UC07 AND UC08
INTELLIGENT HOST ADAPTER
TECHNICAL MANUAL
(MSCP/TMSCP COMPATIBLE)

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.

REVISION NOTICE

This manual has been updated to include descriptions of new features added to the U07/08 firmware, Revision H. In addition, changes have been made to the text and figures in subsections 5.4 and 5.5 to reflect new menus and options added to FRD for the support of multi-tape drives and Magneto-Optical disk drives. The firmware revision can be identified by a part number on the PROMS located in U29 on the UC07 and U29, U22 on the UC08. Users with Revision G firmware and below should refer to Revision C of the manual for corresponding menus and text.

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1.1 Introduction

This manual is designed to help you install and use your UC07 or UC08
Intelligent Host Adapter. It assumes that you have some knowledge of hardware
configuration, LSI-11 bus architecture and terminology, and interpretations of
error messages and device register contents.

The contents of the nine sections and two appendices are described as follows:

- **Section 1 (General Description):** This section contains an overview of
  the UC07/08 Intelligent Host Adapter.

- **Section 2 (Controller Specifications):** This section contains the
  specifications for the UC07/08 Host Adapter.

- **Section 3 (Installation and Configuration Planning):** This section
  contains a discussion of possible configurations and some considerations
  for planning the configuration.

- **Section 4 (Installation):** This section contains the information needed to
  set up and physically install the controller, including switch settings and
  cabling.

- **Section 5 (NOVRAM Setup and Subsystem Testing):** This section
  describes the firmware-resident diagnostics and contains instructions for
  loading drive configuration parameters into the NOVRAM.

- **Section 6 (Troubleshooting):** This section describes fault isolation
  procedures that can be used to pinpoint trouble spots.

- **Section 7 (MSCP/TMSCP Compatibility and ODT Programming):** This
  section describes the UC07/08's registers and presents an overview of the
  Mass Storage Control Protocol (MSCP).

- **Section 8 (Functional Description):** This section describes the controller
  architecture.

- **Section 9 (Interfaces):** This section describes the controller, LSI-11 bus,
  and SCSI interfaces.

- **Section 10 (SCSI Protocol Description):** This section describes the
  protocol used on the SCSI bus.

- **Appendix A (Autoconfigure, CSR and Vector Addresses):** 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 UC07/08 Host Adapter in the field.

- **Appendix C (Drive Parameters):** This appendix provides NOVRAM parameter-setting information for various optical and magnetic disk drives and subsystems.

1.2 Subsystem Overview

The UC07 Host Adapter connects high-capacity SCSI-compatible magnetic disk, optical disk, or magnetic tape subsystems to the Q-Bus in computers manufactured by Digital Equipment Corporation (DEC). Via switch selection, the UC07 implements either DEC's Mass Storage Control Protocol (MSCP) for disk subsystems or Tape Mass Storage Control Protocol (TMSCP) for tape subsystems 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.

The UC08 Host Adapter combines the capabilities of two UC07s on a single printed circuit board assembly. This allows the user to separate slow and fast SCSI peripherals, attaching slower tape devices or optical drives to one SCSI bus, while high-speed magnetic drives use the other SCSI bus.

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 UC07 provides just such a subsystem. The UC07 relieves the host CPU of many file maintenance tasks. The UC07 Host Adapter performs these MSCP functions: error checking and correction, bad block replacement, seek optimization, command prioritizing and ordering, and data mapping.

1.2.2 Small Computer System Interface (SCSI)

The Small Computer System Interface, which is used as the UC07 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 UC07, connect computers to the SCSI bus. Intelligent peripheral controllers support mass-storage peripherals such as mini-Winchester disk drives or 8mm tape 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 and data commands to be overlapped if there is more than one peripheral controller on the bus.

COMPUTER | HOST ADAPTER — SCSI BUS — CONTROLLER

PERIPHERAL UNITS SUCH AS RIGID DISKS, FLEXIBLE DISKS, MAGNETIC TAPE, REMOVABLE DISKS OR OPTICAL DISKS

SINGLE INITIATOR, SINGLE TARGET

SINGLE INITIATOR, MULTI TARGET

MULTI INITIATOR, MULTI TARGET
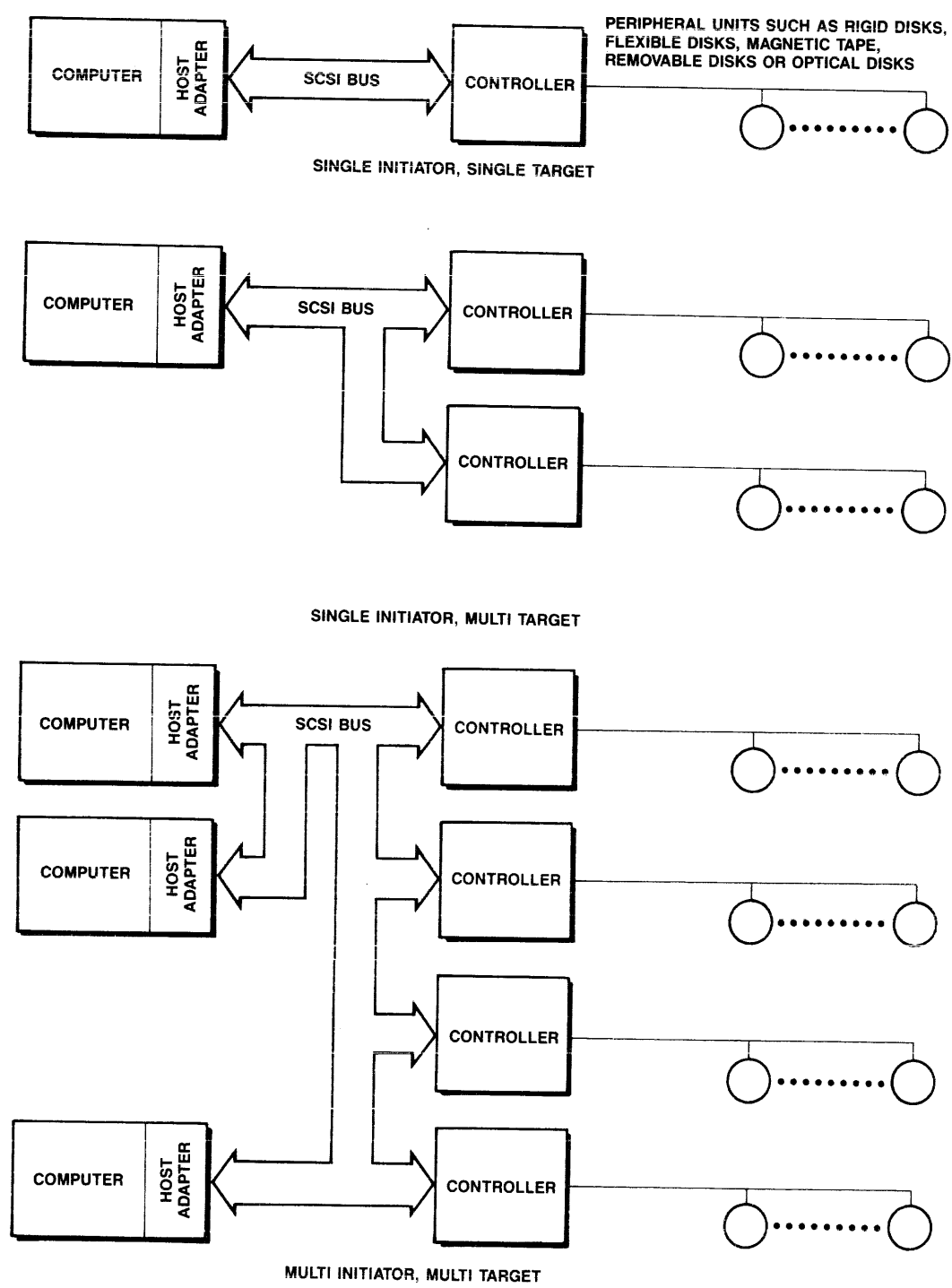
Figure 1-1. SCSI Bus Overview

UC0701-2062

1.3 Physical Organization Overview

The UC07 or UC08 Intelligent Host Adapter is a quad-wide printed circuit board that contains either one (UC07) or two (UC08) microprocessor-based SCSI host adapters. The board connects directly to the host computer's Q-Bus.

In MSCP mode, each UC07 or UC08 SCSI port can support up to seven SCSI peripheral controllers. Each peripheral controller can have from one to eight devices attached to it. Regardless of the combination scheme, eight (8) is the maximum number of logical units that can be attached to a single UC07 or UC08 SCSI Port. The SCSI devices can be a mixture of magnetic disk or optical disk devices. Special software might be required when mixing optical and magnetic devices on the same UC07 or UC08.

In TMSCP mode, each UC07 or UC08 SCSI port can support up to seven tape devices with a SCSI interface.

Aggregate data storage capacities are limited only by the capacities of the peripherals.

Figure 1-2 shows two possible SCSI configurations for the UC07; Figure 1-3 shows a possible configuration for the UC08. The configuration in Figure 1-3 is a single CPU, multi-initiator, multi-target configuration. Figure 1-4 shows a dual CPU scheme which offers multiple access to a shared set of peripherals. Special software is required to support this application.
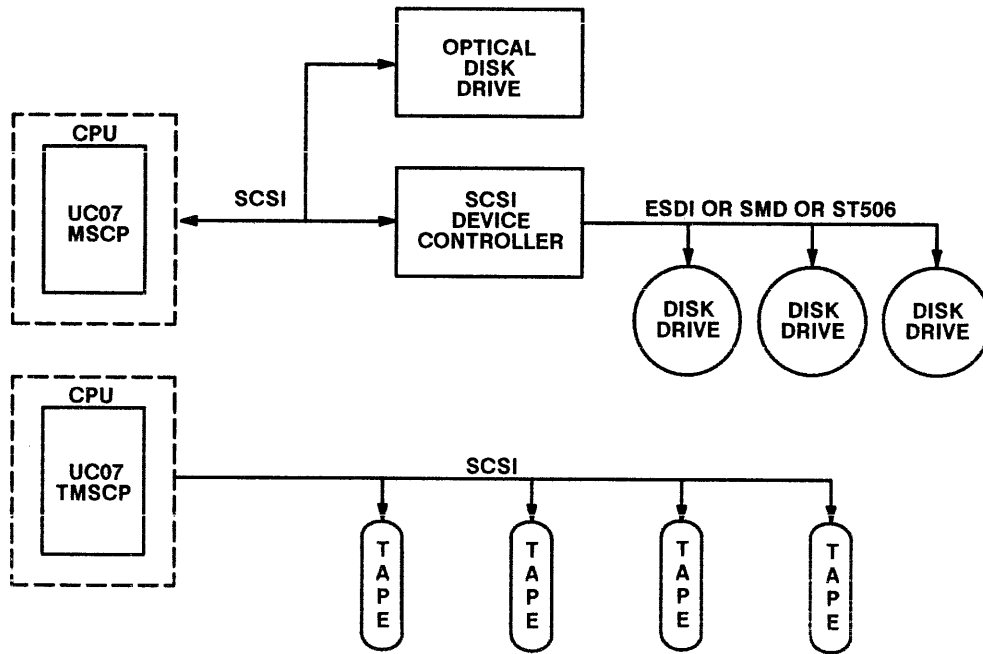
Figure 1-2. Typical UC07 Subsystem Configurations
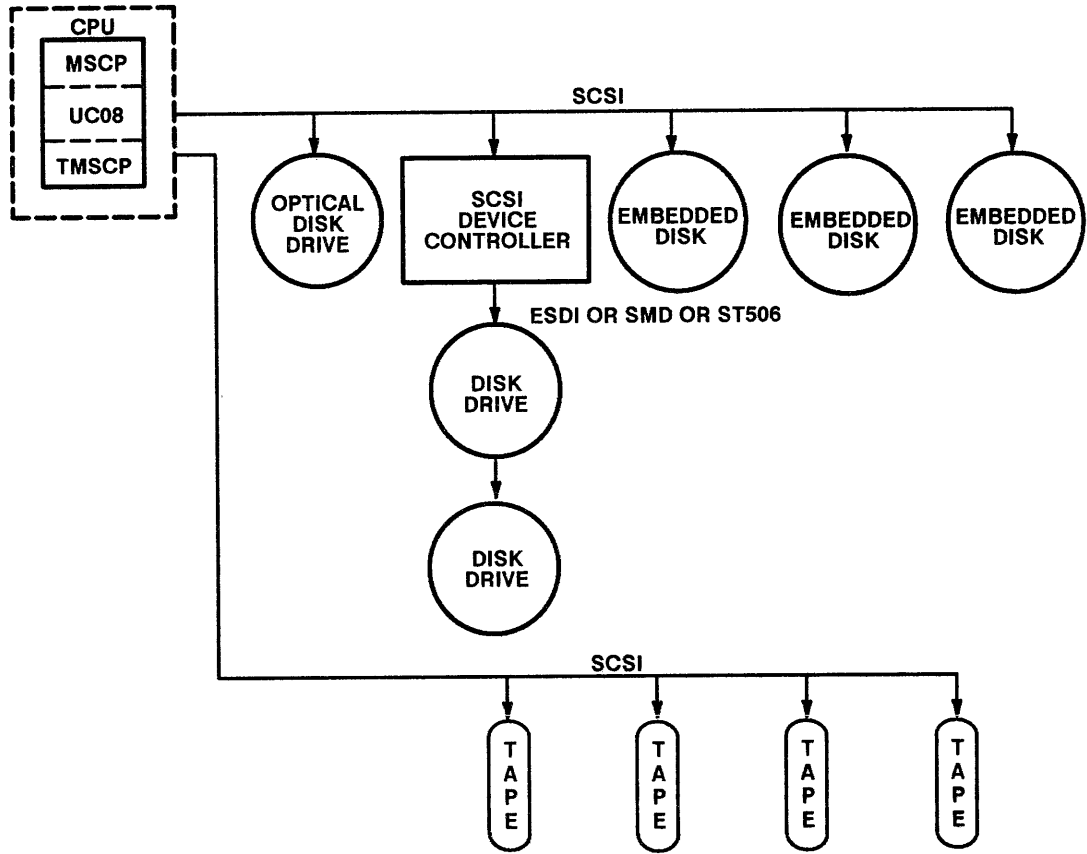
UC07/08-02

Figure 1-3. Typical UC08 Subsystem Configuration

UC07/08-03
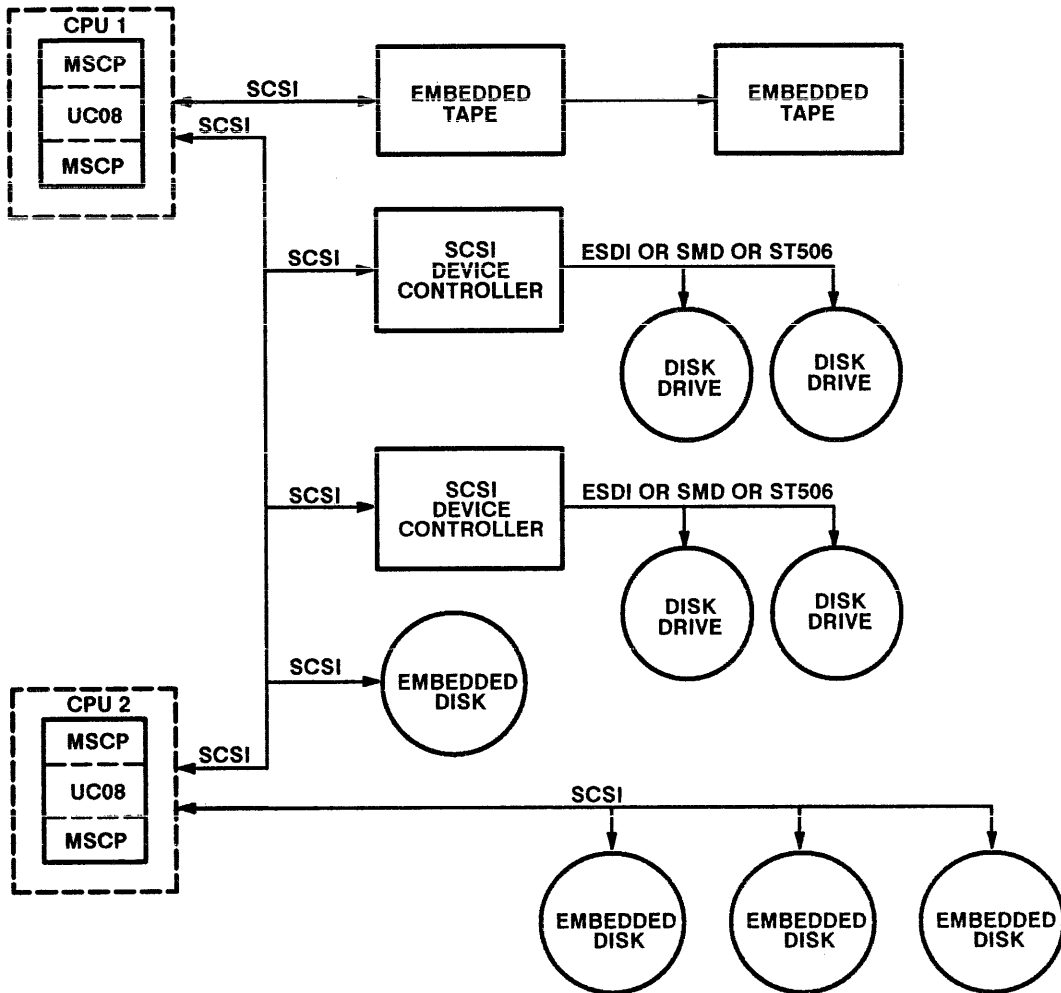
Figure 1-4. Dual CPU UC08 Subsystem Configuration

1.4 Host Adapter Models and Options

The intelligent host adapter, with appropriate peripherals, provides a DEC MSCP-compatible or TMSCP-compatible mass storage subsystem. The host adapter is available in four basic models: the UC07, the UC08, the UC07-III, and the UC08-III. The UC07 and UC07-III each have a single SCSI port; the UC08 and UC08-III are dual versions, each board having two SCSI ports. The UC07-III and the UC08-III are designed for use with the MicroVAX III, while the UC07 and UC08 are for use with the LSI-11. Figure 1-5 shows a photograph of a UC08-III board and a UC08 board.

The current version of the UC07 is contained on a quad-wide printed wiring board. EMULEX is in the process of

favor of a dual-wide board. With the exception of a change in form factor, jumper locations, and the selection of termination power, switch definitions are identical to the current quad-wide version. Only the physical location of the components has changed. Component locations on the dual-wide version are shown in Figure 1-6. Jumper configuration for the dual-wide version are shown in Table 4.7. The new board is completely backward compatible with older firmware and hardware revisions of the UC07. See Appendix D for details about termination power jumpering on the dual-wide UC07.

Each intelligent host adapter board is identified by a top level assembly tag that is glued to the 8031 microprocessor chip on the printed circuit board assembly. Tables 1-1 through 1-4 give the top level assembly number of each of the four models of host adapters, along with the part numbers of the items that are delivered with them.

Table 1-1. UC07 Basic Contents

Itm	Qty	Description	Part Number
1	1	Host Adapter, Quad-wide	UC0710201-02
2	1	Manual	UC0751001-00
3	1	Host Adapter, Dual-wide	UC0710205-02

Table 1-2. UC08 Basic Contents

Itm	Qty	Description	Part Number
1	1	Host Adapter	UC0810201-02
2	1	Manual	UC0751001-00

Table 1-3. UC07-III Basic Contents

Itm	Qty	Description	Part Number
1	1	Host Adapter	UC0710201-04
2	1	Manual	UC0751001-00
3	1	Distribution Panel	UC0710203-00
4	2	Gap Filler Panel	QT1420102-00

Table 1-4. UC08-III Basic Contents

Itm	Qty	Description	Part Number
1	1	Host Adapter	UC0810201-04
2	1	Manual	UC0751001-00
3	1	Distribution Panel	UC0710203-00
4	2	Gap Filler Panel	QT1420102-00
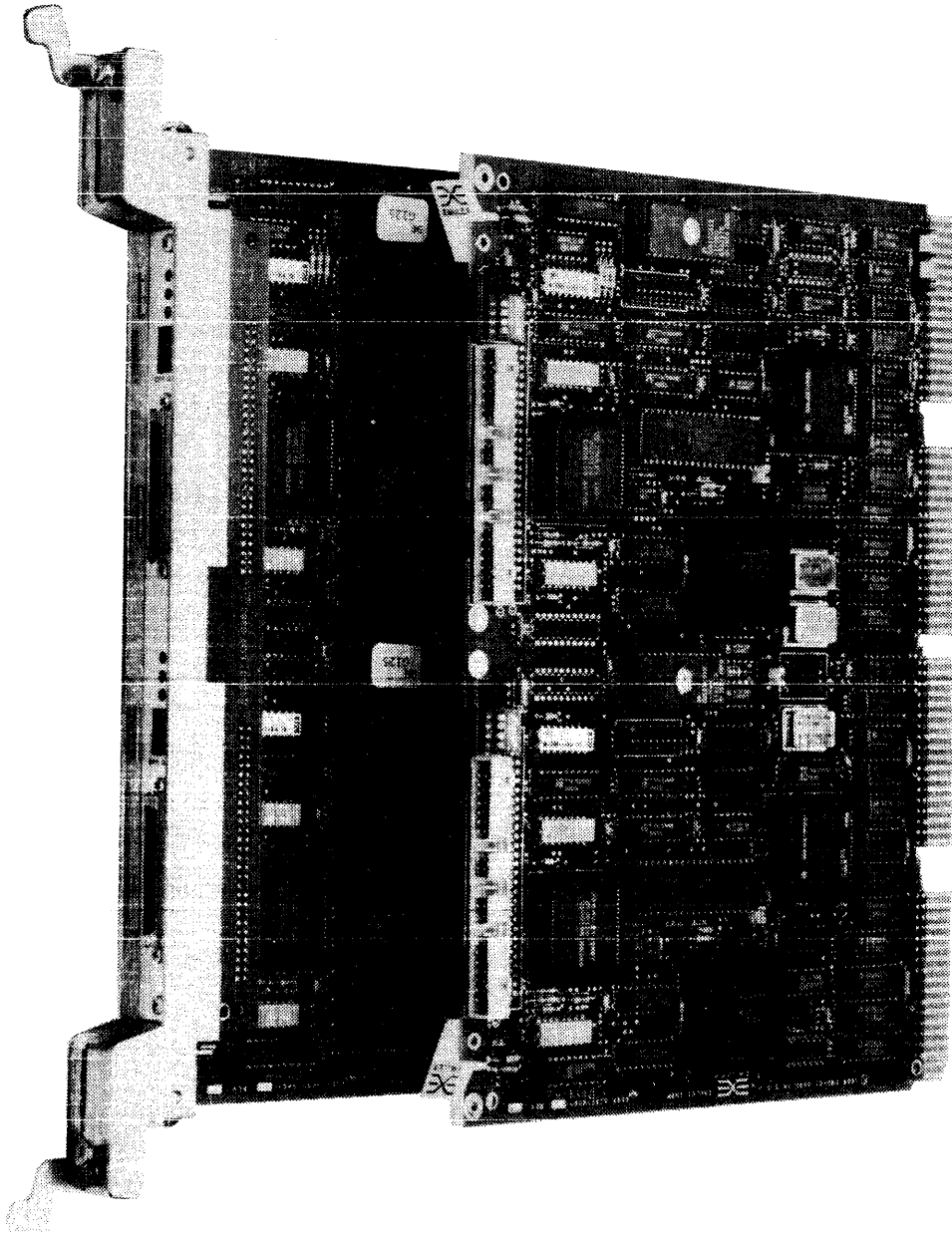
Figure 1-5. UC08-III and UC08 Host Adapters

UC0701-2069
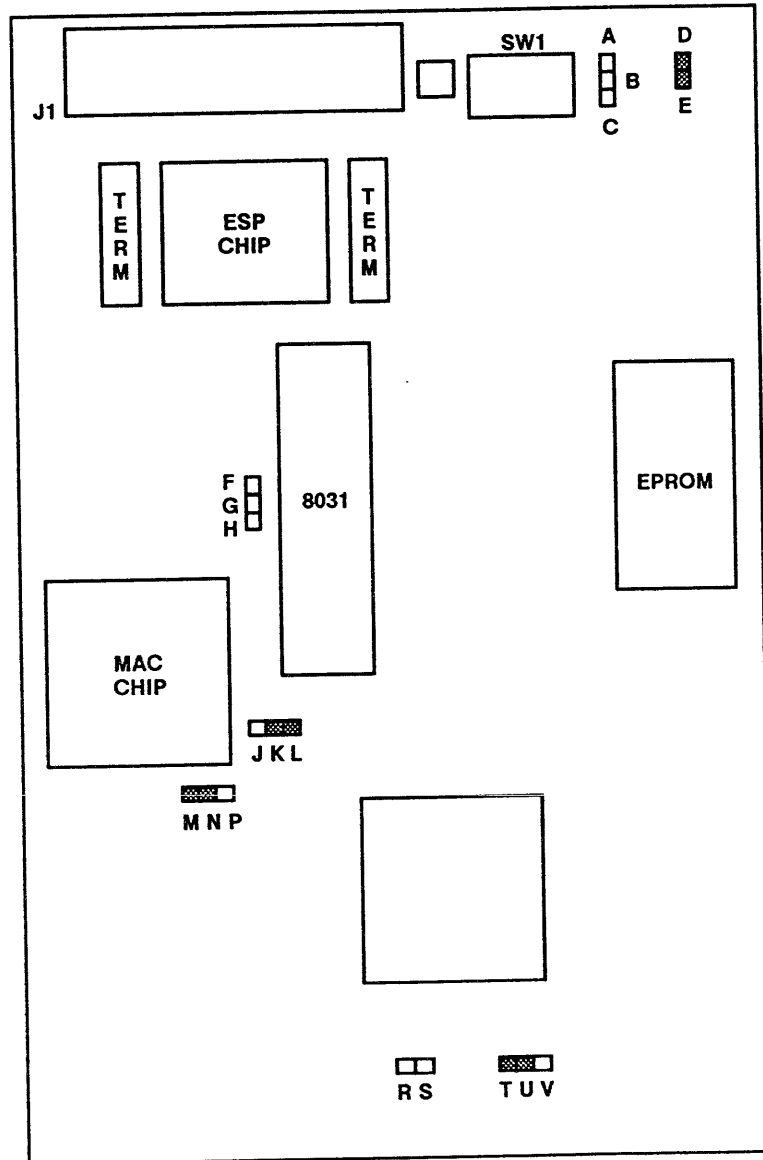
Figure 1-6. UCO7 Dual-wide Component Locations

1.4.1 Subsystem Options

Table 1-5 lists the options that can be ordered to tailor your UC07 or UC08 to your particular application. Options are specified as separate line items on a sales order.

Table 1-5. UC07 and UC08 Options

Option	Description
PU0213001	MICRO/PDP/VAX Cable Kit for MICRO/PDP-11 or MicroVAX chassis patch panels. Converts UC07 J1, UC08 J1, or UC08 J2 to AMP connector. Includes SCSI cable, adapter, and hardware. Fully compatible with all Emulex SCSI subsystems.
PU0120105	MICRO/PDP/VAX Patch Panel. Required for installation of Emulex CP24 Distribution Panel and UC07/08 Controllers. Ordered in addition to PU0213001, above.
PU0113003	Rack mount cable kit for universal RETMA rack mount applications. Converts UC07 J1, UC08 J1, or UC08 J2 to AMP connector. Includes SCSI cable, rack mount, adapter, and hardware. Fully compatible with all Emulex SCSI subsystems.
PU0113004	LSI-11/23 Chassis Mount Kit for LSI-11/23 BC type chassis. Mounts AMP connector in LSI-11/23 BC chassis. Includes SCSI cable, adapter, and hardware. Fully compatible with all Emulex SCSI subsystems.
CKUC07-15	High-density Cable Kit. Contains one 15-foot, 50-pin, high-density shielded cable necessary for UC07-III and UC08-III. Connects host adapter located in CPU chassis to distribution panel located in adjacent peripheral cabinet. Two kits necessary for UC08-III.

1.5   Features

The following features enhance the usefulness of the UC07/08 Host Adapter.

1.5.1   Microprocessor Design

The UC07/08 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 chip and host adapter controller chip, the UC07/08 can perform DMA transfers on the host LSI-11 bus in excess of 2M bytes per second with a peak rate of 950 nanoseconds per word.

1.5.3   Firmware-resident Diagnostics

The UC07/08 host adapter firmware incorporates a self-contained set of media preparation and diagnostic utilities.

These utilities allow the user to communicate directly with the UC07/08 via a firmware-resident terminal driver that is compatible with either CRT or hardcopy devices connected to an LSI-11 or MicroVAX console port. These firmware-resident diagnostics (F.R.D.) provide several important configuration and media preparation functions, including the ability to:

- Configure the host adapter NOVRAM
- Format magnetic disk drives
- Test the media surface of disk drives and replace defective blocks
- Perform reliability testing of the attached disk or tape subsystem
- Initialize the RCT area on optical media
- Provide read/write test capability on a special diagnostic area of the optical media

1.5.4   Custom Configuration Capability

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

1.5.5   Self-test

The UC07/08 incorporates an internal self-test routine which exercises all parts of the microprocessor, the onboard memory, the buffer controller, the Host Adapter Controller (HAC), and the ESP chip. Although this test does not completely test all circuitry, successful execution indicates a very high probability that the host adapter is operational. If the UC07/08 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).

1.5.6   Error Control and Block Replacement

The UC07/08 offers a choice of three different methods of error control which are user-selectable via NOVRAM. Each of these modes has unique advantages depending on the application.

1.5.7   Manual Bad Block Replacement

For magnetic disk devices, the firmware-resident diagnostics allow the user to manually enter bad blocks that are not replaceable with normal methods.

1.5.8   Command Queuing

The UC07/08 has a buffer which can store up to fifteen MSCP commands. The UC07/08 has the ability to sort these stored commands to provide optimal access to the attached disk drives. The ability to store and sort commands makes the UC07/08 particularly efficient in heavily loaded mulit-user systems.

1.5.9   Disconnect/Reconnect

The UC07/08 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 UC07/08 to initiate commands simultaneously on multiple 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.

1.5.10   Adaptive DMA

During each DMA data transfer burst, the UC07/08 monitors the LSI-11 bus 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 or TMSCP initialization sequence, or the UC07/08 defaults to 16 words per burst. In addition, the UC07/08 allows the user to select the delay between data bursts via NOVRAM. Because of these adaptive DMA techniques, the UC07/08 ensures that CPU functions, including interrupt servicing, are not locked out for excessive periods of time by high-speed disk or tape transfers.

1.5.11   Block-mode DMA

The UC07/08 supports block-mode DMA for accessing memory. In this mode, the initial address of the data is transmitted, followed by a burst of up to 16 words of data. The memory address is automatically incremented to accommodate this burst. Block mode transfers considerably reduce the overhead associated with DMA operations.

1.5.12   22-bit Addressing

The UC07/08 supports the 22-bit addressing capability of the extended LSI-11 bus.

1.5.13   Multi-CPU Support

The UC07/08 offers two kinds of multi-CPU support: MSCP emulation and TMSCP emulation.

1.5.13.1   MSCP Emulation

The use of dynamic multi-initiator configurations in multiple CPUs has been added. This feature is required in multi-CPU configurations where asynchronous and unsolicited SCSI resets from one CPU must not be allowed to interfere with ongoing operations performed by other CPUs on the same SCSI bus. If this feature is used, all devices on the SCSI bus must support disconnects. Note that the current SCSI specification does not clearly define conditions that can occur if some SCSI devices on the same SCSI bus are powered OFF. Therefore, Emulex requires that all devices sharing a common SCSI bus be powered ON for proper operation.

Write Once Read Many (WORM) optical drives are not supported in this configuration unless used for read-only purposes. Ensure that proper SCSI termination is observed, as well as maximum SCSI cable length. (See Table 2-1 for cable length details.)

1.5.13.2 TMSCP Emulations

The UC07/08 supports the use of multi-CPU configurations with the TMSCP emulation. However, because some SCSI tape devices could go into self-test modes which will run for up to 1.5 minutes, dynamic sharing of tape devices is not allowed. Emulex recommends each tape device be logically mounted to only one CPU at a time.

1.5.14 Fast File Search (Tape Emulation Only)

UC08 firmware revision "G" and above supports the use of high speed file search operations available on EXABYTE tape drives. Certain limitations in the way high speed searches operate on the EXABYTE drive might not be compatible with all operations performed by various DEC operating systems; therefore, this feature can be disabled via a switch located on the UC07/08. Refer to Table 4-1 for switch settings.

1.5.15 User Selectable SCSI Autoconfigure

This feature allows the user to ask the UC07/08 to load its NOVRAM device information by using the INQUIRY, MODE SELECT, MODE SENSE, or READ CAPACITY commands to locate and identify all disk devices present on the SCSI bus. The autoconfigure process also loads each device's physical geometry information into the NOVRAM for use as default values, unless modified by the user.

This feature autoconfigures all available SCSI devices and all attached logical units until a maximum of eight drives are found. Once a device is identified, it is listed on the console with the vendor identification, the product identification, and the revision level (if the device is CSS compatible). Once completed, the default values are displayed if you wish to edit any entry. Only disk devices allow for autoconfigure.

1.5.16 Multiple Tape Drive Support

The UC07/08 supports up to seven SCSI tape devices by appearing to the system as multiple drives attached to a single TMSCP tape coupler. Each device can be accessed individually.

Multi-drive configurations are very useful in applications that require automated unattended backups. With seven 8mm drivers attached to a single UC07 port, over 14 gigabytes of unattended backup capability are provided. In addition to the above convenience, the UC07 supports any mix of SCSI tape devices, including:

- 4mm DAT
- 8mm Helical Scan
- 1/2" cartridge
- 1/2" reel-to-reel
- Full 3480 compatibility

1.6 Compatibility

In designing the UC07/08, Emulex has made every effort to maintain compatibility with the SCSI Interface. However, because of the flexibility of the SCSI Interface Specification itself, and the large number of vendors producing "SCSI-compatible" disk and tape controllers, it is virtually impossible to guarantee that any particular SCSI disk or tape controller will function correctly when attached to the UC07/08. In addition, some of the restrictions imposed by the requirements of MSCP compatibility might prevent some devices which rely heavily on "vendor unique" command modifiers from being supported. The following section will summarize the various compatibility issues mentioned in the manual and also will list a number of vendor-specific devices which have been tested and found to work with the UC07/08.

1.6.1 Protocol Compatibility

The UC07/08 is compatible with the SCSI Interface Specification as defined by ANSI X3T9.2/82-2 Rev 17B for Direct Access, WORM, and Sequential Access devices. In addition, the industry standard, Common Command Set, is fully supported. The following documents were used for reference during the development of the SCSI interface on the UC07/08:

- ANSI specification X3T9.2/82-2 Rev 17B

- CDC SCSI Interface Specification 64721700 Rev B

- Emulex SCSI Disk Controller Programming Reference Manual (P/N MD2352501)

- Exabyte Corp. Interface Users Manual MKT-016-00

- Optimem Optical Disk Drive Interface Manual (P/N G09-083890-001)

- Maxtor Corp. XT-8000S Product Specification and OEM Manual (1015586 Rev A)

1.6.1.1 MSCP Compatibility

In the MSCP mode, when using magnetic disk drives, the UC07/08 is compatible with the standard DEC DU device driver used in all DEC operating systems. In the MSCP mode, when using optical disk drives, the UC07/08 is compatible with either the Emulex OD/OT Driver for VMS-based systems, or the optical software produced by Perceptics Corp.

In order to support the full host-initiated block replacement scheme provided by MSCP, the SCSI magnetic disk driver controller must support both the SCSI READ LONG and SCSI WRITE LONG commands as defined by the industry standard Common Command Set (CCS). All Emulex SCSI disk controllers support this requirement. When using non-Emulex device controllers, refer to the technical documentation supplied with the device.

1.6.1.2   TMSCP Compatibility

In TMSCP mode, the UC07/08 is fully compatible with the standard DEC TMSCP device driver for TK50/70 operation. Each SCSI port designated for TMSCP appears as one controller with up to seven tape devices attached.

1.6.2   Device Compatibility

The following is a list of the SCSI devices that have been tested or reviewed and found to be compatible with the UC07/08. If your device does not appear on this list, it does not mean that it will not work. However, Emulex cannot guarantee correct operation or performance. In these cases, Emulex support will be limited to helping you identify the cause of the incompatibility.

CAUTION

With the exception of products manufactured by Emulex, no warranties, either expressed or implied, are made as to the reliability or performance of any devices listed in this document. In addition, Emulex is not responsible for the applicability of any of the devices listed to a particular system configuration or for their intended use.

Magnetic Disk Controllers:

- Emulex MD01
- Emulex MD21
- Emulex MD23
- Emulex MD25

Magnetic Disk Drives with Embedded SCSI Controllers:

- Imprimis Wren Series
- Imprimis 9720S Series
- Imprimis Sabre 850S
- Maxtor 4000S Series
- Maxtor 8000S Series
- Micropolis 137XS Series
- Priam 738
- Hewlett-Packard 97548S

Optical Disk Drives: (WORM)

- LMSI LD1200 12-inch
- LMSI LD5105 5.25-inch
- Optimem 1000/Rev 2 SCSI Controller
- Optimem 2400
- Laserdrive Ltd. Model 840
- Magneto-Optical Drive (erasable)
- Sony Magneto-Optical Drive
- Richo Magneto-Optical Drive

Magnetic Tape Drives:

- Exabyte Corp. 8400 8mm Tape Drive
- Sony 4mm DAT Drive
- Gigatrend 4mm DAT Drive
- LMSI 3480
- Wang DAT
- Wang Tek

1.6.3 CPU Compatibility

The UC07/UC08 is compatible with the Q-Bus used on all DEC LSI-11 and all DEC MicroVAX II or 3XXX series computers.

The UC07/UC08 is not supported on DEC MicroVAX I computers due to the lack of "Scatter Gather" support.

1.6.4   Known Limitations

1.6.4.1   EXABYTE Limitations

ULTRIX 11 and ULTRIX 32M share the same EXABYTE limitation: When either system is used with EXABYTE in TMSCP mode, the "r" key cannot be used with *TAR* (Tape Archive) to append files. This operation requires the drive to position between blocks and overwrite. The drive is not capable of this operation.

1.6.4.2   Operating Systems Limitations

The following operating systems support only one tape drive per TMSCP port:

- RSX11M
- RSX11M PLUS
- RSTS/E
- RT11

Your software might create a second limitation: Automated switching of tape drives at EOT as used in unattended backup is the responsibility of the operating system software. VMS supports the definition of multiple tape units as part of its backup utility; however, your software must support this feature. Consult your VMS backup utility documentation for details regarding available features and configuration.

Other operating systems might require special software or command files written by the user. Consult the appropriate documentation.

1.6.4.3   Firmware Limitations

The current version of UC07/08 firmware does not support the SCSI Reserve and Release functions. It therefore cannot function as a dual-ported disk in applications that require the disk to be on-line to only one CPU at a time (to provide proper Lock Management Functions).

1.6.4.4   Multi-CPU Limitations

In the case where multi-CPUs share a common set of multiple tape drives, Emulex recommends that each tape device be logically mounted by only one CPU at a time. It is possible for each CPU to simultaneously mount and access different tape drives on the same SCSI bus.

1.6.4.5   Stand Alone Backup Kit (STABACKIT) Limitations

Tapes built using the Stand Alone Backup Kit (STABACKIT)
may not successfully bootstrap VMS. This condition is unpredictable and
depends on the size of the files on the tape. This condition is caused because the
command timeout values used on the Space Records are not designed to be used
with 8mm tapes. Timeouts can occur when the Space Record operation causes
the tape to space over many file marks.

Emulex does not recommend the use of STABACKIT to build bootable tapes on
8mm Helical Scan Drives. Standalone Back-up tapes can be successfully built
and booted on 4mm DAT, 1/2 inch reel-to-reel or cartridge drives, or 3480
drives.

1.6.5   Multi-initiator

This configuration can be used in applications that require multiple CPU access
to a shared set of peripherals among two or more CPUs. By programming the
NOVRAM on each host adapter, the user can determine which of the attached
drives can be accessed by any CPU. This configuration requires special care to
prevent dynamic multi-access unless special software is used to perform Lock
Management Functions.

Also, because the Intelligent Host Adapter passes QBUS resets directly through
to the SCSI bus in the form of SCSI bus resets, some form of protection must be
defined to prevent the host adapter on any one CPU from issuing SCSI resets
while the SCSI bus is being accessed by another host adapter. This condition has
been eliminated when the UC07/08 firmware is used for MSCP emulation.
However, in TMSCP mode SCSI resets are not filtered; exercise care to prevent
power up or booting of other CPUs attached to the same tape SCSI port, both of
which might cause resets during tape operations.

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2.1 Overview

This section contains the general, environmental, physical, and electrical specifications for the UC07/08 Host Adapter.

Subsection	Title
2.1	Overview
2.2	General Specifications
2.3	Environmental Specifications
2.4	Physical Specifications
2.5	Electrical Specifications

2.2 General Specifications

Table 2-1 contains general specifications for the UC07/08 Host Adapter.

Table 2-1. UC07/08 General Specifications

Parameter	Description
FUNCTION	Providing mass data storage to Digital Equipment Corporation (DEC) computers that use the LSI-11 Bus
Logical CPU Interface	Switch-selectable emulation of DEC's Mass Storage Control Protocol (MSCP) or Tape Mass Storage Control Protocol (TMSCP)
Diagnostics	Embedded diagnostics
Operating System Compatibility (MSCP)	Micro/VMS V4.0 and above RSTS/E V8.0 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
Operating System Compatibility (TMSCP)	Micro/VMS V4.0 and above RSTS/E V9.6 and above RSX-11M PLUS V3.0 and above RT-11 V5.4 and above Ultrix-11 V3.0 and above Ultrix-32m V2.2 and above

Table 2-1. UC07/08 General Specifications (continued)

Parameter	Description
CPU I/O Technique	Direct Memory Access (DMA), including adaptive techniques and block mode
INTERFACE	
CPU Interface	Q-Bus interface
Device Base Address (MSCP)	Standard 17772150_8 Alternates 17772154_8 17760334_8 17760340_8 17760344_8 17760350_8 17760354_8 17760360_8 17760364_8 17760370_8 17760374_8 17760400_8 17760404_8 17760410_8 17760414_8 17760420_8
Device Base Address (TMSCP)	Standard 17774500_8 Alternates 17760404_8 17760410_8 17760414_8 17760444_8 17760450_8 17760454_8 17760504_8 17760510_8 17760514_8 17760520_8 17760524_8 17760530_8 17760534_8 17760540_8 17760544_8
Vector Address	Programmable
Priority Level	BR4 or BR5 (jumper-selectable)

Table 2-1. UC07/08 General Specifications (continued)

Parameter	Description
Peripheral Interface	Small Computer System Interface (SCSI)
Driver Option	Single ended
Maximum Length	20 ft. (6 m.)
SCSI Commands used with MSCP Implementation	00H Test Unit Ready 03H Request Sense 04H Format Unit (extended)* 07H Reassign Block 08H Read 0AH Write 12H Inquiry 15H Mode Select 1AH Mode Sense 1BH Start/Stop Unit 25H Read Capacity 28H Read (extended) 2AH Write (extended) E8H Read Long** EAH Write Long**
Firmware Diagnostic Access Path	
LSI-11	Standard console terminal
MicroVAX	Standard console terminal or GPX workstation monitor
*Formatting only **Vendor-unique commands on Emulex disk drive controllers	

2.3 Environmental Specifications

Table 2-2 contains the environmental specifications for the UC07/08 Host Adapter.

Table 2-2. UC07/08 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	UC07: 40 BTU per hour UC08: 80 BTU per hour

2.4 Physical Specifications

Table 2-3 contains the physical specifications for the UC07/08 Host Adapter.

Table 2-3. UC07/08 Physical Specifications

Parameter	Description
PACKAGING	Single, quad-wide, four-layer PCBA
Dimensions	10.436 by 8.70 inches 26.507 by 22.098 centimeters
Shipping Weight	3 pounds

2.5 Electrical Specifications

Table 2-4 lists and describes the electrical specifications for the UC07/08 Host Adapter.

Table 2-4. UC07/08 Electrical Specifications

Parameter	Description
POWER	UC07: +5 VDC $\pm$ 5%, 2.3 A max.* UC08: +5 VDC $\pm$ 5%, 4.5 A max.*
BUS LOADING	AC bus loads: 2.5 max. DC bus loads: 1 max.
SCSI BUS TERMINATION POWER	Jumper-selectable, 4.75 VDC to 5.25 VDC, diode-isolated and fused at 1 A
*Maximum current rating might be slightly higher if board is jumpered to supply terminator power.	

3.1 Overview

This section is designed to help you determine the best possible subsystem configuration for your application. It will outline the performance capabilities, design constraints, and other factors which must be taken into account when configuring your subsystem. It is not intended to help you generate, adjust, or configure your operating system to use a UC07- or UC08-based subsystem. For information on these subjects you should consult your operating system documentation.

The UC07 and UC08 are high speed, Intelligent Host Adapters that allow you to interface a wide variety of SCSI devices to the DEC Q-Bus. The use of the SCSI bus as the peripheral bus provides a high degree of configuration flexibility not normally available with device controllers using dedicated peripheral buses. The following subsections show some of the possible configurations and outline the performance issues and restrictions that apply to each:

Subsection	Title
3.1	Overview
3.2	UC07 and UC08 Versions
3.3	UC07 and UC08 Configurations
3.4	Performance Considerations

3.2 UC07 and UC08 Versions

The Intelligent Host Adapter is available in two basic versions, the UC07 and the UC08.

3.2.1 UC07

The UC07 is the most basic version of the Intelligent Host Adapter. It consists of a single UNIBUS to SCSI bus Host Adapter on one quad-wide circuit board. The UC07 appears to the operating system as a single MSCP or TMSCP emulation (depending on board setup) that resides at one of 16 switch selectable base addresses assigned to MSCP or TMSCP emulations. The UC07 performs either an MSCP or a TMSCP emulation, as determined by an onboard switch setting. If desired, the SCSI bus of two or more UC07 Host Adapters can be connected to the same SCSI cable to form a single SCSI bus with shared peripherals. However, this type of connection is only usable if all Host Adapters are set to perform the same type of emulation (MSCP or TMSCP). In either mode, each SCSI Port can support a maximum of seven (7) SCSI target devices. Each MSCP SCSI target can support up to eight (8) LUNs; however, the maximum number of LUNs that can be attached to an MSCP SCSI Port is eight (8).

3.2.2 UC08

The UC08 consists of two completely independent Intelligent Host Adapters, each with its own UNIBUS and SCSI bus interface, on one quad-wide circuit board. The UC08 appears to the operating system as two independent MSCP or TMSCP emulations, each of which reside at one of 16 switch selectable base addresses assigned to MSCP and TMSCP emulations. Each of the host adapters is individually switch selectable for either MSCP or TMSCP emulation. Thus, one UC08 can appear to the operating system as either one MSCP and one TMSCP, two MSCP or two TMSCP emulations. If desired, the two SCSI buses on one UC08 Host Adapter can be connected to the same SCSI cable to form a single SCSI bus with shared peripherals. However, this type of connection is only usable if both UC08 sections that share the SCSI bus are set to perform the same type of emulation (MSCP or TMSCP). In either mode, each SCSI port can support a maximum of seven (7) SCSI target devices. Each MSCP SCSI target can support up to eight (8) LUNs; however, the maximum number of LUNs that can be attached to an MSCP SCSI port is eight (8).

3.3 UC07 and UC08 Configurations

NOTE

A SCSI device can be either an initiator or a target.
An initiator is a SCSI device that requests an
operation to be performed by another SCSI device.
A target is a SCSI device that performs an operation
requested by an initiator. On the SCSI bus, the
UC07/08 always acts as an initiator.

The possible configurations for the Intelligent Host Adapter are as follows:

1. **Single initiator, single target, single host adapter.**

   This is the most basic use of the UC07 or UC08. The UC07 can function as either an MSCP or TMSCP controller. When performing an MSCP emulation, the attached target device can be either a magnetic or optical disk device.

2. **Single initiator, multi-target, single host adapter.**

   In this configuration, the UC07 initiator can be in MSCP or TMSCP mode. Special software might be required when using this configuration with a mixture of optical WORM and magnetic drives on the same MSCP emulation. In general, there are no restrictions to mixing 4mm, 8mm, or other SCSI tape devices on the same SCSI port. Tapes and disks must not be mixed on the SCSI Bus in this configuration because a host adapter would be required to perform MSCP and TMSCP simultaneously.

3. **Single initiator, single target, dual host adapter.**

This configuration uses either two UC07s or a single UC08. It is most generally used with the UC08 when a single CPU needs both MSCP and TMSCP on a single quad-wide board slot.

This configuration can also be used to allow mixing of both magnetic and optical disks on the same CPU, while allowing the user to operate the magnetic disk with the standard DEC DU Driver while a separate custom driver is used for the optical disks.

Another possible use of this configuration is in a single CPU system with multiple drives, where the user wants to split the drives between two host adapters to balance the DMA load and provide better performance than is possible with multiple drives on one host adapter.

4. **Single initiator, multi-target, dual host adapter.**

This is very similar to Configuration 3 above, except that if each initiator is performing MSCP emulation, then each initiator can support multiple targets on its SCSI bus. If either initiator is performing a TMSCP emulation, that initiator must have only one target device attached to its SCSI Bus.

5. **Multi-initiator, single or multi-target, dual host adapter, multi-CPU.**

This configuration can be used in applications that require multiple CPU access to a shared set of peripherals among two or more CPUs. By programming the NOVRAM on each host adapter, the user can determine which of the attached drives can be accessed by any CPU. This configuration requires special care to prevent dynamic multi-access unless special software is used to perform Lock Management Functions.

Also because the Intelligent Host Adapter passes Q-Bus resets directly through to the SCSI Bus in the form of SCSI bus resets, some form of protection must be defined to prevent the Host Adapter on any one CPU from issuing SCSI resets while the SCSI Bus is being accessed by another Host Adapter. This condition has been eliminated with UC07/08 revision "G" and later firmware.

The current version of UC07/08 firmware does not support the SCSI Reserve and Release functions. It therefore cannot function as a dual-ported disk in applications that require the disk to be on-line to only one CPU at a time (to provide proper Lock Management Functions). Such applications include LAVC or other non-HSC-based cluster configurations.

It is still possible for each CPU to simultaneously mount and access different tape drives on the same SCSI bus because multi-CPUs share a common set of multiple tape drives; however, Emulex recommends that each tape device be logically mounted by only one CPU at a time.

6. **Other Complex Configurations.**

Figure 3-1 illustrates a very complex multi-CPU, multi-host-adapter configuration, which demonstrates the high degree of system configuration flexibility that the Intelligent Host Adapter provides. This configuration requires special lock management software to control multi-user dynamic access to the shared peripherals.

In this configuration, one of the magnetic disks shared by CPU "A" and CPU "B" is set up as a split logical drive. CPU "A" is set up to use the first half of this drive as the system disk, and to bootstrap from this disk. The second half of the drive is either mounted as Read Only or left unmounted by CPU "A". CPU "B" is set up to use the second half of the split drive as the system disk, and to bootstrap from this disk, with the first half of the disk mounted as Read Only or unmounted.
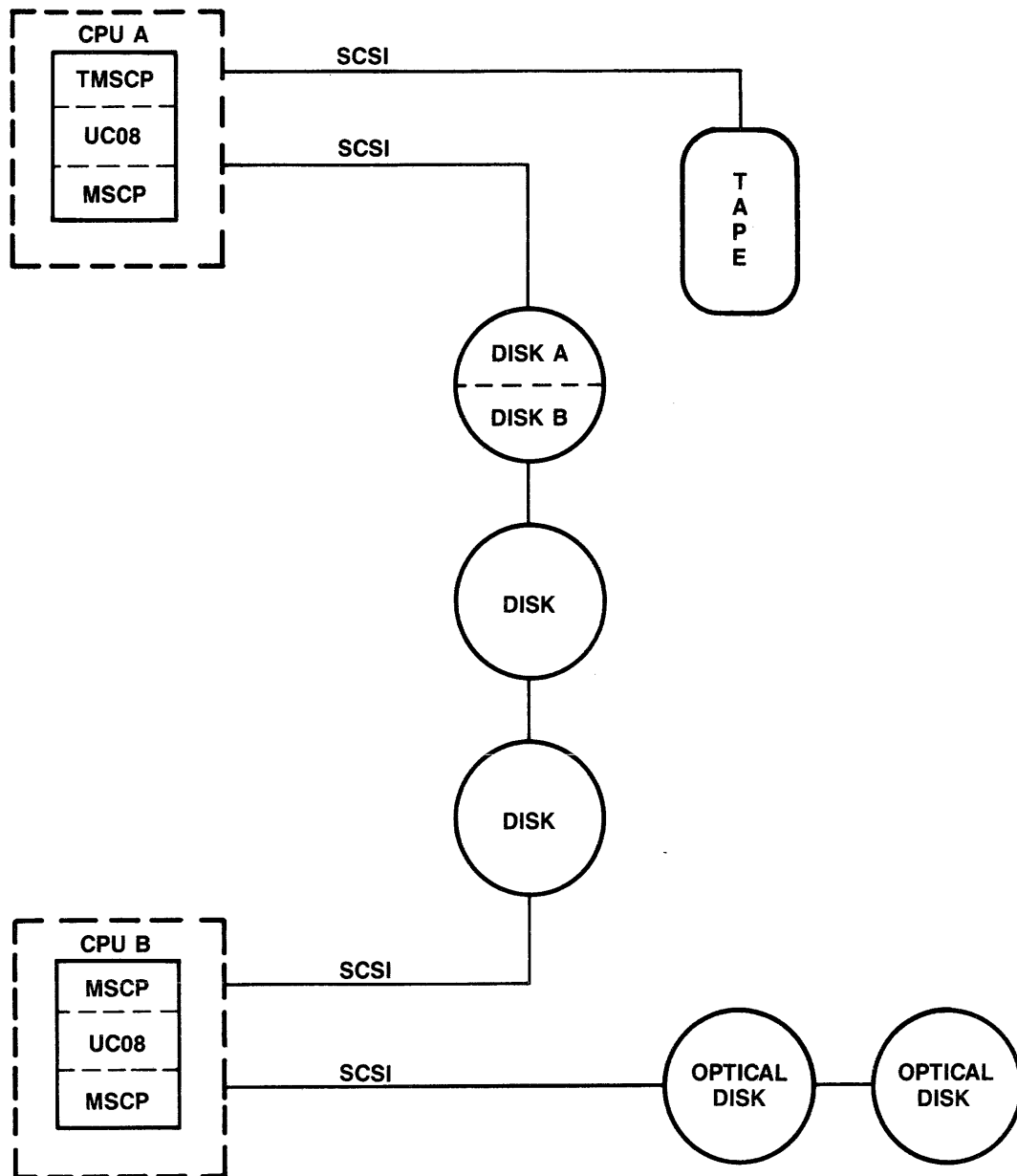
UC0701-2051

Figure 3-1. Complex UC08 Configuration

3.4   Performance Considerations

3.4.1   Disk Subsystems

The UC07 Host Adapter uses the Emulex ESP chip to provide an extremely high speed logical connector to the SCSI bus. In addition, the UC07 supports synchronous transfer disk devices that can support transfer rates up to 4.9 M bytes per second.

The main advantage offered by the UC07 is configuration flexibility. In addition, SCSI's ability to interleave DMA operations in multi-drive, multi-tasking applications might provide better performance than a similarly configured ESDI subsystem.

3.4.2   Tape Subsystems

The UC07/08 can be used with a wide variety of SCSI-based tape drives. The main differences between drive types used will show in capacity and performance. The following subsections list the effects of drive type.

3.4.2.1   8mm and 4mm Cartridge Tape Drives

The UC07 can be used with a wide variety of 8mm to 4mm DAT tape drives to emulate a DEC TK50/70 subsystem. The UC07 and Exabyte combination offers the user a highly reliable, extremely high capacity tape subsystem. However, this combination does perform differently than a SCSI-based 1/2 inch reel-to-reel tape subsystem. In general, the following differences should be expected:

- The transfer rate of the UC07/EXABYTE is lower than that available with a 50 IPS or faster GCR tape subsystem. However, backup times in multi-reel backup applications will be similar or lower for the UC07/Exabyte subsystem due to more efficient streaming and lack of operator intervention for tape changing.

- Any operations that utilize large amounts of tape positioning and directional changes will be considerably slower on the UC07/Exabyte tape subsystem. This means that logical operations such as mounting, initializing, etc., will appear to take longer than would similar operations on traditional tape subsystems. The 4mm DAT will offer some improvement over 8mm, but will not be as fast as 1/2 cartridge or reel-to-reel drives.

- Emulex strongly recommends that the 8mm- and 4mm-based tape subsystems be used primarily with minimum tape positioning utilities such as VMS Backup, RSX-11M BRU, RSTS Backup or SAVRES, or RT11 BUP. Other utilities such as COPY, PIP, and FLX should be used only as absolutely necessary. While the UC07 is compatible with all these utilities, the combination of positioning commands, file mark generation, etc., associated with these utilities makes the UC07 tape subsystem very slow when compared to traditional tape subsystems.

3.4.2.2   1/2" Cartridge and Reel-to-Reel Drives

The 1/2" cartridge drives, such as the LSMI 3480, or 1/2" reel-to-reel drives, offer performance comparable to standard 1/2" Pertec Interface tape drives. This means that all normal utilities used with traditional Pertec tape subsystems can be used with no performance penalties.

4.1 Overview

This section describes the installation of the UC07/08 Host Adapter. Including this overview, this section is divided into six main subsections:

Subsection	Title
4.1	Overview
4.2	Inspection
4.3	UC07/08 Host Adapter Setup (both models)
4.4	Installing the UC07/08-III in the MicroVAX III
4.5	Installing the UC07/08 in the MicroVAX II and LSI-11
4.6	Operation

The installation subsections **do not** contain every step necessary for bringing up the system. An Installation Checklist for each model outlines the process at the beginning of each installation subsection.

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

The UC07/08 is software transparent to DEC MSCP and TMSCP drivers under MicroVMS and Ultrix-32m. Refer to DEC software documentation for sysgen, addressing, and other information.

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.

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.

UC07/08 CONFIGURATION REFERENCE SHEET

GENERAL INFORMATION

1. Host computer type _____
2. Host computer operating system _____
   Version _____

	Port 1 (UC07 and UC08)	Port 2 (UC08 only)
3. Subsystem Model Controller(s)		
Peripheral(s)		

UC07/08 CONFIGURATION

1. Warranty expiration date _____
2. Top assembly number _____
3. Serial number _____

	Port 1 (UC07 and UC08)	Port 2 (UC08 only)
4. Firmware revision number		
5. Q-bus address		
6. Interrupt vector address		
7. Emulation (MSCP or TMSCP)		

8. Switch settings (□ = OFF ■ = ON)
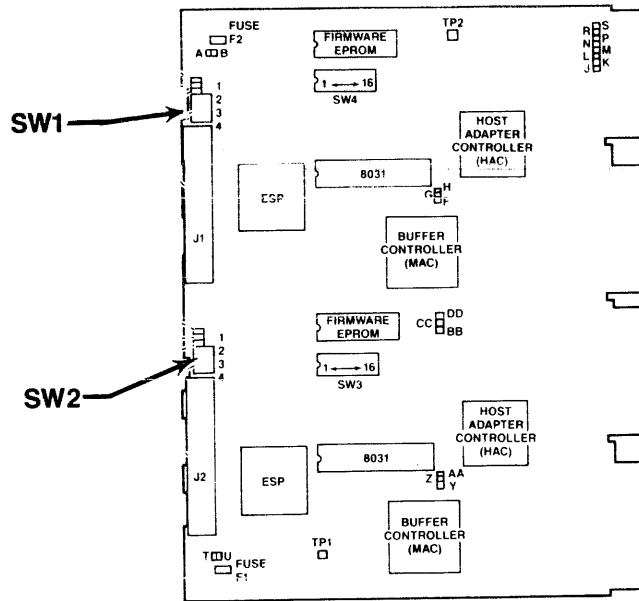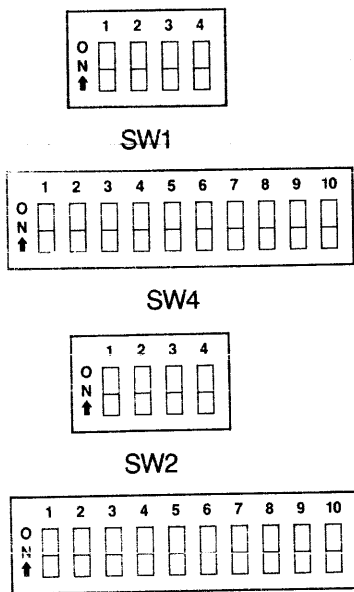
U26 label identifies top assembly and serial numbers.
U29 label identifies Port 1 firmware revision. U22 label identifies Port 2 firmware revision.
Use Pencil

UC0701-2036

Figure 4-1. UC07/08 Configuration Reference Sheet

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 UC07/08 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 UC07/08 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 Host Adapter Setup

Before installing the UC07/08, you must set the Q-bus address and emulation type. Since a UC08 includes two separate host adapters on a single board, you have to set the address and emulation for both adapters. Since it is necessary to differentiate between settings for the two adapters, we will call the adapter associated with the SCSI connector labeled J1, Port 1, and the adapter associated with connector J2, Port 2. If you have a UC07, you can ignore all references to Port 2.

There are two versions of both the UC07 and UC08, one for use in LSI-11 and MicroVAX-II applications and the other for use in MircoVAX-III systems. The MicroVAX-III version has a substantial "handle" on the outside edge of the board and is called a UC07-III or UC08-III. The configuration of both the plain and -III versions are the same.

Figure 4-2 shows the locations of the configuration switches, connectors, and jumpers on the UC07/08; Figure 4-3 shows the same items on the UC07/08-III. The two figures also give the factory settings for all jumpers on the UC07/08. Jumpers that are installed at the factory are shown shaded in the two figures.
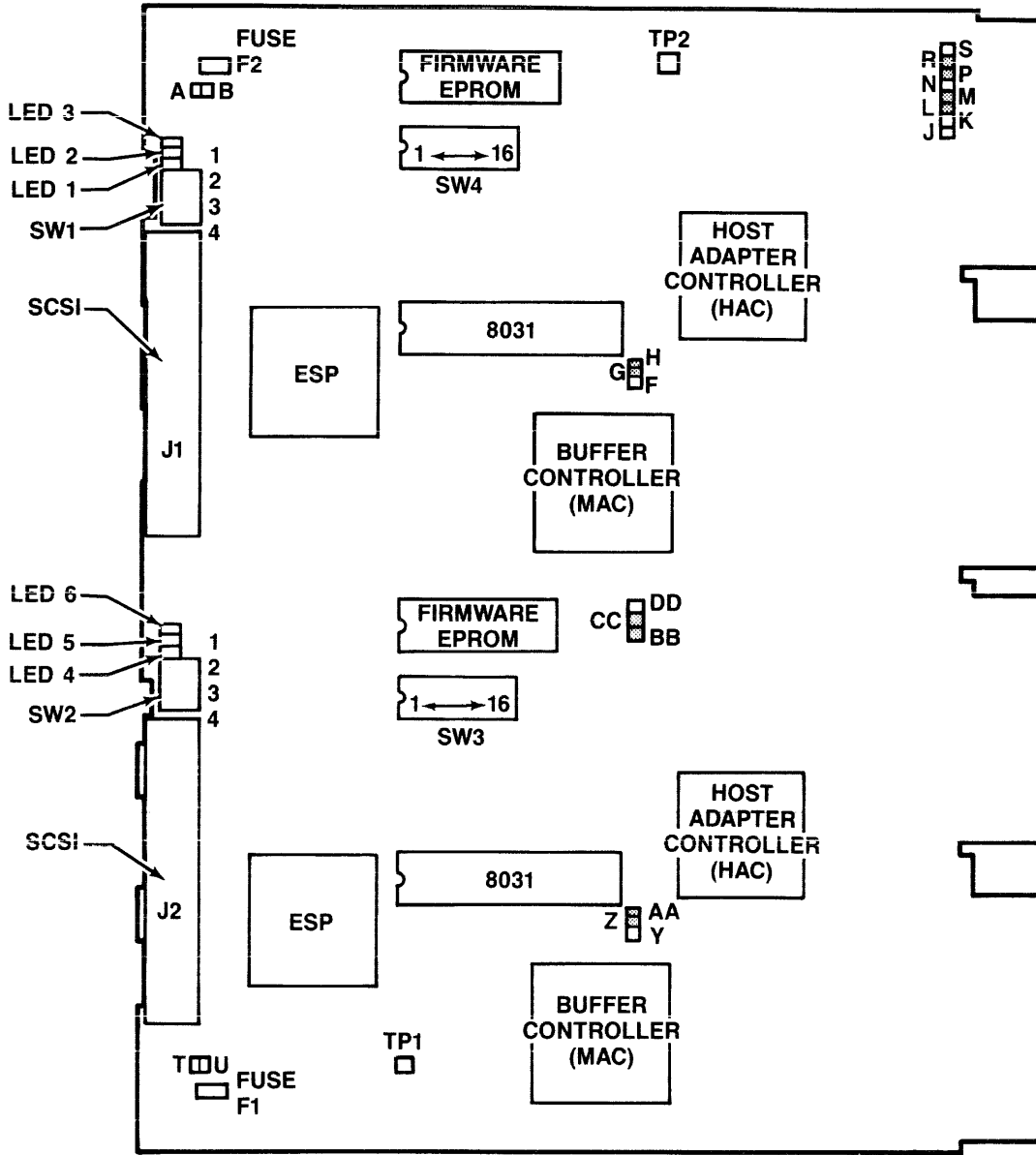
NOTE: TP1 AND TP2 ARE GROUND REFERENCES

UC0701-2053

Figure 4-2. UC07/08 Host Adapter Assembly
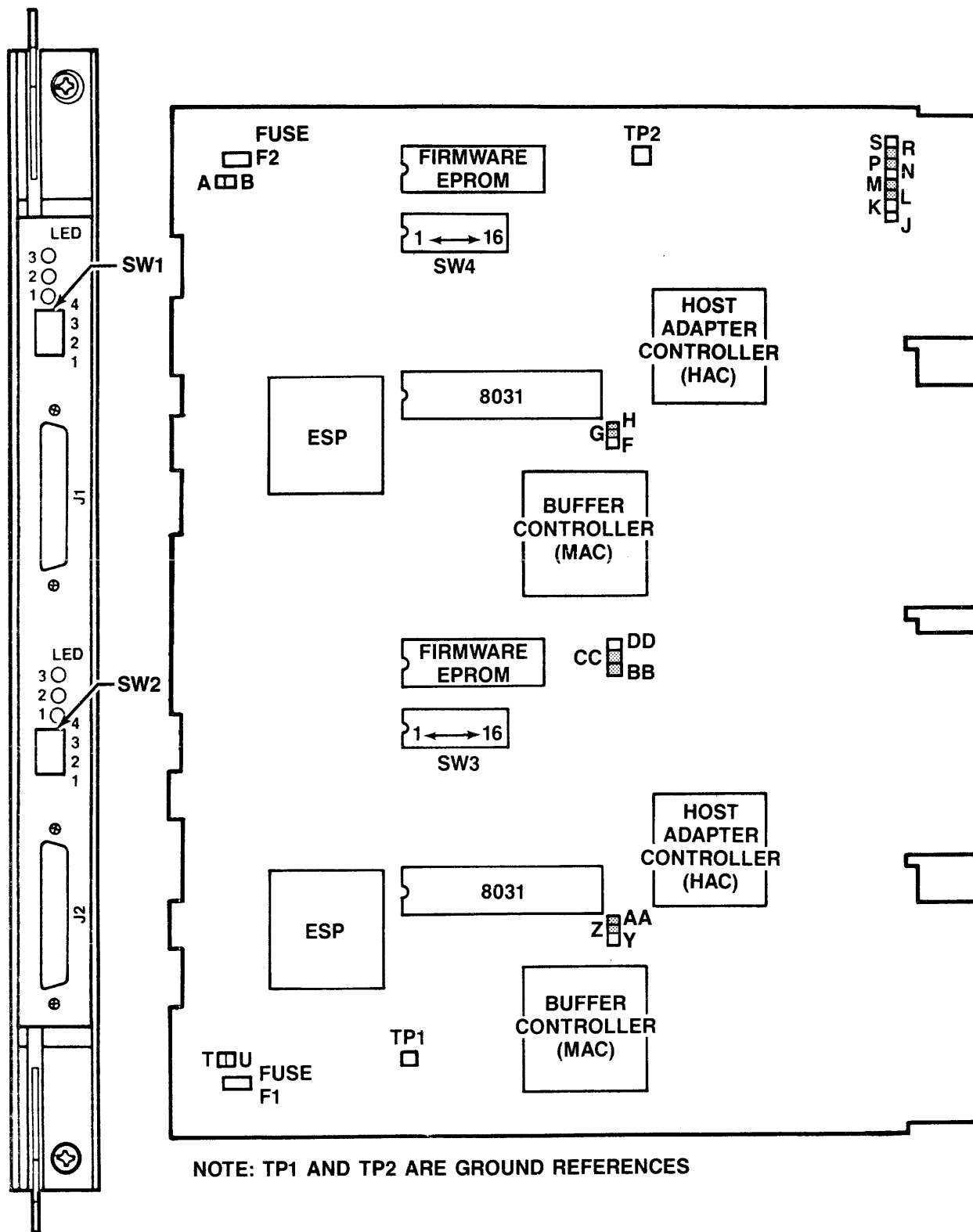
NOTE: TP1 AND TP2 ARE GROUND REFERENCES

UC0701-2054

Figure 4-3. UC07/08-III Host Adapter Assembly

Table 4-1 defines the function and factory configuration of all switches on the UC07/08 adapter.

Table 4-1. UC07/08 Switch Definitions and Factory Configuration

Switch	OFF(0)	ON(1)	Fact	Function	Section
			Port 1 (J1)		
SW1-1	Run	Reset/Halt	OFF(0)	Run vs. Reset/Halt	6.4
SW1-2	Enable	Disable	OFF(0)	Fast File Search	4.3.6
SW1-3	-	-	OFF(0)	Reserved	
SW1-4	Normal	Loop	OFF(0)	Loop on Self Test Error	
SW4-1	-	-	OFF(0)	Host Adapter Q-bus Address	4.3.2
SW4-2	-	-	OFF(0)	Host Adapter Q-bus Address	4.3.2
SW4-3	-	-	OFF(0)	Host Adapter Q-bus Address	4.3.2
SW4-4	-	-	OFF(0)	Host Adapter Q-bus Address	4.3.2
SW4-5	TMSCP	MSCP	ON(1)	Emulation	4.3.1
SW4-6	Disable	Enable	OFF(0)	Autoboot (MSCP only)	4.3.4
SW4-7	-	-	OFF(0)	Reserved	
SW4-8	-	-	OFF(0)	Reserved	
SW4-9	-	-	OFF(0)	Reserved	
SW4-10	-	-	OFF(0)	Reserved	
			Port 2 (J2)		
SW2-1	Run	Reset/Halt	OFF(0)	Run vs. Reset/Halt	6.4
SW2-2	Enable	Disable	OFF(0)	Fast File Search	4.3.6
SW2-3	-	-	OFF(0)	Reserved	
SW2-4	Normal	Loop	OFF(0)	Loop on Self Test Error	
SW3-1	-	-	OFF(0)	Host Adapter Q-bus Address	4.3.2
SW3-2	-	-	OFF(0)	Host Adapter Q-bus Address	4.3.2
SW3-3	-	-	OFF(0)	Host Adapter Q-bus Address	4.3.2
SW3-4	-	-	OFF(0)	Host Adapter Q-bus Address	4.3.2
SW3-5	TMSCP	MSCP	ON(1)	Emulation	4.3.1
SW3-6	Disable	Enable	OFF(0)	Autoboot (MSCP only)	4.3.4
SW3-7	-	-	OFF(0)	Reserved	
SW3-8	-	-	OFF(0)	Reserved	
SW3-9	-	-	OFF(0)	Reserved	
SW3-10	-	-	OFF(0)	Reserved	
ON(1) = Closed			Reserved switches must be left OFF		
OFF(0) = Open			Fact = Factory switch setting		

NOTE

If you change a switch position on the UC07/08 or change configuration values in NOVRAM, you must also reset the UC07/08 so that the adapter's initialization sequence reads the codes established by the switch settings and/or NOVRAM. To reset the UC07/08, either toggle (ON then OFF) switch SW1-1 (SW2-1 for Port 2), or power-down and power-up the system.

4.3.1 Emulation

Each host adapter on the UC07/08 is capable of performing one of two emulations: MSCP to support disk devices, and TMSCP to support tape devices. Select the appropriate emulation for your application. See Table 4-2 for switch setting information.

Table 4-2. Emulation Selection

Port	Switch	OFF	ON	Function
1	SW4-5	TMSCP	MSCP	Emulation
2	SW3-5	TMSCP	MSCP	Emulation

4.3.2 Host Adapter Bus Address

Every Q-Bus 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 device, in this case an MSCP or TMSCP host adapter.

The starting address for the host adapter associated with Port 1 (J1) is selected using switches SW4-1 through SW4-4. When there is a second host adapter (Port 2) on the board (UC08), its address is selected using SW3-1 through SW3-4.

CAUTION

For UC08 and UC08-III boards, both Port 1 and Port 2 must not be set to the same host adapter bus address.

4.3.2.1 Disk (MSCP) Emulations

The address selected by the address switches varies depending on the emulation selected. Table 4-3 lists the addresses and switch settings for MSCP emulations.

The standard address for MSCP devices is 17772150, which is typically assigned to the first MSCP-type device on a system.

For more information on determining the Q-Bus address, refer to DEC operating system and MicroVAX 3500/3600 system documentation.

Table 4-3. MSCP Emulation Bus Address Settings

Port 1 (J1)					Port 2 (J2)				
Bus Address (in octal)	--- SW4 ---				Bus Address (in octal)	--- SW3 ---			
	4	3	2	1		4	3	2	1
17772150	0	0	0	0	17772150	0	0	0	0
17772154	0	0	0	1	17772154	0	0	0	1
17760334	0	0	1	0	17760334	0	0	1	0
17760340	0	0	1	1	17760340	0	0	1	1
17760344	0	1	0	0	17760344	0	1	0	0
17760350	0	1	0	1	17760350	0	1	0	1
17760354	0	1	1	0	─17760354	0	1	1	0
17760360	0	1	1	1	17760360	0	1	1	1
17760364	1	0	0	0	17760364	1	0	0	0
17760370	1	0	0	1	17760370	1	0	0	1
17760374	1	0	1	0	17760374	1	0	1	0
17760400	1	0	1	1	17760400	1	0	1	1
17760404	1	1	0	0	17760404	1	1	0	0
17760410	1	1	0	1	17760410	1	1	0	1
17760414	1	1	1	0	17760414	1	1	1	0
17760420	1	1	1	1	17760420	1	1	1	1
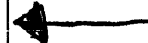
4.3.2.2 Tape (TMSCP) Emulations

The address selected by the address switches varies depending on the emulation selected. Table 4-4 lists the addresses and switch settings for TMSCP emulations.

The standard address for TMSCP devices is 17774500, which is typically assigned to the first TMSCP-type device on a system.

For more information on determining the Q-Bus address, refer to DEC operating system and MicroVAX 3500/3600 system documentation.

Table 4-4. TMSCP Emulation Bus Address Settings

Port 1 (J1)					Port 2 (J2)				
Bus Address (in octal)	--- SW4 ---				Bus Address (in octal)	--- SW3 ---			
	4	3	2	1		4	3	2	1
17774500	0	0	0	0	17774500	0	0	0	0
17760404	0	0	0	1	17760404	0	0	0	1
17760410	0	0	1	0	17760410	0	0	1	0
17760414	0	0	1	1	17760414	0	0	1	1
17760444	0	1	0	0	17760444	0	1	0	0
17760450	0	1	0	1	17760450	0	1	0	1
17760454	0	1	1	0	17760454	0	1	1	0
17760504	0	1	1	1	17760504	0	1	1	1
17760510	1	0	0	0	17760510	1	0	0	0
17760514	1	0	0	1	17760514	1	0	0	1
17760520	1	0	1	0	17760520	1	0	1	0
17760524	1	0	1	1	17760524	1	0	1	1
17760530	1	1	0	0	17760530	1	1	0	0
17760534	1	1	0	1	17760534	1	1	0	1
17760540	1	1	1	0	17760540	1	1	1	0
17760544	1	1	1	1	17760544	1	1	1	1

4.3.3   Interrupt Vector Address

The interrupt vector address for the UC07/08 is programmed into the device by the operating system during the MSCP initialization sequence.

4.3.4   Autoboot (LSI-11 Only)

The UC07/08 has an autoboot feature which you can enable for Port 1 or Port 2 using switches as described in Table 4-5. See subsection 5.4.1.6 for a complete description of this option.

Table 4-5. Autoboot

Port	Switch	OFF	ON	Function
1	SW4-6	Disable	Enable	Autoboot
2	SW3-6	Disable	Enable	Autoboot

4.3.5 Interrupt Priority Level

The UC07/08 is factory configured for interrupt request (IRQ) level 4 (BR4). This is the preferred configuration for most DEC Q-Bus systems. In the case of special applications, the user may change to IRQ5 (BR5) via jumpers. Table 4-6 below describes the different jumper settings. If you use IRQ5, Emulex strongly recommends that the UC07/08 be located ahead of all DEC devices on the bus.

Table 4-6. Interrupt Priority Level Quad-wide

Port	Jumper	BR4 (Factory)	BR5
1	P-R R-S	IN OUT	OUT IN
2	L-M M-N	IN OUT	OUT IN

Table 4-7. Interrrupt Priority Level Dual-wide (UC07/D)

Jumper	BR4 (Factory)	BR5
T-U V-U	IN OUT	OUT IN

4.3.6 Fast File Search Switch

The UC07/08 is factory configured to enable fast file search mode on the attached EXABYTE drive. In this mode, all software SPACE FILE MARK commands are sent unmodified directly to the tape drive. If the command is for the forward direction, the drive spaces forward at high speed the number of file marks specified in the command. However, because the EXABYTE cannot read while it is in high speed, the UC07/08 cannot keep track of the number of individual records that have been spaced over.

Although not usual, it is quite possible for an application program to request that the TMSCP tape device indicate its position on tape by maintaining a count of how many records from BOT it is on the tape. If your application requires this type of position tracking, it might be necessary for you to disable fast file search by turning SW1-2 to the ON position. When fast file search is disabled, the UC07/08 converts all SPACE FILE MARK commands to SPACE RECORD commands. This enables the UC07/08 to keep track of the exact number of records spaced over.

Emulex has verified that normal VMS/RSX utilities work correctly with fast file search enabled. Note that certain operating systems have demonstrated incompatibility with Fast File Search mode and might require that you disable the feature for proper operation.

4.4   Installing the UC07/08-III in the MicroVAX-III

This subsection describes the physical installation of the UC07/08-III Host Adapter in DEC's MicroVAX 3500 and 3600. You should have already completed steps 1 and 2 on the following Installation Checklist:

UC07/08-III INSTALLATION CHECKLIST

☐ 1. Inspect the UC07/08-III Host Adapter. (Subsection 4.2)

☐ 2. Set up the switches and jumpers on the UC07/08-III module. (Subsection 4.3)

☐ 3. Install the adapter in the MicroVAX 3500/3600 backplane.

☐ 4. Install the UC07/08-III Distribution Panel in the rack-mount cabinet and connect to the UC07/08-III PCBA.

☐ 5. Install and connect the disk or tape controller(s) to the UC07/08-III Distribution Panel.

☐ 6. Run the onboard embedded diagnostics. (This step includes formatting the disk drives.) See Section 5.

☐ 7. Bring the system up.

4.4.1   Maintaining FCC Class A Compliance

Emulex has tested the UC07/08-III Intelligent Host Adapter with DEC computers that comply with FCC Class A limits for radiated and conducted interference. When properly installed, the UC07/08-III does not cause compliant computers to exceed Class A limits.

The UC07/08-III Host Adapter subsystem has only one physical configuration. The UC07/08-III PCBA is installed in the MicroVAX 3500/3600 cabinet and the UC07/08 Distribution Panel and disk drives are mounted in a separate rack-mount 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 UC07/08-III, nothing must be done that would reduce this shield's effectiveness. That is, when the UC07/08-III 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.

4.4.2 Physically Installing the UC07/08-III PCBA

The following subsections describe the physical installation of the UC07/08-III Host Adapter PCBA.

4.4.2.1 System Preparation

To prepare the MicroVAX 3500/3600 to accept the UC07/08-III, use the following procedure:

1. Power down the system by switching OFF the main power switch.

2. Open the front chassis door.

3. Remove a blank cover from the front of the chassis so that an empty slot is exposed.

4.4.2.2 Slot Selection

The UC07/08-III may be assigned to any desired slot because it uses the Q-Bus four-level interrupt scheme to perform distributed interrupt arbitration.

There must be no unused slots between the CPU and the UC07/08-III.

4.4.2.3 Mounting

Plug the UC07/08-III into the MicroVAX 3500/3600 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.

The UC07/08-III PCBA includes a front panel with extractor handles. To install the board, slide the board in the slot with the extractor handles in the open position (aligned with the front panel of the PCBA). See Figure 4-4. When the board is properly positioned in the throat of the bus connectors, seat the board by pushing the extractor handles towards the center of the front panel.

The front panel of the UC07/08 PCBA might be set back further than the panels of the DEC boards in the backplane. Install a gap-filler panel on either side of the UC07/08-III, between a flat-board cover and the front panel of the UC07/08-III. (Each UC07/08-III is shipped with two gap-filler panels; refer to Tables 1-3 and 1-4 for part number.)

Use a Philips head screwdriver and push and turn the handle-locking screws a quarter-turn to lock the UC07/08-III PCBA into the chassis.

EXTRACTOR
HANDLE

SCREW

UC07/08
FRONT
PANEL

SCREW

EXTRACTOR
HANDLE

CPU CHASSIS
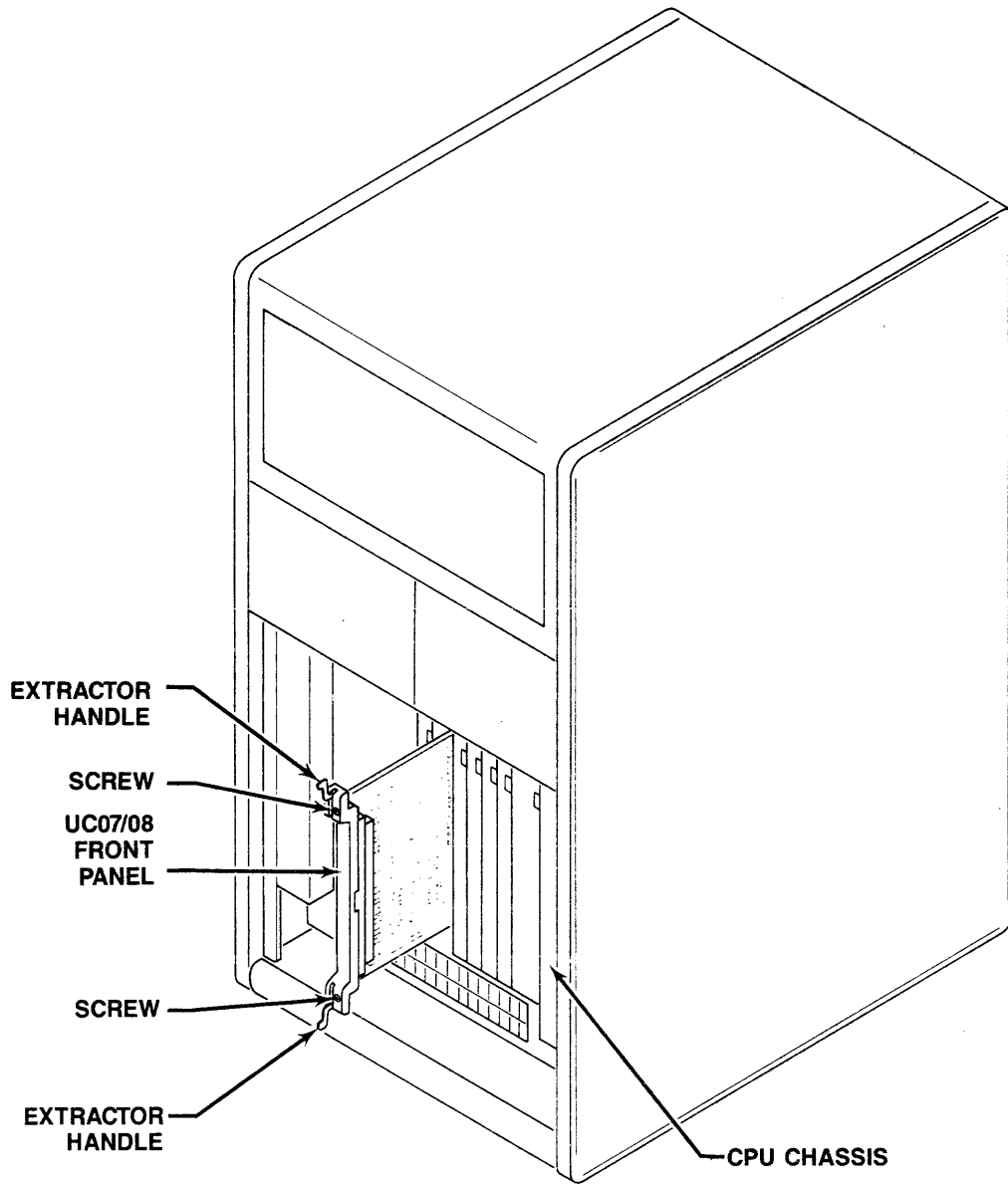
UC0701-2055

Figure 4-4. Mounting the UC07/08-III PCBA in a MicroVAX 3500/3600

4.4.2.4   SCSI Controller Preparation

The SCSI controllers attached to the UC07/08 Host Adapter must be configured to work with the adapter. Generally, there are five variables which must be considered:

- The controller's SCSI bus address
- SCSI bus parity generation and checking
- SCSI bus disconnect/reconnect capability
- SCSI bus synchronous data transfer support
- Drive LUN and parameters

Every controller and host adapter on a given SCSI bus must have a unique address. (Remember that with the UC08, you have two separate SCSI ports and thus can have two separate buses.) The range of addresses available is from 0 to 7. Traditionally, the following addresses are assigned to the various devices on a SCSI bus:

Host Adapter	7
First Target Device	0
Second Target Device	1

These assignments are arbitrary, but the adoption of such a scheme ensures that no two devices are accidentally assigned the same number.

During your configuration of the UC07/08's NOVRAM (Section 5), you will be required to specify the both the host adapter's SCSI address and the SCSI address(es) of the controllers which it is to support. Select addresses for those controllers now and configure them accordingly. See the manufacturer's manual for instructions.

The UC07/08 always generates parity during SCSI bus transfers. If parity checking is an optional feature of your SCSI controller, enable it now. If your controller can not generate parity (presumably it will also not check parity, but that does not matter), you must disable the UC07/08's parity checking feature when you load the NOVRAM. See subsections 5.4.1.4 and 5.5.2.2.

The UC07/08 supports the SCSI disconnect/reconnect feature, which allows the target of a SCSI command to logically disconnect from the initiator while processing the command. This frees the SCSI bus for other operations and thus increases performance.

If the controller you are using supports this feature, enable it (if necessary) now. You will also have to enable the UC07/08's support of this feature when you are loading its NOVRAM (see subsections 5.4.1.25 and 5.5.2.2).

The UC07/08-III supports synchronous SCSI data transfers. If your SCSI device supports this feature, refer to the device's manual and take the steps necessary to enable it.

As every controller and host adapter on the SCSI bus must have a unique address, so to must each drive on a controller have a unique Logical Unit Number (LUN). If drive has an embedded SCSI controller, then its LUN is always 0. However, if your controller supports more than one drive (as with Emulex's MD25, which supports four), you will have to assign each drive a unique LUN starting with 0 (or one if that is the number lowest number available for that drive type; the controller will still refer to it as LUN 0). Assign additional drives sequential addresses (i.e., 0, 1, 2, ...).

Each drive will have some unique characteristics which will have to be reported to the UC07/08 when you load its NOVRAM. The UC07/08 will identify the drive by its controller's SCSI address and LUN.

4.4.2.5   Subsystem Placement

Place and install the controller and drive assemblies according to the manufacturer's instructions. Position the subsystems in their final places before beginning the installation of the UC07/08. This positioning allows the I/O cable routing and length to be accurately judged.

4.4.3   Cabling

In a UC07/08-III subsystem, the UC07/08-III PCBA is installed in the MicroVAX 3500/3600 cabinet and the SCSI subsystem is mounted in a separate cabinet. The UC07/08-III interfaces with the SCSI device(s) it controls using one or two 50-conductor round shielded cables, the UC07/08-III Distribution Panel, and one or two 50-conductor flat-ribbon cables. Whether one or two cables are required depends on whether a UC07 or UC08 is being installed. For the rest of this discussion, we will assume a two SCSI bus system is being installed. If not, ignore references to the Port 2 system (UC08 J2).

The two round-shielded cables are connected from the high-density connectors J1 and J2 on the UC07/08-III PCBA front panel to the 50-pin connectors J1 IN and J2 IN (respectively) on the front side of the UC07/08-III Distribution Panel. From connectors J3 OUT and J4 OUT on the back side of the UC07/08-III Distribution Panel, two 50-conductor flat-ribbon cables attach to connectors on the first SCSI controller on the SCSI bus. Maximum cable length (cumulative) is 6 meters. Figure 4-5 is a basic cabling diagram.
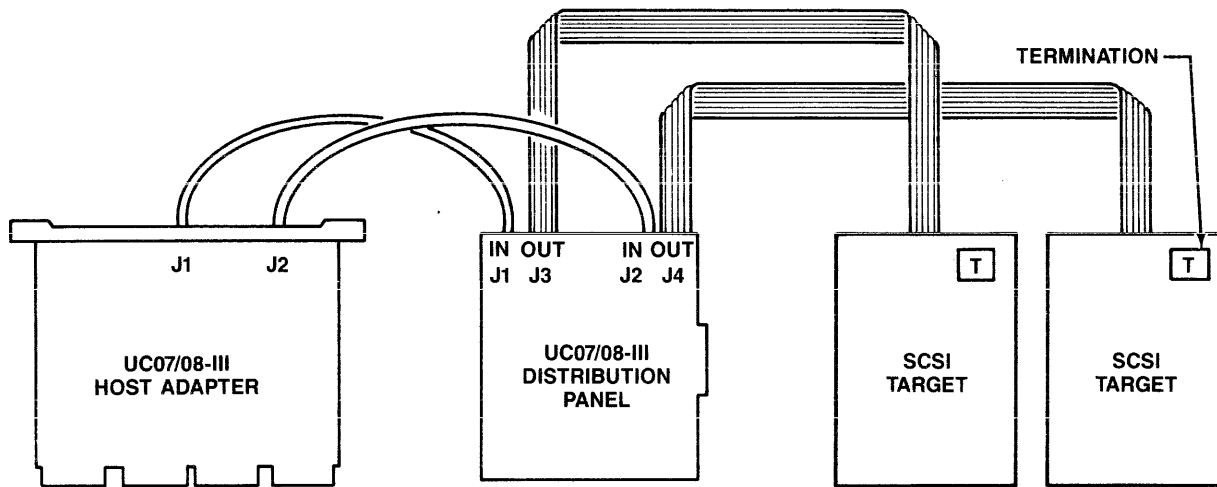
Figure 4-5. Basic Cabling

UC0701-2056

Because the UC07/08-III PCBA and the SCSI subsystems are located in separate cabinets, the cables that run between the cabinets are shielded. The points of cabinet exit and entry must not cause the computer installation to exceed FCC limits for RFI. The UC07/08-III Distribution Panel, rack-mount panel, and round-shielded cables designed for this purpose are available from Emulex (subsection 1.3). The UC07/08-III Distribution Panel (Figure 4-6) is designed to fit directly into a rack-mount panel which installs in any standard 19-inch RETMA rack. The rack-mount panel is shown in Figure 4-7.

Procedure:

1. Ensure the UC07/08-III PCBA is installed in the backplane of the MicroVAX 3500/3600 and that the system power is OFF.

2. Remove two of the four small panels from one side of the rack-mount panel (Figure 4-8). Install a UC07/08-III Distribution Panel (Figure 4-6) in the resulting aperture and secure it with the four captive screws. Tighten the screws finger-tight. Make sure that no gaps are present around the UC07/08-III Distribution Panel.
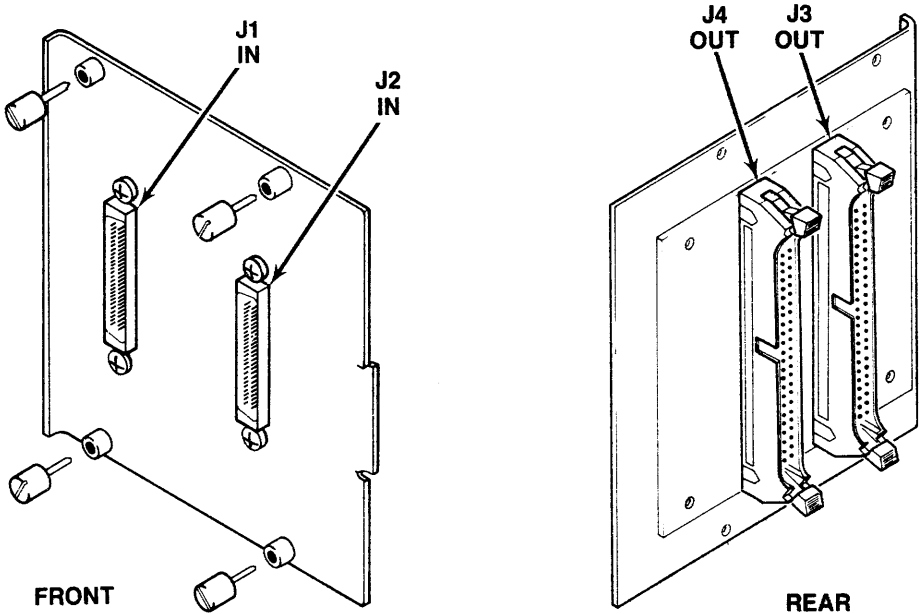
UC0701-2057

Figure 4-6. UC07/08-III Distribution Panel
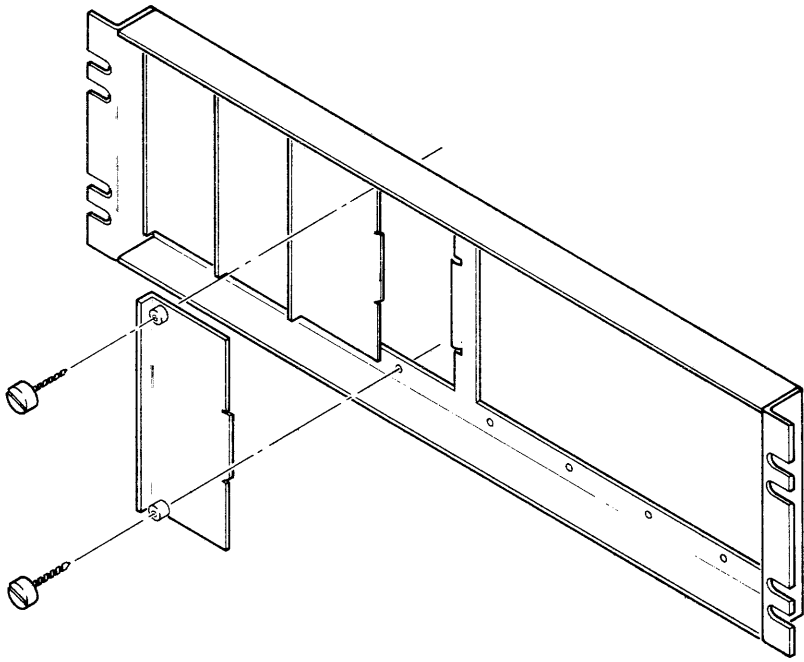
UC0701-2058

Figure 4-7. Rack-Mount Panel

3. Install the rack-mount panel containing the UC07/08-III Distribution Panel in the RETMA rack in the transport cabinet (Figure 4-8).

4. Connect the round-shielded cables from the UC07/08-III PCBA to the Distribution Panel. Align the top of the cable header on the first round-shielded cable (the cable runs out the bottom) with the top of the high-density connector J1 on the front panel of the UC07/08-III PCBA. Hold in the latch on the top of the cable header and press the header into J1; connect the header at the other end to connector J1 IN on the front side of the UC07/08-III Distribution Panel. Repeat for the second round-shielded cable from J2 on the UC07/08-III PCBA to connector J2 IN on the UC07/08-III Distribution Panel.

5. Connect the flat-ribbon cables from the UC07/08-III Distribution Panel to the SCSI controller in the disk or tape subsystem. Align the molded arrow on the cable header of the first flat-ribbon cable with pin 1 of connector J3 OUT on the back side of the UC07/08-III Distribution Panel. Press the header into J3 OUT; attach the header at the other end of the cable to the appropriate connector SCSI controller. Repeat for the second flat-ribbon cable from J4 OUT on the UC07/08-III Distribution Panel to the appropriate connector on the second SCSI subsystem. Make sure that the latches on the connector fully engage the cable header.

End of Procedure

4.4.3.1 Termination

SCSI buses are terminated at each end. The UC07/08-III provides termination for one end of the cable. The last SCSI device on the bus must likewise terminate the bus; however, controllers daisy chained between the UC07/08 and last controller on the bus must have their terminators removed. See the controller or subsystem manufacturer's documentation for instructions in installing or removing terminators.

4.4.3.1.1 Termination Power

The UC07/08-III can be configured to provide termination power to the terminator at the opposite end of the SCSI bus. This feature might be required in certain applications in which the SCSI device at the opposite end of the SCSI bus cannot provide termination for the SCSI bus. The UC07-III can provide power to a remote termination circuit by placing jumper A-B IN. On the UC08-III, this feature is enabled by placing jumper A-B IN for Port 1 (connector J1) or placing jumper T-U IN for Port 2 (connector J2). The factory setting is OUT for both of these jumpers. Emulex recommends the use of keyed connectors in applications where the UC07/08-III provides terminator power. This will prevent accidental grounding or misconnection of termination power.

The termination power on the UC07/08-III has the following characteristics:

-   4.75 volts DC to 5.25 volts DC
-   Fused at 1 ampere (Fuses: F1 and F2)
-   Diode to prevent backflow of power into the UC07/08-III
-   Jumpers to enable or disable this feature

RACK-MOUNT
PANEL

SCSI SUBSYSTEM

HOST
UC07/08-III
ADAPTER

FLAT RIBBON
CABLES

ROUND
SHIELDED
CABLES

LATCH

J3 OUT

CABLE
HEADER

UC07/08-III
FRONT
PANEL

FLAT RIBBON
CABLES

J1
IN

ROUND
SHIELDED
CABLES

ROUND
SHIELDED
CABLES

J4 OUT

J2
IN

J1

J2

UC07/08-III
DISTRIBUTION
PANEL
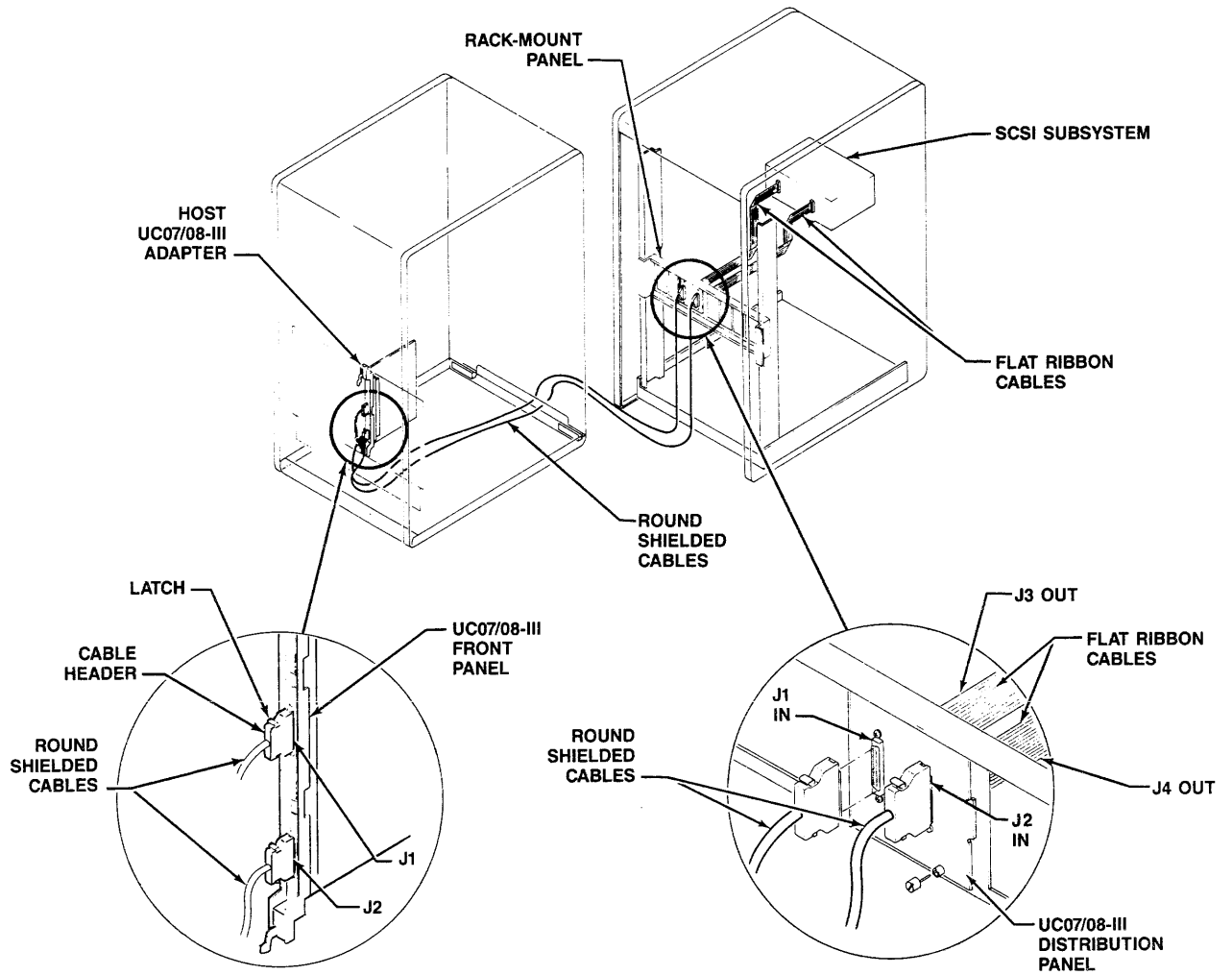
UC0701-2059

Figure 4-8. UC07/08-III Subsystem Cabling

4.5   Installing the UC07/08 in the MicroVAX-II and LSI-11

This subsection describes the physical installation of the UC07/08 Host Adapter in DEC's MicroVAX-II and LSI-11 systems. You should have already completed steps 1 and 2 on the following Installation Checklist:

UC07/08 INSTALLATION CHECKLIST

☐ 1. Inspect the UC07/08 Host Adapter. (Subsection 4.2)

☐ 2. Set up the switches and jumpers on the UC07/08 module. (Subsection 4.3)

☐ 3. Install the adapter in the Q-Bus backplane.

☐ 4. Install and connect the disk or tape controller(s) to the UC07/08.

☐ 5. Run the onboard embedded diagnostics. (This step includes formatting the disk drives.) See Section 5.

☐ 6. Bring the system up.

4.5.1   Maintaining FCC Class A Compliance

Emulex has tested the UC07/08 Intelligent Host Adapter with DEC computers that comply with FCC Class A limits for radiated and conducted interference. When properly installed, the UC07/08 does not cause compliant computers to exceed Class A limits.

The UC07/08 Host Adapter may be installed in a large number of configurations, with its associated SCSI subsystems in the same cabinet as the CPU and UC and with the subsystem in a separate cabinet.

When the SCSI subsystem and UC07/08 are located in the same cabinet, they may connected using unshielded, 50-wire cables.

When the SCSI subsystem and the UC07/08 are located in separate cabinets, you must use shielded cables for the transition between the two cabinets. Also, the areas where the cable enter and leave the CPU and subsystem cabinets must be constructed so as not to destroy the cabinets RFI shielding capability. See below. For such installations, it is the customer's sole responsibility to ensure that FCC Class A compliance is maintained by the system with the UC07/08 installed.

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 UC07/08, nothing must be done that would reduce this shield's effectiveness. That is, when the UC07/08 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.

4.5.2 Physically Installing the UC07/08 PCBA

The following subsections describe the physical installation of the UC07/08 Host Adapter PCBA.

4.5.2.1 System Preparation

To prepare the MicroVAX-II or LSI-11 to accept the UC07/08, use the following procedure:

LSI-11 and MicroVAX-II Preparation:

1. Power down the system by switching OFF the main AC breaker.

2. Remove the rear cover from the chassis so that the patch panel is exposed. The rear cover is held on by snap pads. Grasp the cover at the top and bottom, and pull straight back.

3. Loosen the captive screws from the patch panel using a standard screwdriver.

4. Remove the patch panel.

5. Find the flat-ribbon cable that connects the CPU module to the patch panel. For easier board installation, you may disconnect the CPU flat-ribbon cable from the patch panel.

LSI-11 Series Preparation:

1. Power down the system by switching OFF the main ac breaker.

2. Remove the cover from the chassis so that the backplane is exposed. Do not replace the covers or patch panels until the installation is verified (Section 5).

4.5.2.2   Slot Selection

The UC07/08 may be assigned to any desired slot because it uses the Q-Bus four-level interrupt scheme to perform distributed interrupt arbitration.

There must be no unused slots between the CPU and the UC07/08.

4.5.2.3   Mounting

The UC07/08 Host Adapter should be plugged into the Q-Bus 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 pressing it into place.

4.5.2.4   SCSI Controller Preparation

The SCSI controllers attached to the UC07/08 Host Adapter must be configured to work with the adapter. Generally, there are five variables which must be considered:

- The controller's SCSI bus address
- SCSI bus parity generation and checking
- SCSI bus disconnect/reconnect capability
- SCSI bus synchronous data transfer support
- Drive LUN and parameters

Every controller and host adapter on a given SCSI bus must have a unique address. (Remember that with the UC08, you have two separate SCSI ports and thus can have two separate buses.) The range of addresses available is from 0 to 7. Traditionally, the following addresses are assigned to the various devices on a SCSI bus:

Host Adapter	7
First Disk Controller	0
Second Disk Controller	1
First Tape Controller	4

These assignments are arbitrary, but the adoption of such a scheme ensures that no two devices are accidentally assigned the same number. In MSCP mode, each SCSI port can support a maximum of seven (7) SCSI target devices. Each SCSI target can support up to eight (8) LUNs; however, the maximum number of LUNs that can be attached to a SCSI port is eight (8).

During your configuration of the UC07/08's NOVRAM (Section 5), you will be required to specify the both the host adapter's SCSI address and the SCSI address(es) of the controllers which it is to support. Select addresses for those controllers now and configure them accordingly. See the manufacturer's manual for instructions.

The UC07/08 always generates parity during SCSI bus transfers. If parity checking is an optional feature of your SCSI controller, enable it now. If your controller can not generate parity (presumably it will also not check parity, but that does not matter), you must disable the UC07/08's parity checking feature when you load the NOVRAM. See subsections 5.4.1.4 and 5.5.2.2.

The UC07/08 supports the SCSI disconnect/reconnect feature, which allows the target of a SCSI command to logically disconnect from the initiator while processing the command. This frees the SCSI bus for other operations and thus increases performance.

If the controller you are using supports this feature, enable it (if necessary) now. You will also have to enable the UC07/08's support of this feature when you are loading its NOVRAM (see subsections 5.4.1.25 and 5.5.2.2).

The UC07/08 supports synchronous SCSI data transfers. If your SCSI device supports this feature, refer to the device's manual and take the steps necessary to enable it.

As every controller and host adapter on the SCSI bus must have a unique address, so to must each drive on a controller have a unique Logical Unit Number (LUN). If drive has an embedded SCSI controller, then its LUN is always 0. However, if your controller supports more than one drive (as with Emulex's MD25, which supports four), you will have to assign each drive a unique LUN starting with 0 (or one if that is the number lowest number available for that drive type; the controller will still refer to it as LUN 0). Assign additional drives sequential addresses (i.e., 0, 1, 2, ...).

Each drive will have some unique characteristics which will have to be reported to the UC07/08 when you load its NOVRAM. The UC07/08 will identify the drive by its controller's SCSI address and LUN.

4.5.2.5   Subsystem Placement

Place and install the controller and drive assemblies according to the manufacturer's instructions. Position the subsystems in their final places before beginning the installation of the UC07/08. This positioning allows the I/O cable routing and length to be accurately judged.

4.5.3   Cabling

The UC07/08 is connected to SCSI controllers using a standard 50-wire flat cable with 50-pin headers. Connector J1 on the UC07/08 is SCSI Port 1 and J2 is SCSI Port 2. Connect these ports to the SCSI disk or tape subsystem that you intend to support with the UC07/08, observing proper cable orientation (pin 1 on J1 and J2 is marked with a triangle molded into the connector). The maximum cable length allowed is 6 meters.

4.5.3.1   Termination

SCSI buses are terminated at each end. The UC07/08 provides termination for one end of the cable. The last SCSI device on the bus must likewise terminate the bus; however, controllers daisy chained between the UC07/08 and last controller on the bus must have their terminators removed. See the controller or subsystem manufacturer's documentation for instructions in installing or removing terminators.

4.5.3.1.1   Termination Power

The UC07/08 can be configured to provide termination power to the terminator at the opposite end of the SCSI bus. This feature might be required in certain applications in which the SCSI device at the opposite end of the SCSI bus cannot provide termination for the SCSI bus. The UC07 can provide power to a remote termination circuit by placing jumper A-B IN. On the UC08, this feature is enabled by placing jumper A-B IN for Port 1 (connector J1) or placing jumper T-U IN for Port 2 (connector J2). The factory setting is OUT for both of these jumpers. Emulex recommends the use of keyed connectors in applications where the UC07/08 provides terminator power. This will prevent accidental grounding or misconnection of termination power.

The termination power on the UC07/08 has the following characteristics:

- 4.75 volts DC to 5.25 volts DC
- Fused at 1 ampere (Fuses: F1 and F2)
- Diode to prevent backflow of power into the UC07/08
- Jumpers to enable or disable this feature

4.5.3.1.2   Dual-wide UC07 Installation

If you are installing a dual-wide UC07, refer to Appendix D for jumper definitions and alternative termination power options.

4.6 Operation

There are no operational instructions. The UC07/08 is ready for initialization as soon as its drives are integrated and tested.

4.6.1 Indicators

There are three light emitting diodes (LEDs) on the UC07/08. These LEDs are used for both diagnostics and for normal operations.

If switch SW1-1 is OFF, the UC07/08 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. When the UC07/08 successfully completes the preliminary test, LED3 illuminates indicating that the UC07/08 is waiting for the MSCP or TMSCP initialization sequence.

During the MSCP initialization sequence, initiated by host software control, the UC07/08 executes a self-test that exercises the buffer adapter functions of the ESP chip, the Host Adapter Adapter (HAC) chip and its associated circuitry, the onboard RAM, and the control memory PROM. If the UC07/08 passes this sequence of its self-test successfully, all the LED indicators on the UC07/08 are OFF.

If a fatal error is detected either during self-test or while the system is running, all three of the LED indicators are ON (illuminated). If the UC07/08 fails to pass its power-up self-tests, you can select a special diagnostic mode (switch SW1-4 or SW4-4 ON) which causes the LED indicators to display an error code. See Self-Test Error Reporting, in Section 6, TROUBLESHOOTING.

During normal operation, LED1 and LED2 flicker occasionally. These LEDs are used to indicate Q-Bus activity.

5.1 Overview

This section describes how to set the NOVRAM parameters to configure the UC07/08 Host Adapter for your system. Including this overview, this section is divided into seven main subsections:

Subsection	Title
5.1	Overview
5.2	NOVRAM
5.3	F.R.D.
5.4	Starting F.R.D.
5.5	Disk F.R.D.
5.6	Tape F.R.D.
5.7	Integration and Operation

5.2 NOVRAM

The UC07/08 utilizes an onboard 512 Byte Non-Volatile Random Access Memory (NOVRAM) to store various pieces of subsystem configuration information needed by the UC07/08 to determine device types, device addresses, device configurations, and to enable or disable various user-programmable options. Diagnostic programs embedded in the firmware of the UC07/08 (Firmware Resident Diagnostics) provide the ability to access the NOVRAM.

5.3 F.R.D.

F.R.D. is an interactive, menu-driven utility program that allows the user to communicate with the UC07/08 via the host CPU console device. Using F.R.D., the user is able to perform various functions, such as loading the NOVRAM with configuration data, formatting and surface-verifying the media on magnetic drives, and initializing RCT areas on both the magnetic and optical media.

In addition to these preparation capabilities, F.R.D. also can be used to perform reliability testing of the subsystem. While not designed to isolate problems to the component level, these reliability tests can aid in isolating a problem to either the SCSI side or the host side of the system.

The UC07/08 actually contains two separate versions of F.R.D., Disk F.R.D. and Tape F.R.D. Each has a separate set of menus, NOVRAM functions, and command options appropriate to either disk or tape requirements. The F.R.D. program that runs when F.R.D. is started depends on whether the UC07/08 is set for MSCP (Disk) or TMSCP (Tape) emulation.

5.4   Starting F.R.D.

F.R.D. is designed to be run from the host CPU console in an offline mode, that is, with the host's normal operating system not running. F.R.D. is started by issuing a special command sequence via console ODT. The startup procedure is identical for either Disk F.R.D. or Tape F.R.D. There are two methods for starting F.R.D., depending on the host CPU type.

5.4.1   Starting F.R.D. on a MicroVAX II or MicroVAX III

F.R.D. is started by issuing a special command sequence via console ODT. To start F.R.D. on a MicroVAX, first apply power to the system. Put the system in console mode, then enter the following commands via the host console in response to the > > > prompt:

```
> > >I                               !BUS INIT
> > >D/P/W 20001F40 20<CR>           !ENABLE MEMORY
> > >D/P/L 20088000 80000000<CR>     !SETUP MAP 0
> > >D/P/L 20088004 80000001<CR>     !SETUP MAP 1
> > >D/P/W 2000XXXX 1<CR>            !INIT CONTROLLER
> > >D/P/W 2000YYYY 3003<CR>         !ENABLE SPECIAL MODE
> > >D/P/W 2000YYYY 4401<CR>         !UPLOAD DRIVER
> > >S  80<CR>                       !START DRIVER
```

NOTE: XXXX and YYYY are offsets dependent on the address of the UC07/08 controller. See Tables 5-1 and 5-2 for appropriate values.

For a GPX terminal, enter the following commands via the host console in response to the > > > prompt:

```
> > >I                               !BUS INIT
> > >D/P/W 20001F40 20<CR>           !ENABLE MEMORY
> > >D/P/L 20088000 80000000<CR>     !SETUP MAP 0
> > >D/P/L 20088004 80000001<CR>     !SETUP MAP 1
> > >D/P/W 2000XXXX 1<CR>            !INIT CONTROLLER
> > >D/P/W 2000YYYY 3003<CR>         !ENABLE SPECIAL MODE
> > >D/P/W 2000YYYY 4401<CR>         !UPLOAD DRIVER
> > >S  82<CR>                       !START DRIVER
```

NOTE: XXXX and YYYY are offsets dependent on the address of the UC07/08 controller. See Tables 5-1 and 5-2 for appropriate values.

Table 5-1. MicroVAX Offsets for MSCP Emulation

UC07/08 Bus Address	XXXX	YYYY
17772150	1468	146A
17772154	146C	146E
17760334	00DC	00DE
17760340	00E0	00E2
17760344	00E4	00E6
17760350	00E8	00EA
17760354	00EC	00EE
17760360	00F0	00F2
17760364	00F4	00F6
17760370	00F8	00FA
17760374	00FC	00FE
17760400	0100	0102
17760404	0104	0106
17760410	0108	010A
17760414	010C	010E
17760420	0110	0112

Table 5-2. MicroVAX Offsets for TMSCP Emulation

UC07/08 Bus Address	XXXX	YYYY
17774500	1940	1942
17760404	0104	0106
17760410	0108	010A
17760414	010C	010E
17760444	0124	0126
17760450	0128	012A
17760454	012C	012E
17760504	0144	0146
17760510	0148	014A
17760514	014C	014E
17760520	0150	0152
17760524	0154	0156
17760530	0158	015A
17760534	015C	015E
17760540	0160	0162
17760544	0164	0166

5.4.2 Starting F.R.D. on an LSI-11 System

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

> @ 177xxxxx/ 000000 1 < LF >
> @ 177yyyyy/ 5400 30003 < CR >
> @/000400 42000 < CR >
> @ 177yyyyy/ 2000 < CR >   !TEST FOR 2000
> @ 200G

NOTE: XXXXX and YYYYY are offsets dependent on the address of the UC07/08 controller. See Tables 5-3 and 5-4 for the appropriate values.

Table 5-3. LSI-11 Offsets for MSCP Emulation

UC07/08 Bus Address	XXXXX	YYYYY
17772150	72150	72152
17772154	72154	72156
17760334	60334	60336
17760340	60340	60342
17760344	60344	60346
17760350	60350	60352
17760354	60354	60356
17760360	60360	60362
17760364	60364	60366
17760370	60370	60372
17760374	60374	60376
17760400	60400	60402
17760404	60404	60406
17760410	60410	60412
17760414	60414	60416
17760420	60420	60422

Table 5-4. LSI-11 Offsets for TMSCP Emulation

UC07/08 Bus Address	XXXXX	YYYYY
17774500	74500	74502
17760404	60404	60406
17760410	60410	60412
17760414	60414	60416
17760444	60444	60446
17760450	60450	60452
17760454	60454	60456
17760504	60504	60506
17760510	60510	60512
17760514	60514	60516
17760520	60520	60522
17760524	60524	60526
17760530	60530	60532
17760534	60534	60536
17760540	60540	60542
17760544	60544	60546

When the appropriate starting procedure is completed, F.R.D. identifies itself by displaying the controller type and firmware revision. Then, it displays the menu options. See subsection 5.5 for more information on using Disk F.R.D. or subsection 5.6 for Tape F.R.D.

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

In this subsection, operator responses to Disk F.R.D. prompts appear in **bold** print. The symbols used in this subsection 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

5.4.4   Terminating F.R.D.

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

- Press the BREAK key
- Re-initialize the system, or
- Halt the CPU.

You can restart the diagnostics from a halted condition if you have not changed the memory contents. On an LSI-11 system, enter **200G** at the ODT prompt. On a MicroVAX system, enter **S 80**. For a GPX terminal, enter **S 82**.

5.5   Disk F.R.D.

Once started, Disk F.R.D. will display the menu shown in Section 5.5. The Disk F.R.D. Menu has been specially tailored to offer only those functions appropriate to the preparation and testing of magnetic or optical disk drives.

The following sections define each of the available options, their function, and the situations to which they apply. The following sections are presented in the order that they will most commonly be used. This might not correspond to the order listed in the menu.

Not all the options listed above in the main menu are supported on all device types used with the UC07/08. In these cases, depending on the type of device, Disk F.R.D. returns an "option not supported" message when an unsupported operation is attempted. Unsupported operations are noted in subsequent paragraphs.

The main menu and each submenu will prompt you for required input. When you enter a valid selection, Disk F.R.D. will either perform the selected operation or display the next menu. If you make an invalid entry, Disk F.R.D. rejects it and reprompts you.

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

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

```
                        Option Menu

 1 - Format                          2 - Verify
 3 - Format and Verify               4 - Data Reliability Test
 5 - Format, Verify, & Data Reliability   6 - Read Only
 7 - List Known Units                8 - Replace Block
 9 - Optical Write RCT              10 - Optical Read all Diag. Sectors
11 - Optical Write a Diag. Sector   12 - Issue Mode Select
13 - Display NOVRAM                 14 - Edit/Load NOVRAM

                 Enter option number: 14
```
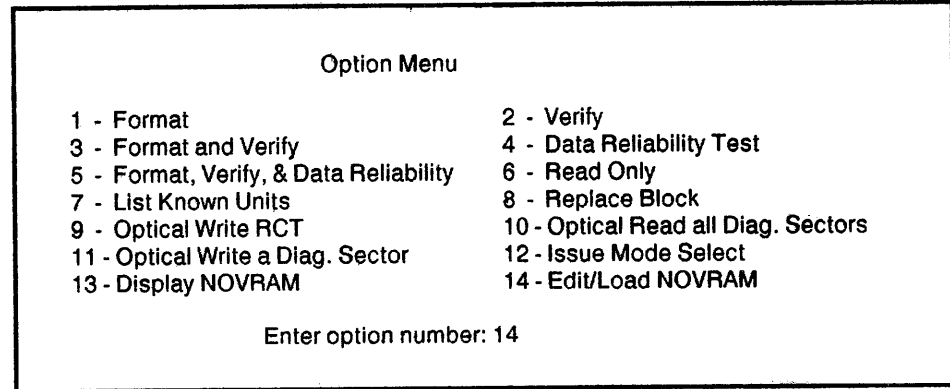
Figure 5-1. Disk F.R.D. Main Menu

The option descriptions that follow are ordered according to logical use. If you need to reference an option quickly, check the Table of Contents.

5.5.1   Option 14 - Edit or Load NOVRAM

The UC07/08 Host Adapter uses an onboard NOVRAM to store the subsystem configuration and device geometry information it needs to control the disk drives attached to its SCSI bus.

Before you can begin to use the other Disk F.R.D. options to prepare or test your disk subsystem, your UC07/08 must have the subsystem configuration data loaded in its NOVRAM. This information can be loaded into the NOVRAM using one of the two following methods:

1. Autoconfigure

When you select Option 14, you are prompted with a question, "**Do you want to Auto-configure Host Adapter and SCSI bus? [Y or N, def = N]**" If you answer "Y", F.R.D. displays a message asking you to make sure that all attached devices are powered on and ready.

Enter a < Carriage Return >. The UC07/08 then uses SCSI TEST UNIT READY, INQUIRY and other SCSI commands to determine the address and other pertinent information about each attached device.

Information stored in NOVRAM includes drive geometry, SCSI ID, and LUNs for all devices attached to that SCSI ID. Only devices that identify themselves as Random Access Magnetic disk devices cause parameters to be loaded in the NOVRAM. In addition, Autoconfigure displays information about the vendor identification, the product identification, and the revision level information returned by the INQUIRY command of any disk.

Several restrictions must be observed when using Autoconfigure:

- The device must be CCS compatible.
- The device must identify itself as either a Host Adapter (Initiator), Random Access Magnetic Disk, Sequential Access Tape, or WORM (optical) device.
- Autoconfigure cannot resolve SCSI ID conflicts. Before starting Autoconfigure, ensure each SCSI device on the bus has a unique SCSI address. (The UC07/08 will default to SCSI address 7. *If you have more than one UC07/08 on the SCSI bus, you must change the address to avoid conflicts.*)

Failure to observe these restrictions might result in failure of the Autoconfigure feature (No devices shown), or cause the SCSI bus to hang.

After Autoconfigure is finished, the UC07/08 NOVRAM will contain information about SCSI ID, LUNs, and drive geometry as default values. Disk F.R.D. will continue with the rest of the Load/Edit NOVRAM option menu. You will be prompted to load any NOVRAM values not obtainable by Autoconfigure such as DMA Burst Length, MSCP Replacements, etc. When you are prompted for information about autoconfigure-loaded parameters, you can either accept the default value as loaded by Autoconfigure or change it.

Disk F.R.D. prompts you to choose one of four different device type of codes. Once a drive is chosen, the rest the of Disk F.R.D. menu will ask questions appropriate to that device type.

If you specify a type code other than 4 (Autosize), F.R.D. asks if you want to alter device geometry. If the answer is "N", you will not be prompted for information about device geometry. If you answer "Y", each question about drive geometry will be prefaced by a comment that indicates the drive geometry might not be changeable; in these cases, the device default will be used.

If you choose type code 4 (Autosize), you will not be prompted for any information concerning device geometry. The UC07/08 will obtain that information from the device each time the device is brought online. This allows the user to freely exchange drives of different sizes without changing the NOVRAM.

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When you select Option 14, you are prompted with the question, **"Do you want to Auto-configure the SCSI bus"?** If you answer "N", you are then prompted for NOVRAM information. You must know the SCSI ID and LUN information for each device you intend to configure. In addition, unless you choose type code 4, you will be asked to supply device geometry information for each device you configure.

If you specify a type code other than 4 (Autosize), F.R.D. asks if you want to alter device geometry. If the answer is "N", you will not be prompted for information about device geometry. If you answer "Y", each question about drive geometry will be prefaced by a comment that indicates the drive geometry might not be changeable; in these cases, the device default will be used.

NOTE

The default value, which appears with the range of
values for each option, is indeterminate and indicates
only the current value. This value might or might not
be the value that your installation requires.

5.5.1.1 DMA Threshold

This parameter sets the DMA threshold value. The UC07/08 uses this value to
determine how many words into a DMA burst it will wait before checking to see
if another device on the Q-Bus has set DMR. The valid range is from 1 through
8. The higher you set this value, the less often the UC07/08 will relinquish bus
mastership to other devices. In MicroVAX systems, this parameter is important
because the CPU sets DMR whenever it wants to service an Q-Bus bus interrupt.
In MicroVAX systems with a large number of interactive terminal users, the
frequency of Q-Bus bus interrupts can be quite high. In this type of application,
if you set the DMA threshold too low, the effect is to increase the length of time it
takes for disk applications to be completed. If you set the DMA threshold too
high, it might affect the apparent user terminal response time. We recommend
setting this value to eight, then decreasing it only if terminal response or data late
problems on other devices occur.

5.5.1.2 DMA Burst Delay

This parameter sets the value of time in microseconds that the UC07/08 waits to
raise DMR between DMA bursts. The valid range is 2 through 32, in multiples of
2. The suggested value is 4.

On LSI-11 systems, where the system memory resides directly on the LSI-11 bus,
we recommend using a minimum value of 4. This is the value specified by the
LSI-11 Bus Handbook.

On MicroVAX systems or LSI-11 systems (LSI-11/83) where the system memory
resides on a private memory bus, this value can be set to the minimum of 2 for
maximum disk DMA performance.

Keep in mind that the lower you set this value, the less opportunity other devices
will have to get their DMA requests honored. This is particularly true if the
UC07/08 is on the front of the bus. If you have a lightly-loaded system with a
limited number of users and disk speed is the important consideration, set this
value to the minimums defined above. If you add interactive users and devices
to the system, you might need to increase the value of this parameter to maintain
a balance among disk throughput, terminal response, and DMA needs of other
devices on the bus.

5.5.1.3   Host Adapter SCSI Address

This parameter sets the SCSI address of the UC07/08. The valid range is from 0 through 7, and the suggested value is 7. *If you have more than one UC07/08 connected to the same SCSI bus, you must change this value to avoid conflicts.*

5.5.1.4   Enable SCSI Parity Checking

This parameter enables or disables SCSI parity checking. A yes response enables parity checking, while a no response disables parity checking. Before enabling this option, ensure that the SCSI device you are connecting supports parity.

5.5.1.5   Enable ESP Chip Slow Cable Mode

This parameter enables or disables the ESP IC's slow cable feature. A yes response enables the slow cable mode, while a no response disables the mode.

This feature might need to be enabled in systems where unshielded cables of maximum SCSI bus length are used in noisy environments. The Emulex SCSI Processor (ESP) IC used on the UC07/08 is a very high speed device. Because of this speed, it is possible for the IC to react to a short duration noise pulse, which might be ignored by slower or lower performance SCSI chips. When the slow cable mode is enabled, the ESP chip requires longer signal durations on these critical signals, thereby acting as a noise filter. We recommend using shielded SCSI cables and minimizing cable lengths, to eliminate the need for slow cable mode.

If you must use unshielded maximum length cables, we recommend that you enable slow cable mode. Except in the case of very high speed synchronous disk drives, this use of slow cable mode will have no adverse effect on system performance.

5.5.1.6   Unit Offset or Autoboot Unit Number

The **Unit Offset or Autoboot Unit Number** parameter functions differently, depending on whether the UC07/08 is at the standard base address, or at an alternate base address. The valid range for this parameter is from 0 through 15.

The following two subsections (Autoboot Unit Number and Unit Offset) respectively describe the operation of the UC07/08 at the standard base address, and at an alternate base address.

5.5.1.6.1   Autoboot Unit Number

When the UC07/08 is at the standard base address, the automatic bootstrapping option causes the system to boot automatically from the selected logical unit (0 through 7) on power-up. This option is enabled whenever the UC07/08 is set to the standard base address. This option cannot be used with a MicroVAX or in a system that uses an 11/73B CPU module. When automatic bootstrapping is enabled, the **Unit Offset or Autoboot Unit Number** parameter selects the autoboot logical unit.

The automatic bootstrapping process requires that the LSI-11 CPU module be configured for power-up mode 0. The following table lists the configuration settings for several popular LSI-11 CPUs.

CPU	Configuration Setting
11/73A	Install W3 and W7
11/23+	Remove J18-J19 and J18-J17
11/23	Remove W5 and W6
11/02	Remove W5 and W6

If you are using automatic bootstrapping, the controller will wait indefinitely for the boot device to come online and ready.

If your UC07/08 is installed at an alternate LSI-11 bus address, you can still bootstrap from a drive supported by the UC07/08, by using any boot process other than autoboot.

5.5.1.6.2   Unit Offset

If the UC07/08 is installed as a second MSCP controller at an alternate address, the **Unit Offset or Autoboot Unit Number** parameter has 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.

This parameter allows you to specify the MSCP Unit number of the first drive on the UC07/08 when your UC07/08 is being installed as a second MSCP controller (at an alternate LSI-11 bus address). You may specify a unit number that is contiguous with the highest unit number on the MSCP controller at the primary LSI-11 bus address, or you may leave a gap.

5.5.1.7   Type Code

Each SCSI target device attached to the host adapters SCSI bus must be defined in the NOVRAM by a type code. A maximum of 7 SCSI target devices can be attached to each SCSI bus. SCSI initiator devices on the bus are not identified in the NOVRAM; however, the total number of SCSI devices including targets and initiators cannot exceed 8. The UC07/08 recognizes four different type codes (Type Code 1 through Type Code 4) for SCSI target devices. Autoconfigure will assign a default value for type code as determined by information returned from the device during Autoconfigure.

For each SCSI target device that you define, Disk F.R.D. will prompt you for the remaining configuration parameters. The type code you specify for each target device determines which configuration parameters are required. The type codes are as follows:

TYPE CODE 1 (ST506 Device)

A type code of 1 indicates that the SCSI target device being configured is a SCSI/ST506 device (for example, an Emulex MD01).

TYPE CODE 2 (ESDI Device)

A type code of 2 indicates that the SCSI target device being configured is a SCSI/ESDI device (for example, an Emulex MD21, MD23, or MD25, or a disk drive with an embedded SCSI controller).

TYPE CODE 3 (Optical Device)

A type code of 3 indicates that the SCSI target device being configured is a WORM (Write Once Read Many) optical drive or a Magneto-Optical drive. After you specify type code 3, you will be asked to specify the device. If the device is a Magneto-Optical device, enter "Y". If the device is a WORM device, enter "N".

TYPE CODE 4 (Autosize Device)

A type code of 4 indicates that the SCSI target device being configured is any one of the three previous types, and that the physical configuration is to be defined by data received from the target device. The purpose of Type Code 4 is to allow the target device parameters to change, without having to reconfigure the device parameters in the NOVRAM each time a new device is attached. This feature is particularly useful in systems using a removable Winchester drive, such as the Emulex ER2/S.

In order to use Type Code 4, the target device must support the following SCSI commands:

- INQUIRY (12H)
- MODE SENSE (1AH)
- READ CAPACITY (25H)

CAUTION

If Type Code 4 is used to autosize optical disks, disk packs written with the Emulex UC04 Host Adapter will NOT be format compatible with the UC07/08. See Appendix C for UC04 compatibility data.

A number of factors must be taken into account when using Type Code 4. The values returned and the source of these values varies from device to device and vendor to vendor. Because of the wide variety of device types and device vendors' products that can be attached to the UC07/08, it is beyond the scope of this manual to identify the method used by a specific vendor or device type. In general, the following methods are widely used today:

1. Physical geometry, option configuration, and other device-dependent information is written on the device media at format time. The actual values used might come from default parameters supplied by the device controller itself, or from values supplied by the host adapter that was attached to the device at the time that the device was formatted.

2. Physical geometry, option configuration, and other device-dependent information is supplied by the device controller based on jumper and switch settings on the device controller or coded in the device controller's firmware.

Because of these inconsistencies, the UC07/UC08 uses the following methods to define drive size when Type Code 4 is selected.

Format Operation

When the UC07/UC08 performs a format operation, it will first perform a mode sense with the Return Default Values bit set. The information returned will be used to issue a mode select followed by a format command. This means that any parameter saved on the disk will be destroyed, and the drive will be formatted to its default size.

Normal Operation

Except when formatting, the UC07/UC08 uses a MODE SENSE with the SAVED bit set to size the drive.

Note

If you use the list option to display the drive size on a previously unformatted or non-UC07/UC08 formatted drive, the drive size and the contents of the NOVRAM will be incorrect.

5.5.1.8 Block Size

This parameter specifies the size of a logical block, in bytes, on the optical drive. The acceptable values are 0 for a block size of 512 bytes, or 1 for a block size of 1024 bytes. Disk F.R.D. will request this parameter only for Type Code 3.

5.5.1.9 Number of Blocks per Track

This parameter specifies the number of blocks per track. The valid range is from 1 through 255. Disk F.R.D. will request this parameter only for Type Code 3.

5.5.1.10 Size of Drive in Blocks

This parameter specifies the size of the optical drive in blocks. The valid range is from 200 through 4,294,967,295. Disk F.R.D. will request this parameter only for Type Code 3.

5.5.1.11 Total Number of Physical Sectors per Track

This parameter specifies the total number of physical sectors per track, including spares. The valid range is from 1 through 255. Disk F.R.D. will request this parameter only for Type Codes 1 and 2.

5.5.1.12 Total Number of Physical Heads

This parameter specifies the total number of physical data heads per physical drive. The valid range is from 1 through 63. Disk F.R.D. will request this parameter only for Type Codes 1 and 2.

5.5.1.13 Total Number of Physical Cylinders

This parameter specifies the total number of physical cylinders per physical drive, including spares. The valid range is from 1 through 4095. Disk F.R.D. will request this parameter only for Type Codes 1 and 2.

5.5.1.14 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. Disk F.R.D. will request this parameter only for Type Codes 1, 2, and 4. The suggested value is 1.

5.5.1.15   Number of Alternate/Spare Cylinders

This parameter specifies the number of spare cylinders per physical drive. The valid range is from 2 through 250. At least two cylinders must be specified as alternates, as the sector replacement algorithm needs tracks for working space. The suggested minimum value is 2.

Disk F.R.D. will request this parameter only for Type Codes 1, 2, and 4. If there are no spare sectors, Disk F.R.D. will not request this parameter.

5.5.1.16   Enable MSCP Replacements

This parameter enables or disables MSCP replacements. A yes response enables MSCP replacements, while a no response disables MSCP replacements. Disk F.R.D. will request this parameter only for Type Codes 1, 2, and 4. For details about the effect of this option and device requirements, see subsection 5.4.1.28.

5.5.1.17   Enable Transparent Replacements

Disk F.R.D. will request this parameter only if the answer to the previous question (enable MSCP replacements) was no, and the Type Code is 1, 2, or 4. This parameter will also be requested for type code 3 devices that you identify as Magneto-Optical. This parameter enables or disables transparent replacements. A yes response enables transparent replacements, while a no response disables transparent replacements. For details about the effect of this option, see subsection 5.4.1.28.

5.5.1.18   Ignore FCT Errors

Disk F.R.D. will request this parameter only if transparent replacements are enabled, and the Type Code is 1, 2, or 4. This parameter will also be requested for type code 3 devices that you identify as Magneto-Optical. A yes response to this parameter causes Disk F.R.D. to ignore FCT errors.

This parameter should be set to YES only in case of a malfunction which has caused the FCT area to become corrupt. If this happens, the UC07/08 will not bring the device online, thus making it impossible to access the data on the device. Setting this parameter to YES allows the online function to ignore FCT errors and allows the device to be brought online to retrieve the data. Once the data has been retrieved, this parameter should reset to NO and the device reformatted.

5.5.1.19   Split Drive

This parameter allows the drive defined by this parameter block to be split into two logical disk units. Disk F.R.D. will request this parameter only for Type Codes 1 and 2. A yes response splits the drive.

Use of the split option enables seek ordering and overlapped seek processing in the MSCP Controller, which reduces performance, particularly during times when both logical units of a split physical drive are active. The SCSI target device to which the split drive is attached must have SCSI disconnects disabled. In addition, a format command to EITHER logical unit will reformat the entire drive (BOTH logical units).

5.5.1.20   Starting Block Number for Second Logical Drive

This parameter will be requested only if the answer to the previous question (split drive) was yes. This parameter specifies the starting block number of the second logical drive. If the starting block number entered does not fall on a track boundary, Disk F.R.D. will truncate the value to the next lower track boundary. The valid range is any value between 10 cylinders from the beginning of the drive and 10 cylinders from the end of the drive.

5.5.1.21   Reduced Write Current Cylinder

Disk F.R.D. will request this parameter only for Type Code 1. 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.

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

5.5.1.22   Write Precompensation Cylinder

Disk F.R.D. will request this parameter only for Type Code 1. 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 write precompensation is required, specify the total number of physical cylinders.

5.5.1.23   Step Code

Disk F.R.D. will request this parameter only for Type Code 1. This parameter specifies the stepping mode of the disk drive. The valid range is from 0 through 65,535. The table below is an example based on the Emulex MD01. For other devices, consult the user manual supplied with the device.

Step Code	Stepping Mode
0	Unbuffered, 3 msec
1	Buffered, 11 usec
2	Buffered, 12 usec

For the MD01, Emulex recommends the fastest buffered step code available (step code of 1). Use a slower buffered step code or the unbuffered step code if your drive requires it.

5.5.1.24   Removable Media

This parameter indicates whether the disk media is fixed or removable. A yes response indicates that the media is removable; a no response indicates fixed media.

5.5.1.25   Disable SCSI Disconnects

This parameter will not be requested if the drive has been configured as a split drive. This parameter disables or enables SCSI disconnects. 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 might dictate that you disable disconnects.

A yes response disables SCSI disconnects, while a no response enables SCSI disconnects.

5.5.1.26   Prevent Manual Spindown

This parameter allows the user to prevent inadvertant spindown of a mounted media. This parameter is particularly important when a WORM optical drive is used because failure to write cached data and device maps to a disk before it is spun down can result in data loss.

A yes response causes the UC07/08 to issue a SCSI Prevent/Allow Media Removal command with the Prevent bit set whenever a device is brought online. This command prevents manual spindown of the drive until a Dismount command is issued by the operating system. When the operating system issues a Dismount command, the UC07/08 issues a SCSI Prevent/Allow Media Removal command with the Prevent bit reset to unlock the drive and allow manual spindown of the drive.

A no response disables the UC07/08 from sending the SCSI Prevent/Allow Media Removal command during Mount and Dismount operations. No is the default setting. Regardless of how this parameter is set, the UC07/08 will issue a SCSI Stop command to the device when a Dismount/Unload command is issued by the operating system.

5.5.1.27   Enable Synchronous Data Transfers

This parameter enables or disables synchronous SCSI data transfers. A yes response enables synchronous data transfers; a no response disables synchronous data transfers. Before enabling this option, be sure that the target device being configured supports synchronous SCSI data transfers.

5.5.1.28   Disable Host Adapter of Polling Drives

During normal operation, the UC07/08 will periodically issue Test Unit Ready commands to determine changes in Power On status of devices on the SCSI bus. This action resets the Attention condition issued by SCSI devices on the first access after a power on. In some cases, where the user has written a SCSI driver that interfaces directly with the device via SCSI commands, for example, Pass Thru SCSI Mode, polling must be disabled to allow the driver to detect and reset this attention condition. A yes response disables polling.

A no response enables normal device polling. When the UC07/08 is used in systems which use a standard MSCP driver this parameter must be enabled (user response = n) to allow proper operating system response to drive Powerup/Powerdown transitions.

5.5.1.29   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. The value that you select in NOVRAM for each controller's SCSI address must match the corresponding SCSI address selected on the controller. Similarly, the value that you select in NOVRAM for each drive's LUN must match the corresponding LUN value selected on the drive. In addition, no two SCSI devices on any one SCSI bus can have the same SCSI address.

The SCSI controller address range is 0 through 7; the SCSI LUN range is 0 through 7. For each physical unit that you configure, you will be prompted to specify a value for both the SCSI controller address and for the drive LUN. If Autoconfigure was used, the NOVRAM will already be loaded with the correct values for each SCSI device and its attached LUNs.

After you have answered all the configuration questions, F.R.D. will prompt for another unit. If no units remain to be configured, or you have reached the limit of 8 logical unit numbers, F.R.D. will ask if you want to change any parameters before loading the NOVRAM.

```
Do you want to configure another unit [Y or N, def = N]?

Do you want to change any parameters [Y or N, def = N]?

** ALL DATA ON DRIVE CAN BE LOST **
DO YOU WANT TO LOAD THE NOVRAM [Y or N]?
```

5.5.1.30   Defect Management

The UC07/08 offers the user a choice of three methods to manage defects on magnetic disks. The type of defect management used must be programmed in the NOVRAM for each SCSI target device. The type of defect management scheme you choose depends on your application and the capabilities of the SCSI target device performing the defect management.

5.5.1.30.1   Host-Initiated Bad Block Replacement

Sometimes referred to as MSCP-compatible mode, Host-Initiated Bad Block Replacement is a scheme whereby the host software is responsible for issuing MSCP "replace" commands to initiate block replacement. The conditions under which the host software issues a replace command are dependent upon the host software and the type of error information generated by the UC07/08.

This mode of operation is fully DEC compatible and provides software control of replacements. It even allows blocks with uncorrectable or otherwise inaccessible data to be replaced by using a forced error flagging scheme to mark the replaced block, in such a way as to inform the operating system that only the data in the block is bad, while the block itself is good.

This method also provides power fail protection for those cases where a power fail occurs in the middle of a replacement operation. Various flags are used to indicate what step of the replacement is in progress at all times, so that when power is re-applied, any replacement in process can begin where it left off. We recommend using this mode whenever possible.

To use MSCP replacement, the target device absolutely must support all four of the following:

- A 48-bit ECC that guarantees that any 16-bit data error will be reported as an uncorrectable ECC error.

- SCSI Re-assign, Read Long, and Write Long commands

- The SCSI target device must guarantee that the ECC provided by the UC07/08 during the Write Long operation is not modified in any way by the target device before being written to disk.

- The SCSI target device must guarantee that the ECC written to the disk during the Write Long operation is not modified in any way by any subsequent Read or Read Long operation.

The only SCSI devices that we guarantee to support Host-Initiated Bad Block Replacement are the Emulex MD01, MD21, MD23, and MD25 controllers, and the Emulex ER2/S removable subsystem.

While some SCSI device controllers and embedded drives might support these features, Emulex cannot guarantee proper operation now or in the future.

It is the user's responsibility to contact the vendor of the SCSI device to secure compliance and performance commitments.

This mode is enabled by answering yes to the NOVRAM prompt, **"Do you want to enable MSCP replacements?"**

5.5.1.30.2 Controller-Initiated Bad Block Replacement

Sometimes referred to as transparent mode, Controller-Initiated Bad Block Replacement is supplied as a best-case alternative to Host-Initiated Bad Block Replacement for those SCSI target devices that do not provide the features required for host-initiated replacement. In this mode, the UC07/08 firmware initiates and controls the replacement operations transparently to the host software. This mode allows blocks with correctable data errors to be replaced via the SCSI re-assign command. The replacement operation is protected during power fails by caching the data and using flags that indicate the progress that has been made on any replace command that was in progress when the power fail occurred. During the replacement operation, a special FCT area on the disk is used to cache replacement data and progress flags.

The principle disadvantage of this method is that since forced error flagging cannot be done, blocks with uncorrectable data errors or inaccessible data fields cannot be replaced dynamically during system operation. In the case of uncorrectable data errors (for example, uncorrectable ECC error, block not found, etc.) the UC07/08 simply reports the fact that an uncorrectable error has occurred. The operating system will then proceed to deal with the error much as it would deal with a "Forced Error". Blocks with uncorrectable data errors can only be replaced by using the replace block operation of Disk F.R.D.

Blocks with correctable or soft data errors are replaced dynamically by the controller before they become uncorrectable. For these replacements to occur, the SCSI target device must support the SCSI re-assign commands and must report the fact that a correctable error has occurred. Correctable errors can include ECC-correctable data errors or retry-corrected header operations. If the target device simply sends corrected data or retries the operation until it is successful, but does not report the error to the UC07/08, no replacements will occur.

Correctable errors will be reported to the operating system via the MSCP error log packets, to enable the operating system to be aware that replacements have in fact taken place. This allows the user to monitor the status of a particular drive.

This mode is enabled by answering no to the NOVRAM prompt, "**Do you want to enable MSCP replacements?**" and yes to the NOVRAM prompt, "**Do you want to enable transparent replacements?**"

5.5.1.30.3 Non-Block-Replaceable Device Mode

The Non-Block-Replaceable Device Mode must be used if the SCSI target device does not support the SCSI re-assign command, or if the target device is an optical device. This mode completely precludes dynamic block replacement of any kind while operating the system.

All errors, correctable or uncorrectable, will be reported to the system via MSCP errlog messages. This mode of operation should only be used with devices that provide very sophisticated error recovery schemes that preclude the occurrence of reported errors (for example, optical devices).

This mode is enabled by answering no to the NOVRAM prompt, **"Do you want to enable MSCP replacements?"** and no to the NOVRAM prompt, **"Do you want to enable transparent replacements?"**

NOTE

All of the following options are designed to be run on multiple drives. Prior to starting each option you will be prompted for a device number to test. Device numbers can be entered in any sequence. To terminate the drive number prompt, enter a < CR >. All operations except Reliability are performed on a single drive at a time. Any drive which fails is dropped and testing moves to the next drive in the string. The Reliability tests are run on all specified devices simultaneously.

5.5.2   Option 1 - Format

The Format option initially formats a magnetic disk drive. The operation writes sector headers and initializes the drive's RCT tables. 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.

The SCSI Device Controller performs the actual format operation in response to a SCSI format command with the "Complete List" and "Format Data" bits set. The Defect List sent will indicate no defects.

Depending on the SCSI device controller used, the format operation might also replace defective blocks contained in the Manufacturer's Defect List (MDL), perform a Read after Write pass with worst case data patterns and replace any blocks with errors, or any other tests to find and replace defective blocks. The following subsections are a list of actions performed by Emulex SCSI bridge controllers during formatting.

CAUTION

When Option 1 (Format) is used, BOTH logical units on a split drive WILL BE FORMATTED. When formatting a split drive, YOU MUST SPECIFY BOTH UNITS WHEN ASKED FOR DEVICE NUMBERS TO TEST.

5.5.2.1   Emulex MD01 (SCSI/ST506)

When the format command is received, the MD01 will format the entire unit using the geometry information sent from the UC07/08 via the Mode Select Command. After the format completes, each block on the drive is read. Any block that produces an error during the read operation is replaced.

5.5.2.2   Emulex MD21, MD23, and MD25 (SCSI/ESDI)

When the format command is received, the MD21, MD23 and MD25 will format the entire unit using the geometry information sent from the UC07/08 via the mode select command. Any blocks listed in the drive's MDL will be replaced during the format operation. Blocks listed in the Grown Defect List (GDL) are not replaced during format. This is done purposefully to prevent blocks which may have been erroneously replaced in the event of a system malfunction. Because the MD21, MD23 and MD25 controllers replace all blocks listed in the MDL, they do not use the read pass performed by the MD01 controller.

When the mode select command containing the drive geometry information is received, the MD21, MD23 or MD25 checks the value supplied for the number of sectors per track. If the drive being formatted is in hard sector mode and there is a difference between the value requested and value returned by the drive, the Mode Select Command will be rejected by the MD21, MD23 or MD25. Disk F.R.D. will print a warning message:

MODE SELECT COMMAND FAILED FORMATTING WITH DRIVE DEFAULT PARAMETERS

The format will continue to normal completion. The consequence of this message is that the value returned for user size might not be accurate. This can be corrected either by reloading the NOVRAM with the correct value for the number of sectors per track, or by setting the NOVRAM to autoconfigure the device.

5.5.2.3   Non-Emulex SCSI Devices

In general, most SCSI devices on the market today support the Mode Select Command and will follow the same rules that Emulex controllers follow. Keep in mind that the Mode Select is an optional SCSI command. Some devices do not support the Mode Select Command because their geometry is fixed by switch settings, by jumper settings, or by firmware. In this case, the Mode Select Command will fail and Disk F.R.D. will print a warning message. Operation will continue as described for the MD21, MD23 and MD25 controllers. The only way to guarantee that a valid user size is presented to the system is either by setting the NOVRAM to autoconfigure the device, or by ensuring that the geometry values loaded into the NOVRAM match the actual drive geometry.

5.5.2.4   Magneto-Optical Devices

Although Magneto-Optical devices appear to the system as rewritable devices, they have some peculiarities which must be taken into account during format. When the Sony drive is issued a format, the drive actually formats and certifies the pack. The Richo drive does a dummy format which does nothing. In addition the Richo drive reacts like a WORM drive: when it reads an unwritten block, it returns a Blank Check condition. This means that a block must be written before it can be read since a Blank Check is unacceptable on a magnetic device. The UC07/08 fixes this by performing a Single Pattern Write Pass of the entire pack when the Format option is used. This makes all blocks on the disk readable after format, just like a magnetic drive.

5.5.3   Option 2 - Verify

The Verify option write- and read-exercises all user-available blocks. Disk F.R.D. uses four worst-case data patterns to find and replace pattern-sensitive blocks not found in the drive defect list. It asks for the logical unit number (LUN) of the drive to be verified. After you have entered all the LUNs to be verified, Disk F.R.D. will prompt for the number of Write/Read passes.

Verify operations are performed on 32 logical blocks at a time. Logical blocks are referenced by Logical Block Number (LBN).

During verify operations, Disk F.R.D. does not do anything to cause the SCSI target device to diminish its normal error recovery techniques. This means that the ability of Disk F.R.D. to find and replace defective areas on the media depends on the target device reporting that an error condition has occurred. Generally, the lower the level of filtering that the device does, the more efficient the Verify option will be.

When Disk F.R.D. encounters a block that it cannot access because of header or data field errors, Disk F.R.D. displays the LBN in error. Because the failing pattern might not be the first pattern, it is possible that replacement blocks might 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 reported by the SCSI target device.

At the end of all testing or when you enter a <Ctrl C>, Disk F.R.D. reports the number of bad blocks detected by the Verify operation. There will be no message if the Verify option does not detect any errors.

5.5.4   Option 3 - Format and Verify

The Format and Verify option formats a drive, then tests the surface for defective and pattern-sensitive sectors. It performs both of the operations that are available separately with options 1 (Format) and 2 (Verify). This option also offers a bad block replacement feature which, when enabled, replaces any bad blocks found during the verify operation.

5.5.5   Option 4 - Data Reliability Test

The Data Reliability Test option thoroughly tests the disk 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-to-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, Disk F.R.D. displays text error messages. These messages are primarily for use by Emulex technical support personnel.

5.5.6 Option 5 - Format, Verify, and Reliability Test

The Format, Verify, and Reliability Test option combines Options 1 (Format), 2 (Verify), and 4 (Data Reliability Test). This option automates the initialization and testing of drives, since you can select multiple drives and activate the data reliability test without having to wait for the format and verify options to complete. The format and verify portions of this option run in the order of the drives selected. Drives with hard faults are dropped and the sequence moves to the next drive in the list. The reliability portion of this option runs simultaneously on all selected drives.

5.5.7 Option 6 - Read-Only Test

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

The Read-Only Test option also offers a bad block replacement feature that, when enabled, replaces any bad blocks. Because Disk F.R.D. 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 might cause problems if the replaced blocks contain executable program files. For this reason, you should back up sensitive data before running the Read-Only Test option with the replacement feature enabled.

The Read-Only Test option can be used only if the drive is formatted.

5.5.8′ Option 7 - List Known Units

The List Known Units option lists all the drives that are configured in the NOVRAM. Only those units that the controller can select are listed as available.

A user size (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.

> **Note:** When creating partitions under ULTRIX, be sure a partition does not extend past the user area into the RCT or diagnostic area. Like all MSCP devices, the UC07/UC08 depends on the host software to control accesses to the RCT and diagnostic area of the disk. Failure to observe the user size limitation may corrupt the disk and render it unusable without reformatting.

The user size reported by this option is calculated from geometry data contained in the NOVRAM for either Type Code 1 or Type Code 2. When Type Code 4 is used to autoconfigure devices, the user size is calculated from geometry information returned by the Mode Sense command.

In order for the reported user size to be accurate, the following two conditions must be met:

- When using SCSI target devices that support Mode Select and Mode Sense, a Mode Select Failure message must not have occurred during format of the device. If such a message was received, then the user size reported by this option will be incorrect, because the geometry information contained in the NOVRAM does not agree with the geometry parameter used by the device during formatting. If this occurs, you can correct the user size by reloading the NOVRAM with the correct geometry information and reformatting the drive.

- When using SCSI target devices that do not support Mode Select and Mode Sense, you must ensure that the drive geometry values loaded into the NOVRAM are identical to those used by the target device.

5.5.9 Option 8 - Replace Block

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

5.5.10   Option 11 - Optical Write a Diagnostic Sector

The Optical Write a Diagnostic Sector option verifys the ability of the optical subsystem to correctly perform write operations in a special diagnostic area before attempting to write data in the RCT or data area. Each time this option is invoked, the UC07/08 writes the next blank section available from the diagnostic area. The data field is written with the LBN of the sector being written. After the write occurs, a read check is performed to verify proper write operation.

5.5.11   Option 10 - Optical Read All Diagnostic Sectors

The Optical Read All Diagnostic Sectors option performs a read operation on all diagnostic sectors previously written. Proper read operation is verified by comparing the LBN information read from the data field with the LBN being accessed and verifying that they match.

5.5.12   Option 9 - Write RCT

Option 9 is used to initialize the RCT area on a disk drive as required by MSCP. This option is designed primarily for use on optical (WORM) drives that cannot use the FORMAT option. Also, use this option to initialize the RCT area on a magnetic or Magneto-Optical drive that has previously been formatted by a non-Emulex host adapter.

This option will prompt for a serial number to be written into the RCT area. Before writing the RCT, this option first checks to see if the device is a WORM. If so, it will check to see if the RCT already exists. If it does, F.R.D. will inform the user that a valid RCT already exists, and no write will be performed. If the RCT Write is successful, F.R.D. performs a READ pass to verify that the RCT was properly written. If the attached drive is a WORM, this option should only be used after verifying proper subsystem operation using Option 10 (Optical Read All Diagnostic Sectors) and Option 11 (Optical Write a Diagnostic Sector).

The UC07/08 does not require an RCT on Optical WORM disk packs. This option has been provided to create packs that must be used on Emulex UC04/14 or UC07/08 host adapters with Revision "F" or lower firmware.

5.5.13   Option 12 - Issue Mode Select

This option enables a user to issue a MODE SELECT command to a device that is configured in NOVRAM. Data can be altered (if CSS compatible) one byte at a time. Consult the drive manufacturers' documentation to find the appropriate SCSI parameter values to issue to the drive. The SCSI commands that must be supported are MODE SENSE and MODE SELECT. Note that issuing Mode Select is of no use if the device does not save the parameters.

5.5.14   Option 13 - Display NOVRAM

This option displays the current contents of the NOVRAM.

5.6   Tape F.R.D.

Tape F.R.D. is a diagnostic utility designed to provide the following functions:

- Load and Edit the configuration data needed by the UC07/08

- Test the functions of the host adapter and tape drive

- Verify the switch settings on the UC07/08 module.

Options are selected through menus, which are accessed from the host system console.

NOTE

Configuration options must be loaded into the NOVRAM before the host adapter can be used. Although the NOVRAM is loaded at the factory, its contents might not meet your system requirements.

After you specify the type of terminal and enter a < return >, Tape F.R.D. displays the Tape F.R.D. Main Menu.

5.6.1   Initial Screen

The initial Tape F.F.D. screen shows the revision level of the Tape F.R.D. firmware being used, the tape drive status, and the CSR address location. Tape F.R.D. prompts you to specify whether you are using a video or hardcopy terminal to run the diagnostics.

NOTE

Video display mode supports only DEC VT100 series video terminals and compatible video terminals. Use Hardcopy mode for all other terminals.

After you specify the type of terminal and enter a < return >, Tape F.R.D. displays the Tape F.R.D. Main Menu.

5.6.2 Tape F.R.D. Main Menu

Figure 5-2 shows the Tape F.R.D. Main Menu as it appears on a video display terminal. This menu presents choices for running tape diagnostic tests, configuring the subsystem for tape drive characteristics, and for displaying the switch settings.

```
                    MAIN MENU


        a - All tests
        d - Drive configuration
        n - NOVRAM maintenance
        t - Test selection menu
        s - Display switch settings



                Select function (def = a) :


ctrl/c - Returns you to the previous level
ctrl/u - Deletes current input if no <CR> entered
ctrl/w - Rewrites screen or prompt
```
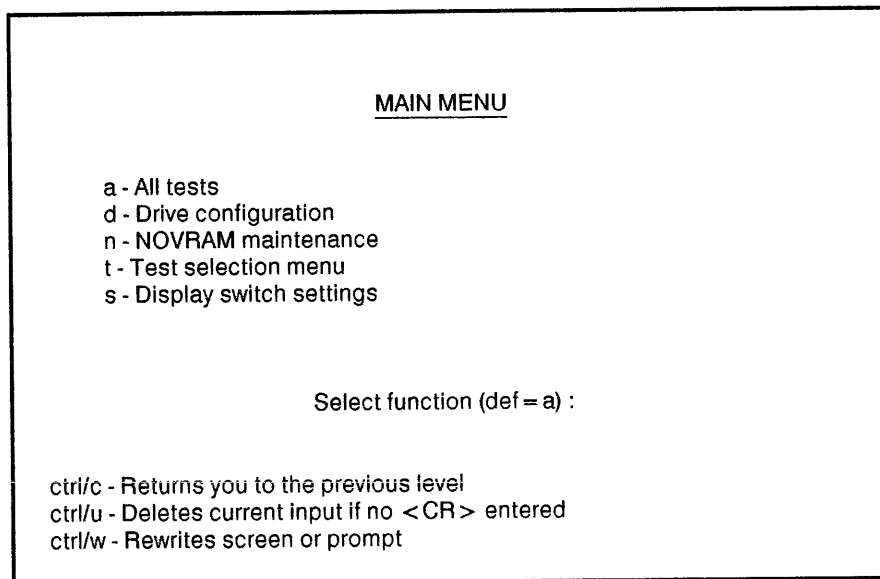
Figure 5-2. Tape F.R.D. Main Menu

NOTE

On initial power up, some drives (i.e., Exabyte) might be unaccessible on the SCSI bus for up to 120 seconds while running self tests. Because of this, the drive status that Tape F.R.D. returns can vary, depending on the state of the drive when Tape F.R.D. was started. The drive status can be any of the following:

- Unit not there
- Unit offline or not ready
- Unit online

To make a selection from the Main Menu, type the letter of the selection you want and follow it with a <return>. The choices are:

A - All tests. All onboard firmware installation diagnostic tests are executed and any errors reported. This is a basic reliability test.

D - Drive configuration. This option is used to specify the SCSI address and LUN of all attached drives. You can also load the address even if no drive is attached. This allows you to add drives later without running F.R.D. When this option is selected, the current drive configuration is displayed. The default value displayed is the current value.

You are then asked if you want to modify the configuration. If you answer "N", the control is returned to the Main Menu.

```
Number of drives to configure (1-7,def = 2 dec) :
Drive #1 i.d. (0-7,def = 1 dec) :
Drive #1 Lun number (0-7,def = 0 dec) :
Drive #2 i.d. (0-7,def = 0 dec) :
Drive #2 Lun number (0-7,def = 0 dec) :

Modify?  (y/n,def = n) :
```

Figure 5-3. Drive Configuration Menu

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. The value that you select in NOVRAM for each controller's SCSI address must match the corresponding SCSI address selected on the controller. Similarly, the value that you select in NOVRAM for each drive's LUN must match the corresponding LUN value selected on the drive. In addition, no two SCSI devices on any one SCSI bus can have the same SCSI address.

The SCSI controller address range is 0 through 7; the SCSI LUN range is 0 through 7. For each physical unit that you configure, you will be prompted to specify a value for both the SCSI controller address and for the drive LUN.

N - NOVRAM maintenance. Current configuration values are displayed and any errors are reported. You can make changes to the NOVRAM through this option.

T - Test selection menu. This option lets you selectively run any of the six onboard diagnostic tests. A loop count selection lets you determine how many times the tests are run.

S - Display switch settings. The switchpack ON/OFF settings are portrayed on this screen to verify that the firmware has interpreted your settings correctly. The specific configuration options represented by the switch settings are also identified.

5.6.2.1   All Tests

This option performs the following tests, in sequence: BOT and rewind test, write/read test, filemark test, space forward/reverse test, positioning test, and host memory DMA test.

Your response to the loop count prompt determines the number of passes of the test loop. A value of 0 causes the test sequence to continue until halted with a <ctrl/c>.

5.6.2.2   NOVRAM Maintenance

This function lets you specify the UC07/08's configuration options. When selected, the NOVRAM's current data is displayed on the terminal. You will see the NOVRAM parameter descriptor, followed by the range of values in parentheses.

The NOVRAM menu for the TMSCP emulation is shown in Figure 5-4.

NOTE

The default value, which appears with the range of values for each option, is indeterminate and indicates only the current value. This value might or might not be the value that your installation requires.

If the NOVRAM maintenance function fails, it could be because of corrupted or unprogrammed NOVRAM. In this case, an error message will be printed and you are permitted to continue the operation.

You will then be asked if you want to modify the NOVRAM.

If you answer "N", control is returned to the Main Menu.

```
Enable SCSI disconnect (y/n, def = y) :
Usec delay between DMA bursts (2/4, def = 4) :
Adaptive DMA (y/n, def = y) :
Enable SCSI slow cable mode (y/n, def = n) :
Enable SCSI parity checking (y/n, def = n) :
Enable synchronous SCSI transfer mode (y/n, def = y) :
Adaptive DMA threshold (1-7, def = 1 dec) :
Max retry count for tape errors (0-10, def = 0 dec) :
SCSI adapter i.d. (0-7, def = 7 dec) :

Modify?  (y/n, def = n) :
```

Figure 5-4. Sample TMSCP NOVRAM Maintenance Menu

If you answer "Y", the cursor moves to the first data field to be modified and you can make changes.

At a hardcopy terminal, the descriptors will be output and the cursor will be positioned at the end of the prompt.

If you enter a CTRL/Z or CTRL/C, control returns to the main menu and the NOVRAM will not be written.

Menu selections are described below.

Options:

- **Enable SCSI disconnect.** This parameter disables or enables SCSI disconnects. 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 might dictate that you disable disconnects.

  A yes response enables SCSI disconnects, while a no response disables SCSI disconnects.

- **Usec delay between DMA bursts.** This parameter sets the value of time in microseconds that the UC07/08 waits to raise DMR between DMA bursts. The valid values are either 2 or 4.

  On LSI-11 systems, where the system memory resides directly on the LSI-11 bus, we recommend using a minimum value of 4. This is the value specified by the LSI-11 Bus Handbook.

  On MicroVAX systems or LSI-11 systems (LSI-11/83) where the system memory resides on a private memory bus, this value can be set to the minimum of 2 for maximum disk DMA performance.

- **Adaptive DMA.** This parameter enables or disables the UC07/08's adaptive DMA mode. Enabling this option ensures that CPU or other device functions are not locked out for excessive periods of time, by allowing the UC07/08, while in the middle of a Block Mode DMA transfer, to release the bus to another device. When disabled, the UC07/08 will seize the bus for the entire DMA burst count.

  A yes response enables adaptive DMA, while a no response disables the mode.

- **Enable SCSI slow cable mode.** This parameter enables or disables the ESP IC's slow cable feature. A yes response enables the slow cable mode, while a no response disables the mode.

  This feature might need to be enabled in systems where unshielded cables of maximum SCSI bus length are used in noisy environments. The Emulex SCSI Processor (ESP) IC used on the UC07/08 is a very high speed device. Because of this speed, it is possible for the IC to react to a short duration noise pulse, which might be ignored by slower or lower performance SCSI chips. When the slow cable mode is enabled, the ESP chip requires longer signal durations on these critical signals, thereby acting as a noise filter. We recommend using shielded SCSI cables and minimizing cable lengths, to eliminate the need for slow cable mode.

  If you must use unshielded maximum length cables, we recommend that you enable slow cable mode. Except in the case of very high speed synchronous disk drives, this use of slow cable mode will have no adverse effect on system performance.

- **Enable SCSI parity checking.** This parameter enables or disables SCSI parity checking. A yes response enables parity checking, while a no response disables parity checking. Before enabling this option, ensure that the SCSI device you are connecting supports parity.

- **Enable synchronous SCSI transfer mode.** This parameter enables or disables synchronous SCSI transfer mode. A yes response enables synchronous SCSI data transfers; a no response disables the mode. Make sure the target device being configured supports synchronous transfers before enabling this mode.

- **Adaptive DMA threshold.** This parameter sets the DMA threshold value. The UC07/08 uses this value to determine how many words into a DMA burst it will wait before checking to see if another device on the LSI-11 bus has set DMR. The range is 1 through 7.

The higher you set this value, the less often the UC07/08 will relinquish bus mastership to other devices. In MicroVAX systems, this parameter is important because the CPU sets DMR whenever it wants to service an LSI-11 bus interrupt. In MicroVAX systems with a large number of interactive terminal users, the frequency of LSI-11 bus interrupts can be quite high. In this type of application, if you set the DMA threshold too low, the effect is to increase the length of time it takes for tape applications to complete. If you set the DMA threshold too high, it might affect the apparent user terminal response time. We recommend setting this value over decreasing it only if terminal response or data late problems on other devices occur.

- **Max retry count for tape errors.** This parameter defines the number of retry operations that the controller will try before reporting an error. This is not a software parameter and will not affect software retries. Lowering the retry count will reduce the time required to initialize a tape, especially for tri-density drives. The range is 0 through 10. For an Exabyte drive, we recommend a value of 0, since this device does its own retries.

- **SCSI adapter i.d.** This parameter sets the SCSI address of the UC07/08 host adapter. The valid range is from 0 through 7.

5.6.2.3   Test Selection

This option permits you to selectively run any of the six tests by means of a menu. Type the letter of the test, followed by a < return >, at the prompt. Repeat for as many tests as you want, then select "Go" to begin test execution.

```
            TEST SELECTION MENU

     B - BOT and Rewind
     W - Write/Read
     F - File mark
     S - Space forward/reverse
     P - Positioning
     E - Positioning to EOT
     R - Request Sense
     H - Host Memory DMA
     L - Loop Count
     D - Display selections
     C - Clear selections
     G - Go
     X - Exit this Menu


            Select Function (def = X):


  CTRL/C - Returns you to the previous level
  CTRL/U - Deletes current input if no <CR> entered
```
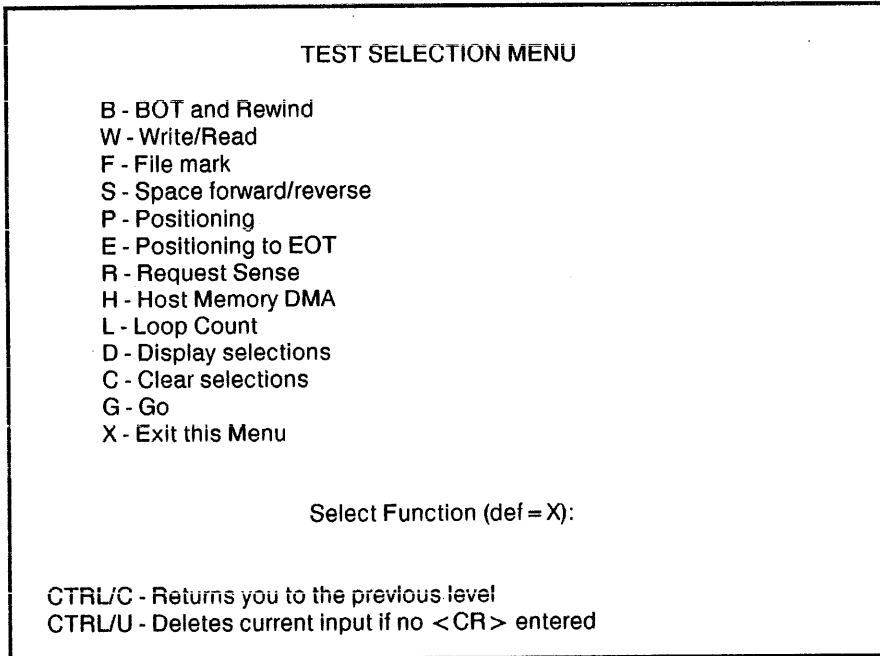
Figure 5-5. Sample Tape F.R.D. Test Selection Menu

Six diagnostic tests and their descriptions follow. Other selections deal with displaying and running the tests.

B -   **BOT and Rewind.** The UC07/08 checks for the Beginning of Tape (BOT) status by issuing a write, then a rewind, command.

W -   **Write/Read.** The UC07/08 issues a series of write and read commands and compares the data.

F -   **Filemark.** The UC07/08 writes a filemark, rewinds, spaces forward a record, and checks for the End of File (EOF).

S - **Space forward/reverse.** In this test, the UC07/08 issues commands to check that the tape drive is properly spacing forward and backward with respect to the EOF mark.

P - **Positioning.** The UC07/08 issues write, rewind, and space commands to check that the tape drive can position properly.

E - **Positioning to EOT.** The UC07/08 issues write, rewind, and space commands from BOT to EOT. On a full-length tape, this test could run for over two hours. You can shorten this time by using special low-capacity tape cartridges available from Exabyte.

R - **Request Sense.** This option causes the information returned by the SCSI request sense command to be displayed.

H - **Host Memory DMA.** The UC07/08 uses host memory as a scratch pad to verify that the LSI-11 Bus function is transferring data properly.

L - **Loop Count.** This option lets you determine how many times, from 0 to 255, a given test is executed. Selecting 0 is equivalent to selecting an infinite number of passes. If this option is not used, the default number of executions is 1.

D - **Display selections.** This is a convenience option. Test selection is typically made by selecting (but not executing) the tests you want all at once, then selecting the "Go" option which executes the tests. If you want to see the tests you have selected prior to executing them, **Display selections** will list them on the screen. You can then either go ahead with test execution or change the tests.

C - **Clear selections.** If you want to cancel the tests you have previously selected but not executed, this option will effectively cancel all selections.

G - **Go.** This option begins test execution. You will be asked for confirmation that you do want to run the tests.

X - **Exit this Menu.** This option will return you to the Main Menu.

Completed tests are followed by a message on the screen confirming the number of passes made and the number, if any, of hard, soft, or device errors.

5.6.2.4 Display Switch Settings

This option shows the switch settings of SW1 and SW4 when using TMSCP on SCSI Port 0 or SW2 and SW3 when using TMSCP on SCSI Port 1. A sample display for SW1 (SW2 for Port 2) follows in Figure 5-6; a sample display for SW4 (SW3 for Port 2) is shown in Figure 5-7.

```
Switch 1/2
OFF    ON
------- -------

|        |
|  [ * ] |     1    UC07/08 Host Adapter Reset Switch, Unreadable Hardware Switch
|  [ * ] |     2    Not Used
|  [ * ] |     3    Not Used
|  [ * ] |     4    Continue on self test error
|        |
------- -------
```
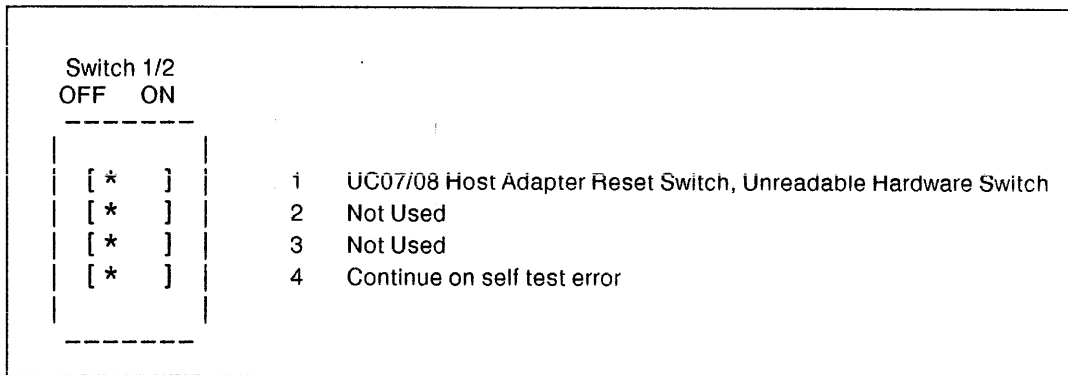
Figure 5-6. Sample SW1 or SW2 Switch Setting Display

```
Switch 3/4
OFF     ON
------- -------

|        |
|  [ * ] |     1    \
|  [ * ] |     2    Address = 17774500 Oct
|  [ * ] |     3    /
|  [ * ] |     4    /
|  [ * ] |     5    TMSCP
|  [   ] |     6    Unreadable hardware switch
|  [ * ] |     7    Not Used
|  [ * ] |     8    Not Used
|  [ * ] |     9    Not Used
|  [ * ] |    10    Not Used
|        |
------- -------
```
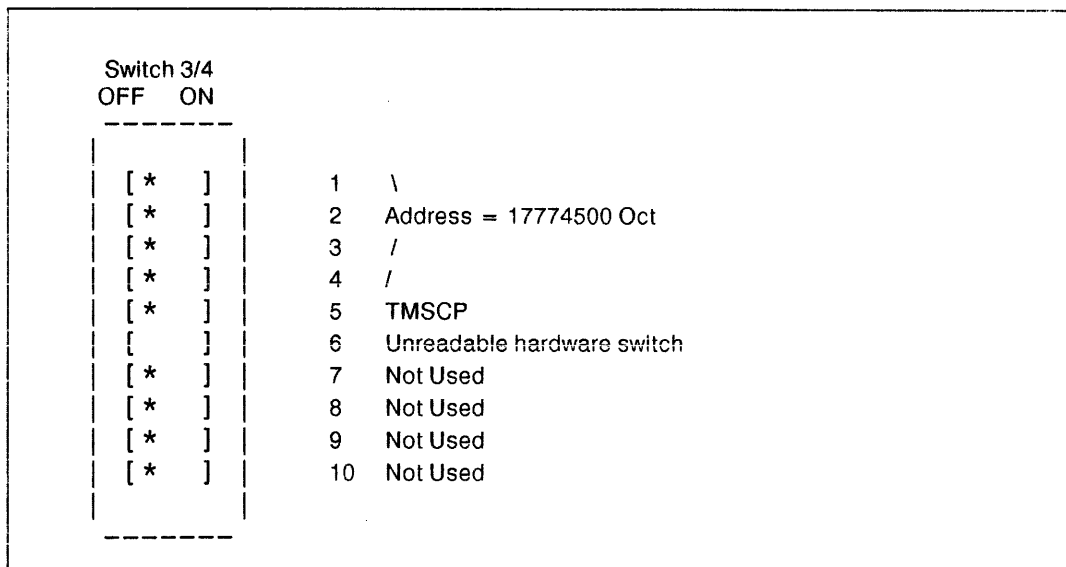
Figure 5-7. Sample SW3 or SW4 Switch Setting Display

5.7   Integration and Operation

5.7.1   Testing and Indicators

There are three light emitting diodes (LEDs) on the UC07/08 PWB. These LEDs are used for both diagnostics and for normal operations.

If switch SW1-1 is OFF, the UC07/08 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 base address register

The self-test routine consists of two test sequences: preliminary and self-test. The preliminary test sequence exercises the 8031 microprocessor chip and the Emulex SCSI Processor (ESP) chip. When the UC07/08 successfully completes the preliminary test, LED3 illuminates indicating that the UC07/08 is waiting for MSCP or TMSCP initialization.

During MSCP or TMSCP initialization, by host software control, the UC07/08 executes a second 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 EPROM. If the UC07/08 passes this sequence of its self-test successfully, all three UC07/08 LED indicators are OFF.

If a fatal error is detected either during self-test or while the system is running, all three of the LED indicators are ON (illuminated). If the UC07/08 fails to pass its power-up self-tests, you can select a special diagnostic mode (switch SW1-4 or SW2-4 ON) which causes the LED indicators to display an error code. See Fault Isolation Procedure, in Section 6, TROUBLESHOOTING.

During normal operation, LED1 and LED2 flicker occasionally. These LEDs are used to indicate LSI-11 Bus activity and SCSI activity, respectively.

5.7.2   Operation

There are no operational instructions. The UC07/08 is ready for MSCP or TMSCP initialization as soon as it is powered up.

BLANK

6.1   Overview

This section describes the several diagnostic features with which the UC07/08 Host Adapter is equipped, and outlines fault isolation procedures that use these diagnostic features.

Subsection	Title
6.1	Overview
6.2	Service
6.3	Fault Isolation Procedure
6.4	Power-Up Self-Diagnostic
6.5	Fatal Error Codes

6.2   Service

Your Emulex UC07/08 Host Adapter has been 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 UC07/08 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 product to EMULEX without authorization. A product or component returned for service without an authorization will be returned to the owner at the owner's expense.

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

Emulex 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 a message.

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, you should have made a record of the switch settings on the Configuration Reference Sheet.

After you have contacted Emulex and received an RMA, package the product (preferably using the original packing material) and send it **postage paid** to the address provided by the Emulex representative. You must also insure the package.

6.3 Fault Isolation Procedure

This fault isolation procedure is provided in flowchart form in Figure 6-1. This procedure is based on standard troubleshooting techniques as well as the self-diagnostics incorporated into the UC07/08. The procedure is designed to be used if the self-test fails or if many errors are flagged by the subsystem during normal operation. (If neither of these events takes place, then it is not necessary to follow these procedures.)

START

POWER UP UC07/08
DO NOT BOOT SYSTEM

1

READ SA
REGISTER

SA REGISTER
IS 5400₈ — NO → FATAL HARDWARE ERROR. RESEAT CONTROLLER
OR MOVE IT TO ANOTHER BACKPLANE SLOT.
CHECK CONTROLLER SWITCHES FOR CORRECT
CSR SELECTION. ENSURE YOU ARE ACCESSING
I/O PAGE ON 22-BIT SYSTEMS.

YES

UPLOAD F.R.D.
TO MEMORY.
SEE SECTION 5.3.1

EXAMINE THE
SA REGISTER.
IS BIT 15 SET? — NO → SUCCESSFUL
F.R.D. LOAD

YES

SA BITS
07:00=121? — YES → FATAL F.R.D. DMA TO MEMORY, ON MICROVAX III,
CHECK TO ENSURE YOU HAVE ENABLED MEMORY
MAP. SEE SECTION 5.3.1 → CALL EMULEX
CUSTOMER SERVICE
IF RETRY IS
UNSUCCESSFUL

NO

SA BITS
07:00 = ?
SEE SECTION 6.5 — NO → CALL EMULEX
CUSTOMER SERVICE

YES

DETERMINE FAULT AND
ATTEMPT TO CORRECT

1

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Figure 6-1. Fault Isolation Chart

6.4   Power-Up Self-Diagnostic

The UC07/08 executes an extensive self-diagnostic to ensure that the host adapter is in good working order. The self-test is divided into several parts. Table 6-1 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 base address register. The other tests are executed as the controller interacts with the MSCP or TMSCP initialization routine. If the UC07/08 fails any of the tests, it posts a fatal error code in the low byte of the SA register (base address plus 2) and turns on all three LEDs. The MSCP and TMSCP fatal error codes used by the UC07/08 are listed in Table 6-2.

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, halt the CPU. Turn ON SW1-4 (UC07/UC08 Port 1) or SW2-4 (UC07/UC08 Port 2). Next, the host computer must be powered down or the UC07/08 Reset/Halt switch (SW1-1 for UC07/08 Port 1; SW2-1 for Port 2) must be toggled (turned ON and then OFF) to cause the UC07/08 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 6-1.

If the UC07/08 completes the diagnostic mode without errors, all three LEDs are OFF. After testing is complete, be sure to turn OFF SW1-4 or SW2-4. Reset the UC07/08 Host Adapter before using it.

Table 6-1. LED Error Codes

LED 3	2	1	Error Description
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 EPROM Checksum Test failed
0	0	0	Self-diagnostic complete without errors
1	1	1	Refer to Table 6-2

NOTE

The UC07/08 might fail the power-up self-diagnostic if the SCSI target device that supplies terminator power to the SCSI bus is powered off. Proper operation of the SCSI bus requires that terminator power be present at all times.

6.5 Fatal Error Codes

If the UC07/08 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 6-2 lists the MSCP and TMSCP fatal error codes used by the UC07/08.

Table 6-2. MSCP and TMSCP Fatal Error Codes used by the UC07/08

Octal Code	Hex Code	Description
0	0	No information in message packet.
1	1	Possible parity or timeout error when the UC07/08 attempted to read data from a message packet.
2	2	Possible parity or timeout error when the UC07/08 attempted to write data to a message packet.
4	4	UC07/08 diagnostic self-test indicated a controller RAM error.
5	5	UC07/08 diagnostic self-test indicated a firmware checksum error.
6	6	Possible parity or timeout error when the UC07/08 attempted to read an envelope address from a command ring.
7	7	Possible parity or timeout error when the UC07/08 attempted to write an envelope address to a command ring.
11	9	Host did not communicate with UC07/08 within the time frame established while bringing the controller online.
12	A	Operating system sent more commands to the UC07/08 than the controller can accept.
13	B	UC07/08 unable to perform DMA transfer operation correctly.
14	C	UC07/08 diagnostic self-test indicated controller fatal error.
16	E	The MSCP or TMSCP connection identifier is invalid.
23	13	An error occurred during the MSCP or TMSCP initialization sequence.

Additional fatal error messages might appear. These error codes are listed in Table 6-3.

Table 6-3. 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

7.1 Overview

This section contains an overview of the UC07/08 device registers that are accessible to the Q-Bus and that are used to monitor and control the UC07/08 Host Adapter. The registers are functionally compatible with DEC implementations of MSCP controllers.

The following table outlines the contents of this section.

Subsection	Title
7.1	Overview
7.2	Overview of MSCP Subsystem
7.3	MSCP and TMSCP Command Compatibility
7.4	Registers
7.5	Bootstrap Command (Disk Only)

7.2 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.

7.3 MSCP and TMSCP Command Compatibility

A complete description of MSCP commands and the corresponding status responses which the UC07/08 Host Adapter posts is beyond the scope of this manual.

7.3.1 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 UC07/08.

7.3.1.1 Minimal Disk or Tape Subset

The UC07/08 Host Adapter supports the entire minimal disk subset of MSCP commands, and the entire minimal tape subset of TMSCP commands.

7.3.1.2 Diagnostic and Utility Protocol (DUP)

The UC07/08 Host Adapter does not support any of the DUP commands or maintenance read/write commands. Therefore, the UC07/08 is not compatible with DEC diagnostics that use the MSCP or TMSCP DUP commands.

7.4 Registers

During normal operation, the UC07/08 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 UC07/08 has two 16-bit registers in the 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 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 three 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.

7.5   Bootstrap Command (Disk Only)

To allow the system to be easily bootstrapped from peripherals attached to the UC07/08 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 MicroVAX or on systems using an 11/73B CPU module.

The Bootstrap Command can be issued from the console after the system is powered up, or it can be incorporated into a firmware routine that is located in a Bootstrap ROM. (The ROM would not be located on the UC07/08 PWB, but on some other module in the system.) The Bootstrap Command causes the UC07/08 to load the first logical block from the selected peripheral into host memory starting at location 00000.

To issue the Bootstrap Command to the UC07/08, at the console emulator prompt, enter the following sequence (operator input is displayed in **boldface**):

@7**xxxxx**/00000<lf>   <lf> = LINE FEED
7**yyyyy**/005400 **30003**<cr>   <cr> = CARRIAGE RETURN
@**/000400 40000**<cr>
@**RS/456332 304**<cr>
@**R0/103741 0**<lf>
R1/001276 **772150**<cr>
@**0G**

NOTE: XXXXX and YYYYY are offsets dependent on the address of the UC07/08 controller. See Table 7-1 for the appropriate values.

Table 7-1. LSI-11 Offsets for MSCP Emulations

UC07/08 Bus Address	XXXXX	YYYYY
17772150	72150	72152
17772154	72154	72156
17760334	60334	60336
17760340	60340	60342
17760344	60344	60346
17760350	60350	60352
17760354	60354	60356
17760360	60360	60362
17760364	60364	60366
17760370	60370	60372
17760374	60374	60376
17760400	60400	60402
17760404	60404	60406
17760410	60410	60412
17760414	60414	60416
17760420	60420	60422

8.1 Overview

This section contains a description of the UC07/08 Host Adapter's architecture.

8.2 UC07 and UC08 Host Adapter Architecture

The UC07 and UC08 are microprocessor-based host adapters, each of which is contained on a single quad-wide PCBA. The UC07 is a single-function host adapter, while the UC08 is a dual-function host adapter that is essentially two UC07s contained on a single PCBA. The remainder of this section describes the architecture of only the UC07; the architecture of each part of the dual-function UC08 is similar. The UC07's major functional blocks are shown in Figure 8-1.

The UC07 Host Adapter is organized around the eight-bit 8031 microprocessor. The board has an eight-bit internal data bus with 16-bit addressing capability. The 8031 addresses the Buffer Controller, the Host Adapter Controller (HAC), and the Emulex SCSI Processor (ESP) 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 HAC and the Buffer Controller for the large data transfers, which are their specialties.

The UC07 uses a 64K Byte erasable programmable read-only memory (EPROM), which contains the firmware (control program). Also, the UC07 has 64K bytes of random access memory (RAM), which is used for data buffering and working storage.

The LSI-11 Bus interface contains 22 lines. Sixteen of the lines are multiplexed for both address and data; six are used for only address. The HAC is used for programmed I/O, CPU interrupts, and DMA 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 HAC has automatic LSI-11 Bus address generation capability that, in conjunction with a byte counter, allows the interface to conduct LSI-11 Bus DMA transfers without direct microprocessor intervention after the interface is set up for a transfer. This automatic DMA capability is used with the UC07 Buffer Controller to transfer large blocks of data directly between host memory and the UC07's RAM.

The SCSI interface and control is implemented using a single LSI chip, the ESP. 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 64K RAM buffer and the SCSI interface, and between the LSI-11 Bus interface and the 64K 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.
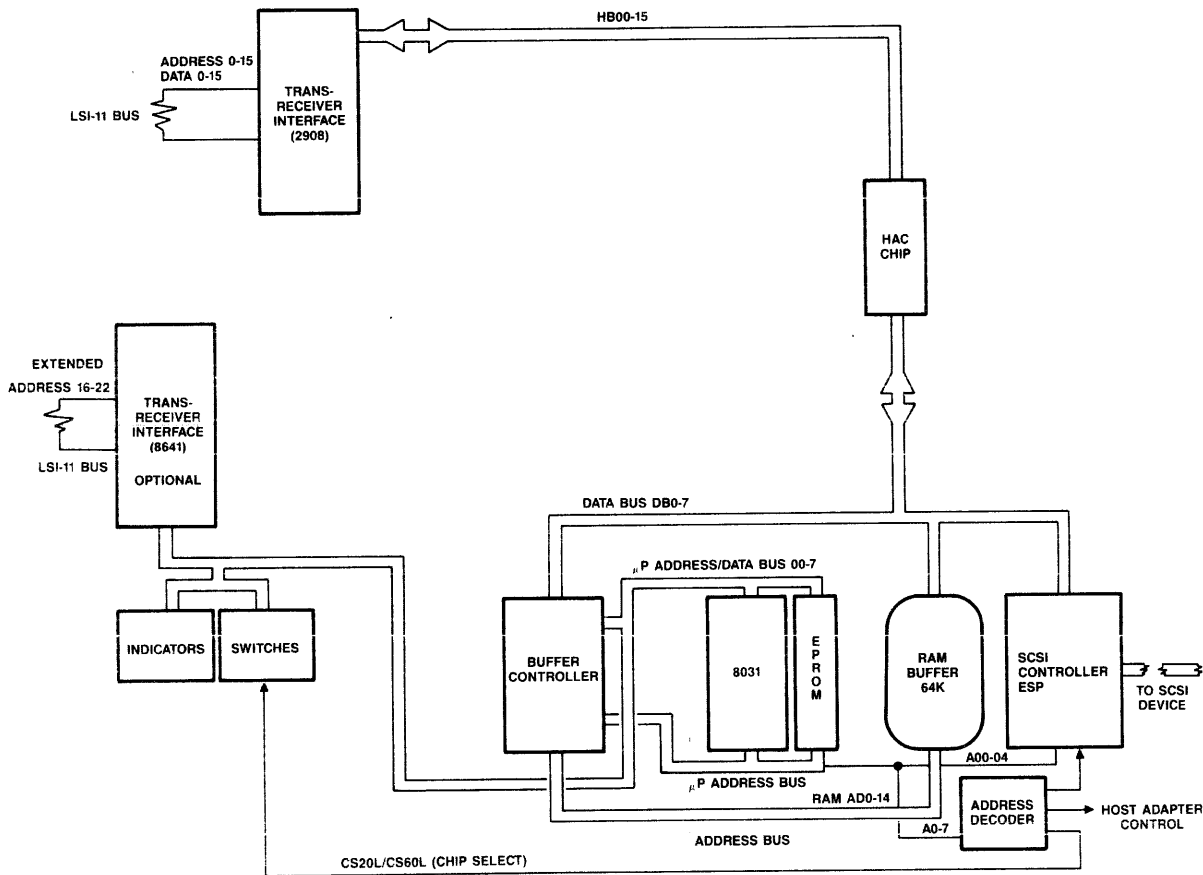
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Figure 8-1. UC07 Block Diagram

9.1 Overview

This section describes the interfaces that the host adapter incorporates. It includes information on the host adapter's implementation of SCSI bus specification electrical and mechanical requirements. Including this overview, the section is divided into the following subsections.

Subsection	Title
9.1	Overview
9.2	Host Adapter to Q-Bus Interface
9.3	Host Adapter to SCSI Bus Interface

9.2 Host Adapter to Q-Bus Interface

The Q-Bus between the CPU and the UC07/8 Host Adapter contains 42 bidirectional signal lines and two unidirectional signal lines. Q-Bus interface pin assignments are listed and described in Figure 9-1. These signal lines provide the means by which the CPU and the host adapter communicate with each other.

The Q-Bus interface is used for programmed I/O, CPU interrupts, and DMA data transfer operations. Addresses, data, and control information are sent along these signal lines, some of which contain time-multiplexed information. The Q-Bus interface lines are grouped in the following categories:

- **Twenty-two Address Lines** <BDAL21:BDAL00>. Of these, there are 16 multiplexed data/address lines <BDAL15:BDAL00>; two multiplexed address/parity lines <BDAL17:BDAL16>; and four extended address lines <BDAL21:BDAL18>.

- **Six Data Transfer Control Lines.** BBS7, BDIN, BDOUT, BRPLY, BSYNC, and BWTBT.

- **Ten Interrupt Control and Direct Memory Access Control Lines.** BIAKI, BIAKO, BIRQ4, BIRQ5, BIRQ6, BIRQ7, BDMGO, BDMR, BSACK, BDMGI.

- **Six System Control Lines.** BDCOK, BHALT, BINIT, BEVNT, BPOK, and BREF.

SIDE 2		SIDE 1
+ 5V	A	BIRQ5
	B	BIRQ6
GND	C	BDAL16
	D	BDAL17
BDOUT	E	
BRPLY	F	
BDIN	H	
BSYNC	J	GND
BWTBT	K	
BIRQ4	L	
BIAKI	M	GND
BIAKO	N	BDMR
BBS7	P	BHALT
BDMGI	R	BREF
BDMGO	S	
BINIT	T	GND
BDAL00	U	
BDAL01	V	
+ 5V	A	BDCOK
	B	BPOK
GND	C	BDAL18
	D	BDAL19
BDAL02	E	BDAL20
BDAL03	F	BDAL21
BDAL04	H	
BDAL05	J	GND
BDAL06	K	
BDAL07	L	
BDAL08	M	GND
BDAL09	N	BSAK
BDAL10	P	BIRQ7
BDAL11	R	BEVNT
BDAL12	S	
BDAL13	T	GND
BDAL14	U	
BDAL15	V	

SOLDER SIDE

COMPONENT SIDE

CONNECTOR A

CONNECTOR B

Figure 9-1. Q-Bus Interface Pin Assignments

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9.2.1 Interrupt Priority Level

The host adapter is jumper-selectable to issue level 4 or level 5 interrupt requests and to monitor levels 5 and 6. The level 4 request is necessary to allow compatibility with an LSI-11 CPU.

9.2.2 Register Address

The host adapter has two registers visible to the Q-Bus. Their addresses are determined by DIP switches. See Section 4 for detailed address and switch setting information.

9.2.3 DMA Operations

All DMA data transfer operations are performed under microprocessor control. When doing a Read From Memory operation, a check is made for memory parity or nonexistent memory (NXM) errors; during a Write operation a check is made for NXM errors. If an error is detected, an MSCP status error is returned.

9.3 Host Adapter to SCSI Bus Interface

This subsection provides information on the host adapter's implementation of SCSI bus electrical and mechanical requirements.

9.3.1 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 host adapter 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 host adapter resides.

9.3.1.1 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 host adapter single-ended pin assignments are shown in Table 9-1.

9.3.1.2 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.

9.3.2 SCSI Interface Electrical Description

The host adapter interfaces to SCSI controllers via the SCSI bus. A 50-pin male IDC connector at location J1 on the UC07 board (J1 and J2 on the UC08 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 9-2.

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 9-1. UC07/08 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	--
25		Not connected
26	TERMPWR	Output
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
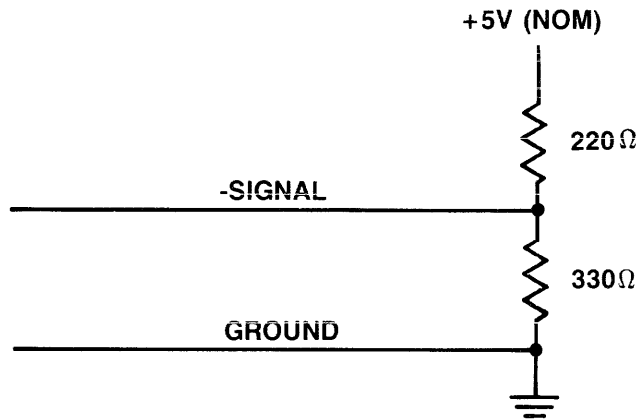
Figure 9-2. UC07/08 SCSI Bus Signals Termination

UC0701-0587

9.3.3 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 10.3. 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 10.3.3.1.

9.3.3.1   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 9-2.

In Table 9-2, 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 host adapter generates parity which is selected through NOVRAM parameters. Parity is not guaranteed valid during the Arbitration Phase.

The host adapter's SCSI bus pin assignments are listed in Table 9-2; the host adapter supports only the SCSI single-ended option.

Table 9-2. 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 9-2. 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.
TERMPWR	Termpwr	Provides jumper-selectable termination power to the terminator at the opposite end of the SCSI bus.

9.3.3.2   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 9-3.

The timing diagram shown in Figure 9-3 indicates the typical relationship between SCSI bus signals and SCSI phase sequencing.

Table 9-3. 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.

Table 9-3. 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		

BUS SET DELAY — Maximum time for an SCSI device to assert BSY and its SCSI ID bit on the data bus after it detects Bus Free Phase.

BUS FREE DELAY — Minimum time that an SCSI device shall wait from its detection of Bus Free Phase until its assertion of BSY.

BUS CLEAR DELAY — Maximum time for an SCSI device to stop driving all bus signals after Bus Free Phase is detected or SEL received from an SCSI device during arbitration.

ARBITRATION DELAY — Minimum time an SCSI device shall wait from asserting BSY for arbitration until the data bus can be examined to see if arbitration has been won.

BUS SETTLE DELAY — Time to wait for the bus to settle after changing certain control signals.

Note: All Signals Shown Active Low

Initiator asserts BSY
2 deskew delays
Systems with no arbitration start here
Target asserts BSY

(Busy)	-BSY
(Select)	-SEL
(Control/Data)	-C/D
(Input/Output)	-I/O
HANDSHAKE (Request)	-REQ
(Acknowledge)	-ACK
(Attention)	-ATN
(Message)	-MSG
(Reset)	-RST
(Data bit)	DB(7-0,P)

Arbitration ID's — Initiator ID & Target ID

Note:
DB(7) (= Most significant bit. = Highest priority ID for arbitration

BUS FREE PHASE

Initiator tries to get bus — Initiator has bus and selects Target.

Note:
DB(P) = Data parity (odd). Parity is not valid during arbitration.

The use of parity is a system option.

Note:
In a typical system, a computer's host adapter will act as the Initiator and an I/O device's control unit will act as the Target.

SEL and BSY are both false for at least one Bus Settle Delay.

ARBITRATION PHASE

— Implementation of this phase is a system option.

— At least one Bus Free Delay, but no more than one Bus Set Delay, after Bus Free Phase has been detected. The Initiator asserts BSY and its own SCSI device ID bit on the data bus.

— The Initiator waits an Arbitration Delay then examines the data bus. If a higher priority SCSI device ID bit is true on the data bus (DB7 is the highest), the Initiator loses arbitration and releases BSY. If no higher priority SCSI device ID bit is true on the data bus, then the Initiator wins arbitration and asserts SEL.

— Bus devices having lost arbitration, shall release BSY and their own SCSI device ID bit within a Bus Clear Delay after SEL becomes true.

— The Initiator that wins arbitration waits at least a Bus Clear Delay plus a Bus Settle Delay after asserting SEL before changing any signals on the bus.

SELECTION PHASE

— During this phase, the I/O signal is deasserted to distinguish this phase from the Reselection Phase.

— NON-ARBITRATING SYSTEMS: In systems with the Arbitration Phase not implemented, after detecting the Bus Free Phase, the Initiator waits a minimum of one Bus Clear Delay, then it asserts the data bus with both the desired Initiator ID bit and the Target's ID bit. After two deskew delays, the Initiator asserts SEL.

— ARBITRATING SYSTEMS: In systems with the Arbitration Phase implemented, the Initiator that won arbitration has both BSY and SEL asserted and changes the data bus after two Bus Settle Delays. The data bus is then asserted with both the desired Initiator ID bit and the Target's ID bit. Two deskew delays later BSY is released.

— IN ALL SYSTEMS: The Target determines that it is selected when SEL and its SCSI device ID bit are true and BSY and I/O are false for at least a Bus Settle Delay. The Target then asserts BSY within a Selection Abort Time.

— Two deskew delays after the Initiator detects BSY true, it releases SEL and may change data bus signals.

Figure 9-3. SCSI Bus Timing Diagram (Sheet 1 of 3)

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"Bus settle delay"

(Busy)   -BSY   L

(Select)   -SEL   H

(Control/Data) -C/D

(Input/Output) -I/O

Write peripheral device

Read peripheral device

(Request) -REQ

Typical "REQ"/"ACK" handshake cycle

(Acknowledge) -ACK

(Attention) -ATN   H

(Message) -MSG   H

(Reset) -RST   H

Last data (write peripheral)

(Data bit) DB(7-0,P)

valid valid First data (write peripheral) valid valid valid valid

1st CMD byte Last CMD byte First data (read peripheral) Last data (read peripheral)

Target "requests" command from Initiator.

Target "requests" data transfer with Initiator

=== COMMAND PHASE ===

The Target asserts. C/D and deasserts I/O and MSG for all of the handshakes of this phase.

The transfer is from Initiator to Target.

HANDSHAKE PROCEDURE:

The Target asserts REQ. The Initiator drives data (7-0,P) to their desired values, waits at least one deskew delay plus a cable skew delay, and asserts ACK. The Initiator continues to drive data (7-0,P) until REQ is false.

When ACK is true at the Target, the Target reads the data (7-0,P), then asserts REQ.

When REQ becomes false at the Initiator, the Initiator may change or release data (7-0,P) and deassert ACK.

The Target continues requesting command bytes. The number of bytes depends on the command group code detected from the first command byte received.

=== DATA PHASE ===

DATA IN PHASE: Read Peripheral.

Data is to be sent from Target to Initiator.

Target asserts I/O, deasserts C/D, and MSG during the REQ/ACK handshake of this phase.

HANDSHAKE PROCEDURE:

The Target first drives data (7-0,P) to their desired values, waits at least one deskew delay plus a cable skew delay, then asserts REQ. Data (7-0,P) shall remain valid until ACK is true at the Target.

The Initiator shall read data (7-0,P) after REQ is true, then asserts ACK.

When ACK becomes true at the Target, the Target may change or release data (7-0,P) and deassert REQ.

After REQ is false, the Initiator deasserts ACK. After ACK is false, the Target may continue the transfer by drawing data (7-0,P) and asserting REQ.

DATA OUT PHASE: Write Peripheral.

Data is to be sent from Initiator to Target

Target deasserts C/D, I/O and MSG during the REQ/ACK handshake of this phase. Refer to the handshake procedure of the Command Phase

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Figure 9-3. SCSI Bus Timing Diagram (Sheet 2 of 3)

Figure 9-3. SCSI Bus Timing Diagram (Sheet 3 of 3)

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10.1 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 UC07/08. This section is divided into the following subsections:

Subsection	Title
10.1	Overview
10.2	SCSI Bus Overview
10.3	SCSI Bus Phases
10.4	SCSI Bus Phase Sequencing
10.5	SCSI Bus Conditions
10.6	SCSI Commands
10.7	SCSI Group Code 0 Command Descriptions
10.8	SCSI Group Code 1 Command Descriptions
10.9	SCSI Group Code 7 Command Descriptions

10.2 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 UC07/08 SCSI command standard is based on the ANSI X3T9.2/82-2 Revision 17B (16 Dec. 85) SCSI Interface Specification and the industry-standard SCSI Common Command Set (CCS).

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). Three basic SCSI configurations are supported with the UC07/08 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. When a host and a controller communicate, one acts as the Initiator and one as the Target. The Initiator (usually the host, the UC07/08) originates an operation and the Target (usually a peripheral controller) performs the operation. Sample system configurations supported by UC07/08 hardware are shown in Figure 10-1.

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.

SCSI bus data transfers are asynchronous or synchronous 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 or multiple requests can be performed in synchronous mode.

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 9.3.3.1.

10.2.1 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.

PERIPHERAL UNITS SUCH AS RIGID DISKS,
FLEXIBLE DISKS, MAGNETIC TAPE,
REMOVABLE DISKS OR OPTICAL DISKS

SINGLE INITIATOR, SINGLE TARGET

SINGLE INITIATOR, MULTI TARGET

MULTI INITIATOR, MULTI TARGET
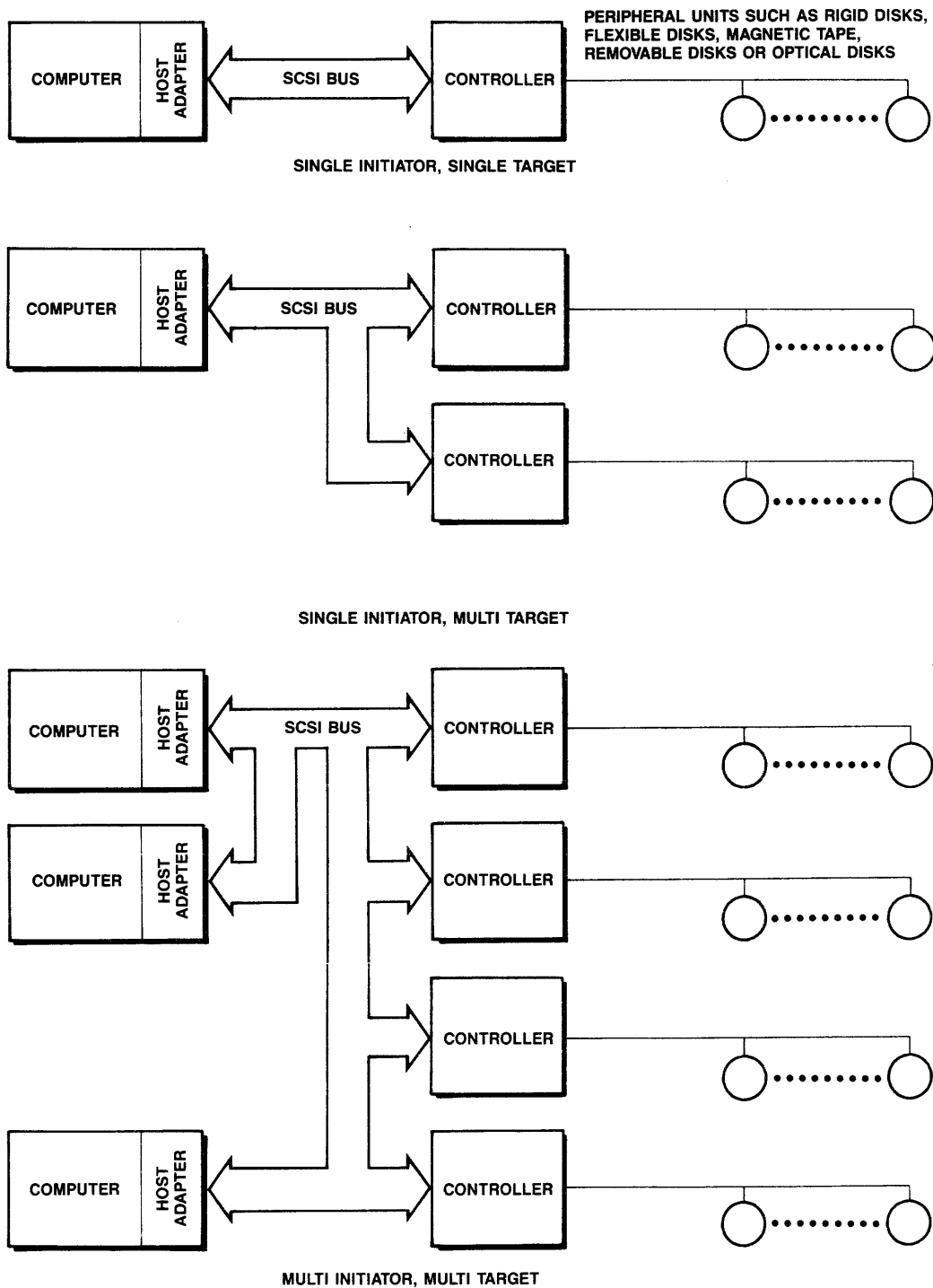
UC0701-2062

Figure 10-1. Sample SCSI Bus Configurations

10.3   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 UC07/08, include the disconnect function and reselection function (see subsection 10.3.2).   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 9.3.3.

10.3.1   Arbitration Phase

The Arbitration Phase is an optional implementation on the SCSI bus.   This phase is used when multiple controllers or processors contend for SCSI bus ownership. Since multiple host adapters and/or controllers might desire control of the SCSI bus concurrently, arbitration for the SCSI bus is a requirement for controllers attached to the UC07/08.

10.3.2   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 UC07/08 selects a target to perform some function (for example, 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 10.6.) The IDENTIFY message also informs the Target if the Initiator supports the disconnect function.

10.3.3   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.

10.3.3.1   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 10.6 for definitions of SCSI commands and all SCSI CDBs supported by the UC07/08.)

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.

10.3.3.2   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 might have no data to be transferred and therefore have a null Data Phase. Synchronous and asynchronous data transfer mode are supported by the UC07/08.

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.

10.3.3.3   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 10.3.3.3.1.

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.

10.3.3.3.1   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 10-1 lists and describes the status codes that are recognized by the UC07/08.

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 10-1. 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		

10.3.3.4   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. Table 10-2 lists the error messages that are supported by the UC07/08. Unsupported messages will cause the UC07/08 to abort and restart the command.

Table 10-2. UC07/08 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.
01	EXTENDED	Used for synchronous Data Transfer Request.
02	SAVE DATA POINTER	Issued by the Target to direct the Initiator to save a copy of the present active data pointer.
03	RESTORE 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.
09	MESSAGE PARITY ERROR	
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 10.5.1).
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 UC07/08 at the beginning of every command sequence.

10.4   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 10-2.

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 10.3.

PHASE SEQUENCING WITH ARBITRATION
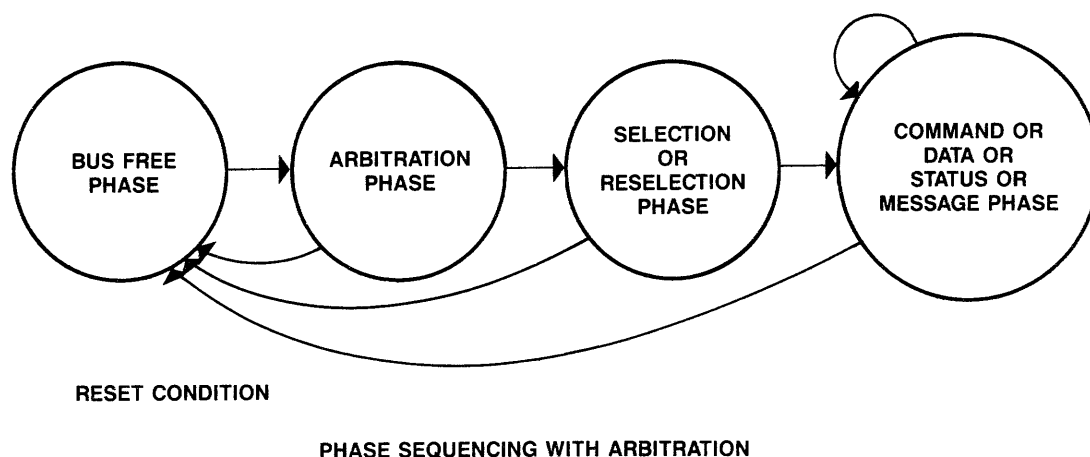
Figure 10-2. SCSI Bus Phase Sequences

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10.5   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.

10.5.1   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 UC07/08 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 UC07/08 will re-submit outstanding commands to the target after the reset condition clears.

10.5.2   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.

10.6   SCSI Commands

An Initiator (such as the UC07/08) 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 UC07/08 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 UC07/08 follow the guidelines listed in the ANSI SCSI specification.

NOTE

The commands listed apply to Emulex controllers (Medalist and Champion). Other controllers might 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 UC07/08 is shown in the applicable descriptions in subsection 10.7 (Group Code 0 CDBs), 10.8 (Group Code 1 CDBs), and 10.9 (Group Code 7 CDBs). The following table lists, by subsection number, command names and operation codes for SCSI commands issued by the UC07/08:

Subsection	UC07/08 SCSI Command	Opcode (Hexadecimal)
10.7.1	FORMAT UNIT	04
10.7.2	INQUIRY	12
10.7.3	REWIND (Tape only)	01
10.7.4	MODE SELECT	15
10.7.5	MODE SENSE	1A
10.7.6	READ (Tape)	08
10.7.7	READ (Disk)	08
10.7.8	RE-ASSIGN BLOCK	07
10.7.9	REQUEST SENSE	03
10.7.10	START/STOP UNIT	1B
10.7.11	TEST UNIT READY	00
10.7.12	WRITE FILEMARKS (Tape only)	10
10.7.13	SPACE (Tape only)	11
10.7.14	ERASE (Tape only)	19
10.7.15	LOAD/UNLOAD (Tape only)	1B
10.7.16	WRITE (Tape)	0A
10.7.17	WRITE (Disk)	0A
10.8.1	READ CAPACITY	25
10.8.2	READ (EXTENDED)	28
10.8.3	WRITE (EXTENDED)	2A
10.9.1	READ LONG	E8
10.9.2	WRITE LONG	EA

10.7   SCSI Group Code 0 Command Descriptions

This subsection provides detailed descriptions of SCSI Group Code 0 commands, including CDB formats, hexadecimal operation codes, 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 10-3. 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 UC07/08, acting as a SCSI bus Initiator, supports up to eight LUNs: eight disk drives assuming they are not split, or 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.

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

* Control byte. The control byte is always zero.

Figure 10-3. Sample Group 0 Command Descriptor Block

10.7.1   Format Unit (Opcode 04H)

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	Bit 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 can 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 10-3 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 10-3. Only the block address mode is supported.

Table 10-3. UC07/08 Controller Format Modes

Bits					Mode
04	03	02	01	00	
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 can be supplied by the user. This mode can 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 can 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.

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.

10.7.2   Inquiry (Opcode 12H)

The **INQUIRY** CDB, shown below, is a means by which the Initiator can 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.

Byte	07	06	05	Bit 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.

10.7.3   Rewind (Opcode 01H, Tape Only)

The **REWIND** CDB, shown below, allows you to rewind to the beginning of a tape.

Byte	Bit 07	06	05	04	03	02	01	00
0	0	0	0	0	0	0	0	1
1	0	0	0	0	0	0	0	Immed
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	X	X	0	0	0	0	0	0

Rewind Timing - Byte 01, Bits <00:00>

If the Immed bit equals 0, then the Rewind command will be completed into the Initiator after the entire operation is complete. If the Immed bit equals 1, then the command will be completed into the Initiator upon acceptance of the command.

10.7.4   Mode Select (Opcode 15H)

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	07	06	05	Bit 04	03	02	01	00
00	0	0	0	1	0	1	0	1
01	LUN			PF	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

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

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

Page Format - Byte 01, Bit <04>

This byte is supported for devices that have implemented the bit. See subsection 10.7.4 for further details.

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.

10.7.5   Mode Sense (Opcode 1AH)

The **MODE SENSE** CDB, shown below, enables an Initiator to receive device parameters from the target controller. **MODE SENSE** is a complementary command to the **MODE SELECT** command.

Byte	07	06	05	Bit 04	03	02	01	00
00	0	0	0	1	1	0	1	0
01		LUN		PF	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

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

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

Page Format - Byte 01, Bit <04>

This byte is supported for devices that have implemented the bit. See subsection 10.7.4 for further details.

Parameter List Length - Byte 04

This byte specifies the length in bytes of the Parameter List sent during the Data In Phase of this command.

10.7.6   Read (Opcode 08H, Tape)

The **READ** CDB for tape, shown below, causes the target to transfer one or more blocks of data to the Initiator.

Byte	07	06	05	Bit 04	03	02	01	00
0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	0	SILI	Fixed
02	Transfer Length (msb)							
03	Transfer Length							
04	Transfer Length (lsb)							
05	X	X	0	0	0	0	0	0

The following definitions clarify bits 0 and 1:

Byte 1 Bit 0 = Fixed
0 = Read Variable Block Mode
1 = Read Fixed Length Mode

Byte 1 Bit 1 = SILI
0 = Do not suppress Illegal Length Check condition status
1 = Suppress Illegal Length Check condition status

10.7.7   Read (08H, Disk)

The **READ** CDB for disk, 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	0	0	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.

10.7.8   Re-Assign Block (Opcode 07H)

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	07	06	05	Bit 04	03	02	01	00
00	0	0	0	0	0	1	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.

10.7.8.1   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 UC07/08 re-assigns only a single block at a time, this length is always four bytes.

Byte	07	06	05	Bit 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)							

Length of Defect List - Bytes 02 through 03

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.

10.7.8.2   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.

10.7.9   Request Sense (Opcode 03H)

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	07	06	05	Bit 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

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

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

<u>**Number of Requested Sense Bytes - Byte 04**</u>

This byte contains the number of bytes of data the Initiator has allocated for the sense information. The UC07/08 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 UC07/08 asks for 128 bytes, it will accept any number between 4 and 128.

10.7.9.1   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	07	06	05	Bit 04	03	02	01	00
00	VADD	1	1	1	0	0	0	0
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 10-4.

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.

Table 10-4. 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 might 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 additional 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 UC07/08 as nonrecoverable and nonretryable drive errors.

10.7.10   Start/Stop Unit (Opcode 1BH)

The **START/STOP UNIT**, shown below, requests that the target controller cause the LUN to spin up or spin down. The controller automatically performs a **START/STOP UNIT** function during its initialization operation.

Byte	07	06	05	Bit 04	03	02	01	00
00	0	0	0	1	1	0	1	1
01		LUN		0	0	0	0	Immed
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	Start
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.

Immediate Bit - Byte 01, Bit 00

When set to 1, this bit indicates the status will be returned as soon as the operation is initiated. If the bit is cleared, the controller will return the status when the operation is completed.

Start/Stop Bit - Byte 04, Bit 00

When set to 1, the START bit requests the logical unit be made ready for use. When cleared, the bit requests that the logical unit be stopped.

10.7.11   Test Unit Ready (Opcode 00H)

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.

Byte	07	06	05	Bit 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

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

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

10.7.12   Write Filemarks (Opcode 10H, Tape Only)

The **WRITE FILEMARKS** CDB, shown below, allows you to write a specified number of filemarks.

Byte	07	06	05	Bit 04	03	02	01	00
0	0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	0	0
2	Number of Filemarks (msb)							
3	0	0	Number of Filemarks					
4	0	0	Number of Filemarks (lsb)					
5	0	0	0	0	0	0	0	0

10.7.13   Space (Opcode 11H, Tape Only)

The **SPACE** CDB, shown below, is used to position in the forward or reverse direction, over elements of the data set (data blocks, filemarks, occurrence of n sequential filemarks, end-of-data).

Byte	07	06	05	Bit 04	03	02	01	00
0	0	0	0	1	0	0	0	1
1	0	0	0	0	0	0	Code	
2	Count (msb)							
3	0	0	Count					
4	0	0	0	Count (lsb)				
5	X	X	0	0	0	0	0	0

Count specifies the number of elements to be spaced over. A positive value of Count spaces in the forward direction. To space in the reverse direction, set Count to the 2's complement of the number of elements to be spaced over.

Code specifies the spacing action, as follows:

Code		Action
0	0	Space Data Blocks
0	1	Space Filemarks

10.7.14   Erase (Opcode 19H, Tape Only)

The **ERASE** CDB, shown below, allows you to erase a section of tape.

Byte	07	06	05	Bit 04	03	02	01	00
0	0	0	0	1	1	0	0	1
1	0	0	0	0	0	0	0	Long
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	X	X	0	0	0	0	0	0

If the Long bit equals 1, then a full erase from the current logical position to the physical end of tape will occur.

10.7.15   Load/Unload (Opcode 1BH, Tape Only)

The **LOAD/UNLOAD** CDB, shown below, allows you to load or unload the tape in the drive.

Byte	Bit 07	06	05	Bit 04	03	02	01	00
0	0	0	0	1	1	0	1	1
1	0	0	0	0	0	0	0	Immed
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	Load
5	X	X	0	0	0	0	0	0

The Load bit specifies the load or unload actions, as follows:

Load	Action
0	Rewind, Unload, drive is NOT READY
1	Load, Rewind to BOT, drive is READY

10.7.16   Write (Opcode 0AH, Tape)

The **WRITE** CDB for tape, shown below, transfers one or more bytes of data from the Initiator to the current position on the tape.

Byte	07	06	05	Bit 04	03	02	01	00
0	0	0	0	0	1	0	1	0
1	0	0	0	0	0	0	0	Fixed
02	Transfer Length (msb)							
03	Transfer Length							
04	Transfer Length (lsb)							
05	X	X	0	0	0	0	0	0

10.7.17   Write (Opcode 0AH, Disk)

The **WRITE** CDB for disk, 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	07	06	05	Bit 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	0	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 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.

10.8   SCSI Group Code 1 Command Descriptions

SCSI Group Code 1 command names and operation codes supported by the UC07/08 are listed by subsection number in the following table. These commands will only be used if the device size exceeds the limitation of group 0 command set.

Subsection	UC07/08 SCSI Command	Opcode (Hexadecimal)
10.8.1	READ CAPACITY	25
10.8.2	READ (EXTENDED)	28
10.8.3	WRITE (EXTENDED)	2A

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 UC07/08 SCSI command is described in a separate subsection.

A sample Group 1 CDB is shown in Figure 10-4. 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 always zero. 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	07	06	05	Bit 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 10-4. Sample Group 1 Command Descriptor Block

10.8.1 Read Capacity (Opcode 25H)

The **READ CAPACITY** CDB, shown below, allows the Initiator to determine the maximum accessible logical block number on the specified LUN. This command also returns the size of the logical block. The information is returned to the Initiator during the Data In phase.

Byte	07	06	05	Bit 04	03	02	01	00
00	0	0	1	0	0	1	0	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	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

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 - Bytes 06 through 09

These bytes are reserved and must be zero.

10.8.2   Read (Extended) (Opcode 28H)

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	0	0	0	0	0	0	0	0

If the disconnect function is enabled, the Target can disconnect from the Initiator while executing this command.

If any reservation access conflict exists, the Target terminates the **READ (EXTENDED)** command with a RESERVATION CONFLICT status code; no data is read.

If an error occur curing a read operation, the Target 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.

10.8.3   Write (Extended) (Opcode 2AH)

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	07	06	05	Bit 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	0	0	0	0	0	0	0	0

If the disconnect function is enabled, the Target 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 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.

10.9 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 UC07/08. These commands must be supported for MSCP-type replacements.

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 SCSI command is described in a separate subsection.

A sample Group 7 CDB is shown in Figure 10-5. 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 UC07/08, acting as a SCSI bus Initiator, supports up to eight LUNs: eight disk drives, assuming that none of the drives are split. 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 UC07/08 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 10-5. Sample Group 7 Command Descriptor Block

10.9.1   Read Long (Opcode E8H)

The **READ LONG** CDB, 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	07	06	05	Bit 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.

10.9.2 Write Long (Opcode EAH)

The **WRITE LONG** CDB, 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	07	06	05	Bit 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.

NOTE: The device must not change the ECC bytes supplied by the UC07/08. These bytes must be written on the block specified by the command.

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 4.3.2.

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 of the Q-Bus 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 Q-Bus-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 Q-Bus. 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_8 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 Vector 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	**TU81**[2]	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 Q-Bus 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,	760500,
	330	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 (UC07/08)**		**772150**[1]
---->	**UDA50 (UC07/08)**		**760354**
		Gap	760360
	DMF32	Gap	760400
	KMS11	Gap	760420
	VS100	Gap	761440
	TU81	**Gap**	**774500**[1]
	TU81	**Gap**	**760444**
	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 firmware PROMs on the UC07 and UC08.

B.2 Exchanging PROMS

The UC07 firmware PROM is located in the socket at U29; the UC08 firmware PROMs are located at U22 and U29. Remove the existing PROMs from their sockets using an IC puller or an equivalent tool.

The PROMs are identified by the part numbers on top of the PROMs. Refer to Figure B-1 for proper pin 1 orientation and place the UC07 PROM in U29 and the UC08 PROMs in U22 and U29. Make certain that each 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.)

Host Adapter	PROM Number	PCBA Location
UC07	G143	U29
UC08	G143	U22, U29

PIN 1 —

VIEWED FROM
COMPONENT SIDE
OF BOARD
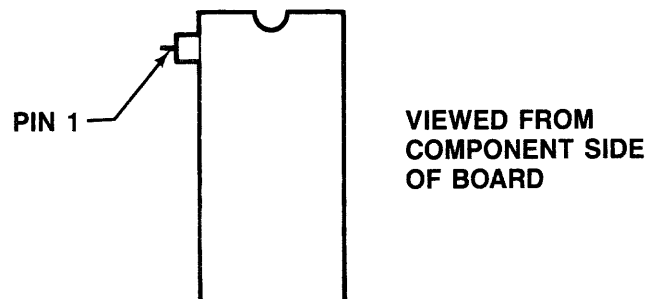
UC0701-2052

Figure B-1. IC Pin 1 Orientation
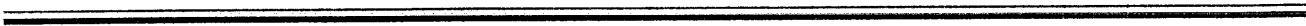
C.1 UC04 Optical Drive Compatibility

Table C-1 lists the optical disk drive NOVRAM parameters for various optical drives. If your application requires you to maintain compatibility with an Emulex UC04 optical disk subsystem, program the UC07/08 NOVRAM using the parameters in this table.

Table C-1. Optical Drive NOVRAM Settings for UC04 Compatibility

	Optimem	Optotech	OSI	Toshiba
Block size	1024	512	1024	1024
Blocks per track	25	20	32	11
Blocks per disk	999,999	390,000	1,000,000	262,723
NOTE: All values are in decimal				

C.2 UC04 Magnetic Drive Compatibility

If your application requires you to maintain format compatibility with an Emulex UC04 magnetic disk subsystem, program the UC07/08 NOVRAM for Type Code 1 or 2, and use the parameter values specified in the UC04 manual.

C.3 General Drive Parameter Settings

Tables C-2 and C-3 list the NOVRAM parameters for some Emulex bridge controller and drive combinations that Emulex has tested. If your drive does not appear in either table, or is an embedded SCSI drive, all the information needed, with the exception of spares and sector offset, can be found in your drive's manual.

If you have an embedded SCSI drive and the manual for the drive does not state the number of sectors per track, you can make the following calculation to determine the value to be entered when F.R.D. asks for the number of physical sectors per track. If the result of the calculation is a fraction, truncate the result to the nearest integer.

Sectors per track =

$$\frac{\text{Physical blocks per drive}}{\text{Physical cylinders per drive X Physical heads per drive}}$$

Example: For a 760M byte drive, having 1624 cylinders, 15 heads, and 1,484,375 physical blocks, how many sectors are there per track?

Sectors per track

$$= \frac{1,484,375}{1624 \times 15} = \frac{1,484,375}{24,360} = 60.935$$

which truncates to 60 sectors per track.

If the drive is being formatted with the default values and you get a message during formatting that a mode select error has occurred, you can ignore the message. The value calculated for user size will be close enough that no problem should occur due to slight differences between the actual user size and the calculated user size.

Table C-2. DRIVE CONFIGURATION PARAMETER VALUES FOR EMULEX MD01-BASED SUBSYSTEMS

PARAMETER	DRIVE NAME						
	ATASI 3046	CDC Wren I	CDC Wren II-917	CDC Wren II-925	FUJITSU M2243AS	MAXTOR XT1140	RODIME 208
Type Code	1	1	1	1	1	1	1
Physical Sectors per Track	17	17	17	17	17	17	17
Heads	7	5	9	9	11	15	8
Physical Cylinders	645	697	917	925	754	918	640
Spare Sectors per Track	1	1	1	1	1	1	1
Spare Cylinders	2	2	2	2	2	2	2
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
Removable Media Flag	N	N	N	N	N	N	N

Table C-3. ESDI DRIVE CONFIGURATION PARAMETER VALUES FOR EMULEX MD21, MD23, AND MD25-BASED SUBSYSTEMS

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
Type Code	6	6	6	6	6	6	6	6	6
Physical Sectors per Track	36	35	36	34	34	52	35	35	35
Heads	9	10	10	7	15	8	8	15	12
Physical Cylinders	969	823	823	1224	1224	1632	1024	1224	1217
Spare Sectors per Track	1	1	1	1	1	1	1	1	1
Spare Cylinders	2	2	2	2	2	2	2	2	2
Removable Media Flag	N	N	N	N	N	N	N	N	N

D.1 Overview

This section outlines the different methods for providing termination power.

D.2 Termination

SCSI buses are terminated at each end. The UC07/08 provides termination for one end of the cable. The last SCSI device on the bus must likewise terminate the bus; however, controllers daisy chained between the UC07/08 and last controller on the bus must have their terminators removed. See the controller or subsystem manufacturer's documentation for instructions in installing or removing terminators.

D.2.1 Termination Power

The new dual-wide version of the UC07 provides four methods of providing for termination power. Table D-1 shows the jumper setting for each method. Figures D-1 through D-4 illustrate the schematics for termination power.

The dual-wide UC07 was designed to comply with the latest SCSI specification concerning SCSI termination power. As configured from the factory, the SCSI terminating network on the UC07 uses +5V supplied on pin 26 of the SCSI bus. The 5 volts can be supplied by other devices on the SCSI bus, or by the UC07 itself. In the factory configuration, the UC07 supplies power to pin 26 of the SCSI bus.

In some cases, the user might require that the UC07 provide power for its own terminators without applying power to pin 26. This can be accomplished by cutting one etch and adding a jumper. See Table D-1 for further details.

For the UC07 to supply termination power to pin 26, install jumper A-B for Port 1 (Connector J1) and/or T-U for Port 2 (Connector J2). See subsection 4.3.7 for further details. Each UC17/18 SCSI port is equipped with a 4.7 μF tantalum capacitor and a .01 μF capacitor. These capacitors prevent noise due to high current switching from affecting termination power.

The termination power on the UC07 has the following characteristics:

- 4.40 volts DC to 4.90 volts DC
- Fused at 1 ampere (Fuses: F1 and F2)
- Diode to prevent backflow of power into the UC07
- Jumpers to enable or disable this feature

Table D-1. Termination Power Options

Setting	Port 1 Jumper	Port 2 Jumper	Description
Fact.	A-B IN C-D IN D-E OUT	R-P IN S-T IN T-U OUT	The UC07 supplies termination power to the bus. The UC17/18 termination network is connected to pin 26.
Alt. 1	A-B OUT C-D IN D-E OUT	R-P OUT S-T IN T-U OUT	The UC07 termination network is connected to pin 26. Pin 26 is unpowered by the UC17/18.
Alt. 2	A-B IN C-D Cut D-E IN	R-P IN S-T Cut T-U IN	The UC07 supplies termination power to the bus. The UC07 termination network is connected to the +5V supplying the UC17/18.
Alt. 3	A-B OUT C-D Cut D-E IN	R-P OUT S-T Cut T-U IN	The UC07 termination network is connected to the +5V supplying the UC07. Pin 26 is unpowered by the UC07.

D.2.1.1   SCSI Bus Noise Sensitivity

In it's present form, the SCSI bus is very sensitive to noise on termination power. The factory configuration should present no problems in most applications; however, in some applications involving multiple CPUs and a large number of heavily loaded SCSI disks on the same SCSI bus, termination power noise might be detected. If you have an application as described above and experience problems such as data errors, drives going offline, etc., change to Termination Power Alternate 3. If this does not help, contact Emulex Technical Support.
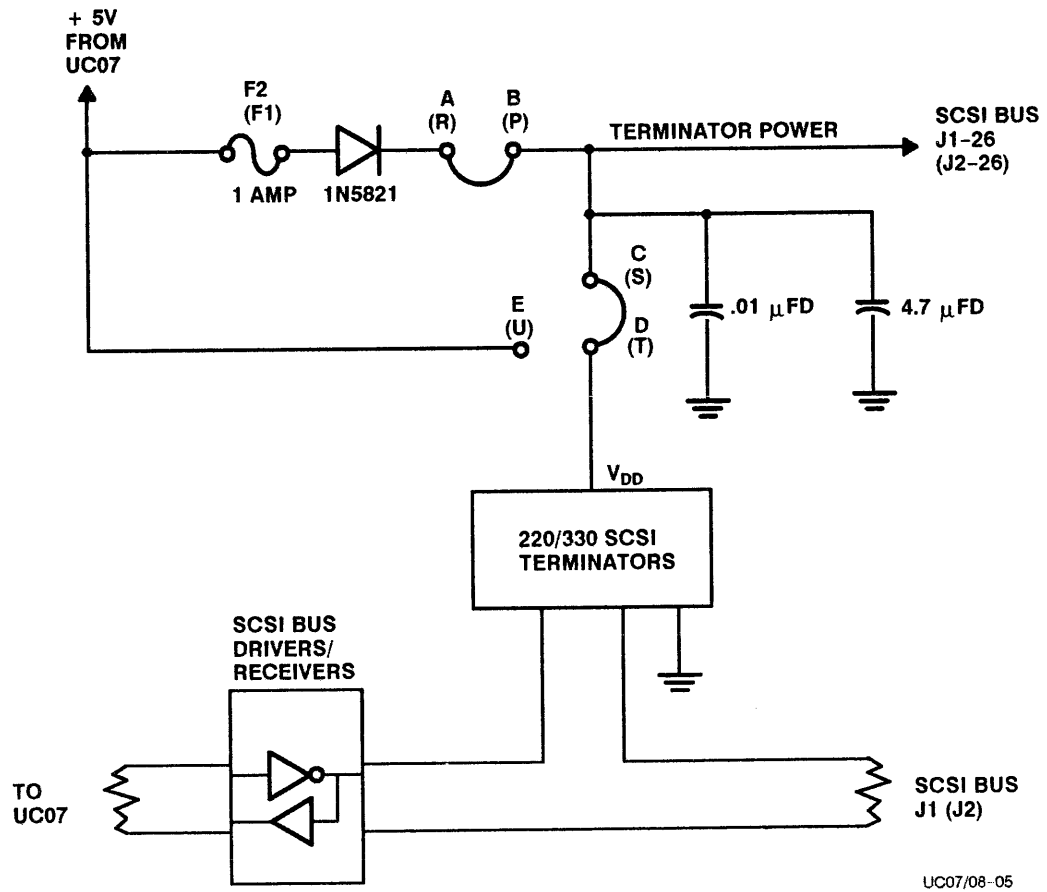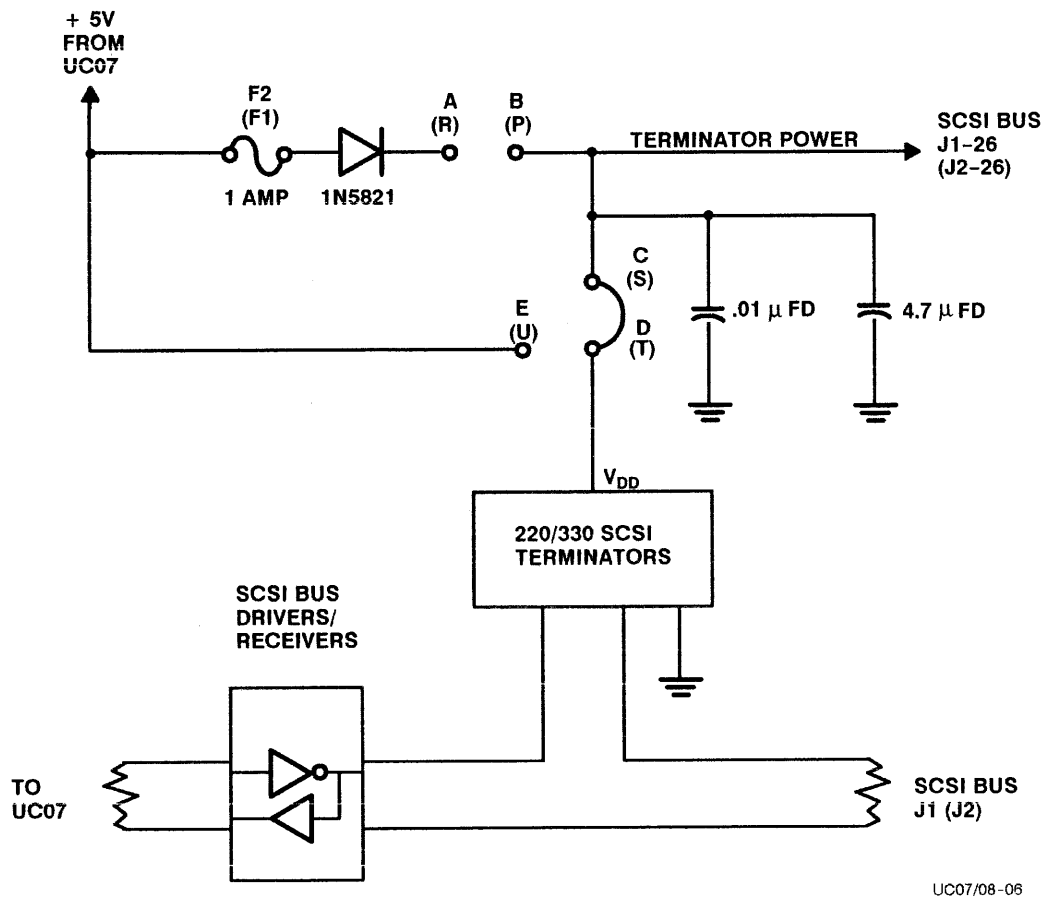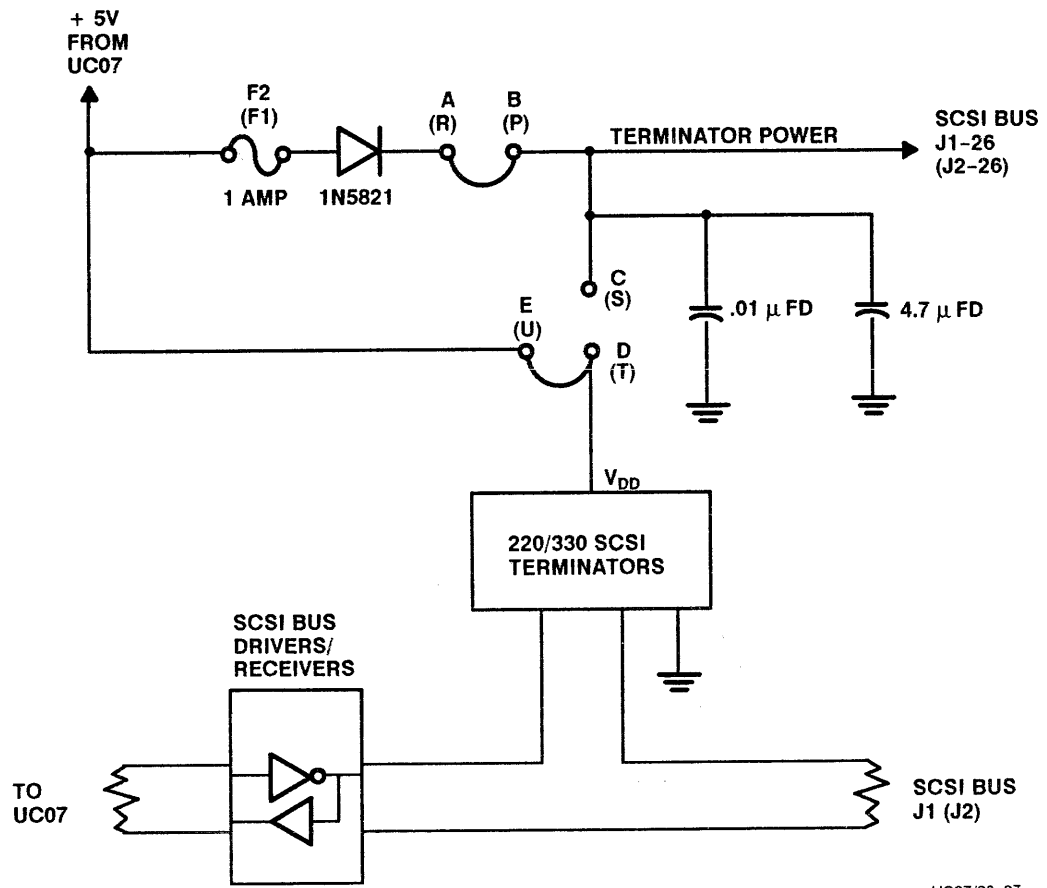
Figure D-1. Termination Power Schematic (Factory Configuration)

Figure D-2. Termination Power Schematic (Alternate 1)
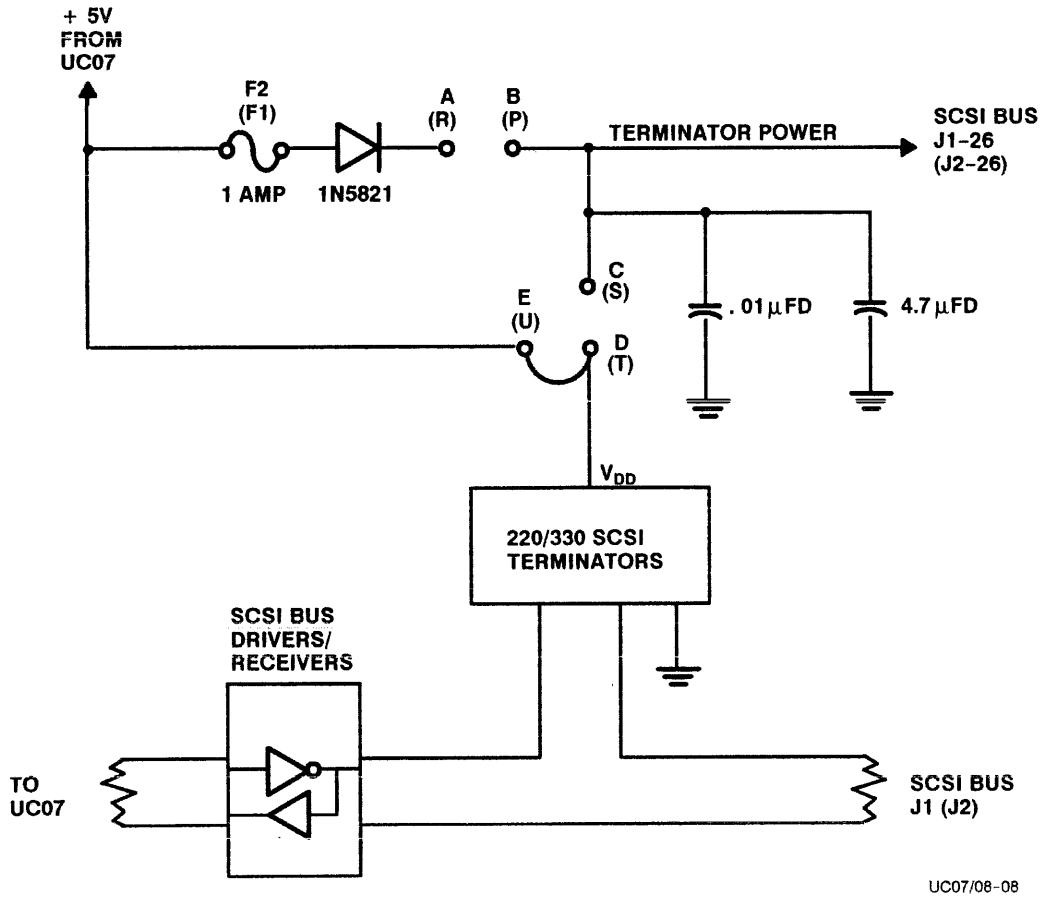
Figure D-3. Termination Power Schematic (Alternate 2)

Figure D-4. Termination Power Schematic (Alternate 3)

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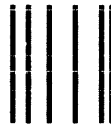
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