POINTER	Issued by the Target to direct the Initiator to save a copy of the present active data pointer.
04	DISCONNECT	Issued by the Target just before releasing the -BSY signal to indicate to the Initiator that the present physical connection is temporarily broken. The current data, command, and status pointers are not saved.
06	ABORT	Issued by the Initiator to the Target to clear the specified LUN and cause the SCSI bus to go to the Bus Free Phase.
07	MESSAGE REJECT	Issued by the Initiator or Target in response to a received message that was undefined.
0C	BUS DEVICE RESET	Issued by the Initiator to the Target to reset all current I/O activities on the SCSI bus. This message generates a hard Reset Condition (see subsection 9.5.1).
80-FF	IDENTIFY *	Issued by the Target or Initiator to establish a connection to a particular LUN. The following bits have particular meaning: Bit 07 - Always set to one. Bit 06 - Set if the Initiator can support Disconnect and Reconnect sequences. Bits <02:00> - Specify LUN address (hexadecimal) in a Target.

* If the disconnect function is supported, this message will be issued by the UC14/MO at the beginning of every command sequence.

9.4 SCSI Bus Phase Sequencing

The status of the SCSI bus is a function of the control signals. These signals place the bus in one of four phases: Arbitration, Selection/Reselection, Information Transfer, and Bus Free. The order in which SCSI bus phases are used follows a prescribed sequence, shown in Figure 9-2.

All SCSI command sequences start with the Bus Free Phase. The normal progression is from the Bus Free Phase to the Arbitration Phase. During arbitration, hosts/controllers contest for control of the SCSI bus; priority is given to the one with the highest SCSI bus address.

Once a host or controller has control of the SCSI bus, the bus enters the Selection/Reselection Phase. This phase allows the master of the bus to select a specific device for communication. An Initiator can select a Target to initiate an operation, or a Target can reselect an Initiator to continue an operation.

After a physical path between an Initiator and a Target is established, the bus moves into one of the Information Transfer Phases. These phases include six types of information exchange:

- Data Out Phase
- Data In Phase
- Command Phase
- Status Phase
- Message In Phase
- Message Out Phase

These types of SCSI bus information exchange are described in more detail in subsection 9.3.

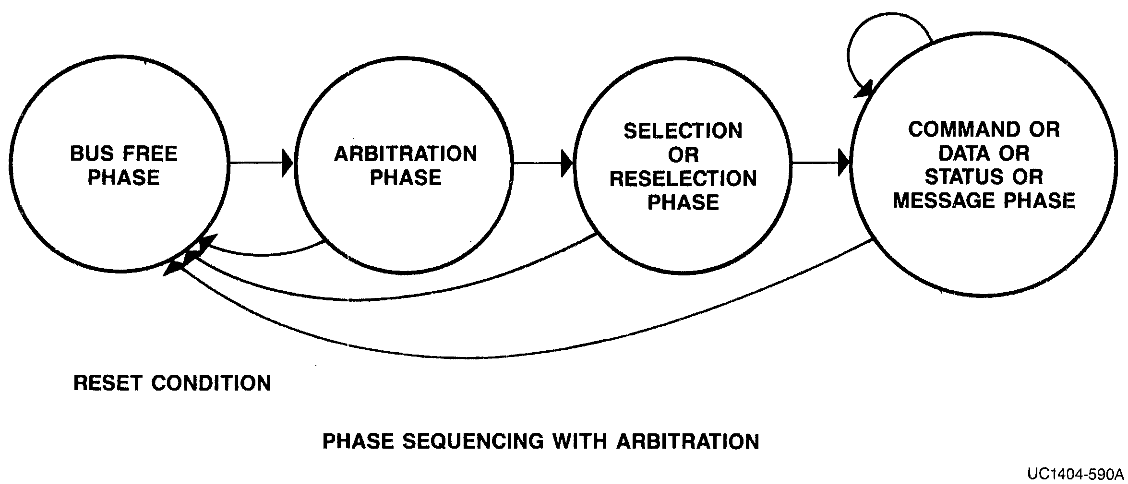


Figure 9-2. SCSI Bus Phase Sequences

9.5 SCSI Bus Conditions

The SCSI bus has the following asynchronous conditions:

- Reset Condition
- Attention Condition

These conditions cause certain SCSI device actions and can alter the phase sequence. The two conditions are discussed in the subsections below.

9.5.1 Reset

The Reset Condition is used to immediately clear all bus masters from the SCSI bus. This condition takes precedence over all other SCSI bus phases and conditions. During the Reset Condition, no bus signal except RST is guaranteed to be valid.

The UC14/MO supports a "hard" reset option. When the target detects a Reset Condition, it should perform the following actions:

- Clear all uncompleted commands

- Release device reservations
- Return device operating modes (such as the **MODE SELECT** command) to their default conditions

The UC14/MO will re-submit outstanding commands to the target after the reset condition clears.

9.5.2 Attention

The Attention Condition allows an Initiator to inform a Target that the Initiator has a message ready. The Target can obtain this message in the Message Phase.

9.6 SCSI Commands

An Initiator (such as the UC14/MO) issues SCSI commands to a Target device by transferring a command packet, called a Command Descriptor Block (CDB). The command contained in the CDB determines the length of the CDB. The first byte of a CDB contains the command. This byte, called the Operation Code, has two components: the Group Code and the Command Code.

The UC14/MO issues Group Code 0, Group Code 1, and Group Code 7 SCSI commands to the target controller. Group Code 0 CDBs contain six bytes and Group Code 1 CDBs contain ten bytes. Group Code 7 CDBs, which are vendor unique and are 10 bytes long. The Command Code defines the type of SCSI command. SCSI command types are defined as specific CDB bit patterns in the ANSI SCSI specification; CDBs issued by the UC14/MO follow the guidelines listed in the ANSI SCSI specification.

NOTE

The commands listed apply to Emulex controllers (Medalist and Champion). Other controllers may handle some of the commands slightly differently. See the manufacturer's manuals for details.

The structure of each SCSI command packet that can be issued by the UC14/MO is shown in the applicable descriptions in subsection 9.7 (Group Code 0 CDBs), 9.8 (Group Code 1 CDBs), and 9.9 (Group Code 7 CDBs). The following table lists, by subsection number, command names and operation codes for SCSI commands issued by the UC14/MO:

Subsection	UC14/MO SCSI Command	Code
9.7.1	**FORMAT UNIT**	04
9.7.2	**INQUIRY**	12
9.7.3	**MODE SELECT**	15
9.7.4	**READ**	08
9.7.5	**RE-ASSIGN BLOCK**	07
9.7.6	**REQUEST SENSE**	03
9.7.7	**TEST UNIT READY**	00
9.7.8	**WRITE**	0A
9.8.1	**READ (EXTENDED)**	28
9.8.2	**VERIFY**	2F
9.8.3	**WRITE (EXTENDED)**	2A
9.8.4	**WRITE AND VERIFY**	2E
9.9.1	**READ LONG**	E8
9.9.2	**WRITE LONG**	EA

9.7 SCSI Group Code 0 Command Descriptions

This subsection provides detailed descriptions of SCSI Group Code 0 commands, including CDB formats, hexadecimal operation code, byte and bit functions, and any necessary effects produced by the commands. Each SCSI command is described in a separate subsection.

A sample Group 0 CDB is shown in Figure 9-3. The first byte of a command (Byte 00) contains two fields: the Group Code in the high-order three bits (bits <07:05>), and the Command Code in the low-order five bits (bits <04:00>). The Group Code determines the length of the command packet in the CDB, and together the Group and Operation Codes determine the operation to be performed.

Bits <07:05> of byte 01 in the CDB contain the LUN of the device being addressed. The UC14/MO, acting as a SCSI bus Initiator, supports up to nine LUNs: eight disk drives and one tape drive. The LUN must be specified for all commands. The definition of the low-order bits in byte 01 is based on the current command.

The UC14/MO uses bits 06 and 07 of the last byte (vendor unique) to control retrys and error correction attempts in the target. Bits 00 and 01 of the last byte are normally used to link commands. However, the UC14/MO never links commands, so these bits are always zero.

Byte	Bit 07	06	05	04	03	02	01	00
00	Group Code			Command Code				
01	LUN			Command-Dependent Parameters				
02	Command-Dependent Parameters							
03	Command-Dependent Parameters							
04	Command-Dependent Parameters							
05	0	0	0	0	0	0	0	0

Figure 9-3. Sample Group 0 Command Descriptor Block

9.7.1 Format Unit (04)

The **FORMAT UNIT** CDB, shown below, is used to write header and data blocks on the entire disk. This command normally writes all header fields and initializes data fields. This command is described as it relates to Medalist and Champion controllers. Other controller types are similar, but consult the manufacturer's manuals for differences.

Byte	Bit 07	06	05	04	03	02	01	00
00	0	0	0	0	0	1	0	0
01		LUN		FMD	CPL		Defect List Format	
02	0	0	0	0	0	0	0	0
03	0	0	0	0	0	0	0	0
04				Interleave Code (LSB)				
05	0	0	0	0	0	0	0	0

The command in this CDB may disconnect from the Initiator.

Logical Unit Number (LUN) - Byte 01, Bits <07:05>

These bits specify the LUN of the addressed device for this command.

Format Data (FMD) - Byte 01, Bit 04

When the FMD bit status is set to one, **FORMAT UNIT** data is supplied during the Data Out Phase of the command. No defect list will be supplied with this data. See Table 9-3 for an explanation of how this bit affects the format mode.

Complete List (CPL) - Byte 01, Bit 03

This bit is always set to one, and indicates that any previous Defect Map or defect data is erased. The Target must create a Defect List as it formats the media.

Defect List Format - Byte 01, Bits <02:00>

These bits specify additional information related to the format of the Defect List. Together with the FMD and CPL bits, these bits specify the mode of a Format operation. The Format modes are listed in Table 9-3. Only the block address mode is supported.

Table 9-3. UC14/MO Controller Format Modes

Bits 04	03	02	01	00	Mode
0	0	0	0	0	Not used.
0	1	0	0	0	**Format Mode.** The target controller performs a complete format of the specified disk and destroys the old Bad Sector File. A new Bad Sector File may be supplied by the user. This mode may be used during the format operation on an uninitialized disk drive.
1	0	0	0	0	Not used.
1	1	0	0	0	**Format Mode with Update.** In this mode, the target uses the Bad Sector File already on the disk and adds to it. This mode may also be used to format an uninitialized disk drive.

Interleave Code - Bytes 03 through 04

The code in the Interleave field requests that the logical blocks be related in a specific fashion to the physical blocks to compensate for differences in execution time between the host processor and the target Controller, if necessary. Emulex recommends that a 1:1 sequential interleave be used for Winchester drives and a 2:1 interleave for Iomega drives.

The most significant byte of the Interleave field (Byte 03) must be zero. An Interleave value of zero (hexadecimal) requests that the Target use its default interleave.

If a value greater than 1 is specified in the Interleave field, that number indicates where the next logical block in sequence is located with respect to the logical block just before it. For example, if an interleave code of 3 is specified and n is a logical block, then n+1 is the third contiguous block from n.

9.7.2 Inquiry (12)

The **INQUIRY** CDB, shown below, is a means by which the Initiator may request information regarding the controller and its attached peripheral device.

When this command is sent to a nonexistent LUN, the controller transfers the **INQUIRY** data back to the initiator and terminates the command with a GOOD status. The Initiator examines the Device Type Qualifier field to determine if it is a valid LUN.

				Bit				
Byte	07	06	05	04	03	02	01	00
00	0	0	0	1	0	0	1	0
01	Logical Unit Number			Reserved				
02	Reserved							
03	Reserved							
04	Allocation Length							
05	Vendor Unique		Reserved				Flag	Link

Allocation Length - Byte 04, Bits <07:00>

These bits specify the number of bytes allocated by the Initiator for returned **INQUIRY** data. A value of 0 means that no data will be transferred to the Initiator and is not considered an error. Any other value indicates the maximum number of bytes to be transferred.

9.7.3 Mode Select (15)

The **MODE SELECT** CDB, shown below, enables an Initiator to specify device parameters to the target controller. This command is used only during drive formatting operations.

Byte	Bit 07	06	05	04	03	02	01	00
00	0	0	0	1	0	1	0	1
01	LUN			0	0	0	0	0
02	0	0	0	0	0	0	0	0
03	0	0	0	0	0	0	0	0
04	Parameter List Length							
05	0	0	0	0	0	0	0	0

The target controller must not disconnect from the Initiator while executing this command.

Logical Unit Number (LUN) - Byte 01, Bits <07:05>

These bits specify the LUN of the addressed device for this command.

Parameter List Length - Byte 04

This byte specifies the length in bytes of the Parameter List sent during the Data Out Phase of this command. For Medalist and Champion controllers, this value will be 15 hex. For other controllers, consult the manufacturer's manual.

9.7.3.1 Mode Select Parameter List

The Mode Select Parameter List, shown following, is sent during the Data Phase of the **MODE SELECT** command to specify parameters for ST-506-compatible disk drives. The parameter list is shown for Medalist and Champion controllers. Other controllers are similar, but consult the manufacturer's manual for differences.

Byte	Bit 07	06	05	04	03	02	01	00
00	0	0	0	0	0	0	0	0
01	0	0	0	0	0	0	0	0
02	0	0	0	0	0	0	0	0
03	Block Descriptor Length							
04	0	0	0	0	0	0	0	0
05	0	0	0	0	0	0	0	0
06	0	0	0	0	0	0	0	0
07	0	0	0	0	0	0	0	0
08	0	0	0	0	0	0	0	0
09	0	0	0	0	0	0	0	0
0A	0	0	0	0	0	0	0	0
0B	0	0	0	0	0	0	0	0
0C	Number of Alternate Cylinders							
0D	Number of Heads				SSZ	SST		BFS
0E	Logical Number of Sectors/Track							
0F	Logical Number of Cylinders (MSB)							
10	Logical Number of Cylinders (LSB)							
11	Write Precompensation Cylinder Number (MSB)							
12	Write Precompensation Cylinder Number (LSB)							
13	Reduced Write Current Cylinder Number (MSB)							
14	Reduced Write Current Cylinder Number (LSB)							

Block Descriptor Length - Byte 03

This byte specifies the length of the Block Descriptor in decimal bytes, starting at Byte 04. Valid lengths are 0 and 17 (decimal).

Density Code - Byte 04

This byte defines the density of the media on the addressed LUN. The Density Code has a value of zero to indicate the LUN is a hard disk drive.

Number of Alternate Cylinders - Byte 0C

This byte specifies the number of cylinders to be used for alternate addressing. Bad tracks are mapped on the alternate cylinders.

Number of Heads - Byte 0D, Bits <07:04>

These bits specify the number of heads on the disk drive.

Sector Size (SSZ) - Byte 0D, Bit 03

This bit indicates the sector size. If the SSZ bit is set to one, the sector size is 256 bytes. If the SSZ bit is reset to zero, the sector size is 512 bytes. The UC14/MO uses 512-byte sectors.

Spare Sectors/Track (SST) - Byte 0D, Bits <02:01>

These bits indicate the number of spare sectors/track. The bit patterns are listed and described in Table 9-4.

Table 9-4. Spare Sectors/Track Bits

Bits 01	Bits 02	Number of Spare Sectors/Track
0	0	0
0	1	1
1	0	2
1	1	3

Buffered Step (BFS) - Byte 0D, Bit 00

This bit indicates if the disk drive Step operation (involving the time intervals in which the Step signal pulses occur) is or is not to be buffered. If the BFS bit is set to one, the Step operation is buffered. If the BFS bit is reset to zero, the Step operation is non-buffered.

Logical Number of Sectors/Track - Byte OE

This byte specifies the logical number of sectors per track which can be accessed by the user. The value of this field plus the value of the spare sectors per track field equals the total number of physical sectors per track.

Logical Number of Cylinders - Bytes 0F through 10

The value in this field minus 2 (for Medalist) or minus 3 (for Champion) specifies the logical number of cylinders in the user's address space. The subtracted cylinders are dedicated to the Bad Sector File and to diagnostic data. The value in this field plus the value of the Number of Alternate Cylinders field equals the total number of physical cylinders.

Write Precompensation Cylinder Number - Bytes 11 through 12

For Medalist controllers, these bytes specify the number of the first cylinder at which the disk drive begins writing data using a time-precompensated format.

For Champion controllers, byte 11 specifies the number of sectors by which sector 0 is offset from sector 0 of the previous track. Byte 12 is not used.

Reduced Write Current Cylinder Number - Bytes 13 through 14

For Medalist controllers, these bytes specify the number of the cylinder at which the disk drive supplies a different amount of current to the head during a write operation. These bytes are not used by Champion controllers.

9.7.4 Read (08)

The **READ** CDB, shown below, causes the transfer of data from the Target device to the Initiator. The **READ** command specifies the starting block number and the number of data blocks to be read. The **READ** command terminates when the number of data blocks to be read is transferred.

Byte	Bit 07	06	05	04	03	02	01	00
00	0	0	0	0	1	0	0	0
01	LUN			Logical Block Address (MSB)				
02	Logical Block Address							
03	Logical Block Address (LSB)							
04	Number of Blocks to Transfer (LSB)							
05	ECC	ERTY	0	0	0	0	0	0

If the disconnect function is enabled, the target controller can disconnect from the Initiator while executing this command.

Logical Unit Number (LUN) - Byte 01, Bits <07:05>

These bits specify the LUN of the addressed device for this command.

Logical Block Address - Bytes 01 through 03

These bytes specify the logical block address where the read operation is to begin.

Number of Blocks to Transfer - Byte 04

This byte specifies the number of contiguous logical blocks of data to be transferred. When this byte is zero, 256 logical blocks of data are transferred. Any other value between 1 and 256, inclusive, indicates that number of logical blocks is to be transferred.

Error Correction Code (ECC) - Byte 05, Bit 07

This bit indicates if ECC Checking operations are or are not disabled. If the ECC bit is set to one, ECC Checking operations are disabled. If the ECC bit is reset to zero, ECC Checking operations are enabled.

Error Retry (ERTY) - Byte 05, Bit 06

This bit indicates whether Error Retry operations are or are not disabled. If the ERTY bit is set to one, Error Retry operations are disabled. If the ERTY bit is reset to zero, Error Retry operations are enabled.

9.7.5 Re-Assign Block (07)

The **RE-ASSIGN BLOCK** CDB, shown below, sends a defect block to the Target during the Data Phase of the command. The defect block is a single logical block addresses that is to be re-assigned.

Byte	Bit 07	06	05	04	03	02	01	00
00	0	0	0	0	0	1		1
01		LUN		0	0	0	0	0
02	0	0	0	0	0	0	0	0
03	0	0	0	0	0	0	0	0
04	0	0	0	0	0	0	0	0
05	0	0	0	0	0	0	0	0

Logical Unit Number (LUN) - Byte 01, Bits <07:05>

These bits specify the LUN of the addressed device for this command.

9.7.5.1 Re-assign Block Header

During the Data Out Phase of the **RE-ASSIGN BLOCK** command, data is sent in two pieces. The first piece is the Block Header, shown below, which defines the length of the defect list. Since the UC14/MO re-assigns only a single block at a time, this length is always four bytes.

Byte	Bit 07	06	05	04	03	02	01	00
00	0	0	0	0	0	0	0	0
01	0	0	0	0	0	0	0	0
02	Length of Defect List (MSB)							
03	Length of Defect List (LSB)						0	0

<u>**Length of Defect List - Bytes 02 through 03**</u>

The value in the Length of Defect List field specifies the total number of bytes (not the total number of defect descriptors) sent during the Data Out Phase of the **RE-ASSIGN BLOCK** command. It is always four.

9.7.5.2 Re-assign Block Defect Descriptor Format

The **RE-ASSIGN BLOCK** defect descriptor is shown below.

Byte	Bit 07	06	05	04	03	02	01	00
00	Defect Block Address (MSB)							
01	Defect Block Address							
02	Defect Block Address							
03	Defect Block Address (LSB)							

The Defect Block Address bytes are converted to the appropriate track and block addresses by the target controller. Block addresses that specify previously detected or specified addresses are processed and produce duplicate entries in the Bad Sector File if the re-assignment results in the use of another spare block.

If the LUN has insufficient capacity to re-assign the defective logical block, the target controller terminates the **RE-ASSIGN BLOCK** command with a CHECK CONDITION status code and sets the Sense Key in the Extended Sense Byte to MEDIUM ERROR. The Logical Block Address is returned in the Information Bytes of the sense data.

Defect List Block Address - Bytes 00 through 03

These bytes specify the address of the block that contains the defect.

9.7.6 Request Sense (03)

The **REQUEST SENSE** CDB, shown below, is used to obtain more detailed information after execution of a command. Typically, a **REQUEST SENSE** command is issued after a previous command has completed and a CHECK CONDITION status code has been issued to the Initiator.

An Initiator normally issues a **REQUEST SENSE** command as soon as it receives a CHECK CONDITION status code to obtain the Sense data saved by the target controller.

Byte	Bit 07	06	05	04	03	02	01	00
00	0	0	0	0	0	0	1	1
01	LUN			0	0	0	0	0
02	0	0	0	0	0	0	0	0
03	0	0	0	0	0	0	0	0
04	Number of Requested Sense Bytes							
05	0	0	0	0	0	0	0	0

The target controller must not disconnect from the Initiator while executing this command.

Logical Unit Number (LUN) - Byte 01, Bits <07:05>

These bits specify the LUN of the addressed device for this command.

Number of Requested Sense Bytes - Byte 04

This byte contains the number of bytes of data the Initiator has allocated for the sense information. The UC14/MO always allocates 128 bytes for the sense data, although it normally looks only at the first seven bytes. The target controller does not have to return this many bytes. Although the UC14/MO asks for ten bytes, it will accept any number between four and ten.

9.7.6.1 Extended Sense Byte Format

The Extended Sense Byte format is shown below. Note that the format is only seven bytes long, although the controller can actually return up to 128 bytes. If it does, the last 121 bytes will be ignored.

Byte	Bit 07	06	05	04	03	02	01	00
00	VADD	1	1	1	Vendor Unique Code			
01	0	0	0	0	0	0	0	0
02	0	0	0	0	Sense Key			
03	Logical Block Address (MSB)							
04	Logical Block Address							
05	Logical Block Address							
06	Logical Block Address (LSB)							

Valid Address (VADD) - Byte 00, Bit 07

If this bit is set, the Logical Block Address (Bytes 03 through 06) contains valid information related to the error code.

Sense Key - Byte 02, Bits <03:00>

The Sense Key bits indicate status information about any errors detected during the operation. The errors are listed and defined in Table 9-5.

Table 9-5. Extended Sense Byte Sense Keys

Hex Code	Error	Description
00	NO SENSE	There is no Sense Key information to be reported for the designated LUN. This code occurs for a successfully completed command.
01	RECOVERED ERROR	The last command was completed successfully, but with some recovery action performed by the Target.
02	NOT READY	The addressed LUN cannot be accessed. Operator intervention may be required.
03	MEDIUM ERROR	The command terminated with a nonrecoverable-error condition which was probably caused by a flaw in the media or by an error in the recorded data.
04	HARDWARE ERROR	A nonrecoverable hardware error (e.g., controller failure, device failure, parity error, etc.) was detected while the Target was performing the command or while the Target was performing a Self-Test operation.
05	ILLEGAL REQUEST	There was an illegal parameter in the command or in the addi- tional required parameters supplied as data for some related commands.
06	UNIT ATTENTION	The addressed LUN has been reset. This error is reported the first time any command is issued after the condition is detected; then the requested command is not performed. This condition is cleared when the next command is issued by the same host adapter. UNIT ATTENTION is reported to all SCSI devices that subsequently issue a command to the LUN.
07	DATA PROTECT	A write operation was attempted on a write-protected device.
08	BLANK CHECK	A blank sector was encountered during read operation or a previously written sector was encountered during a write operation.
08-FF	DRIVE ERROR	These codes are interpreted by the UC14/MO as nonrecoverable and nonretryable drive errors.

Logical Block Address - Bytes 03 through 06

These bytes specify the Logical Block Address where the error specified by the Sense Key Error Code occurred.

9.7.7 Test Unit Ready (00)

The **TEST UNIT READY** CDB, shown below, causes a test to be performed to ensure the disk drive is powered-on and ready. This condition is indicated by a GOOD status code being returned in response to this command. If the disk drive is not ready, a **REQUEST SENSE** command can be issued to obtain detailed information about the reason the disk drive is not ready (unavailable).

Byte	Bit 07	06	05	04	03	02	01	00
00	0	0	0	0	0	0	0	0
01		LUN		0	0	0	0	0
02	0	0	0	0	0	0	0	0
03	0	0	0	0	0	0	0	0
04	0	0	0	0	0	0	0	0
05	0	0	0	0	0	0	0	0

The target controller must not disconnect during execution of this command.

Logical Unit Number (LUN) - Byte 01, Bits <07:05>

These bits specify the LUN of the addressed device for this command.

9.7.8 Write (0A)

The **WRITE** CDB, shown below, causes data to be transferred from the Initiator to the Target device. The amount of data written is a multiple of the block length. The **WRITE** command specifies the starting logical block number and the number of blocks to be written.

Byte	Bit 07	06	05	04	03	02	01	00
00	0	0	0	0	1	0	1	0
01	LUN			Logical Block Address (MSB)				
02	Logical Block Address							
03	Logical Block Address (LSB)							
04	Number of Blocks in Transfer							
05	0	ERTY	0	0	0	0	0	0

If the disconnect function is enabled, the target controller may disconnect from the Initiator while executing this command.

Logical Unit Number (LUN) - Byte 01, Bits <07:05>

These bits specify the LUN of the addressed device for this command.

Logical Block Address - Bytes 01 through 03

These bytes specify the logical block where the write operation is to begin.

Number of Blocks to Transfer - Byte 04

This byte specifies the number of contiguous logical blocks of data to be transferred. When this byte contains all zeros, 256 logical blocks of data are transferred. Any other Number of Blocks to Transfer value indicates that number of blocks are to be transferred.

Error Retry (ERTY) - Byte 05, Bit 06

This bit indicates whether Error Retry operations are or are not disabled. If the ERTY bit is set to one, Error Retry operations are disabled. If the ERTY bit is reset to zero, Error Retry operations are enabled.

9.8 SCSI Group Code 1 Command Descriptions

SCSI Group Code 1 command names and operation codes supported by the UC14/MO are listed by subsection number in the following table:

Subsection	UC14/MO SCSI Command	Code
9.8.1	**READ (EXTENDED)**	28
9.8.2	**VERIFY**	2F
9.8.3	**WRITE (EXTENDED)**	2A
9.8.4	**WRITE AND VERIFY**	2E

This subsection provides detailed descriptions of the commands, including CDB formats, hexadecimal operation code, byte and bit functions, and any necessary effects produced by the commands. Each UC14/MO SCSI command is described in a separate subsection.

A sample Group 1 CDB is shown in Figure 9-4. The first byte of a command (Byte 00) contains two fields: the Group Code in the high-order three bits (bits <07:05>), and the Command Code in the low-order five bits (bits <04:00>). The Group Code determines the length of the command packet in the CDB, and together the Group and Command Codes determine the operation to be performed. Bits <07:05> of byte 01 in the CDB contain the LUN of the device being addressed.

The last byte (byte 09) in every CDB is a Control Byte which is differentiated into two groups:

- The low-order two bits control the ability to link commands in a sequence and to notify the host adapter that a particular command (CDB) step has been completed. These two bits are designated Flag and Link and are always set to 0 by the UC14/MO.

- The remaining bits in the Control Byte indicate whether the Error Retry and ECC Checking operations are or are not disabled.

The remaining bytes in the CDB contain Command-Dependent Parameters.

NOTE

If a byte in a CDB can be any bit pattern, it is specified as **Not Used** in the paragraphs describing that CDB. If a byte in a CDB must be all zeros, it is specified as **Reserved** in the paragraphs describing that CDB.

Byte	Bit 07	06	05	04	03	02	01	00
00	Group Code			Command Code				
01	LUN			Command-Dependent Parameters				
02	Command-Dependent Parameters							
03	Command-Dependent Parameters							
04	Command-Dependent Parameters							
05	Command-Dependent Parameters							
06	Command-Dependent Parameters							
07	Command-Dependent Parameters							
08	Command-Dependent Parameters							
09	ECC	ERTY	0	0	0	0	Flag	Link

Figure 9-4. Sample Group 1 Command Descriptor Block

9.8.1 Read (Extended) (28)

The **READ (EXTENDED)** CDB, shown below, performs the same function as the Group 0 **READ** command: it causes the transfer of data from the Target device to the Initiator. The amount of transferred data is a multiple of the block length (i.e., 512 data bytes/block). The **READ (EXTENDED)** command specifies the starting block number and the number of data blocks to be read. The **READ (EXTENDED)** command terminates when the number of data blocks to be read has been transferred.

Byte	Bit 07	06	05	04	03	02	01	00
00	0	0	1	0	1	0	0	0
01	LUN			0	0	0	0	0
02	Logical Block Address (MSB)							
03	Logical Block Address							
04	Logical Block Address							
05	Logical Block Address (LSB)							
06	0	0	0	0	0	0	0	0
07	Number of Blocks (MSB)							
08	Number of Blocks (LSB)							
09	ECC	ERTY	0	0	0	0	Flag	Link

If the disconnect function is enabled, the UC14/MO can disconnect from the Initiator while executing this command.

If any reservation access conflict exists, the UC14/MO terminates the **READ (EXTENDED)** command with a RESERVATION CONFLICT status code; no data is read.

If an error occur curing a read operation, the UC14/MO terminates the **READ (EXTENDED)** command, sends a CHECK CONDITION status code to the Initiator, and sets the Sense Key that defines the error condition in the Extended Sense Byte.

Logical Unit Number (LUN) - Byte 01, Bits <07:05>

These bits specify the LUN of the addressed device for this command.

Logical Block Address - Bytes 02 through 05

These bytes specify the logical block address where the Extended read operation is to begin.

Reserved - Byte 06

This byte is reserved and must be zero.

Number of Blocks - Bytes 07 through 08

This byte specifies the number of contiguous logical blocks of data to be transferred. When this byte contains all zeros, no logical blocks of data are transferred. Any other value between 1 and 256, inclusive, indicates that number of logical blocks are to be transferred.

Error Correction Code (ECC) - Byte 09, Bit 07

This bit indicates if ECC Checking operations are or are not disabled. If the ECC bit is set to one, ECC Checking operations are disabled. If the ECC bit is reset to zero, ECC Checking operations are enabled.

Error Retry (ERTY) - Byte 09, Bit 06

This bit indicates if Error Retry operations are or are not disabled. If the ERTY bit is set to one, Error Retry operations are disabled. If the ERTY bit is reset to zero, Error Retry operations are enabled.

Flag - Byte 09, Bit 01 (Not Used)

The Flag bit is meaningful only when the Link bit (bit 00 in Byte 05) is set. Therefore, if both the Flag and Link bits are set, an interrupt is requested for this command in a group of linked commands.

Link - Byte 09, Bit 00 (Not Used)

The use of the Link bit is optional. If the Link bit is set, an automatic link is made to the next command at the successful completion of the current command from the Initiator. Status is returned for each command executed.

9.8.2 Verify (2F)

The **VERIFY** CDB, shown below, causes the specified number of blocks to be verified.

Byte	Bit 07	06	05	04	03	02	01	00
00	0	0	1	0	1	1	1	1
01	LUN			0	0	0	0	0
02	Logical Block Address (MSB)							
03	Logical Block Address							
04	Logical Block Address							
05	Logical Block Address (LSB)							
06	0	0	0	0	0	0	0	0
07	Number of Blocks (MSB)							
08	Number of Blocks (LSB)							
09	ECC	ERTY	AV	0	0	0	Flag	Link

If the disconnect function is enabled, the UC14/MO can disconnect from the Initiator while executing this command.

Logical Unit Number (LUN) - Byte 01, Bits <07:05>

These bits specify the LUN of the addressed device for this command.

Byte Check (BYTC) - Byte 01, Bit 01

Setting this bit to one causes the specified logical blocks to be read and compared with the data in the data buffer. Data is transferred from the Initiator just as in a write operation. If the BYTC bit is reset to zero, the data is just read and the ECC is checked for correctness; no Data Transfer operation occurs between the Initiator and the Target. It is always set to zero.

Logical Block Address - Bytes 02 through 05

These bytes specify the logical block where the Verify operation is to begin.

Reserved - Byte 06

This byte is reserved and must be zero.

Number of Blocks - Bytes 07 through 08

This byte specifies the number of contiguous logical blocks of data to be verified. When the Number of Blocks to Transfer is zero, no logical blocks of data are verified. Any other value between 1 and 256, inclusive, indicates that number of logical blocks are to be verified.

Error Retry (ERTY) - Byte 09, Bit 06

This bit indicates if Error Retry operations are or are not disabled. If the ERTY bit is set to one, Error Retry operations are disabled. If the ERTY bit is reset to zero, Error Retry operations are enabled.

Error Correction Code (ECC) - Byte 09, Bit 07

This bit indicates if ECC Checking operations are or are not disabled. If the ECC bit is set to one, ECC Checking operations are disabled. If the ECC bit is reset to zero, ECC Checking operations are enabled.

Alternate Vectoring (AV) - Byte 09, Bit 05

This bit indicates if Alternate Vectoring operations are or are not enabled. When Alternate Vectoring operations are enabled, when the UC14/MO performs a Seek operation to a command-specified sector that is on a defective track, it causes the disk drive to perform a Seek operation to the alternate track that contains the valid sector.

If the AV bit is set to one, Alternate Vectoring operations are disabled. If the AV bit is reset to zero, Alternate Vectoring operations are enabled. It is always set to zero.

Flag - Byte 09, Bit 01

The Flag bit is meaningful only when the Link bit (bit 00 in Byte 09) is set. Therefore, if both the Flag and Link bits are set, an interrupt is requested for this command in a group of linked commands.

Link - Byte 09, Bit 00

The use of the Link bit is optional. If the Link bit is set, an automatic link is made to the next command at the successful completion of the current command from the Initiator. Status is returned for each command executed.

9.8.3 Write (Extended) (2A)

The **WRITE (EXTENDED)** CDB, shown below, performs the same function as the Group 0 **WRITE** command; it causes data to be transferred from the Initiator to the Target device. The amount of data written is a multiple of the block length. The **WRITE (EXTENDED)** command specifies the starting logical block number and the number of blocks to be written.

Byte	Bit 07	06	05	04	03	02	01	00
00	0	0	1	0	1	0	1	0
01	LUN			0	0	0	0	0
02	Logical Block Address (MSB)							
03	Logical Block Address							
04	Logical Block Address							
05	Logical Block Address (LSB)							
06	0	0	0	0	0	0	0	0
07	Number of Blocks (MSB)							
08	Number of Blocks (MSB)							
09	ECC	ERTY	AV	0	0	0	Flag	Link

If the disconnect function is enabled, the UC14/MO may disconnect from the Initiator while executing this command.

Logical Unit Number (LUN) - Byte 01, Bits <07:05>

These bits specify the LUN of the addressed device for this command.

Logical Block Address - Bytes 02 through 05

These bytes specify the logical block where the Extended write operation is to begin.

Reserved - Byte 06

This byte is reserved and must be zero.

Number of Blocks - Bytes 07 through 08

This byte specifies the number of contiguous logical blocks of data to be transferred. When the Number of Blocks to Transfer is zero, no logical blocks of data are transferred. Any other value between 1 and 256, inclusive, indicates that number of logical blocks are to be transferred.

Error Correction Code (ECC) - Byte 09, Bit 07

This bit indicates if ECC Checking operations are or are not disabled. If the ECC bit is set to one, ECC Checking operations are disabled. If the ECC bit is reset to zero, ECC Checking operations are enabled.

Error Retry (ERTY) - Byte 09, Bit 06

This bit indicates if Error Retry operations are or are not disabled. If the ERTY bit is set to one, Error Retry operations are disabled. If the ERTY bit is reset to zero, Error Retry operations are enabled.

Alternate Vectoring (AV) - Byte 09, Bit 05

This bit indicates if Alternate Vectoring operations are or are not enabled. When Alternate Vectoring operations are enabled, when the UC14/MO performs a Seek operation to a command-specified sector that is on a defective track, it causes the disk drive to perform a Seek operation to the alternate track that contains the valid sector.

If the AV bit is set to one, Alternate Vectoring operations are disabled. If the AV bit is reset to zero, Alternate Vectoring operations are enabled. It is always set to zero.

Flag - Byte 09, Bit 01

The Flag bit is meaningful only when the Link bit (bit 00 in Byte 05) is set. Therefore, if both the Flag and Link bits are set, an interrupt is requested for this command in a group of linked commands.

Link - Byte 09, Bit 00

The use of the Link bit is optional. If the Link bit is set, an automatic link is made to the next command at the successful completion of the current command from the Initiator. Status is returned for each command executed.

9.8.4 Write and Verify (2E)

The **WRITE AND VERIFY** CDB, shown below, causes data for the specified number of blocks to be written and then verified.

Byte	Bit 07	06	05	04	03	02	01	00
00	0	0	1	0	1	1	1	0
01	LUN			0	0	0	BYTC	0
02	Logical Block Address (MSB)							
03	Logical Block Address							
04	Logical Block Address							
05	Logical Block Address (LSB)							
06	0	0	0	0	0	0	0	0
07	Number of Blocks (MSB)							
08	Number of Blocks (LSB)							
09	ECC	ERTY	AV	0	0	0	Flag	Link

If the disconnect function is enabled, the UC14/MO may disconnect from the Initiator while executing this command.

Logical Unit Number (LUN) - Byte 01, Bits <07:05>

These bits specify the LUN of the addressed device for this command.

Byte Check (BYTC) - Byte 01, Bit 01

Setting this bit to one causes the specified logical blocks to be read and compared with the data sent from the Initiator the second time for the verify operation. Data is transferred from the Initiator just as in a write operation. If the BYTC bit is zero, the data is just read and the ECC is checked for correctness; no Data Transfer operation occurs between the Initiator and the Target.

Logical Block Address - Bytes 02 through 05

These bytes specify the logical block where the Write and Verify operation is to begin.

Reserved - Byte 06

This byte is reserved and must be zero.

Number of Blocks - Bytes 07 through 08

This byte specifies the number of contiguous logical blocks of data to be transferred. When the Number of Blocks to Transfer is zero, no logical blocks of data are transferred. Any other value between 1 and 256, inclusive, indicates that number of logical blocks are to be transferred.

Error Retry (ERTY) - Byte 09, Bit 06

This bit indicates if Error Retry operations are or are not disabled. If the ERTY bit is set to one, Error Retry operations are disabled. If the ERTY bit is reset to zero, Error Retry operations are enabled.

Alternate Vectoring (AV) - Byte 09, Bit 05

This bit indicates if Alternate Vectoring operations are or are not enabled. When Alternate Vectoring operations are enabled, when the UC14/MO performs a Seek operation to a command-specified sector that is on a defective track, it causes the disk drive to perform a Seek operation to the alternate track that contains the valid sector.

If the AV bit is set to one, Alternate Vectoring operations are disabled. If the AV bit is reset to zero, Alternate Vectoring operations are enabled. It is always set to zero.

Flag - Byte 09, Bit 01

The Flag bit is meaningful only when the Link bit (bit 00 in Byte 09) is set. Therefore, if both the Flag and Link bits are set, an interrupt is requested for this command in a group of linked commands.

Link - Byte 09, Bit 00

The use of the Link bit is optional. If the Link bit is set, an automatic link is made to the next command at the successful completion of the current command from the Initiator. Status is returned for each command executed.

9.9 SCSI Group Code 7 Command Descriptions

SCSI Group Code 7 commands are vendor-unique SCSI commands. Group code 7 command names and operation codes are issued by the UC14/MO.

This subsection provides detailed descriptions of the commands, including CDB formats, hexadecimal operation code, byte and bit functions, and any necessary event-sequence descriptions (i.e., effects produced by the commands). Each Emulex-unique SCSI command is described in a separate subsection.

A sample Group 7 CDB is shown in Figure 9-5. The first byte of a command (Byte 00) contains two fields: the Group Code in the high-order three bits (bits <07:05>), and the Command Code in the low-order five bits (bits <04:00>). The Group Code determines the length of the command packet in the CDB, and together the Group and Command Codes determine the operation to be performed.

Bits <07:05> of byte 01 in the CDB contain the LUN of the device being addressed. The UC14/MO, acting as a SCSI bus Initiator, supports up to eight LUNs: seven disk drives and one tape drive. The LUN must be specified for all commands. If a LUN value issued by the Initiator in an IDENTIFY message differs from the value specified in the CDB, that value supersedes the value specified in the CDB. The definition of the low-order bits in byte 01 is based on the current command.

The last byte is reserved and is always zero. The remaining bytes in the CDB are primarily command-dependent.

NOTE

Bits 00 and 01 of the last byte are normally used to link commands. However, the UC14/MO never links commands, so these bits are always zero.

Byte	Bit 07	06	05	04	03	02	01	00
00	Group Code			Command Code				
01	LUN			Command-Dependent Parameters				
02	Command-Dependent Parameters							
03	Command-Dependent Parameters							
04	Command-Dependent Parameters							
05	Command-Dependent Parameters							
06	Command-Dependent Parameters							
07	Command-Dependent Parameters							
08	Command-Dependent Parameters							
09	0	0	0	0	0	0	0	0

Figure 9-5. Sample Group 7 Command Descriptor Block

9.9.1 Read Long (E8)

The **READ LONG** command, shown below, causes the target controller to perform a read operation of one data block, beginning at the specified block address. The data and the six Error Correction Code (ECC) bytes of the specified block are transferred to the Initiator. The ECC bytes follow the data.

Byte	Bit 07	06	05	04	03	02	01	00
00	1	1	1	0	1	0	0	0
01	LUN			0	0	0	0	0
02	0	Block Address (MSB)						
03	Block Address							
04	Block Address							
05	Block Address (LSB)							
06	0	0	0	0	0	0	0	0
07	0	0	0	0	0	0	0	0
08	0	0	0	0	0	0	0	0
09	0	0	0	0	0	0	0	0

Block Address - Bytes 02 through 05

These bytes specify the block address where the read long operation is to begin.

9.9.2 Write Long (EA)

The **WRITE LONG** command, shown below, causes the target controller to perform a write operation of one data block, starting at the specified logical block address. The data and the six ECC bytes of the specified logical block are written for each logical block specified in the logical block address. The ECC bytes follow the data.

Byte	Bit 07	06	05	04	03	02	01	00
00	1	1	1	0	1	0	0	1
01	LUN			0	0	0	0	0
02	0	Block Address (MSB)						
03	Block Address							
04	Block Address							
05	Block Address (LSB)							
06	0	0	0	0	0	0	0	0
07	0	0	0	0	0	0	0	0
08	0	0	0	0	0	0	0	0
09	0	0	0	0	0	0	0	0

Block Address - Bytes 02 through 05

These bytes specify the block address where the write long operation is to begin.

Appendix A
AUTOCONFIGURE, CSR and VECTOR ADDRESSES

A.1 Overview

The following discussion presents the algorithm for assignment of floating addresses and vectors for all DEC operating systems. Bus addresses are discussed in subsection 3.3.2.

A.2 Determining the CSR Address for use with Autoconfigure

The term Autoconfigure refers to a software utility that is run when the computer is bootstrapped. This utility finds and identifies I/O devices in the I/O page of system memory.

Some devices (like the DM11) have fixed addresses reserved for them. Autoconfigure detects their presence by simply testing their standard address for a response. Specifically, the control/status register (CSR) address, which is usually the first register of the block, is tested.

Addresses for those devices not assigned fixed numbers are selected from the floating CSR address space (760010 - 763776) of the UNIBUS input/output (I/O) page. This means that the presence or absence of floating devices will affect the assignment of addresses to other floating-address devices. Similarly, many devices have floating interrupt vector addresses. According to the DEC standard, vectors must be assigned in a specific sequence and the presence of one type of device will affect the correct assignment of vectors for other devices.

The CSR address for a floating-address device is selected according to the algorithm used during autoconfigure. The algorithm is used in conjunction with a Device Table, Table A-1.

Essentially, Autoconfigure checks each valid CSR address in the floating CSR address space for the presence of a device. Autoconfigure expects any devices installed in that space to be in the order specified by the Device Table. Also, the utility expects an eight-byte block to be reserved for each device that is not installed in the system. Each empty block tells Autoconfigure to look at the next valid address for the next device on the list.

When a device is detected, a block of addresses is reserved for the device according to the number of registers it employs. The utility then looks at the next CSR for that device type. If there is a device there, it is assumed to be of the same type as the one before it and a block is reserved for that device. If there is no response at the next address, that space is reserved to indicate that there are no more devices of that type. Then the utility checks the CSR address (at the appropriate boundary) for the next device in the table.

Table A-1. SYSGEN Device Table

Rank	Device	Number of Registers	Octal Modulus	Rank	Device	Number of Registers	Octal Modulus
1	DJ11	4	10	17	Reserved	4	10
2	DH11	8	20	18	RX11[2]	4	10
3	DQ11	4	10	18	RX211[2]	4	10
4	DU11, DUV11	4	10	18	RXV11[2]	4	10
5	DUP11	4	10	18	RXV21[2]	4	10
6	LK11A	4	10	19	DR11-W	4	10
7	DMC11	4	10	20	DR11-B[3]	4	10
7	DMR11	4	10	21	DMP11	4	10
8	DZ11[1]	4	10	22	DPV11	4	10
8	DZV11	4	10	23	ISB11	4	10
8	DZS11	4	10	24	DMV11	8	20
8	DZ32	4	10	25	DEUNA[2]	4	10
9	KMC11	4	10	**26**	**UDA50[2]**	**2**	**4**
10	LPP11	4	10	27	DMF32	16	40
11	VMV21	4	10	28	KMS11	6	20
12	VMV31	8	20	29	VS100	8	20
13	DWR70	4	10	30	TU81	2	4
14	RL11[2]	4	10	31	KMV11	8	20
14	RLV11[2]	4	10	32	DHV11	8	20
15	LPA11-K[2]	8	20	33	DMZ32	16	40
16	KW11-C	4	10	34	CP132	16	40

[1]DZ11-E and DZ11-F are treated as two DZ11s.

[2]The first device of this type has a fixed address. Any extra devices have a floating address.

[3]The first two devices of this type have a fixed address. Any extra devices have a floating address.

In summary, there are four rules that pertain to the assignment of device addresses in floating address space:

1. Devices with floating addresses must be attached in the order in which they are listed in the Device Table, Table A-1.

2. The CSR address for a given device type is assigned on word boundaries according to the number of UNIBUS-accessible registers that the device has. The following table relates the number of device registers to possible word boundaries.

Device Registers	Possible Boundaries
1	Any Word
2	XXXXX0, XXXXX4
3,4	XXXXX0
5,6,7,8	XXXX00,XXXX20,XXXX40,XXXX60
9 thru 16	XXXX00,XXXX40

   The Autoconfigure utility inspects for a given device type only at one of the possible boundaries for that device. That is, the utility does not look for a DMF32 (16 registers) at an address that ends in 20.

3. An 8-byte gap must follow the register block of any installed device to indicate that there are no more of that type of device. This gap must start on the proper CSR address boundary for that type of device.

4. An 8-byte gap must be reserved in floating address space for each device type that is not installed in the current system. The gap must start on the proper word boundary for the type of device the gap represents. That is, a single DJ11 installed at 760010 would be followed by a gap starting at 760020 to show a change of device types. A gap to show that there are none of the next device on the list, a DH11, would begin at 760040, the next legal boundary for a DH11-type device.

A.3 Determining the Vector Address for use with Autoconfigure

There is a floating vector address convention that is used for communications and other devices which interface with the UNIBUS. These vector addresses are assigned in order starting at 300 and proceeding upwards to 777. Table A-2 shows the assignment sequence. For a given system configuration, the device with the highest floating vector rank would be assigned to vector address 300. Additional devices of the same type would be assigned subsequent vector addresses according to the number of vectors required per device, and according to the starting boundary assigned to that device type.

Table A-2. Priority Ranking for Floating Vector Addresses (starting at 300 and proceeding upwards)

Rank	Device	Number of Vectors	Octal Modulus
1	DC11	2	10
1	TU58	2	10
2	KL11[1]	2	10
2	DL11-A[1]	2	10
2	DL11-B[1]	2	10
2	DLV11-J[1]	8	40
2	DLV11,DLV11-F[1]	2	10
3	DP11	2	10
4	DM11-A	2	10
5	DN11	1	4
6	DM11-BB/BA	1	4
7	DH11 modem control	1	4
8	DR11-A, DRV11-B	2	10
9	DR11-C, DRV11	2	10
10	PA611 (reader+punch)	4	20
11	LPD11	2	10
12	DT07	2	10
13	DX11	2	10
14	DL11-C to DLV11-F	2	10
15	DJ11	2	10
16	DH11	2	10
17	VT40	4	20
17	VSV11	4	10
18	LPS11	6	40
19	DQ11	2	10
20	KW11-W, KWV11	2	10
21	DU11, DUV11	2	10
22	DUP11	2	10
23	DV11 + modem control	3	20
24	LK11-A	2	10
25	DWUN	2	10
26	DMC11	2	10
26	DMR11	2	10
27	DZ11/DZS11/DZV11	2	10
27	DZ32	2	10
28	KMC11	2	10
29	LPP11	2	10

(continued on next page)

Table A-2. Priority Ranking for Floating Vectors Addresses (starting at 300_8 and proceeding upwards) (continued)

Rank	Device	Number of Vectors	Octal Modulus
30	VMV21	2	10
31	VMV31	2	10
32	VTV01	2	10
33	DWR70	2	10
34	RL11/RLV11[2]	1	4
35	TS11[2], TU80[2]	1	4
36	LPA11-K	2	10
37	IP11/IP300[2]	1	4
38	KW11-C	2	10
39	RX11[2]	1	4
39	RX211[2]	1	4
39	RXV11[2]	1	4
39	RXV21[2]	1	4
40	DR11-W	1	4
41	DR11-B[2]	1	4
42	DMP11	2	10
43	DPV11	2	10
44	ML11[3]	1	4
45	ISB11	2	10
46	DMV11	2	10
47	DEUNA[2]	1	4
48	**UDA50[2]**	**1**	**4**
49	DMF32	8	40
50	KMS11	3	20
51	PCL11-B	2	10
52	VS100	1	4
53	Reserved	1	4
54	KMV11	2	10
55	Reserved	2	10
56	IEX	2	10
57	DHV11	2	10
58	DMZ32	6	20
59	CP132	6	20

[1] A KL11 or DL11 used as a console, has a fixed vector.

[2] The first device of this type has a fixed vector. Any extra devices have a floating vector.

[3] ML11 is a Massbus device which can connect to a UNIBUS via a bus adapter.

Vector addresses are assigned on the boundaries indicated in the modulus column of Table A-2. That is, if the modulus is 10, then the first vector address for that device must end with zero (XX0). If the modulus is 4, then the first vector address can end with zero or 4 (XX0, XX4).

Vector addresses always fall on modulo 4 boundaries (XX0, XX4). That is, a vector address never ends in any number but four or zero. Consequently, if a device has two vectors and the first must start on a modulo 10 boundary, then, using 350 as a starting point, the vectors will be 350 and 354.

A.4 A System Configuration Example

Table A-3 contains an example of a system configuration that includes devices with fixed addresses and vectors, and floating addresses and/or vectors.

Table A-4 shows how the device addresses for the floating address devices in Table A-3 were computed, including gaps.

Table A-3. CSR and Vector Address Example

Controller	Vector	CSR
1 UDA50	154	772150
1 DZ11	300	760100
1 UDA50	310	760354
2 DHV11	320, 330	760500, 760500

Table A-4. Floating CSR Address Assignment Example

Installed	Device		Octal Address
	DJ11	Gap	760010
	DH11	Gap	760020
	DQ11	Gap	760030
	DU11	Gap	760040
	DUP11	Gap	760050
	LK11A	Gap	760060
	DMC11	Gap	760070
---->	DZ11		760100
		Gap	760110
	KMC11	Gap	760120
	LPP11	Gap	760130
	VMV21	Gap	760140
	VMV31	Gap	760150
	DWR70	Gap	760170
	RL11	Gap	760200
	LPA11-K	Gap	760220
	KW11-C	Gap	760230
	Reserved	Gap	760240
	RX11	Gap	760250
	DR11-W	Gap	760260
	DR11-B	Gap	760270
	DMP11	Gap	760300
	DPV11	Gap	760310
	ISB11	Gap	760320
	DMV11	Gap	760340
	DEUNA	Gap	760350
---->	**UDA50 (UC14/MO)**		**772150**[1]
---->	**UDA50 (UC14/MO)**		**760354**
		Gap	760360
	DMF32	Gap	760400
	KMS11	Gap	760420
	VS100	Gap	761440
	TU81	Gap	761450
	KMV11	Gap	761460
---->	DHV11		761500
---->	DHV11		761520
		Gap	761530
	DMZ32	Gap	761540
	CP132	Gap	761600

[1]Fixed address

B.1 Overview

This appendix provides instructions for replacing the UC14/MO's firmware PROM.

B.2 Exchanging PROMS

The UC14/MO firmware PROM is located in the socket at U38. Remove the existing PROM from its socket using an IC puller or an equivalent tool.

The UC14/MO PROM is identified by the part numbers on top of the PROMs. Place the UC14/MO PROM in U38. 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
A26	U38

NOTE

Firmware Revision Level B and above requires that jumpers D-E be set IN. See Table 4-2 for UC14/MO Jumper Definitions and Factory Configuration.

Appendix C
SUBSYSTEM CONFIGURATION SELECTION

C.1 Overview

The configuration of the subsystem (i.e., what model of disk drives you are using and how many of each) must be defined either by the NOVRAM or by setting the subsystem configuration switches on the UC14/MO PCBA. The NOVRAM was discussed in Section 4. However, if you wish to select the subsystem configuration with switches instead, this appendix explains how to do it. ESDI drives must be set up via NOVRAM; see Appendix D.

C.2 Selecting the Subsystem Configuration

The characteristics of the disk or tape drives attached to the UC14/MO are specified using switch SW3-1 and switches SW3-6 through SW3-10. Switch SW3-3 is used to select the controller type. Use the following procedure to determine the proper configuration for your subsystem.

1. Find the type of disk drive you wish to use in Table C-1. The UC14/MO supports eight physical or logical drives. Note the configuration numbers associated with the selected drive type.

   Table C-2 lists the SCSI controller device types. Both the Adaptec ACB-4000 and the Emulex Medalist disk controllers can support two drives per controller, but each drive must be the same device type.

2. If you want to include a tape drive in your subsystem, consult Table C-3 for the types of tape drives that are supported by the UC14/MO. Note the configuration numbers associated with the selected tape drive. The UC14/MO supports only the Emulex Titleist family of SCSI tape drive controllers.

3. If you have selected both disk and tape devices, compare the configuration numbers that you have noted for each device type, selecting only those that appear on both lists.

4. If you want to map two logical drives onto one physical drive in any single disk drive subsystem, you must select one of the following configurations: 9, 9A, 10, 10A, 11, 11A, 13, 13A, 14, 14A, 15, 15A, 35, 35A, 36, or 36A.

Table C-1. Disk Drive Type

Manufacturer	Model	Drive Key	Formatted Capacity in M bytes	Configuration
Atasi	3046	100	36.7	01, 01A, 05, 05A, 09, 09A, 13, 13A, 17, 17A, 21, 21A, 25, 25A, 29, 29A
Fujitsu	M2243AS	101	67.5	03, 03A, 07,07A, 11, 11A, 15, 15A, 19, 19A, 23, 23A, 27, 27A, 31, 31A
Maxtor	XT1140	102	110	02, 02A, 06,06A, 10, 10A, 14, 14A, 18, 18A, 22, 22A, 24, 24A, 26, 26A, 30, 30A
IOMEGA	Alpha-10.5	103	10.5	01, 01A, 02, 02A, 03, 03A, 16, 24, 24A, 33, 33A, 39
Rodime	208	105	41.8	20, 20A, 28, 28A, 33, 33A, 34, 34A, 35, 35A, 36, 36A, 37, 37A, 38, 38A
CDC	9415-5-36 (Wren I)	106	28.2	45, 45A, 46, 46A 47, 47A, 48, 48A
CDC	9415-5-86 (Wren II w/ 917 cylinders)	107	67	45, 45A, 46, 46A
CDC	9415-5-86 (Wren II w/ 925 cylinders)	108	67	47, 47A, 48, 48A
Optimem	1000	109	1000	40, 41, 42, 43
OSI	Laserdrive	110	1000	49

Table C-2. SCSI Controller Type

Manufacturer	Model	Units Supported
Emulex	Medalist MD01	100, 101, 102, 105 106, 107, 108 and Table D-1
Adaptec	4000	100, 101, 102, 105 106, 107, 108
IOMEGA	Alpha-10.5	103
Emulex	Titleist MT01, MT02	104
	MD21	Table D-2

Table C-3. Tape Drive Type

Manufacturer	Model	Drive Key	Formatted Capacity	Configuration
Cipher	540	104	Varies	05, 05A, 06, 06A, 07, 07A, 09, 09A, 10, 10A, 11, 11A, 13, 13A, 14, 14A, 15, 15A, 17, 17A, 18, 18A, 19, 19A, 20, 20A, 21, 21A, 22, 22A, 23, 23A, 25, 25A, 26, 26A, 27, 27A, 28, 28A, 29, 29A, 30, 30A, 31, 31A, 34, 34A, 35, 35A, 36, 36A, 37, 37A, 38, 38A

5. Look up the configurations that you have listed in step 4 in Table C-4. Table C-4 fully describes the subsystem that the UC14/MO supports when that configuration is selected. Select the configuration that best suits your application. Table C-4 has eight columns:

   Column 1 (Config Number) is used to make cross referencing between the configuration and device type tables easier.

   Column 2 (Drive Key) indicates the type of drive supported by this configuration. The drive key followed by /M indicates that the drive uses a Medalist disk controller; the drive key followed by /A indicates that the drive uses an Adaptec disk controller.

   Columns 3 (SCSI Address), 4 (Drive LUN), and 5 (MSCP Unit), relate to the number of drives supported by the UC14/MO. The SCSI address in column 3 must be programmed into the disk or tape controller. Each address corresponds to one controller, and each controller can support either one or two physical drives (LUNs--Logical Unit Numbers). In addition, the first LUN in a configuration may be partitioned into two logical drives (MSCP Units). Two examples will make this clear:

   EXAMPLE 1: Refer to configuration 21. This configuration supports two disk controllers at SCSI addresses 0 and 5. Both controllers support drive type 100 (Atasi 3046); the /M indicates that both controllers must be Emulex Medalists. The controller at SCSI Address 0 supports two physical drives (LUN 0 and 1), and the controller at SCSI Address 5 supports one physical drive (LUN 0). The MSCP unit numbering counts all storage devices, regardless of which SCSI Address they are at, so the two drives on the first controller are MSCP units 0 and 1 and the drive on the second controller is MSCP unit 2. The tape drive at SCSI Address 4 is type 104 (Cipher 540), which requires an Emulex Titleist controller. It is designated MSCP unit number 3. (The MSCP designation is for numbering purposes only; tape drives are actually reported as off-line devices to the operating system.)

   EXAMPLE 2: Refer to configuration 9. This configuration supports only one controller, at SCSI Address 0. It is drive type 100 (Atasi 3046); /M indicates that the controller must be an Emulex Medalist. There is only one physical drive, LUN 0, but it is split into two logically separate drives. These logical drives have MSCP unit numbers 0 and 1. The tape drive at SCSI Address 4 is type 104 (Cipher 540), which requires an Emulex Titleist controller. It is designated MSCP unit number 2. (The MSCP designation is for numbering purposes only; tape drives are actually reported as off-line devices to the operating system.)

There are no configurations with just one Winchester disk drive. All configurations with a single Winchester are paired with either tape drives or IOMEGA cartridge drives. If you plan to use only a Winchester drive, select the configuration that contains the tape drive; the UC14/MO will report the tape drive as an offline device to the operating system.

Column 6 (MSCP Unit Capacity) is the capacity of the logical MSCP unit when used with the disk controller. A physical drive with a capacity of 70,000 logical blocks could be split into two logical drives (as in example 2), each with an MSCP Unit Capacity of 35,000 logical blocks.

Column 8 (Rev Level) is the revision level of the firmware that is required to support the indicated configuration. To use a configuration, your firmware must be equal to or higher than the level shown in column 8.

6. When you have decided on a configuration, set UC14/MO switch SW3-1 and switches SW3-6 through SW3-10, as indicated for that configuration in Table C-4.

Table C-4. Drive Configuration

Config No.	Drive Key	SCSI Addr	Drive LUN	MSCP Unit	MSCP Unit Capacity	SW3 3	6	7	8	9	10	1	Rev
01	100/M 103	0 1	0 0	0 1	71408 20301	1	0	0	0	0	1	0	A
01A	100/A 103	0 1	0 0	0 1	71747 20301	0	0	0	0	0	1	0	A
02	102/M 103	0 1	0 0	0 1	218432 20301	1	0	0	0	1	0	0	A
02A	102/A 103	0 1	0 0	0 1	219283 20301	0	0	0	0	1	0	0	A
03	101/M 103	0 1	0 0	0 1	131376 20301	1	0	0	0	1	1	0	A
03A	101/A 103	0 1	0 0	0 1	131939 20301	0	0	0	0	1	1	0	A
05	100/M 100 104	0 4	0 1 0	0 1 2	71408 71408 Varies	1	0	0	1	0	1	0	A
05A	100/A 100 104	0 4	0 1 0	0 1 2	71747 71747 Varies	0	0	0	1	0	1	0	A
06	102/M 102 104	0 4	0 1 0	0 1 2	218432 218432 Varies	1	0	0	1	1	0	0	A
06A	102/A 102 104	0 4	0 1 0	0 1 2	219283 218432 Varies	0	0	0	1	1	0	0	A

continued next page

0 = OFF, open
1 = ON, closed
Config = Configuration
Addr = Address
LUN = Logical Unit Number
* = This configuration may be used to map two logical drives onto one physical drive in any single disk drive subsystem. See step 4 of the procedure for further information.

Table C-4. Drive Configuration (continued)

Config No.	Drive Key	SCSI Addr	Drive LUN	MSCP Unit	MSCP Unit Capacity	SW3							Rev
						3	6	7	8	9	10	1	
07	101/M	0	0	0	131376	1	0	0	1	1	1	0	A
	101		1	1	131376								
	104	4	0	2	Varies								
07A	101/A	0	0	0	131939	0	0	0	1	1	1	0	A
	101		1	1	131939								
	104	4	0	2	Varies								
09*	100/M	0	0	0	35576	1	0	1	0	0	1	0	A
				1	35576								
	104	4	0	2	Varies								
09A*	100/A	0	0	0	35746	0	0	1	0	0	1	0	A
				1	35746								
	104	4	0	2	Varies								
10*	102/M	0	0	0	108960	1	0	1	0	1	0	0	A
				1	108960								
	104	4	0	2	Varies								
10A*	102/A	0	0	0	109378	0	0	1	0	1	0	0	A
				1	109378								
	104	4	0	2	Varies								
11*	101/M	0	0	0	65504	1	0	1	0	1	1	0	A
				1	65504								
	104	4	0	2	Varies								
11A*	101/A	0	0	0	65774	0	0	1	0	1	1	0	A
				1	65774								
	104	4	0	2	Varies								
12	103	0	0	0	20301	0	0	1	1	0	0	0	A
	103	1	0	1	20301								

continued next page

0 = OFF, open
1 = ON, closed
Config = Configuration
Addr = Address
LUN = Logical Unit Number
* = This configuration may be used to map two logical drives onto one physical drive in any single disk drive subsystem. See step 4 of the procedure for further information.

Table C-4. Drive Configuration (continued)

Config No.	Drive Key	SCSI Addr	Drive LUN	MSCP Unit	MSCP Unit Capacity	SW3 3	6	7	8	9	10	1	Rev
13*	100/M	0	0	0 1	62282 8886	1	0	1	1	0	1	0	A
	104	4	0	2	Varies								
13A*	100/A	0	0	0 1	62569 8923	0	0	1	1	0	1	0	A
	104	4	0	2	Varies								
14*	102/M	0	0	0 1	190700 27220	1	0	1	1	1	0	0	A
	104	4	0	2	Varies								
14A*	102/A	0	0	0 1	191425 27331	0	0	1	1	1	0	0	A
	104	4	0	2	Varies								
15*	101/M	0	0	0 1	114644 16364	1	0	1	1	1	1	0	A
	104	4	0	2	Varies								
15A*	101/A	0	0	0 1	115118 16430	0	0	1	1	1	1	0	A
	104	4	0	2	Varies								
16	103	1	0	0	20301	0	1	0	0	0	0	0	A
	104	4	0	1	Varies								
17	100/M	0	0	0	71408	1	1	0	0	0	1	0	A
	104	4	0	1	Varies								
17A	100/A	0	0	0	71747	0	1	0	0	0	1	0	A
	104	4	0	1	Varies								
18	102/M	0	0	0	218432	1	1	0	0	1	0	0	A
	104	4	0	1	Varies								

continued next page

0 = OFF, open
1 = ON, closed
Config = Configuration
Addr = Address
LUN = Logical Unit Number
* = This configuration may be used to map two logical drives onto one physical drive in any single disk drive subsystem. See step 4 of the procedure for further information.

Table C-4. Drive Configuration (continued)

Config No.	Drive Key	SCSI Addr	Drive LUN	MSCP Unit	MSCP Unit Capacity	SW3 3	SW3 6	SW3 7	SW3 8	SW3 9	SW3 10	SW3 1	Rev
18A	102/A 104	0 4	0 0	0 1	219283 Varies	0	1	0	0	1	0	0	A
19	101/M 104	0 4	0 0	0 1	131376 Varies	1	1	0	0	1	1	0	A
19A	101/A 104	0 4	0 0	0 1	131939 Varies	0	1	0	0	1	1	0	A
20	105/M 105 105/M 104	0 5 4	0 1 0 0	0 1 2 3	80976 80976 80976 Varies	1	1	0	1	0	0	0	A
20A	105/A 105 105/A 104	0 5 4	0 1 0 0	0 1 2 3	81665 81665 81665 Varies	0	1	0	1	0	0	0	A
21	100/M 100 100/M 104	0 5 4	0 1 0 0	0 1 2 3	71408 71408 71408 Varies	1	1	0	1	0	1	0	A
21A	100/A 100 100/A 104	0 5 4	0 1 0 0	0 1 2 3	71747 71747 71747 Varies	0	1	0	1	0	1	0	A
22	102/M 102 102/M 104	0 5 4	0 1 0 0	0 1 2 3	218432 218432 218432 Varies	1	1	0	1	1	0	0	A

continued next page

0 = OFF, open
1 = ON, closed
Config = Configuration
Addr = Address
LUN = Logical Unit Number
* = This configuration may be used to map two logical drives onto one physical drive in any single disk drive subsystem. See step 4 of the procedure for further information.

Table C-4. Drive Configuration (continued)

Config No.	Drive Key	SCSI Addr	Drive LUN	MSCP Unit	MSCP Unit Capacity	SW3							Rev
						3	6	7	8	9	10	1	
22A	102/A	0	0	0	219283	0	1	0	1	1	0	0	A
	102		1	1	219283								
	102/A	5	0	2	219283								
	104	4	0	3	Varies								
23	101/M	0	0	0	131376	1	1	0	1	1	1	0	A
	101		1	1	131376								
	101/M	5	0	2	131376								
	104	4	0	3	Varies								
23A	101/A	0	0	0	131939	0	1	0	1	1	1	0	A
	101		1	1	131939								
	101/A	5	0	2	131939								
	104	4	0	3	Varies								
24	102/M	0	0	0	218432	1	1	1	0	0	0	0	A
	102/M	5	0	1	218432								
	103	1	0	2	20301								
24A	102/A	0	0	0	219283	0	1	1	0	0	0	0	A
	102/A	5	0	1	219283								
	103	1	0	2	20301								
25	100/M	0	0	0	71408	1	1	1	0	0	1	0	A
	100/M	5	0	1	71408								
	104	4	0	2	Varies								
25A	100/A	0	0	0	71747	0	1	1	0	0	1	0	A
	100/A	5	0	1	71747								
	104	4	0	2	Varies								
26	102/M	0	0	0	218432	1	1	1	0	1	0	0	A
	102/M	5	0	1	218432								
	104	4	0	2	Varies								

continued next page

0 = OFF, open
1 = ON, closed
Config = Configuration
Addr = Address
LUN = Logical Unit Number
* = This configuration may be used to map two logical drives onto one physical drive in any single disk drive subsystem. See step 4 of the procedure for further information.

Table C-4. Drive Configuration (continued)

Config No.	Drive Key	SCSI Addr	Drive LUN	MSCP Unit	MSCP Unit Capacity	SW3							Rev
						3	6	7	8	9	10	1	
26A	102/A	0	0	0	219283	0	1	1	0	1	0	0	A
	102/A	5	0	1	219283								
	104	4	0	2	Varies								
27	101/M	0	0	0	131376	0	1	1	0	1	1	0	A
	101/M	5	0	1	131376								
	104	4	0	2	Varies								
27A	101/A	0	0	0	131939	0	1	1	0	1	1	0	A
	101/A	5	0	1	131939								
	104	4	0	2	Varies								
28	105/M	0	0	0	80976	1	1	1	1	0	0	0	A
	105/M	5	0	1	80976								
	105/M	2	0	2	80976								
	104	4	0	3	Varies								
28A	105/A	0	0	0	81665	0	1	1	1	0	0	0	A
	105/A	5	0	1	81665								
	105/A	2	0	2	81665								
	104	4	0	3	Varies								
29	100/M	0	0	0	71408	1	1	1	1	0	1	0	A
	100/M	5	0	1	71408								
	100/M	2	0	2	71408								
	104	4	0	3	Varies								
29A	100/A	0	0	0	71747	0	1	1	1	0	1	0	A
	100/A	5	0	1	71747								
	100/A	2	0	2	71747								
	104	4	0	3	Varies								

continued next page

0 = OFF, open
1 = ON, closed
Config = Configuration
Addr = Address
LUN = Logical Unit Number
* = This configuration may be used to map two logical drives onto one physical drive in any single disk drive subsystem. See step 4 of the procedure for further information.

Table C-4. Drive Configuration (continued)

Config No.	Drive Key	SCSI Addr	Drive LUN	MSCP Unit	MSCP Unit Capacity	SW3							
						3	6	7	8	9	10	1	Rev
30	102/M	0	0	0	218432	1	1	1	1	1	0	0	A
	102/M	5	0	1	218432								
	102/M	2	0	2	218432								
	104	4	0	3	Varies								
30A	102/A	0	0	0	219283	0	1	1	1	1	0	0	A
	102/A	5	0	1	219283								
	102/A	2	0	2	219283								
	104	4	0	3	Varies								
31	101/M	0	0	0	131376	1	1	1	1	1	1	0	A
	101/M	5	0	1	131376								
	101/M	2	0	2	131376								
	104	4	0	3	Varies								
31A	101/A	0	0	0	131939	0	1	1	1	1	1	0	A
	101/A	5	0	1	131939								
	101/A	2	0	2	131939								
	104	4	0	3	Varies								
33	105/M	0	0	0	80976	1	0	0	0	0	1	1	A
	103	1	0	1	20301								
33A	105/A	0	0	0	81665	0	0	0	0	0	1	1	A
	103	1	0	1	20301								
34	105/M	0	0	0	80976	1	0	0	0	1	0	1	A
	105/M	0	1	1	80976								
	104	4		2	Varies								
34A	105/A	0	0	0	81665	0	0	0	0	1	0	1	A
	105/A	0	1	1	81665								
	104	4		2	Varies								
35*	105/M	0	0	0	40352	1	0	0	0	1	1	1	A
			1	1	40352								
	104	4		2	Varies								

continued next page

0 = OFF, open
1 = ON, closed
Config = Configuration
Addr = Address
LUN = Logical Unit Number
* = This configuration may be used to map two logical drives onto one physical drive in any single disk drive subsystem. See step 4 of the procedure for further information.

Table C-4. Drive Configuration (continued)

Config No.	Drive Key	SCSI Addr	Drive LUN	MSCP Unit	MSCP Unit Capacity	SW3 3	6	7	8	9	10	1	Rev
35A*	105/A	0	0	0	40688	0	0	0	0	1	1	1	A
			1	1	40688								
	104	4		2	Varies								
36*	105/M	0	0	0	70624	1	0	0	1	0	0	1	A
			1	1	10064								
	104	4		2	Varies								
36A*	105/A	0	0	0	71217	0	0	0	1	0	0	1	A
			1	1	10159								
	104	4		2	Varies								
37	105/M	0		0	80976	1	0	0	1	0	1	1	A
	104			1	Varies								
37A	105/A	0		0	81665	0	0	0	1	0	1	1	A
	104			1	Varies								
38	105/M	0	0	0	80976	1	0	0	1	1	0	1	A
	105/M	5	0	1	80976								
	104	4		2	Varies								
38A	105/A	0	0	0	81665	0	0	0	1	1	0	1	A
	105/A	5	0	1	81665								
	104	4		2	Varies								
39	103	0	0	0	20301	0	0	0	1	1	1	1	A
	103	1	0	1	20301								
40	109	0	0	0	1999850	0	0	1	0	0	0	1	A
			1	1	1999850								
			2	2	1999850								
			3	3	1999850								
	109	1	0	4	1999850								
			1	5	1999850								
			2	6	1999850								
			3	7	1999850								

continued next page

0	= OFF, open
1	= ON, closed
Config	= Configuration
Addr	= Address
LUN	= Logical Unit Number
*	= This configuration may be used to map two logical drives onto one physical drive in any single disk drive subsystem. See step 4 of the procedure for further info.

Table C-4. Drive Configuration (continued)

Config No.	Drive Key	SCSI Addr	Drive LUN	MSCP Unit	MSCP Unit Capacity	SW3 3	6	7	8	9	10	1	Rev
41	109	0	0	0	1999850	0	0	1	0	0	1	1	A
			1	1	1999850								
			2	2	1999850								
			3	3	1999850								
			4	4	1999850								
			5	5	1999850								
			6	6	1999850								
			7	7	1999850								
42	103	1	0	0	20301	0	0	1	0	1	0	1	A
	109	0	0	1	1999850								
			1	2	1999850								
			2	3	1999850								
			3	4	1999850								
			4	5	1999850								
			5	6	1999850								
			6	7	1999850								
43	102	0	0	0	219283	0	0	1	0	1	1	1	A
	109	1	0	1	1999850								
			1	2	1999850								
			2	3	1999850								
			3	4	1999850								
			4	5	1999850								
			5	6	1999850								
			6	7	1999850								
44	102/M	0	0	0	218432	1	0	1	1	0	0	1	A
	102		1	1	218432								
	103	1	0	2	20301								
44A	102/A	0	0	0	219283	0	0	1	1	0	0	1	A
	102		1	1	219283								
	103	1	0	2	20301								

continued next page

0 = OFF, open
1 = ON, closed
Config = Configuration
Addr = Address
LUN = Logical Unit Number
* = This configuration may be used to map two logical drives onto one physical drive in any single disk drive subsystem. See step 4 of the procedure for further information.

Table C-4. Drive Configuration (continued)

Config No.	Drive Key	SCSI Addr	Drive LUN	MSCP Unit	MSCP Unit Capacity	SW3 3	6	7	8	9	10	1	Rev
45	107/M 107 106/M 104	0 5 4	0 1 0 0	0 1 2 3	130912 130912 55152 Varies	1	0	1	1	0	1	1	A
45A	107/A 107 106/A 104	0 5 4	0 1 0 0	0 1 2 3	131725 131725 55573 Varies	0	0	1	1	0	1	1	A
46	107/M 107 106/M 103	0 5 1	0 1 0 0	0 1 2 3	130912 130912 55152 20301	1	0	1	1	1	0	1	A
46A	107/A 107 106/A 103	0 5 1	0 1 0 0	0 1 2 3	131725 131725 81665 20301	0	0	1	1	1	0	1	A
47	108/M 108 106/M 104	0 5 4	0 1 0 0	0 1 2 3	132064 132064 55152 Varies	1	0	1	1	1	1	1	A
47A	108/A 108 106/A 104	0 5 4	0 1 0 0	0 1 2 3	132877 132877 55573 Varies	0	0	1	1	1	1	1	A
48	108/M 108 106/M 103	0 5 1	0 1 0 0	0 1 2 3	132064 132064 55152 20301	1	1	0	0	0	0	1	A

continued next page

0 = OFF, open
1 = ON, closed
Config = Configuration
Addr = Address
LUN = Logical Unit Number
* = This configuration may be used to map two logical drives onto one physical drive in any single disk drive subsystem. See step 4 of the procedure for further information.

Table C-4. Drive Configuration (continued)

Config No.	Drive Key	SCSI Addr	Drive LUN	MSCP Unit	MSCP Unit Capacity	SW3							
						3	6	7	8	9	10	1	Rev
48A	108/A	0	0	0	132877	0	1	0	0	0	0	1	A
	108		1	1	132877								
	106/A	5	0	2	81665								
	103	1	0	3	20301								
49	110	0	0	0	1999850	0	1	0	0	0	1	1	B
		1	0	1	1999850								
		2	0	2	1999850								
		3	0	3	1999850								
		4	0	4	1999850								
		5	0	5	1999850								
		6	0	6	1999850								
50	103	0	0	0	20301	0	1	0	0	1	0	1	B
	103	0	1	1	20301								
53	108/M	0	0	0	132064	0	1	0	1	0	1	1	B
	108/M	0	1	1	132064								
	108/M	5	0	2	132064								
	108/M	5	1	3	132064								
53A	108/M	0	0	0	132877	0	1	0	1	0	1	1	B
	108/M	0	1	1	132877								
	108/M	5	0	2	132877								
	108/M	5	1	3	132877								

0 = OFF, open
1 = ON, closed
Config = Configuration
Addr = Address
LUN = Logical Unit Number
* = This configuration may be used to map two logical drives onto one physical drive in any single disk drive subsystem. See step 4 of the procedure for further information.

Appendix D
DISK DRIVE CONFIGURATION

D.1 Overview

This appendix provides the information you need to set up your drive configuration. The two types of information provided are:

- Drive configuration parameter values for use with UC14/MO's firmware-resident diagnostics
- Recommended drive options

Use the drive configuration parameter values to load your drive configuration into NOVRAM. They are listed in Tables D-1 and D-2. (See subsection 4.9. for parameter definitions.)

Use the recommended drive option information to plan your configuration. Refer to the drive manufacturer's manual for specific instructions on setting the drive for the required options.

D.2 Parameter Values

The drive configuration parameters listed in these tables are for use with the NOVRAM loading, editing, and displaying options of UC14/MO's firmware-resident diagnostics. They relate to the physical geometry of the disk drives; options such as logical splits are left to you.

The configuration tables list each parameter as it is displayed by the diagnostic, as well as each drive certified for use with the UC14/MO. Parameter values in these tables are based on one spare sector per track with no logical splits. Values are listed and entered in decimal.

To use the tables, locate the name of your drive along the top of the tables. Then read down the column beneath the drive name for the parameter values.

If you are looking for a specific parameter value, find the parameter you need in the "parameter" column. Then find your drive in the "drive name" row. The parameter value is listed at the point where the row and the column intersect.

PARAMETER	DRIVE NAME						
	ATASI 3046	CDC Wren I	CDC Wren II-917	CDC Wren II-925	FUJITSU M2243AS	MAXTOR XT1140	RODIME 208
Number of Drives	1	1	1	1	1	1	1
Type Code	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Heads	7	5	9	9	11	15	8
Physical Cylinders	645	697	917	925	754	918	640
Spare Cylinders	2/0	2/0	2/0	2/0	2/0	2/0	2/0
Physical Sectors per Track	17	17	17	17	17	17	17
Spare Sectors per Track	1/0	1/0	1/0	1/0	1/0	1/0	1/0
Split Code	0	0	0	0	0	0	0
Removable Media Flag	0	0	0	0	0	0	0
Reduced Write Current	320	697	917	925	754	918	640
Write Precompensation	320	0	0	0	754	918	640
Step Code	1	1	1	1	1	1	1

[1] Where parameter values differ for Medalist and Adaptec controllers, the first (Medalist) value is separated from the second (Adaptec) value by a slash. All other values are identical for both controllers.

Table D-1. DRIVE CONFIGURATION PARAMETER VALUES (Medalist/Adaptec)[1] for UC14/MO

PARAMETER	DRIVE NAME								
	CDC Wren III	FUJITSU 2246E	HITACHI DK512-17	MAXTOR Ext-4175	MAXTOR Ext-4380	MAXTOR Ext-8380	MICROPOLIS 1350	MICROPOLIS 1558	SIEMENS 1300
Number of Drives	1	1	1	1	1	1	1	1	1
Type Code	6	6	6	6	6	6	6	6	6
Heads	9	10	10	7	15	8	8	15	12
Physical Cylinders	969	823	823	1224	1224	1632	1024	1224	1217
Spare Cylinders	2	2	2	2	2	2	2	2	2
Physical Sectors per Track	36	35	36	34	34	52	35	35	35
Spare Sectors per Track	1	1	1	1	1	1	1	1	1
Split Code	0	0	0	0	0	0	0	0	0
Removable Media Flag	0	0	0	0	0	0	0	0	0
Sector Offset	0	0	0	0	1	0	0	1	11

Table D-2. ESDI DRIVE CONFIGURATION PARAMETER VALUES (Champion) for UC14/MO

EMULEX

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
ATTN: TECHNICAL PUBLICATIONS
3545 HARBOR BOULEVARD
P.O. BOX 6725
COSTA MESA, CA 92628-9928