VMEbus Compatible

Dual Port SCSI-3 Ultra Fast/Wide Host Adapter

Product P/N 222030

MANUAL P/N 342030 Rev B

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Includes:
Installation Instructions
Programming Specification

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Installation

1.1 Introduction

The Macrolink MVS316 SCSI-3 Ultra Host Adapter is a sophisticated, high-speed, microprocessor-based board providing two independent SCSI-3 Ultra Fast/Wide ports on a single 6U VMEbus Eurocard. The SCSI-3 Ultra protocol supports transfers up to 40 Mbytes per second synchronous and 10 Mbytes per second asynchronous. Status, data movement, port arbitration and selection, and SCSI protocols are processed on-board, minimizing driver calls and host intervention, and maximizing overall system throughput. The MVS316 supports 16, 24, and 32 bit addressing with 8, 16, 32, and 64 bit data transfers in slave mode, and 32 and 64 bit data transfers in master mode DMA, normal and block modes.

This manual describes the installation and operation of the MVS316 Dual Port SCSI-3 Ultra Fast/Wide Host Adapter, Macrolink part number 222025.

1.2 Product Features

- Two independently programmable SCSI ports on a single 6U card.
- Built-in diagnostic tests can be invoked via user software.
- LED status indicators.
- Software configurable options.

VMEbus Features

- A16/24/32 addressing in both master and slave modes.
- D08/16/32/64 data transfers in slave mode, D32/64 in master mode.
- Single-cycle and block mode DMA transfers.
- 55 MB/sec bursts, 40MB/sec sustained transfer rate.
- VMEbus address pipelining support.

SCSI Bus Features

- 40MB/sec synchronous and 10MB/sec asynchronous SCSI-3 Ultra Fast/Wide transfers. 38.6 million byte/sec measured sustained throughput, including SCSI overhead.
- Single-ended or differential interface configurable for each port.
- Support for up to 120 LUN devices on each SCSI port (15 targets with 8 logical units each).
- Overlapped SCSI operations (disconnect/reselect).
- SCSI port 1 connection available through the “A” & “C” rows of the P2 backplane connector (jumper selectable option).
- SCSI command support includes odd byte count.

1.3 Unpacking And Inspection

The MVS316 is shipped in a sturdy, reusable padded carton. Optional accessories such as driver software, I/O interconnect panels, and a user's manual will be shipped in a separate carton. Carefully inspect the shipping cartons for signs of damage. If any damage is evident, do not open the package. Notify the freight carrier immediately to receive further instructions. Claims for shortage or damage must be filed within seven days of receipt of the shipment.

The MVS316 uses sensitive electronic circuitry that can be easily damaged by electrostatic discharge. Personnel handling the board must exercise proper static control methods. Open the shipping carton only at an approved static-controlled workstation. Remove the anti-static bag containing the MVS316. Carefully remove the board from the bag and inspect it for damage. An anti-static bag, anti-static bin, or the original packaging material must be used when transporting the board. The shipping cartons and packaging material should be retained for future use in moving, shipping, or storage of the board.

1.4 MVS316 Configuration

Configuration Jumpers

The MVS316 configuration jumpers, labeled as jumper block H1 on the board silkscreen, are described in the table below. The H5 - H8 jumpers are used to enable SCSI Port 1 through the VMEbus P2 connector when an optional I/O panel is installed. See *Cabling* in section 1.5 for more information. Refer to Figure 1-1 to locate the configuration jumpers.

The remaining jumpers on the MVS316 are set at the factory and must not be altered.

Configuration Jumpers

Pins	Function
A32	Enables VME A32 slave address space. All of the on board RAM will be shared with the VME bus. Do not install the A24 or A16 jumpers. Default = Installed.
A24	Enables VME A24 slave address space. The first 64K of RAM will be shared with the VME bus. Do not install the A32 or A16 jumpers. Default = Not Installed.
A16	Enables VME A16 slave address space. The first 256 bytes of RAM will be shared with the VME bus. Do not install the A32 or A24 jumpers. Default = Not Installed.
SCON	Enables VME system controller mode. Default = Not Installed.
T0	Reserved. Default = Not Installed.
T1	Power On Self Test loop. When installed, the POST will run continuously, alternating the Board Status indicator between yellow and green on each pass. The LED will bet set to red if the test fails. Default = Not Installed.
T2	Enables automatic execution of the SCSI application after the power on self test completes. Default = Not Installed.
T3	Reserved. Default = Not Installed.

VMEbus Address

Rotary switches are used to set the most significant byte of the board's VMEbus base address. Switch SW2 (ADRHI) selects the most significant address digit. Switch SW1 (ADRLO) selects the second most significant digit. Refer to Figure 1-1 to locate the Board ID switches.

Slave Mode Address Size

The MVS316 must be configured to match the slave mode address size used by your system. Most systems support A32 extended mode addressing. Some support only A24 standard or A16 short addressing. Install only one address size mode jumper in configuration jumper bank H1 to correspond with the mode used by your system. Installing more than one address size jumper will cause improper board operation.

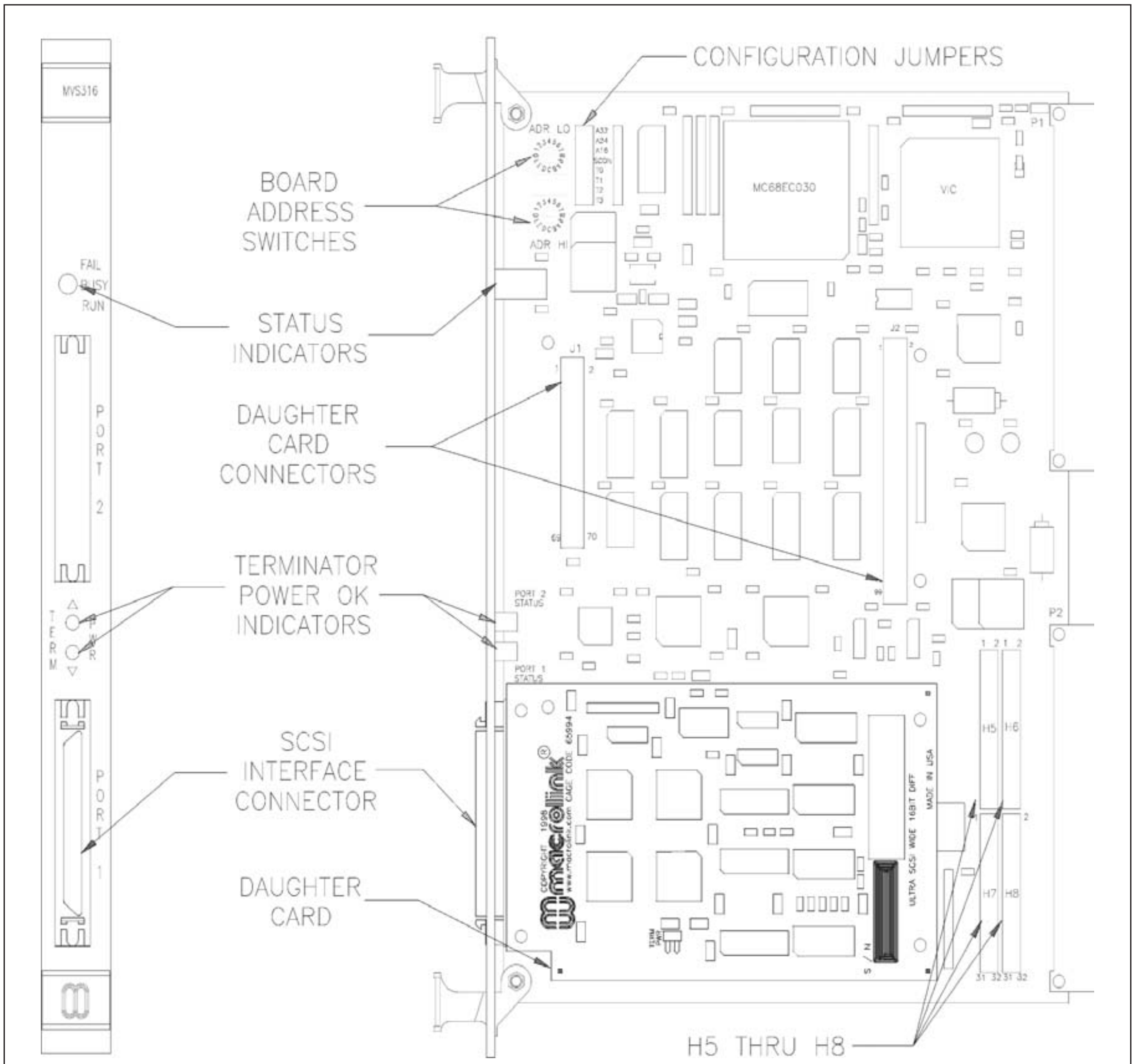

Figure 1 - 1 MVS316 Jumper And Switch Locations

SCSI Bus Termination

Most SCSI installations consist of one computer (host) communicating with one or more peripherals (targets) through a host adapter (the MVS316). Some installations may share the same targets among several hosts. Regardless of the installation, for proper operation the SCSI bus must be correctly terminated at each end, with no terminators installed elsewhere on the bus. The SCSI interface daughter cards, illustrated in Figures 1-2 and 1-3, are equipped with built in active SCSI bus terminators. The terminators can be disabled on the single-ended daughter card by installing jumper H2. The terminators on the differential daughter card cannot be disabled.

Install jumper H2 on the differential daughter card or jumper H3 on the single-ended daughter card to enable the MVS316 to supply terminator power to the SCSI bus. The MVS316 uses self-resetting fuses and isolation diodes to protect the terminator power circuitry from damage.

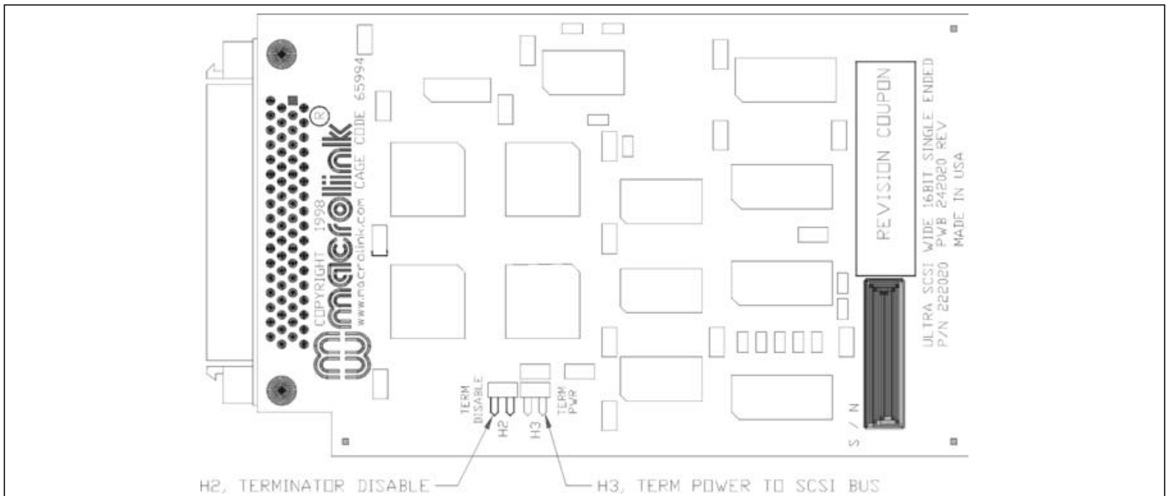

Figure 1-2 Single-Ended SCSI Daughter Card

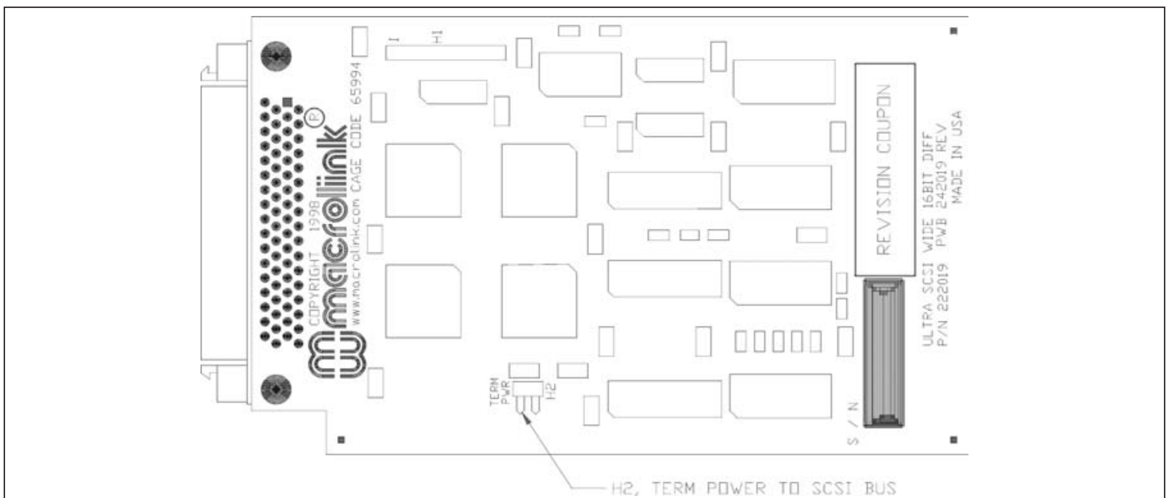

Figure 1-3 Differential SCSI Daughter Card

1.5 Installing The MVS316

Installation

The location of the MVS316 on the DMA priority chain may impact the overall performance of your system. If the MVS316 is placed too low on the chain, it may not be able to get enough bus bandwidth to maintain a high data throughput. Likewise, if the MVS316 is too high on the chain, it may starve boards that have smaller buffers than it.

The MVS316 requires a backplane that provides both P1 and P2 connectors. If your backplane uses jumpers or switches on the VME serial lines, remove or open the bus request (BR0 - BR3 IN/OUT) and the interrupt acknowledge (IACK IN/OUT) jumpers or switches for the slot in which the MVS316 is to be installed. Slide the board into the slot, ensuring that it is fully seated into the backplane connectors. Tighten the board lock down screws to secure the board and guarantee proper RF shielding.

Be sure that the BR0-3 and IACK switches or jumpers are closed or installed for slots on your backplane which do not have boards installed. The system will not operate properly if there is a open in the BR or IACK chain.

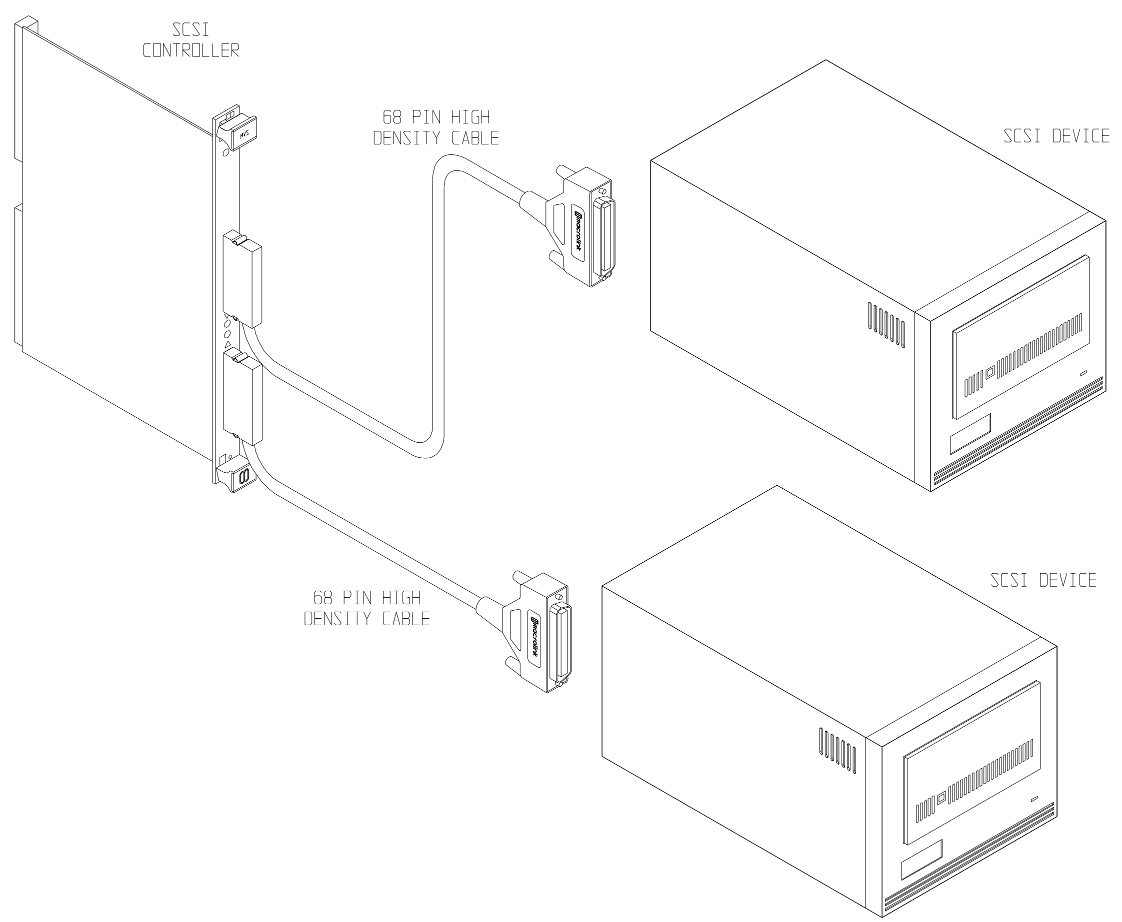

Figure 1 - 4 Direct Connection Of SCSI Devices

Cabling

The MVS316 uses high-density 68 pin connectors (AMP part number 749075-7) for the SCSI ports. The lower connector interfaces to SCSI port 1. If the MVS316 is configured as a single port board, only the lower connector is used. The upper connector interfaces to SCSI port 2. See Figure 1-1 to identify these connectors. Mating connectors may be of the latch type (AMP P/N 749621-7 connector with P/N 749195 or 749204 backshell recommended) or may use jackscrews to secure them to the MVS316 front panel. Figure 1-4 illustrates direct connection of SCSI devices to the MVS316.

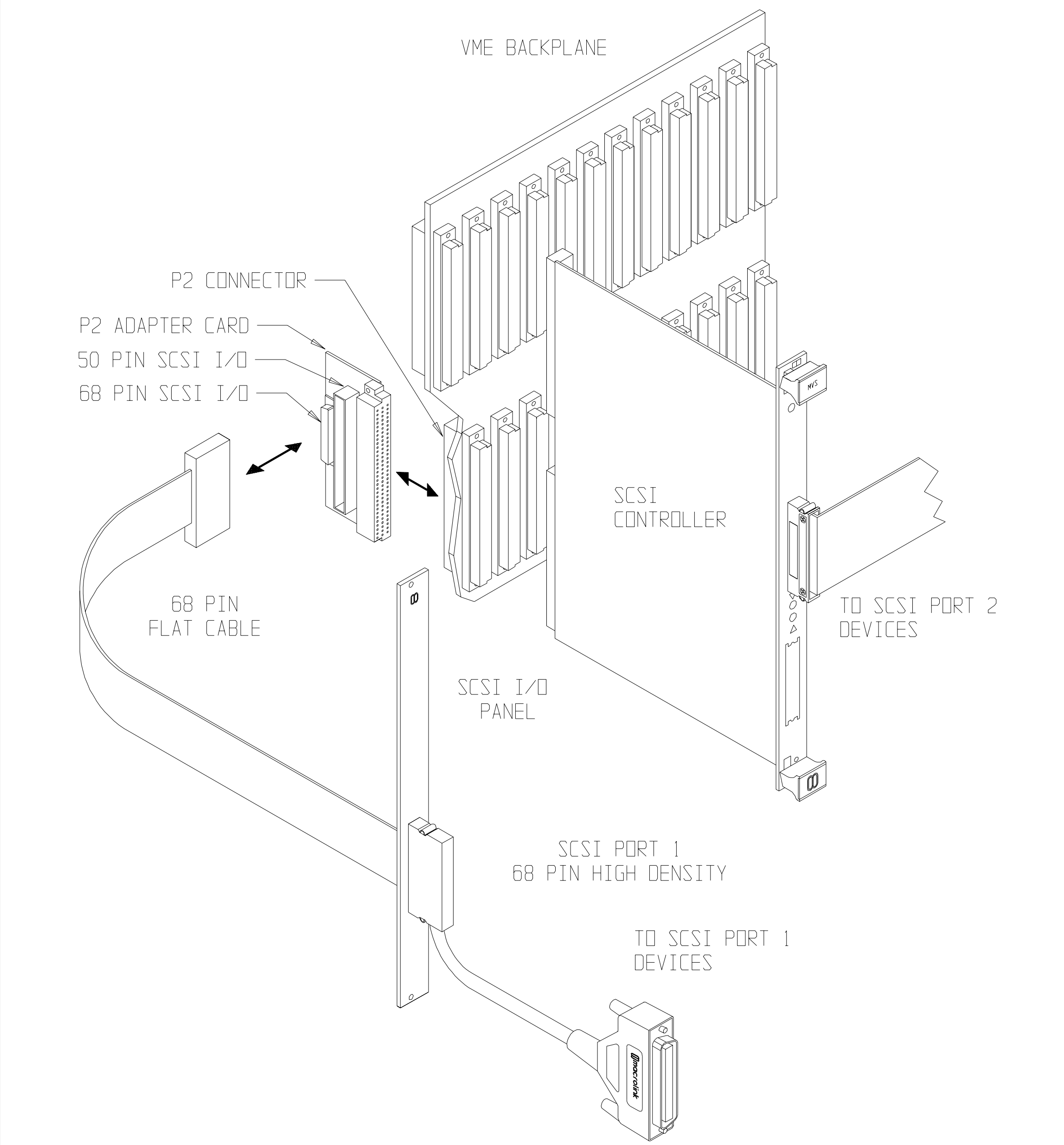

Figure 1 - 5 SCSI Port 1 Through The P2 Connector

Installing the H5-H8 jumper plugs on the MVS316 (see Figure 1-1 for locations) allows access to SCSI port 1 through the VMEbus P2 backplane connector. All four jumper plugs must be installed. This connection requires an optional P2 SCSI connector panel attached to the backplane P2 connector of the slot in which the MVS316 is installed. See Figure 1-5.

1.6 Driver Software

Specific instructions for installing MVS316 host adapter driver software are contained in a README file included in the driver distribution. The driver software is available on several different media types and in a variety of data formats. Contact Macrolink for information on support for your platform.

The MVS316 host adapter driver distribution contains a hierarchical directory tree of source code files that have been converted to a single file by an archiving tool. Some archive formats also contain command scripts that run automatically when the distribution is installed. In all distribution formats, the README file can be accessed when the source files are loaded, without building the driver. Please read the README file before building the host adapter driver from the distribution files.

How To Find The README File

"TAR" format distributions contain pathnames that are relative to the current directory. They can be loaded into any directory. The README file is found in the *src* level directory of the archive. It can be extracted separately into the *src* directory under the current directory by running the following command:

```
tar xvf /dev/rfd0 README
```

This example assumes that /dev/rfd0 is the device file for the drive that contains the distribution media. Your device file name may vary.

"PKG" format distributions contain pathnames that are relative to a "base directory" instead of the current directory. The MVS316 host adapter driver's base directory under Solaris 2™ is /opt/MLINKmvsu/src. "PKG" format is called "datastream" format on some platforms. To access the README file, the distribution files must be installed into the base directory without building the driver from the installed source files. For example, the following command would install the distribution source files into the base directory:

```
pkgadd -d /dev/rmt/0 MLINKmvsu
```

The README file would be installed into the base directory, /opt/MLINKmvsu/src. This example assumes that /dev/rmt/0 is the device file for the drive that contains the distribution media. Your device file name may vary.

1.7 Using The MVS316

Indicators

Three LED indicators are used on the MVS316. The tri-color Board Status Indicator LED denotes the board's operating condition. The Port 1 and Port 2 TPWR LEDs indicate the presence of terminator power on the corresponding SCSI connector.

Board Status Indicator	
LED Color	**Status Indication**
Green	Idle with no SCSI activity.
Yellow	There is activity on the SCSI bus.
Red	Failure, usually a VME bus error.
Off	The SCSI application failed to start properly. The board should be re-initialized. If the problem persists, the board may need to be repaired.

Formatting SCSI Disks

Warning

Never interrupt a SCSI disk drive while it is formatting.

After you have installed the MVS316 driver, you may need to format and/or create a file system on the attached disk drives. This is accomplished by running the appropriate program(s) on the host system. The actual format process of a SCSI interface disk is controlled by its microprocessor. The only job the host system performs is setting up a small parameter block (usually less than 100 bytes) and passing it to the drive. This parameter block establishes characteristics of the drive such as its block (sector) size. Next, the drive is passed a command telling it to begin its internal formatting sequence. Formatting time of SCSI disks is about 20 minutes per Gigabyte of capacity.

Reformatting a SCSI disk is rarely necessary, unless a characteristic of the drive such as the interleave factor must be changed. If you must reformat a drive, be sure that the process will not be interrupted. This includes attempting to perform data transfers to the device or turning off the power. The drive may become unusable because it will not have the proper drive geometry information recorded on the disk. At this point, the only way the drive can be restored is to return it to the manufacturer for repair. If you inadvertently start a format while using the disk label program or performing some other operation, wait for the format to complete before attempting any further operations.

1.8 Returning Products For Repair

Before returning a product for repair, you must first obtain a Return Material Authorization (RMA) number from Macrolink. This number must appear on the outside of the shipping container. Products returned without an RMA number will be refused. When requesting an RMA number, please be prepared to provide the following information:

- Product name or part number.
- Serial number.
- Failure description. An inspection fee may be assessed on items returned without an adequate failure description.

Shipping expenses to Macrolink are to be paid by the customer. Macrolink will pay for standard return shipping for products under warranty.

1.9 RFI Compliance

This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with this instruction manual, may cause interference to radio and television reception. This equipment has been designed to comply with the limits for a Class A computing device in accordance with the specifications in Subpart J of Part 15 of the FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference requiring the user, at the user's own expense, to take whatever measures may be necessary to correct the interference.

If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference in one or more of the following ways:

1. Reorient the receiving antenna.
2. Relocate the computer with respect to the receiver.
3. Move the computer away from the receiver.
4. Plug the computer into a different outlet, so that the computer and receiver are on different circuit branches.
5. Ensure that the mounting screws, attachment connector screws, and grounding connections are securely tightened.
6. Ensure that good quality, shielded and grounded cables are used for data communications.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the booklet *How To Identify And Resolve Radio-TV Interference Problems* prepared by the Federal Communications Commission helpful. This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20420, Stock No. 004-000-0345-4.

To ensure compliance with FCC regulations, only high quality, shielded interconnect cables should be used. Poor quality cables will allow excessive RF radiation.

1.10 Product Specifications

Specifications	
VMEbus	Compliant with the VMEbus revision C.1 specification IEC 821 & IEEE P1014/01.2. Supports both Master & Slave modes.
Master Data Transfer	A32/A24/A16 - D32/D64. Programmable address modifiers. Block Transfers.
Slave Data Transfer	A32/A24/A16 - D64/32/D16/D08. A16 Supervisory access (2D). A24 Supervisory data access (3D). A32 Supervisory data access (0D). A16 non-privileged access (29). A24 non-privileged data access (39). A32 non-privileged data access (09).
Bus Request Lines	BR(0) through BR(3). Programmable selection of all lines.
Interrupt Request	IRQ1 through IRQ7. Programmable selection of all lines.
SCSI Interface	• Multi-threaded operations • Disconnect/reselect • Mandatory/optional/vendor unique command support • Overlapped commands • Command queuing • Up to 240 physical/logical devices (8 LUNs per SCSI ID) • Up to 30 targets (15 per port).
SCSI-2/3 Rates	40MB/s synchronous and 10MB/s asynchronous. Conforms to SCSI specification X3.131-199X.
P2 SCSI Interface	Optional full SCSI-1/SCSI-2 support available via rows A & C of the P2 connector.
Dimensions	6U Dual-height EuroCard (160mm x 233mm). Front Panel: Single-width.
Connectors	Front Panel: Two 68-pin high-density, AMP part number 749075-7. Mating connector AMP part number 749621-7.
Status LEDs	RUN - Green; BUSY - Yellow; FAIL - Red; Port 1 Terminator Power OK - Green; Port 2 Terminator Power OK - Green.
Power	5 VDC @ 5 Amps (maximum) - 75 BTU/hr.
Temperature	0º to 50ºC (32º to 120º F) operating -40º to 68º C (0º to 150º F) storage.
Humidity	10% to 95% non-condensing
Certification	Designed to comply with FCC Part 15 Class A standards.

Programming

This chapter explains the register interface of the MVS316 in detail to assist those who wish to write their own operating system software driver.

The MVS316 has three operating modes that define communications between it and the host system. The MVS316 enters Boot Load mode when system power or the VMEbus RESET line have been cycled, or when a *Software Reset* command is issued. The driver must verify the board has passed its power-on self tests, and switch the board to Initialization mode. During Initialization mode, soft-configuration parameters are downloaded to the board. When initialization is complete, the MVS316 switches to Run mode. In Run mode, the driver passes commands, data, and status between the host and the MVS316 by reading and writing the appropriate registers.

2.1 Boot Load Mode

The MVS316 enters Boot Load mode when system power or the VMEbus RESET line have been cycled. Boot Load mode can also be invoked by issuing a *Software Reset* command. To reset the MVS316, do the following:

- Cycle power, reset the system, or issue a *Software Reset* command.
- Do not access the board for at least 3 seconds. The Status indicator will be yellow indicating that the Power On Self Test is executing.
- After 3 seconds, read the Command register. It should cleared (0x00000000).
- If the POST fails, the Command register will contain the value 0xBADTTTSS, where TTT is the POST test number and SS is the sub-test number that have failed. Consult Appendix B - *Power On Self Test* to determine if the failure is from a recoverable condition, and reinitialize the board after correcting the problem.
- After the POST has completed, the driver can call built-in diagnostic tests (available only during Boot Load mode) or proceed to Initialization mode.

Status Indicator During Boot Load Mode

The operational states indicated by the Board Status Indicator LED vary according to the mode the board is in. The table below identifies the status indications during Boot Load mode.

Status Indicator During Boot Load Mode	
LED Color	**Status Indication**
Green	Ready for a boot loader command.
Yellow	Processing a boot loader command.
Red	Boot loader command failed.
Off	SCSI application failed to start properly.

Boot Load Mode Registers

The table below describes the MVS316 registers when the board is in Boot Load mode. The address of a register is its offset value added to the base address of the MVS316. For example, if the base address is 0xC4000000, the Parameter 0 register is at address 0xC4000004. Some registers have limitations on the mode in which they can be accessed. The access mode codes as shown in the table are:

R = Read access allowed.
W = Write access allowed.
B = Byte (8 bit) access allowed.
S = Short (16 bit) access allowed.
L = Longword (32 bit) access allowed.

Boot Load Mode Registers						
Board offset	**R**	**W**	**B**	**S**	**L**	**Description**
0x0000 - 0x0003	●	●			●	Command/Status register. Used for issuing commands and receiving command status.
0x0004 - 0x0007	●	●	●	●	●	Parameter 0 register.
0x0008 - 0x000B	●	●	●	●	●	Parameter 1 register.
0x000C - 0x000F	●	●	●	●	●	Parameter 2 register.
0x0010 - 0x0013	●	●	●	●	●	Parameter 3 register.
0x0014 - 0x0017	●	●	●	●	●	Parameter 4 register.
0x0018 - 0x001B	●	●	●	●	●	Parameter 5 register.
0x001C - 0x001F	●	●	●	●	●	Parameter 6 register.
0x0020 - 0x0023	●	●	●	●	●	Parameter 7 register.
0x0024 - 0x0027	●	●	●	●	●	Parameter 8 register.
0x0028 - 0x002B	●	●	●	●	●	Parameter 9 register.
0x002C - 0x002F	●	●	●	●	●	Parameter 0xA register.
0x0030 - 0x0033	●	●	●	●	●	Parameter 0xB register.
0x0034 - 0x0037	●	●	●	●	●	Parameter 0xC register.
0x0038 - 0x003B	●	●	●	●	●	Parameter 0xD register.
0x003C - 0x003F	●	●	●	●	●	Parameter 0xE register.
0x0040 - 0x00FB	●		●	●	●	Reserved, do not write to this area.
0x00FC		●	●			Command Interrupt register. Writing this register as a byte with the value of 0x03 will generate an interrupt to the on-board CPU.
0x00FD - 0x00FF	●		●	●	●	Reserved, do not write to this area.
If VME A32 or VME A24 slave address space is selected						
0x0100 - 0x3FFF	●		●	●	●	ASCII Print Buffer. Contains text that may aid customer support.
0X4000 - End of on-board RAM	●		●	●	●	Reserved, do not write to this area.

Boot Load Status Messages

In Boot Load mode, the MVS316 Command register serves a dual purpose. In addition to being used to issue commands to the MVS316, performing a read of this register will indicate command processing status. The MVS316 clears the Command register to indicate that it finished processing a command.

If an invalid command is written to the Command register or an invalid parameter is written to a Parameter register, the status 0x00000BAD will be posted. If an invalid parameter was issued, the ASCII Print Buffer will contain the invalid parameter and value. Although the Command register will not clear, a new command may be issued.

Boot Load Mode Status Messages

Status	Value
Ready For Boot Load Command	0x00000000
Bad Command	0x00000BAD

Boot Load Mode Commands

The table below summarizes the MVS316 Boot Load mode command set. The commands are described in detail in the pages that follow. Follow these steps to issue a command to the MVS316:

- Before issuing a command to the MVS316, read the Command register to make sure it is cleared (contains all zeroes). The MVS316 is not ready to accept a new command if the Command register is not cleared.
- Write any required parameter data to the appropriate registers and write the command to the Command register.
- The Command register will clear to indicate successful completion. After the command completes, the host may read any returned parameters.

All undefined command values are reserved and will return a *Bad Command* status if issued to the MVS316.

Boot Load Mode Commands

Command	Value
Software Reset	0x00000001
NOP	0x00000002
Board Information	0x00000004
Start SCSI Application	0x00000007
External Loop Back Diagnostic	0x00000009
Command Interrupt Diagnostic	0x0000000A
VME Bus Master Dma Diagnostic	0x0000000B
VME Bus Interrupt Diagnostic	0x0000000C
Move Board VME Location	0x0000000F

Software Reset Command (0x00000001)

This command resets the board to the powered-on state and can be used to re-run the board's Power On Self Test. Do not access the board for three seconds after issuing this command, and do not poll this command for completion.

Note: The Software Reset command code is 0x01 in Boot Load mode, and 0x03 in Initialization and Run modes.

NOP Command (0x00000002)

This command can be used to test the boot loader command interface. The Command register will be cleared if the NOP command was properly issued.

Board Information Command (0x00000004)

This command can be issued to retrieve configuration information from the board. This data can be used by the operating system driver to modify its operation. Configuration data is returned to the Parameter 0 through 0xA registers after the command has completed. The following data is available after a Board Information command:

Register	Returned Data
Parameter 0	Board's assembly part number in BCD.
Parameter 1	Firmware part number in BCD.
Parameter 2	Firmware dash number.
Parameter 3	Firmware revision letter in ASCII.
Parameter 4	CPU RAM size.
Parameter 5	VME shared RAM size.
Parameter 6	VIC revision. VIC64 revisions are 0x00-0x0F, VIC068 revisions are 0xF0-0xFF.
Parameter 7	SCSI port 1 installed flag (0 if not installed).
Parameter 8	SCSI port 1 SPIO revision.
Parameter 9	SCSI port 2 installed flag (0 if not installed).
Parameter 0xA	SCSI port 2 SPIO revision.

Start SCSI Application Command (0x00000007)

This command is used to switch the MVS316 to Initialization mode. Within 250ms after issuing this command, the Board Status LED will turn yellow and the MVS316 will switch to Initialization mode.

If configuration jumper T2 (SCSI auto-execution) is installed, the MVS316 will skip Boot Load mode and enter Initialization mode directly after the Power On Self Test has completed.

External Loop Back Diagnostic Command (0x00000009)

This command runs the External Loop Back diagnostic. To execute this diagnostic, both SCSI ports must be installed, with an external loop back cable installed between the ports. A converter must be used if one SCSI port is single-ended and the other is differential.

To start the test, write the repeat count to the Parameter 0 register, then write the External Loop Back Diagnostic command to the Command register. While the test is running, the Board Status LED will be set to yellow. A Software Reset command may be issued to stop the diagnostic and reset the board.

This command may take a long time to complete with a large repeat count. If the diagnostic fails, the Board Status LED will be set to red and the Command register will be set to 0xBAD043SS (SS = POST sub-test number). The ASCII Print Buffer will contain failure information that can be read and analyzed. The board should be reset.

Register	Parameter Data
Parameter 0	Repeat count. A repeat count of 0 will loop forever.

Command Interrupt Diagnostic Command (0x0000000A)

This command runs the VME bus generated command interrupt diagnostic. This test will verify that the Command Interrupt register can generate a CPU interrupt.

To start the diagnostic, write this command to the Command register. Do not access the board for at least 10ms. Write the Command Interrupt register with the byte value 0x03. Do not access the board for at least 10ms. The Command register will be cleared if the diagnostic passed.

During the test, the Board Status LED will be set to yellow. The command will not complete until the Command Interrupt register is written. A Software Reset command may be issued to stop the diagnostic and reset the board.

If the diagnostic fails, the Board Status LED will be set to red and the command register will be set to 0xBAD041SS (SS = POST sub-test number). The ASCII Print Buffer will contain failure information that can be read and analyzed. The board should be reset.

Register	Parameter Data
Command Interrupt	0x03. Write the command to the Command register first, then wait at least 10ms before writing this register.

VME Bus Master DMA Diagnostic Command (0x0000000B)

This command runs the VME Bus Master DMA Diagnostic. The board will become VME bus master and run several VME bus tests using 64K of external VME bus memory.

Write the test parameters to the appropriate registers, then write this command to the Command register. An invalid parameter will generate a Bad Command status. While the diagnostic is running, the Board Status LED will be set to yellow. A Software Reset command may be issued to stop the diagnostic and reset the board.

This command may take a long time to complete with multiple parameters being tested or with a large repeat count. If the diagnostic fails, the Board Status LED will be set to red and the Command register will be set to 0xBAD042SS (SS = POST sub-test number). The ASCII Print Buffer will contain failure information that can be read and analyzed. The board should be reset.

Register	Parameter Data
Parameter 0	Address of the external 64K VME bus memory. The address must be longword aligned. The external VME bus memory must support unaligned transfers as required by the VME bus specification.
Parameter 1	VME bus request level. The VME bus request level determines the VME bus mastership request level. Some VME backplanes only support a specific level. Valid parameters are: 0 VME bus request level 0. 1 VME bus request level 1. 2 VME bus request level 2. 3 VME bus request level 3. 4 Test all bus request levels (0-3).
Parameter 2	VME bus address modifier. The VME bus address modifier determines the transfer's address size and space. Valid parameters are: 0x00 Test all A32 modes. 0x08 A32 non-privileged 64-bit block transfer (MBLT). 0x09 A32 non-privileged data access. 0x0A A32 non-privileged program access. 0x0B A32 non-privileged block transfer (BLT). 0x0C A32 supervisory 64-bit block transfer (MBLT). 0x0D A32 supervisory data. 0x0E A32 supervisory program. 0x0F A32 supervisory block transfer. 0x30 Test all A24 modes. 0x38 A24 non-privileged 64-bit block transfer (MBLT). 0x39 A24 non-privileged data access. 0x3A A24 non-privileged program access. 0x3B A24 non-privileged block transfer (BLT). 0x3C A24 supervisory 64-bit block transfer (MBLT). 0x3D A24 supervisory data access. 0x3E A24 supervisory program access. 0x3F A24 supervisory block transfer (BLT).
Parameter 3	Repeat count. A repeat count of 0 will loop forever.

VME Bus Interrupt Diagnostic Command (0x0000000C)

This command runs the VME bus interrupt logic diagnostic. This diagnostic will check that the board can issue VME bus interrupts. A VME bus interrupt will be generated at a user specified level and vector. Write the test parameters to the appropriate registers, then write this command to the Command register. An invalid parameter will generate a *Bad Command* status.

Register	Parameter Data
Parameter 0	VME bus interrupt level. Valid parameters are 0x01 - 0x07.
Parameter 1	VME bus interrupt vector. Valid parameters are 0x00 - 0xFF.

Move Board VME Location Command (0x0000000F)

This command modifies the board's VME bus base address and shared memory size. These parameters are initially determined by the CONFIG jumpers and the VME address switches SW1 and SW2. To relocate the board or change the address space, write the parameters to the appropriate registers, then write this command to the Command register. An invalid parameter will generate a *Bad Command* status.

After issuing this command, do not access the board for at least 1ms. Do not poll this command for completion. When the command completes, the board can be accessed at the new VME bus location.

Register	Parameter Data
Parameter 0	VME bus base address. Only the most significant address byte may be modified. Examples: VME A32 slave: 0xE2000000 VME A24 slave: 0x7A0000 VME A16 slave: 0xF500
Parameter 1	VME bus shared memory window size. The size must be a power of 2 and at least 256 bytes. A value of 0 will share the maximum size of memory possible for the slave address space selected (A32 max = 16M, A24 max = 64K, A16 max = 256 bytes). Valid examples follow: 0x00000000 Use maximum size. 0x00000100 256 bytes (A16 max). 0x00010000 64K bytes (A24 max). 0x01000000 16M bytes (A32 max).

2.2 Initialization Mode

The MVS216 enters Initialization mode after a Start SCSI Application Command has been issued during Boot Load mode, or after power-up if configuration jumper T2 (SCSI auto-execution) is installed. The register interface is redefined after the board has switched modes, as shown in the below table. These registers are the same for Initialization and Run modes. A detailed description of the registers begins on page 2-11.

MVS316 Registers		
Register	**Format**	**Offset**
Command	Longword	0x00
Data In	Longword	0x04
Data Out	Longword	0x08
Status	Longword	0x0C
Firmware Revision	Byte	0x10
SCSI Port 2 Installed	Byte	0x11
SCSI 1 Differential Interface	Byte	0x12
SCSI 2 Differential Interface	Byte	0x13
Factory Message	Byte	0x14-34
VIC Revision Number	Byte	0x35
SPIO 1 Revision Number	Byte	0x36
SPIO 2 Revision Number	Byte	0x37
CPU SRAM Size In Bytes	Longword	0x38
Shared SRAM Size In Bytes	Longword	0x3C
Reserved Register 1	Byte	0x40
Debug Firmware Flag	Byte	0x41
Reserved Register 2	Byte	0x42
Reserved Register 3	Byte	0x43
Tags Supported	Byte	0x44
SCSI Port 1 Installed	Byte	0x45
Firmware Part Number	Longword	0x60
Parameter 0	Longword	0x64
CPU Interrupt	Byte	0xFC

During Initialization mode, the driver must download 32 controller parameter longwords to the board. They initialize registers that control the operation of the board. Initialization mode will not complete until all the parameters have been downloaded.

The driver may read the defined registers that describe the board's configuration (offsets 0x10 - 0x60) before completing Initialization mode.

Note: In Initialization and Run modes, the value in the Firmware Part Number register should be 300494*nn*, where *nn* is the firmware's dash number. If the Firmware Part Number register contains a zero or if the Command register contains 0x00000BAD after a command is issued, the board is still in Boot Load mode.

Controller Parameters

The driver must load the 32 controller parameters in order. Reserved parameters must be set to a null value (0x00000000). The following steps are repeated for each parameter:

- Read the Command register to verify that the MVS316 is ready to accept a new command. It should be cleared (0x00000000).
- Write the parameter data to the Data In register. Write the *Load Controller Parameter* command to the Command register.
- The board will clear the Command register within 25 microseconds. The parameter is echoed to the Data Out register to allow the driver to test for a valid load.

Controller Parameters

No.	Parameter	Description
0	Interrupt Level	This parameter defines the VMEbus interrupt level. Interrupts are enabled by the *Enable Interrupts* command. Valid interrupt levels are 1 through 7.
1	Interrupt Vector	This parameter specifies the vector placed on the VMEbus during interrupt acknowledge cycles. It is used by the host to determine which device issued an interrupt. Valid interrupt vectors are 0x00 through 0xFF.
2	DMA Bus Request Level	This parameter defines the bus request level for DMA data transfers on the VMEbus. Valid levels are 0 through 3.
3	DMA Address Modifier	This parameter defines the VME address modifier. Supported modifiers are: 0x09 - Extended Non-Privileged Data 0x0D - Extended Supervisory Data 0x39 - Standard Non-Privileged Data 0x3D - Standard Supervisory Data When needed, block mode address modifiers are provided by special on-board logic.
4-7	Reserved 1-4	These parameters are reserved and must be set to zero.
8	SCSI 1 ID	This parameter specifies the SCSI ID for Port 1. Valid ID numbers are 0 through 15. ID 7 is typically assigned to the host adapter (MVS316). The SCSI ID priority structure is: ID 7 Highest priority | ID 0 ID 15 | ID 8 Lowest priority
9-0xD	Reserved 5-9	These parameters are reserved and must be set to zero.
0xE	SCSI 2 ID	This parameter specifies the SCSI ID for Port 2. See Parameter 8 - *SCSI 1 ID* for more information.

Controller Parameters		
No.	**Parameter**	**Description**
0xF-0x1F	Reserved 10-26	These parameters are reserved and must be set to zero.

If a bad controller parameter is loaded into the board, the Status register will contain the value *Bad Controller Parameter*. The Parameter 0 register will contain the number of the bad controller parameter.

After the controller parameters have been loaded, wait up to 250 milliseconds for the Status register to be updated. If the controller parameters were successfully loaded, the Status register will contain the value *Firmware Ready To Run*. Clear the Status register, then write a *Run Firmware* value to the Command register. Wait up to 25 microseconds for the Command register to clear. The board will switch to Run mode and will be ready to process commands.

Only the commands and status messages shown in the tables below are used during Initialization mode.

Initialization Mode Commands	
Command	**Value**
Software Reset	0x00000003
Load Controller Parameter	0x00000004
Run Firmware	0x00000005

Initialization Mode Status Messages	
Status	**Value**
Firmware Started	0x00000002
POST Passed	0x00000003
Bad Script Memory	0x00000005
Firmware Ready To Run	0x00000006
Bad Interrupt	0x00000007
Bad Controller Parameter	0x00000013

2.3 MVS316 Register Descriptions

The address of a register is its offset value added to the base address of the MVS316. For example, if the base address is 0xC4000000, the Status register is at address 0xC400000C. The MVS316 registers are summarized in the table on page 2-8 and described in detail below and in the pages that follow.

Command Register (Base address + Offset of 0)

Command Longword

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
T	T	T	T	T	T	T	T	C	C	C	C	C	C	C	C	P	I	I	I	I	L	L	L	Command							

Bits 31-24 = Tag Number (TT byte)
Bits 23-16 = Chain Count (CC byte)
Bit 15 = SCSI Port (0 = Port 1, 1 = Port 2) PL byte
Bits 14-11 = SCSI ID (0 - 0xF) |
Bits 10-8 = LUN (0 - 7) PL byte
Bits 7-0 = Command code byte

This longword register is used to pass commands to the MVS316. They can be interface commands, which are acted upon by the MVS316, or SCSI target commands, which are passed to the appropriate SCSI device. The Command longword consists of up to four byte fields of information.

The Tag Number byte in bits 31-24 (0xTTnnnnnn) is used with tagged queuing in conjunction with the *SCSI With ATN* and *SCSI Head of Queue* commands. Valid tag numbers are 0x00-0x0F.

The Port-ID-LUN value is in bits 15-8 (0xnnnnPLnn) of the Status longword. The Port bit (bit 15) specifies which port sent the status. The ID bits (Bits 14-11) contain the target ID of the SCSI device that is or was connected to the port. The LUN bits (Bits 10-8) contain the target's LUN.

Data In Register (Offset 0x04)

The longword format Data In register (Offset 0x04) is used to pass controller parameter values to the MVS136 during Boot Load mode. In Run mode, the Data In register is used to pass command parameters to the board.

Data Out Register (Offset 0x08)

The MVS316 will echo the controller parameters to the Data Out register (Offset 0x08) as they are loaded to allow the driver to verify that they were loaded correctly. In Run mode, the Data Out register is used to report the bus error address of either a CPU or VIC bus error or a bad command value after a *Bad Command* error. This register is longword format.

Status Register (Offset 0x0C)

The longword format Status register provides a means for the MVS316 to inform the driver of an operation's success or failure. The driver must clear the Status register after reading it. This is accomplished by writing a zero to the register. New status information will not be posted until the old status has been cleared. This register is defined in detail in section 2.6 - *Status Messages* beginning on page 2-18.

Firmware Revision Register (Offset 0x10)

This register contains an ASCII value which corresponds to the revision of the MVS316 firmware. For example, a value of 0x41 (ASCII 'A') indicates revision 'A' firmware. This is a byte register.

SCSI Port 2 Installed Register (Offset 0x11)

This register indicates whether the MVS316 has a daughter card installed for SCSI port 2. A value of one indicates the SCSI daughter card is installed. This is a byte register. The *Bad Command* status will be reported for commands issued to a port that is not installed.

SCSI Port 1 Differential Interface Register (Offset 0x12)

This register indicates whether SCSI port 1 is configured for single-ended or differential interface. A value of zero specifies single-ended interface. A value of one specifies differential interface. This is a byte register.

SCSI Port 2 Differential Interface Register (Offset 0x13)

This register indicates whether SCSI port 2 is configured for single-ended or differential interface. A value of zero specifies single-ended interface. A value of one specifies differential interface. This is a byte register.

Factory Message Buffer (Offset 0x14-0x34)

This buffer contains the factory-programmed message ‘PN223025RA0#0000.’ It can be read by performing a sequential byte read from offset 0x14 to offset 0x34. The pad value contained in unused locations through 0x34 is a null (zero).

VIC Revision (Offset 0x35)

This register contains the revision number value that is stored in interprocessor communication register 5 of the VIC chip. This is a byte register.

SPIO 1 Revision (Offset 0x36)

This register contains the value that is stored in bits 4-7 of the Port 1 SPIO chip test 3 register. This is a byte register.

SPIO 2 Revision (Offset 0x37)

This register contains the value that is stored in bits 4-7 of the Port 2 SPIO chip test 3 register. This is a byte register.

CPU SRAM Size Register (Offset 0x38)

This register contains the number of bytes of CPU SRAM memory. This is a longword register.

Shared SRAM Size (Offset 0x3C)

This register contains the number of bytes of local bus shared SRAM memory. This is a longword register.

Debug Firmware Flag (Offset 0x41)

This value will normally be 0, indicating non-debug firmware. This value will be 1 for a debug version of the firmware. This is a byte register. The debug version of the firmware runs slower (about 1/5 of normal speed) because it prints extra information into the debug trace buffer during run time. Debug firmware is available by special order from Macrolink.

Tags Supported (Offset 0x44)

This register contains the number of tags per LUN supported with tagged queuing. This is a byte register.

SCSI Port 1 Installed Register (Offset 0x45)

This register indicates whether the MVS316 has a daughter card installed for SCSI port 1. A value of one indicates the SCSI daughter card is installed. This is a byte register. The *Bad Command* status will be reported for commands issued to a port that is not installed.

MVS316 Firmware Part Number (Offset 0x60)

This register contains a unique product number identifying the board as an MVS316 board. This value is 0x300494*nn*, where *nn* is the dash number of the firmware. This is a longword register. If this value is zero, the board is still in Boot Load mode.

CPU Interrupt Register (Offset 0xFC)

This register is used to issue a command to the MVS316. This is accomplished by writing any required parameter data to the Data In register, the command to the Command register, and the value *CPU Interrupt* to this register.

CPU Interrupt Register Values

Name	Value
CPU Interrupt	0x03

2.4 Run Mode

After the MVS316 has been initialized, it enters Run mode. The Status indicator will change from yellow (Busy) to green (Run). The host system can begin communicating with the SCSI targets by issuing commands to the board.

When the MVS316 is connected to a device on either SCSI port, the Status indicator will change to yellow (Busy). If a fatal error is detected, the Status indicator will change to red (Fail) and an appropriate status message will be posted to the Status register.

Issuing Commands

Commands to the MVS316 can be interface commands, which are acted upon within the MVS316, or SCSI target commands, which are passed to the appropriate SCSI device. To issue a command to the MVS316, read the Command register to make sure it is cleared (contains all zeroes). The MVS316 is not ready to accept a new command if the Command register is not cleared. Write any required parameter data to the Data In register, the command to the Command register, and write the value *CPU Interrupt* to the CPU Interrupt register. The MVS316 will clear the Command register within ten milliseconds to indicate that it has accepted the command.

Some commands will now be complete. Others, such as *SCSI With ATN*, will update the Status register upon completion. The MVS316 will interrupt the host when it updates the Status register, if interrupts are enabled. The driver MUST clear the Status register after it has been read. The Status register will not be updated by the MVS316 if it is not cleared.

Command Longword

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
T	T	T	T	T	T	T	T	C	C	C	C	C	C	C	C	P	I	I	I	I	L	L	L	Command							

Bits 31-24 = Tag Number (TT byte)
Bits 23-16 = Chain Count Count (CC byte)
Bit 15 = SCSI Port (0 = Port 1, 1 = Port 2) PL byte
Bits 14-11 = SCSI ID (0 - 0xF) |
Bits 10-8 = LUN (0 - 7) PL byte
Bits 7-0 = Command code byte

The Command longword consists of four byte fields of information. Not all commands require every field. Unused fields *must* be set to zero.

The Tag Number byte (bits 31-24) is used for tagged queuing in conjunction with the *SCSI With ATN* or *SCSI Head of Queue* command. Up to sixteen tags (0x00-0x0F) are supported for tagged queuing. Because the *SCSI With ATN* and *SCSI Head Of Queue* commands use a tag field of 0 to indicate no tagged queuing, it is recommended that tag 0 not be used during normal tagged queuing operation.

The Chain Count byte (bits 23-16) is used with *SCSI With ATN* and *SCSI Head of Queue* commands. The chain count is an unsigned number from 1 to 255 that represents the total number of entries in a DSA command chain table. A chain count of zero is invalid. If tagged queuing is used, the CC byte must be set to 1. See section 2.7 - *Data Structure Arrays* for more information.

The Port-ID-LUN byte (bits15-8) contains three data fields: the Port the command is for, the SCSI ID of the device to be communicated with, and the target's Logical Unit Number, or LUN. Set the ID bits to the target's ID for SCSI commands. Some commands require on a Port or Port-ID specification.

2.5 Run Mode Commands

NOP (0x00000001)

This command is used to test the MVS316 command interface. It is processed immediately. The MVS316 will clear the Command register when the command is complete. No status is returned.

Software Reset (0x00000003)

This command will reset the board to the powered-on state. It may be issued at anytime. After this command is issued wait 3 seconds and then initialize the board. DO NOT access the board during the 3 second waiting period.

Test Status (0x0000PL0A)

Test Status Command																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	P	I	I	I	I	L	L	L	0	0	0	0	1	0	1	0

P = SCSI Port (0 = Port 1, 1 = Port 2)
I = SCSI ID
L = LUN

This command will place a *Test Status* message (0x0000PL0A) in the MVS316 status queue. Any previously queued status messages will be passed to the host first. The PL byte is a don't-care Port-ID-LUN field that will be echoed into the PL byte of the Status register. This command is used to test the status and interrupt functions. An interrupt to the host will be generated if interrupts are enabled.

Enable Interrupts (0x0000000B)

This command enables interrupts to the host each time the Status register is updated. Status messages currently on the queue will be passed to the host with an interrupt. This command is processed immediately. The MVS316 will clear the Command register when the command is complete.

Disable Interrupts (0x0000000C)

This command disables interrupts to the host when the Status register is updated. Any previously queued status messages will be passed to the host without an interrupt. This command is processed immediately. The MVS316 will clear the Command register when the command is complete.

SCSI Bus Reset (0x0000PL0D)

SCSI Bus Reset Command

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	P	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1

P = SCSI Port (0 = Port 1, 1 = Port 2)

This command resets the SCSI bus selected by the Port bit in the PL byte. If the Port bit is 0, SCSI Port 1 will be reset. If the Port bit is 1, SCSI Port 2 will be reset. The firmware will place the *Bus Reset* (0x0000PL0B) message on the status queue. This status is reported only once no matter how many tasks are active on the specified port.

SCSI With ATN (0xTTCCPL0E)

SCSI With ATN Command

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
T	T	T	T	T	T	T	T	C	C	C	C	C	C	C	C	P	I	I	I	I	L	L	L	0	0	0	0	1	1	1	0

T = Tag Number
C = Chain Count Count
P = SCSI Port (0 = Port 1, 1 = Port 2)
I = SCSI ID
L = LUN

This command causes commands in a DSA to be passed to a SCSI target with the SCSI ATN signal active. The driver must write a non-null pointer to the DSA command chain table to the Data In register before issuing this command. The TT byte contains the Tag Number if command queuing is used; otherwise it must contain a zero. Valid tag numbers are 0x00-0x0F. The CC byte contains the number of DSA pointers in the DSA command chain table. The PL byte contains the Port-ID-LUN for this command. The MVS316 will return a status with the TT and PL bytes set accordingly when the command is complete. If tagged queuing is used, the driver must wait for the status for a given Tag and Port-ID-LUN to be returned before issuing another *SCSI With ATN* or *SCSI Head of Queue* to that Port-ID-LUN with the same tag. If tagged queuing is not used, the driver must wait for the status for a given Port-ID-LUN to be returned before issuing another *SCSI With ATN* or *SCSI Head of Queue* to the same Port-ID-LUN.

Initiator Parameters (0x0000PL0F)

Initiator Parameters Command																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	P	I	I	I	I	0	0	0	0	0	0	0	1	1	1	1

P = SCSI Port (0 = Port 1, 1 = Port 2)
I = SCSI ID

This command returns the wide and synchronous communication parameters in the Data Out register. The PL byte contains the target's Port and ID. The LUN bits are ignored. The format of the Data Out register fields is shown in the following table:

Data Out Register after an Initiator Parameters Command																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	S	S	S	S	S	S	S	S	0	0	0	0	0	0	0	W

P = Synchronous period in nanoseconds. (Frequency = 1 / period.)
S = Synchronous REQ/ACK offset. (0 = Asynchronous transfers.)
W = Wide 16 bit data transfers flag. (0 for 8 bit, 1 for 16 bit transfers.)

SCSI Head of Queue (0xTTCCPL11)

SCSI Head of Queue																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
T	T	T	T	T	T	T	T	C	C	C	C	C	C	C	C	P	I	I	I	I	L	L	L	0	0	0	1	0	0	0	1

T = Tag Number
C = Chain Count Count
P = SCSI Port (0 = Port 1, 1 = Port 2)
I = SCSI ID
L = LUN

This command exists to support SCSI head of queue tag messages for the specified Port, SCSI ID, and LUN. This command can be used to implement the SCSI Head Of Queue message, or to place the command at the head of the queue.

This command causes commands in a DSA to be passed to a SCSI target with the SCSI ATN signal active. The driver must write a non-null pointer to the DSA command chain table to the Data In register before issuing this command. The TT byte contains the Tag Number if command queuing is used; otherwise it must contain a zero. Valid tag numbers are 0x00-00xF. The CC byte contains the number of DSA pointers in the DSA command chain table. The PL byte contains the Port-ID-LUN for this command. The MVS316 will return a status with the TT and PL bytes set accordingly when the command is complete. If tagged queuing is used, the driver must wait for the status for a given Tag and Port-ID-LUN to be returned before issuing another *SCSI With ATN* or *SCSI Head of Queue* to that Port-ID-LUN with the same tag. If tagged queuing is not used, the driver must wait for the status for a given Port-ID-LUN to be returned before issuing another *SCSI With ATN* or *SCSI Head of Queue* to the same Port-ID-LUN.

2.6 Status Messages

The Status register provides a means for the MVS316 to inform the driver of an operation's success or failure. The driver must clear the Status register after reading it. This is accomplished by writing a zero to the register. New status information will not be posted until the old status has been cleared.

Status Longword																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
T	T	T	T	T	T	T	T	F	F	F	F	F	F	F	F	P	I	I	I	I	L	L	L	Status							

Bits 31-24 = Tag Number (TT byte)
Bits 23-16 = Failed DSA Number (FF byte)
Bit 15 = SCSI Port (0 = Port 1, 1 = Port 2) PL byte
Bits 14-11 = SCSI ID (0 - 0xF) |
Bits 10-8 = LUN (0 - 7) PL byte
Bits 7-0 = Status Message byte

Up to four byte fields of status information may be returned. The Tag Number byte in bits 31-24 (0xTTnnnnnn) of the Status longword specifies the tag number (0x00-0x0F). This byte is valid when using tagged queuing.

The Failed DSA Number byte in bits 23-16 (0xnnFFnnnn) of the Status longword specifies which DSA in a command chain failed with bad SCSI status. DSAs are numbered from 0. The DSAs preceding the failed DSA have completed successfully. The count is an unsigned number from 0x00 to 0xFF.

The Port-ID-LUN values in bits 15-8 (0x00nnPLnn) of the Status longword specifies the port, target ID, and LUN that generated the status.

Firmware Started (0x00000002)

This status indicates that the SCSI Application has started. The Board Status indicator will be yellow.

POST Passed (0x00000003)

This status indicates the POST has passed. The other registers may now be accessed.

Bad Script Memory (0x00000005)

This status indicates the firmware could not access the script RAM. The board will soft halt with the Board Status indicator set to red. The MVS316 must be reset.

Firmware Ready To Run (0x00000006)

This status indicates the MVS316 is ready to enter Run mode. The driver must issue a *Run Firmware* command to enter Run mode. The Board Status indicator will be set to green when the MVS316 switches to Run mode.

Bad Interrupt (0x00000007)

This status indicates a problem with the MVS316 CPU interrupt logic. The board will soft halt with the Board Status indicator set to red. The MVS316 must be reset.

CPU Bus Error (0x00000008)

This status indicates the MVS316 CPU could not access host memory. The Data Out register will contain the VME address of host memory that could not be accessed. The board will soft halt with the Board Status indicator set to red. The MVS316 must then be reset. This error is typically caused by incorrect system VME configuration.

VIC Bus Error (0xTTFFPL09)

VIC Bus Error Status

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
T	T	T	T	T	T	T	T	F	F	F	F	F	F	F	F	P	I	I	I	I	L	L	L	0	0	0	0	1	0	0	1

T = Tag Number
F = Failed DSA number
P = SCSI Port (0 = Port 1, 1 = Port 2)
I = SCSI ID
L = LUN

This status indicates the MVS316's VME Interface Controller could not transfer SCSI data to or from host memory. The Data Out register will contain the VME address of host memory that could not be accessed. The board will soft halt with the Board Status indicator set to red. The MVS316 must then be reset. This error is typically caused by incorrect system VME configuration.

Troubleshooting VME or VIC Bus Errors

VME and VIC Bus errors are typically caused by incorrect system VME configuration. Check for the following:

- Missing backplane BG[0-3] jumpers on a vacant VME slot between MVS316 and host cpu board.
- Host VME slave space is not enabled.
- Another VME board's slave address space overlaps Host slave space.
- Host VME slave space does not support the address modifier the MVS316 is using (A24 vs. A32).
- Host VME slave space does not support VME mode the MVS316 is using (non-block vs. BLT).
- Host VME slave space does not support D64 mode and the MVS316 is set up to use MBLT mode.
- Host VME slave space is configured larger than host hardware can support.
- Corrupted VME DTACK signal. This causes the board to attempt access at address 0xFFFFFFFE.
- Broken or missing VME terminator. This causes board to attempt access at random addresses.

Test Status (0x0000PL0A)

Test Status																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	P	I	I	I	I	L	L	L	0	0	0	0	1	0	1	0

P = SCSI Port (0 = Port 1, 1 = Port 2)
I = SCSI ID
L = LUN

This status is generated in response to a *Test Status* command. The PL byte contains the Port, ID, and LUN sent with the *Test Status* command.

Bus Reset (0x0000PL0B)

Bus Reset Status																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	P	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1

P = SCSI Port (0 = Port 1, 1 = Port 2)

This status is issued in response to a *Bus Reset* command. Only the Port bit in the PL byte is valid; it indicates which port was reset. This status is reported only once, no matter how many tasks are active on the specified port.

Bad Script (0x0000PL0C)

Bad Script Status																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	P	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0

P = SCSI Port (0 = Port 1, 1 = Port 2)

This status indicates that an unknown SPIO script status has been reported for the port specified in the PL byte. The Data Out register contains the unknown status. This status indicates defective hardware. The board will soft halt with the Board Status indicator set to red. The MVS316 must be reset.

Bad Command (0x0000000D)

Bad Command Status																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1

This status indicates that a bad command was written to the Command register, a command was issued to a port that is not installed, or an invalid parameter was issued. If an invalid parameter was issued, the ASCII Print Buffer will contain the invalid parameter and value. The Data Out register will contain the bad command.

SCSI Gross Error (0xTTFFPL0E)

SCSI Gross Error Status																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
T	T	T	T	T	T	T	T	F	F	F	F	F	F	F	F	P	I	I	I	I	L	L	L	0	0	0	0	1	1	1	0

T = Tag number
F = Failed DSA number
P = SCSI Port (0 = Port 1, 1 = Port 2)
I = SCSI ID
L = LUN

This status indicates that a target has violated a SCSI specification. This usually means the target improperly changed phase with an outstanding synchronous offset. The target is hung on the SCSI bus. The host should reset the specified SCSI bus. The TT byte contains the tag number, the FF byte contains the failed DSA number, and the PL byte contains the related Port, SCSI ID, and LUN.

SCSI Unexpected Disconnect (0xTTFFPL0F)

SCSI Unexpected Disconnect Status																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
T	T	T	T	T	T	T	T	F	F	F	F	F	F	F	F	P	I	I	I	I	L	L	L	0	0	0	0	1	1	1	1

T = Tag Number
F = Failed DSA number
P = SCSI Port (0 = Port 1, 1 = Port 2)
I = SCSI ID
L = LUN

This status indicates the target unexpectedly disconnected from the SCSI bus. The target should have issued a valid message, such as *Disconnect* or *Command Complete*, before disconnecting. The target may be malfunctioning. The TT byte contains the tag number, the FF byte contains the failed DSA number, and the PL byte contains the related Port, SCSI ID, and LUN.

SCSI Reset Received (0x0000PL10)

SCSI Reset Received Status																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	P	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

P = SCSI Port (0 = Port 1, 1 = Port 2)

This status indicates that a SCSI bus reset was received on the specified port. Only the Port bit in the PL byte is valid; it indicates which port was reset. This status is reported only once, no matter how many tasks are active on the specified port.

SCSI Bus Timeout (0xTTFFPL11)

SCSI Bus Timeout Status																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
T	T	T	T	T	T	T	T	F	F	F	F	F	F	F	F	P	I	I	I	I	L	L	L	0	0	0	1	0	0	0	1

T = Tag Number
F = Failed DSA number
P = SCSI Port (0 = Port 1, 1 = Port 2)
I = SCSI ID
L = LUN

This status indicates no target with the specified ID responded within 250ms. This condition may occur if the SCSI bus is not properly terminated; see SCSI Bus Termination in Chapter 1. The TT byte contains the tag number, the FF byte contains the failed DSA number, and the PL byte contains the Port, SCSI ID, and LUN.

SCSI Command Complete (0xTT00PL12)

SCSI Command Complete Status																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
T	T	T	T	T	T	T	T	0	0	0	0	0	0	0	0	P	I	I	I	I	L	L	L	0	0	0	1	0	0	1	0

T = Tag Number
P = SCSI Port (0 = Port 1, 1 = Port 2)
I = SCSI ID
L = LUN

This status indicates the MVS316 has completed processing all DSAs associated with a command chain. The host should check the SCSI status byte of each DSA for correct SCSI status. The TT byte contains the tag number. The PL byte is the Port, SCSI ID, and LUN related to the command chain.

Bad Controller Parameter (0x00000013)

This status indicates that an invalid controller parameter was loaded. The Board Status indicator will be set to red. The MVS316 must be reset.

SCSI Illegal Reconnect (0x0000PL14)

SCSI Illegal Reselect Status																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	P	I	I	I	I	0	0	0	0	0	0	1	0	1	0	0

P = SCSI Port (0 = Port 1, 1 = Port 2)
I = SCSI ID

This status indicates that a target tried to reconnect to the initiator without first sending an Identify message. Only the Port and ID bits of the PL byte are valid. The target is hung on the SCSI bus. The host should reset the SCSI bus.

SCSI Phase Error (0xTTFFPL15)

SCSI Phase Error Status																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
T	T	T	T	T	T	T	T	F	F	F	F	F	F	F	F	P	I	I	I	I	L	L	L	0	0	0	1	0	1	0	1

T = Tag Number
F = Failed DSA number
P = SCSI Port (0 = Port 1, 1 = Port 2)
I = SCSI ID
L = LUN

This status indicates an invalid SCSI bus phase was detected. The target may be malfunctioning. It is hung on the SCSI bus. The host should reset the specified SCSI bus. The TT byte contains the tag number, the FF byte contains the failed DSA number, and the PL byte contains the Port, SCSI ID, and LUN.

Reject Message Received (0xTTFFPL16)

Reject Message Received Status																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
T	T	T	T	T	T	T	T	F	F	F	F	F	F	F	F	P	I	I	I	I	L	L	L	0	0	0	1	0	1	1	0

T = Tag Number
F = Failed DSA number
P = SCSI Port (0 = Port 1, 1 = Port 2)
I = SCSI ID
L = LUN

This status indicates the MVS316 received a reject message from the target. A *Message Abort* or *Abort Tag* will be sent to the target to stop any further transactions. The host should check the contents of the Message Out buffer to determine the type of message rejected. The TT byte contains the tag number, the FF byte contains the failed DSA number, and the PL byte contains the Port, SCSI ID, and LUN.

Data Overflow (0xTTFFPL18)

Data Overflow Status																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
T	T	T	T	T	T	T	T	F	F	F	F	F	F	F	F	P	I	I	I	I	L	L	L	0	0	0	1	1	0	0	0

T = Tag Number
F = Failed DSA number
P = SCSI Port (0 = Port 1, 1 = Port 2)
I = SCSI ID
L = LUN

This status indicates a target is trying to transfer more data than will fit in the host buffer. The target is hung on the SCSI bus. The host should reset the specified SCSI bus. The TT byte contains the tag number, the FF byte contains the failed DSA number, and the PL byte contains the Port, SCSI ID, and LUN.

SCSI Bad Status (0xTTFFPL19)

SCSI Bad Status																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
T	T	T	T	T	T	T	T	F	F	F	F	F	F	F	F	P	I	I	I	I	L	L	L	0	0	0	1	1	0	0	1

T = Tag Number
F = Failed DSA number
P = SCSI Port (0 = Port 1, 1 = Port 2)
I = SCSI ID
L = LUN

This status indicates the MVS316 encountered a bad SCSI status after a command in the DSA chain finished. The next command in the chain will not be executed. The TT byte contains the tag number, the FF byte contains the failed DSA number, and the PL byte contains the Port, SCSI ID, and LUN.

Parity Error (0xTTFFPL1E)

Parity Error Status																															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
T	T	T	T	T	T	T	T	F	F	F	F	F	F	F	F	P	I	I	I	I	L	L	L	0	0	0	1	1	1	1	0

T = Tag Number
F = Failed DSA number
P = SCSI Port (0 = Port 1, 1 = Port 2)
I = SCSI ID
L = LUN

This status indicates a parity error was detected on the SCSI bus. The firmware aborted the target (or the tag for tagged queuing) on receiving the parity error. The host will not receive another status for the aborted nexus. The TT byte contains the tag number, the FF byte contains the failed DSA number, and the PL byte contains the Port, target SCSI ID, and LUN.

2.7 Data Structure Arrays

The VIC moves all SCSI data over the VME bus. The data buffer length and alignment must be a multiple of 4 for D32, and a multiple of 8 for D64 transfers. Odd byte counts will round up to the next longword for D32 transfers and the next double long for D64 transfers.

A data structure array, or DSA, is a table of longwords and pointers consisting of a SCSI CDB plus its related parameter information, assembled in host memory. This memory space must be DMA accessible by the MVS316. Most of the DSA longwords specify the sizes and locations of host allocated buffers. The DSA structures and buffers must be longword aligned and must not start at address 0. The host system is responsible for building the DSA structures and allocating the memory space used by the buffers.

The DSA command chain table contains pointers to one or more DSAs. The address of the DSA command chain table is written to the Data In register before a *SCSI With ATN* or *SCSI Head of Queue* command is issued to the MVS316. The DSA Count (CC) byte in the command longword is set to the number of DSA pointers in the DSA command chain table. The maximum count is 255.

For example, a Format command chain might consist of Test Unit Ready, Format Unit, and Sense Status CDBs. Each CDB will have its own DSA. The pointer to each of these DSAs is contained in the DSA command chain table. To format a SCSI target, the driver would load the Data In register with the DSA command chain table address. The driver would then issue a *SCSI With ATN* or *SCSI Head of Queue* command to the MVS316 with the DSA Count byte set to the number of DSA pointers in the DSA command chain table (in this example, three), and the PL byte corresponding to the SCSI Port, ID, and LUN of the target.

DSA Structure	
DSA Longword	**Offset**
Reserved	0x00
Status Pointer	0x04
CDB Byte Count	0x08
CDB Pointer	0x0C
Message Out Byte Count	0x10
Message Out Pointer	0x14
Residual Data Byte Count	0x18
Reserved	0x1C
Reserved	0x20
Data Byte Count	0x24
Data Pointer	0x28
Reserved	0x2C
Block Mode	0x30

DSA Structure Description

Each DSA structure must have its own memory space allocated for the table entries and buffers. Buffers may not be shared between DSAs.

Reserved (Entry # 0)

This longword is reserved and must be set to zero by the host.

Status Pointer (Entry # 1)

This longword is a pointer to a longword aligned host allocated buffer used to return the SCSI status byte.

CDB Byte Count (Entry # 2)

This longword indicates the length, in bytes, of the SCSI CDB. The maximum CDB length supported is 20 bytes. The optional link and flag bits in the CDB are not supported.

CDB Pointer (Entry # 3)

This longword is a pointer to a host allocated longword aligned SCSI CDB buffer.

Message Out Byte Count (Entry # 4)

This longword indicates the length, in bytes, of the Message Out buffer. The Message Out buffer contains the SCSI messages that will be sent to a SCSI target during a Message Out phase. The maximum message out length supported is 16 bytes.

Message Out Pointer (Entry # 5)

This longword is the pointer to the host allocated longword aligned Message Out buffer. The minimum buffer size is two longwords.

Residual Data Byte Count (Entry # 6)

After an I/O transfer, this longword will contain the residual count, in bytes, of any data not transferred.

Reserved (Entry # 7)

This longword is reserved and must be set to zero by the host.

Reserved (Entry # 8)

This longword is reserved and must be set to zero by the host.

Data Byte Count (Entry # 9)

This longword contains the size, in bytes, of the first (and possibly only) data buffer. The driver must set this longword before issuing a *SCSI With ATN* or *SCSI Head of Queue* command.

Data Pointer (Entry # 10)

This longword is a pointer to the first (and possibly only) data buffer in host memory. The driver must set this longword before issuing a *SCSI With ATN* or *SCSI Head of Queue* command.

Reserved (Entry # 11)

This longword is reserved and must be set to zero by the host.

Block Mode (Entry # 12)

This longword is the block mode flag.

0	No block mode (single cycle transfer)
1	D32 block transfers
2	D64 block transfers

2.8 Board Operation

This section contains a collection of information related to the operation of the MVS316. The information presented here may be valuable to those who are writing their own driver.

Wide Operation

The host controls wide and synchronous operation by using the appropriate message in the message out DSA. Wide SCSI operation should be negotiated the first time the initiator connects to a target, and after a SCSI error status that would require re-negotiation (i.e. target cycled power). The SCSI specification requires the target to enter asynchronous operation after a wide negotiation. The wide message should follow the identify message without any other messages.

The driver may determine the wide and synchronous negotiation parameters for a SCSI ID by using the command *Initiator Parameters*. If a target rejects the wide message, the target will be aborted and a status of *Reject Message Received* will be returned. The target did not process the SCSI command.

Synchronous Operation

The host controls wide and synchronous operation by using the appropriate message in the message out DSA. Synchronous operation should be negotiated the first time the initiator connects to a target, and after a SCSI error status that would require re-negotiation (i.e. target cycled power). The SCSI specification requires the target to enter asynchronous operation after a wide negotiation. Therefore, synchronous negotiation should follow wide negotiation. The synchronous message should follow the identify message without any other messages.

The MVS316 is capable of synchronous operation from 20 MHz (50 ns period) to 3.7 MHz (272 ns period.) If a synchronous period less than 3.7 MHz is requested, the board will negotiate for asynchronous operation. The maximum synchronous offset is 16.

The driver may determine the wide and synchronous negotiation parameters for a SCSI ID by using the *Initiator Parameters* command. If a target rejects the synchronous message, the target will be aborted and a status of *Reject Message Received* will be returned. The target did not process the SCSI command.

Initiator Command Chaining

Command chaining is used in initiator mode to send more than one command to a SCSI target with the *SCSI With ATN* or *SCSI Head of Queue* commands. Bits 16-23 of the commands specify the number of commands in the chain. Commands in the chain must be for the same SCSI ID.

Command chaining will halt if a command in the chain failed with bad SCSI status. The FF byte in the status will contain the zero based chain number of the failing command. For example, if the second command in a chain (DSA 1) has a bad SCSI status, the FF byte in the Status longword will contain 0x01. The first command is assumed to have completed successfully.

Command chaining cannot be used in conjunction with tagged queuing.

Tagged Queuing

Tags are zero-based numbered. For example, if 16 tags are supported, the tags are numbered from 0 to 15. With a maximum of 16 tags supported, the MVS316 can concurrently handle 2 Ports x 15 Targets x 8 LUNs x 16 Tags = 3840 commands! The tag number is placed in bits 24-31 of the *SCSI With ATN* and *SCSI Head of Queue* commands. Status messages posted after completion of an operation contain the tag number in bits 24-31 of the Status longword. The tag number is only used to identify a particular command and has no bearing on the order of execution. *SCSI With ATN* commands are sent to the target on a 'first in first out' basis. The *SCSI Head of Queue* command is used to support head of queue messages.

To use tagged queuing, the two byte SCSI tag message (Simple, Ordered, or Head Of Queue) must be in the DSA Message Out buffer just after the IDENTIFY message, and the Message Byte Count should be set to three instead of one. Except during a SCSI Check condition, the driver must wait for all tagged commands to be completed before issuing untagged commands. To clear a SCSI Check condition, the driver must issue an untagged SCSI Request Sense command, using either a SCSI With ATN or *SCSI Head of Queue* command. Refer to the SCSI specification for the applicable rules.

Because the *SCSI With ATN* and *SCSI Head Of Queue* commands use a tag field of 0 to indicate no tagged queuing, it is recommended that tag 0 not be used during normal tagged queuing operation.

Tag messages should not be sent with the SCSI *Synchronous* or *Wide* messages because if a message gets rejected by the target the host can not tell which message was rejected.

Command chaining can not be used with tagged queuing.

2.9 Firmware Trace Buffer

The MVS316 is equipped with a diagnostic Firmware Trace Buffer that stores messages generated by the firmware. Downloaded controller parameters and certain error conditions are also stored in the trace buffer.

The trace buffer is a circular buffer that starts at offset 0x100 and ends at offset 0x7FFF. The diagnostic trace buffer will not be available on A16 systems because the 256 byte VME address window ends at address 0xFF. The trace buffer can be viewed with an available debugger such as adb or kadb. In order to view the trace buffer, the driver must be built with the option MVS_FIRMWARE_DEBUG defined:

```
#define MVS_FIRMWARE_DEBUG
```

The following describes steps needed to reference the trace buffer on Solaris 2.x. The /kernel/drv/mvsu.conf file must be modified to contain 3 "regs" entries per controller instead of 1 since the maximum memory interface length is 0x3000. If the original mvsu.conf entry is:

```
name="mvsu" class="vme" reg=0x4d,0xc4000000,0x100 interrupts=5,0xc4
   mvsu-cpb-params=0x30203d77
;
```

change it to:

```
name="mvsu" class="vme"
reg=0x4d,0xc4000000,0x3000,
   0x4d,0xc4003000,0x3000,
   0x4d,0xc4006000,0x2000
interrupts=5,0xc4
 mvsu-cpb-params=0x30203d77
;
```

In the above case, to find the virtual address(es) used to access the trace buffer, use adb:

```
adb -k /dev/ksyms /dev/mem
mvsu_ctlrs/48X
mvsu_ctlrs:
mvsu_ctlrs:    4f2        0          43         10
        5          c4         0          3d
        0          2          0          0
        7          0          0          0
        0          0          7          0
        0          0          0          0
        0          0          0          0
        0          0          0          0
        0          0          0          0
        0          0          0          0
        0          601fa000   601ff000   60202000
        30203d77   5          c4         60147ea0
```

The 32kb (0x8000) of memory mapped is in 3 possibly non-contiguous chunks of sizes 0x3000, 0x3000 and 0x2000 bytes. The triplet of virtual addresses are the 3 words displayed before the board parameters word (0x30203d77). In this case, these begin at addresses 0x601fa000 for board offset 0, 0x601ff000 for board offset 0x3000 and 0x60202000 for board offset 0x6000. The trace buffer begins at offset 0x100 (0x601fa100). It can be viewed with adb or kadb.

Interface Signals

This appendix provides signal name and pinout information for the interface connectors used on the MVS316.

A.1 VMEbus Interface Signals

VMEbus Interface Signals		
Signal	**Pin**	**Description**
A01	P1A-30	Address Bus
A02	P1A-29	Address Bus
A03	P1A-28	Address Bus
A04	P1A-27	Address Bus
A05	P1A-26	Address Bus
A06	P1A-25	Address Bus
A07	P1A-24	Address Bus
A08	P1C-30	Address Bus
A09	P1C-29	Address Bus
A10	P1C-28	Address Bus
A11	P1C-27	Address Bus
A12	P1C-26	Address Bus
A13	P1C-25	Address Bus
A14	P1C-24	Address Bus
A15	P1C-23	Address Bus
A16	P1C-22	Address Bus
A17	P1C-21	Address Bus
A18	P1C-20	Address Bus
A19	P1C-19	Address Bus
A20	P1C-18	Address Bus
A21	P1C-17	Address Bus
A22	P1C-16	Address Bus
A23	P1C-15	Address Bus
A24	P2B-4	Address Bus
A25	P2B-5	Address Bus
A26	P2B-6	Address Bus
A27	P2B-7	Address Bus
A28	P2B-8	Address Bus
A29	P2B-9	Address Bus
A30	P2B-10	Address Bus
A31	P2B-11	Address Bus

VMEbus Interface Signals		
Signal	**Pin**	**Description**
D00	P1A-1	Data Bus
D01	P1A-2	Data Bus
D02	P1A-3	Data Bus
D03	P1A-4	Data Bus
D04	P1A-5	Data Bus
D05	P1A-6	Data Bus
D06	P1A-7	Data Bus
D07	P1A-8	Data Bus
D08	P1C-1	Data Bus
D09	P1C-2	Data Bus
D10	P1C-3	Data Bus
D11	P1C-4	Data Bus
D12	P1C-5	Data Bus
D13	P1C-6	Data Bus
D14	P1C-7	Data Bus
D15	P1C-8	Data Bus
D16	P2B-14	Data Bus
D17	P2B-15	Data Bus
D18	P2B-16	Data Bus
D19	P2B-17	Data Bus
D20	P2B-18	Data Bus
D21	P2B-19	Data Bus
D22	P2B-20	Data Bus
D23	P2B-21	Data Bus
D24	P2B-23	Data Bus
D25	P2B-24	Data Bus
D26	P2B-25	Data Bus
D27	P2B-26	Data Bus
D28	P2B-27	Data Bus
D29	P2B-28	Data Bus
D30	P2B-29	Data Bus
D31	P2B-30	Data Bus
Strobes, Active Low (*=0)		
AS*	P1A-18	Address Strobe
DS0*	P1A-13	Data Strobe Zero
DS1*	P1A-12	Data Strobe One
DTACK*	P1A-16	Data Transfer Acknowledge
Master Mode Signals, Active Low		
BBSY*	P1B-1	Bus Busy
BCLR*	P1B-2	Bus Clear
BERR*	P1C-11	Bus Error
BG0IN*	P1B-4	Bus Grant In Zero

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VMEbus Interface Signals		
Signal	**Pin**	**Description**
BG1IN*	P1B-6	Bus Grant In One
BG2IN*	P1B-8	Bus Grant In Two
BG3IN*	P1B-10	Bus Grant In Three
BG0OUT*	P1B-5	Bus Grant Out Zero
BG1OUT*	P1B-7	Bus Grant Out One
BG2OUT*	P1B-9	Bus Grant Out Two
BG3OUT*	P1B-11	Bus Grant Out Three
BR0*	P1B-12	Bus Request Zero
BR1*	P1B-13	Bus Request One
BR2*	P1B-14	Bus Request Two
BR3*	P1B-15	Bus Request Three
Interrupt Lines, Active Low		
IRQ1*	P1B-30	Interrupt Request One
IRQ2*	P1B-29	Interrupt Request Two
IRQ3*	P1B-28	Interrupt Request Three
IRQ4*	P1B-27	Interrupt Request Four
IRQ5*	P1B-26	Interrupt Request Five
IRQ6*	P1B-25	Interrupt Request Six
IRQ7*	P1B-24	Interrupt Request Seven
IACK*	P1A-20	Interrupt Acknowledge
IACKIN*	P1A-21	Interrupt Acknowledge In
IACKOUT*	P1A-22	Interrupt Acknowledge Out
Miscellaneous Signals, Active Low		
LWORD*	P1C-13	Longword, 32 Bit Transfer
WRITE*	P1A-14	Write
SYSRESET*	P1C-12	System Reset
Power		
+5V	P1A,B,C-32	Plus Five Volts DC
+5V	P2B-1,13,32	Plus Five Volts DC
GND	P1A-9,11,15	Signal Ground
GND	P1A-17,19	Signal Ground
GND	P1B-20,23	Signal Ground
GND	P2B-2,12,22,31	Signal Ground
GND	P1C-9	Signal Ground

A.2 Front Panel SCSI Connectors

Single-Ended Interface Signals

SCSI Bus Interface Signals		
Signal	**J1, J2 Pin**	**Description**
GROUND	1 through 16	Signal Ground
TERMPWR	17 & 18	Terminator Power
GROUND	19 through 34	Signal Ground
DB12	35	SCSI Data Bit 12
DB13	36	SCSI Data Bit 13
DB14	37	SCSI Data Bit 14
DB15	38	SCSI Data Bit 15
DBP1	39	SCSI Data Parity, Bits 8-15
DB0	40	SCSI Data Bit 0
DB1	41	SCSI Data Bit 1
DB2	42	SCSI Data Bit 2
DB3	43	SCSI Data Bit 3
DB4	44	SCSI Data Bit 4
DB5	45	SCSI Data Bit 5
DB6	46	SCSI Data Bit 6
DB7	47	SCSI Data Bit 7
DBP	48	SCSI Data Parity, Bits 0-7
GROUND	49 & 50	Signal Ground
TERMPWR	51 & 52	Terminator Power
GROUND	53 & 54	Signal Ground
ATN	55	Attention
GROUND	56	Signal Ground
BSY	57	Busy
ACK	58	Acknowledge
RST	59	Reset
MSG	60	Message
SEL	61	Select
C/D	62	Command/Data
REQ	63	Request
I/O	64	Input/Output
DB8	65	SCSI Data Bit 8
DB9	66	SCSI Data Bit 9
DB10	67	SCSI Data Bit 10
DB11	68	SCSI Data Bit 11

Differential Interface Signals

SCSI Bus Interface Signals		
Signal	**Pin**	**Description**
+DB12	1	SCSI Data Bit 12 Plus
+DB13	2	SCSI Data Bit 13 Plus
+DB14	3	SCSI Data Bit 14 Plus
+DB15	4	SCSI Data Bit 15 Plus
+DBP1	5	SCSI Data Parity, Bits 8-15 Plus
GROUND	6	Signal Ground
+DB0	7	SCSI Data Bit 0 Plus
+DB1	8	SCSI Data Bit 1 Plus
+DB2	9	SCSI Data Bit 2 Plus
+DB3	10	SCSI Data Bit 3 Plus
+DB4	11	SCSI Data Bit 4 Plus
+DB5	12	SCSI Data Bit 5 Plus
+DB6	13	SCSI Data Bit 6 Plus
+DB7	14	SCSI Data Bit 7 Plus
+DBP	15	SCSI Data Parity, Bits 0-7 Plus
DIFFSENSE	16	Differential Sense
TERMPWR	17 & 18	Terminator Power
GROUND	19	Signal Ground
+ATN	20	Attention Plus
GROUND	21	Signal Ground
+BSY	22	Busy Plus
+ACK	23	Acknowledge Plus
+RST	24	Reset Plus
+MSG	25	Message Plus
+SEL	26	Select Plus
+C/D	27	Command/Data Plus
+REQ	28	Request Plus
+I/O	29	Input/Output Plus
GROUND	30	Signal Ground
+DB8	31	SCSI Data Bit 8 Plus
+DB9	32	SCSI Data Bit 9 Plus
+DB10	33	SCSI Data Bit 10 Plus
+DB11	34	SCSI Data Bit 11 Plus
-DB12	35	SCSI Data Bit 12 Minus
-DB13	36	SCSI Data Bit 13 Minus
-DB14	37	SCSI Data Bit 14 Minus
-DB15	38	SCSI Data Bit 15 Minus
-DBP1	39	SCSI Data Parity, Bits 8-15 Minus
GROUND	40	Signal Ground
-DB0	41	SCSI Data Bit 0 Minus
-DB1	42	SCSI Data Bit 1 Minus

SCSI Bus Interface Signals		
Signal	**Pin**	**Description**
-DB2	43	SCSI Data Bit 2 Minus
-DB3	44	SCSI Data Bit 3 Minus
-DB4	46	SCSI Data Bit 4 Minus
-DB5	46	SCSI Data Bit 5 Minus
-DB6	47	SCSI Data Bit 6 Minus
-DB7	48	SCSI Data Bit 7 Minus
-DBP	49	SCSI Data Parity, Bits 0-7 Minus
Ground	50	Signal Ground
TERMPWR	51 & 52	Terminator Power
GROUND	53	Signal Ground
-ATN	54	Attention Minus
GROUND	55	Signal Ground
-BSY	56	Busy Minus
-ACK	57	Acknowledge Minus
-RST	58	Reset Minus
-MSG	59	Message Minus
-SEL	60	Select Minus
-C/D	61	Command/Data Minus
-REQ	62	Request Minus
-I/O	63	Input/Output Minus
GROUND	64	Signal Ground
-DB8	65	SCSI Data Bit 8 Minus
-DB9	66	SCSI Data Bit 9 Minus
-DB10	67	SCSI Data Bit 10 Minus
-DB11	68	SCSI Data Bit 11 Minus

A.3 SCSI On P2 Option Signals

Single-Ended Interface Signals

Single-Ended Interface Signals		
Signal	**P2 Pin**	**Description**
GROUND	C-1 thru 15	Signal Ground
DIFFSENSE	C-16	Differential Interface Sense
TERMPWR	C-17 & 18	Terminator Power
GROUND	C-18 thru 32	Signal Ground
DB12	A-1	SCSI Data Bit 12
DB13	A-2	SCSI Data Bit 13
DB14	A-3	SCSI Data Bit 14
DB15	A-4	SCSI Data Bit 15
DBP1	A-5	SCSI Data Parity, Bits 8-15
DB0	A-6	SCSI Data Bit 0
DB1	A-7	SCSI Data Bit 1
DB2	A-8	SCSI Data Bit 2
DB3	A-9	SCSI Data Bit 3
DB4	A-10	SCSI Data Bit 4
DB5	A-11	SCSI Data Bit 5
DB6	A-12	SCSI Data Bit 6
DB7	A-13	SCSI Data Bit 7
DBP	A-14	SCSI Data Parity, Bits 0-7
GROUND	A-15 & 16	Signal Ground
TERMPWR	A-17	Terminator Power
GROUND	A-18 & 19	Signal Ground
ATN	A-20	Attention
BSY	A-21	Busy
ACK	A-22	Acknowledge
RST	A-23	Reset
MSG	A-24	Message
SEL	A-25	Select
C/D	A-26	Command/Data
REQ	A-27	Request
I/O	A-28	Input/Output
DB8	A-29	SCSI Data Bit 8
DB9	A-30	SCSI Data Bit 9
DB10	A-31	SCSI Data Bit 10
DB11	A-32	SCSI Data Bit 11

Differential Interface Signals

Differential Interface Signals		
Signal	**P2 Pin**	**Description**
+DB12	C-1	SCSI Data Bit 12 Plus
+DB13	C-2	SCSI Data Bit 13 Plus
+DB14	C-3	SCSI Data Bit 14 Plus
+DB15	C-4	SCSI Data Bit 15 Plus
+DBP1	C-5	SCSI Data Parity, Bits 8-15 Plus
GROUND	C-6	Signal Ground
+DB0	C-7	SCSI Data Bit 0 Plus
+DB1	C-8	SCSI Data Bit 1 Plus
+DB2	C-9	SCSI Data Bit 2 Plus
+DB3	C-10	SCSI Data Bit 3 Plus
+DB4	C-11	SCSI Data Bit 4 Plus
+DB5	C-12	SCSI Data Bit 5 Plus
+DB6	C-13	SCSI Data Bit 6 Plus
+DB7	C-14	SCSI Data Bit 7 Plus
+DBP	C-15	SCSI Data Parity, Bits 0-7 Plus
DIFFSENSE	C-16	Differential Interface Sense
TERMPWR	C-17 & 18	Terminator Power
GROUND	C-19	Signal Ground
+ATN	C-20	Attention Plus
+BSY	C-21	Busy Plus
+ACK	C-22	Acknowledge Plus
+RST	C-23	Reset Plus
+MSG	C-24	Message Plus
+SEL	C-25	Select Plus
+C/D	C-26	Command/Data Plus
+REQ	C-27	Request Plus
+I/O	C-28	Input/Output Plus
+DB8	C-29	SCSI Data Bit 8 Plus
+DB9	C-30	SCSI Data Bit 9 Plus
+DB10	C-31	SCSI Data Bit 10 Plus
+DB11	C-32	SCSI Data Bit 11 Plus
-DB12	A-1	SCSI Data Bit 12 Minus
-DB13	A-2	SCSI Data Bit 13 Minus
-DB14	A-3	SCSI Data Bit 14 Minus
-DB15	A-4	SCSI Data Bit 15 Minus
-DBP1	A-5	SCSI Data Parity, Bits 8-15 Minus
GROUND	A-6	Signal Ground
-DB0	A-7	SCSI Data Bit 0 Minus
-DB1	A-8	SCSI Data Bit 1 Minus
-DB2	A-9	SCSI Data Bit 2 Minus
-DB3	A-10	SCSI Data Bit 3 Minus

Differential Interface Signals		
Signal	**P2 Pin**	**Description**
-DB4	A-11	SCSI Data Bit 4 Minus
-DB5	A-12	SCSI Data Bit 5 Minus
-DB6	A-13	SCSI Data Bit 6 Minus
-DB7	A-14	SCSI Data Bit 7 Minus
-DBP	A-15	SCSI Data Parity, Bits 0-7 Minus
-ATN	A-16	Attention Minus
TERMPWR	A-17 & 18	Terminator Power
-BSY	A-19	Busy Minus
GROUND	A-20	Signal Ground
-ACK	A-21	Acknowledge Minus
-RST	A-22	Reset Minus
-MSG	A-23	Message Minus
-SEL	A-24	Select Minus
-C/D	A-25	Command/Data Minus
-REQ	A-26	Request Minus
-I/O	A-27	Input/Output Minus
GROUND	A-28	Signal Ground
-DB8	A-29	SCSI Data Bit 8 Minus
-DB9	A-30	SCSI Data Bit 9 Minus
-DB10	A-31	SCSI Data Bit 10 Minus
-DB11	A-32	SCSI Data Bit 11 Minus

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Power On Self Test

To interpret the results of the Power On Self Test, examine the Command register. If it contains 0 (*Ready For Command*) the Power On Self Test passed. If the Command register contains the value 0xBADTTTSS, the POST has failed. TTT specifies the POST test number that failed. SS specifies the POST sub-test number that failed. The Status LED will be red. The only valid boot loader command is *Software Reset*.

B.1 Power On Self Test LED Codes

Power On Self Test LED Codes	
Color	**Description**
Yellow	Power on self test running.
Green	Power on self test passed.
Red	Power on self test failed.
Off	Power off or board reset asserted.

B.2 Test Descriptions

Power On Self Test Descriptions	
Test Number	**Description**
0x001	CPU RAM data bus test.
0x002	CPU RAM data equals address test.
0x003	CPU RAM data equals ~address test.
0x004	CPU RAM byte lane test.
0x005	CPU RAM word lane test.
0x006	CPU RAM longword lane test.
0x007	VME shared RAM data bus test.
0x008	VME shared RAM data equals address test.
0x009	VME shared RAM data equals ~address test.
0x010	VME shared RAM byte lane test.
0x011	VME shared RAM word lane test.
0x012	VME shared RAM longword lane test.
0x013	LED data bus test.
0x014	Control data bus test.

Power On Self Test Descriptions	
Test Number	**Description**
0x015	Firmware checksum test.
0x016	Extended CPU RAM banks data bus test.
0x017	Extended CPU RAM data equals address test.
0x018	Extended CPU RAM data equals ~address test.
0x019	Extended VME shared RAM data equals address test.
0x020	Extended VME shared RAM data equals ~address test.
0x021	VIC data bus test.
0x022	VIC address bus test.
0x023	VIC generated interrupts to the CPU test.
0x024	VIC type test.
0x025	SCSI port dual ported RAM data bus test.
0x026	SCSI port dual ported RAM data equals address test.
0x027	SCSI port dual ported RAM data equals ~address test.
0x028	SCSI port dual ported RAM byte lane test.
0x029	SCSI port dual ported RAM word lane test.
0x030	SCSI port dual ported RAM longword lane test.
0x031	SCSI port SPIO data bus test.
0x032	SCSI port SPIO byte lane test.
0x033	SCSI port SPIO word lane test.
0x034	SCSI port SPIO address bus test.
0x035	SCSI port SPIO reset test.
0x036	SCSI port SPIO interrupt test.
0x037	SCSI port SPIO script test.
0x038	SCSI port SPIO block DMA test.
0x039	SCSI port SPIO unaligned DMA test.
0x040	SCSI port SPIO type test.
0x041	Command interrupt diagnostic.
0x042	VME bus master DMA diagnostic.
0x043	External loop back diagnostic.
0x100	Invalid CONFIG jumper VME slave address space.
0x200	Bad interrupt during CPU start up.
0x300	Bad interrupt during power on self test.
0x400	Failure to copy SCSI application to RAM.
0x500	SCSI application returned to boot loader.
0x600	Firmware update application returned to boot loader.