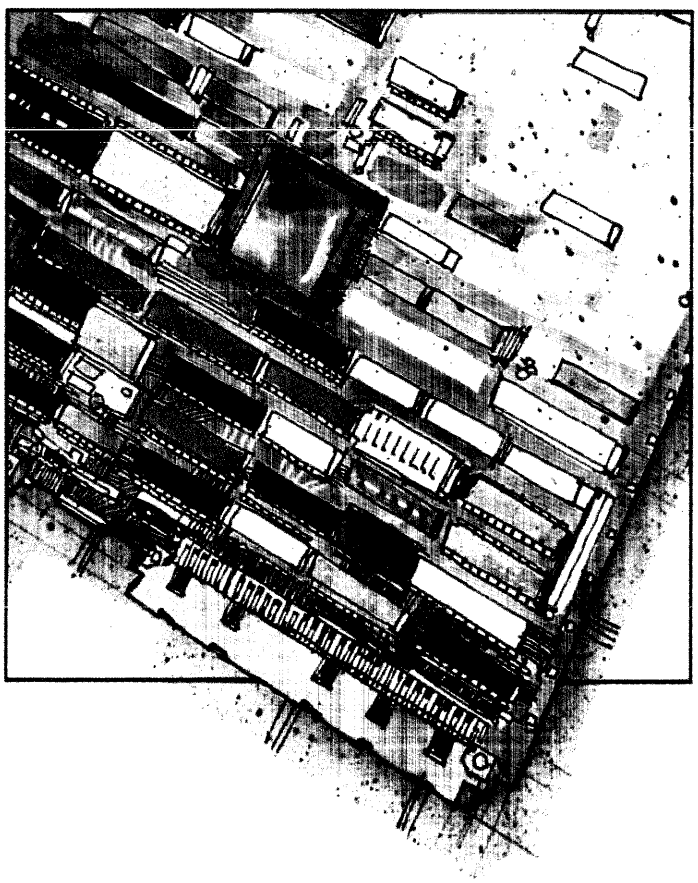
V/SCSI 4210 Jaguar

High-Performance
VMEbus Dual SCSI
Host Adapter

System Integration Guide



INTERPHASE
CORPORATION

V/SCSI 4210 Jaguar

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System Integration Guide

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RECORD OF CHANGES

CHANGE NO.	DATE	TITLE OR BRIEF DESCRIPTION	ENTERED BY
1	09/28/90	Changed style of manual to conform with present style and format. Converted manual into Word Perfect 5.1 Added jumper information and locations for Surface Mount Jaguar. Added Considerations For Maximizing SCSI Synchronous Data Transfers to Chapter 6 (Applications Notes)	
		No other changes were made in this revision	Hue Garrett
2	02/20/91	Made changes to Surface Mount information contained in chapter 2.	Hue Garrett
3	03/13/91	Made PCL recommended changes	Hue Garrett

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CHAPTER 1
INTRODUCTION TO THE V/SCSI 4210

INTENDED AUDIENCE

Interphase wrote this manual for its customers. It is intended for a highly technical audience, specifically, users who need to write their own software drivers.

Readers are assumed to have extensive knowledge of the following:

- The C programming language, including experience writing and installing interface software (drivers).
- The operating system of the host computer.
- SCSI specifications.

SCOPE OF MANUAL

This manual's organization allows you to focus on your specific areas of interest, without giving you more information than needed.

Specifically, this manual contains guidelines on:

- Installing the V/SCSI 4210 Jaguar
- Programming the V/SCSI 4210 Jaguar
- Determining the cause of error messages which may be generated by the board.

GENERAL MANUAL INFORMATION

You will find it very useful to read this *Introduction* completely. It contains information that will clarify many of your questions later. The *Conventions* section can be especially useful for later reference since it defines how certain topics will be presented to you.

Be sure to perform the installation of the product using the *Installation* chapter. Read this chapter thoroughly **before** attempting the installation.

Chapter 3 provides an overview of how the product's interface works. It gives procedures for submitting commands, as well as specific facts about SCSI that affect board operation.

Interphase can supply you with an example driver. If your system only requires minor modifications of this driver, then the source code provided gives a good base from which to start. If your system is radically different, then the example driver at least gives you ideas on what must functionally be contained in a driver.

OVERVIEW

The V/SCSI 4210 Jaguar is a VMEbus SCSI host adapter capable of controlling up to 14 SCSI devices-seven with the primary SCSI port (Port 0), plus seven more if the optional secondary SCSI port (Port 1) is installed. As an alternative, the secondary port can be used to output data to a printer, provided your setup includes the optional printer port daughter card.

SYSTEM INTERFACE

The host processor communicates with the Jaguar through 2 Kbytes of onboard RAM. All commands and responses pass through this 2K space, which is referred to as "short I/O," because it is mapped into the short I/O space of the VMEbus.

Each command to the Jaguar is specified using a host-generated software structure called an Input/Output Parameter Block (IOPB). IOPBs can be built in either the Jaguar's 2K short I/O space or offboard in system memory. In the latter case, command completions are posted to both on- and offboard data structures.

The system-level interface, referred to as "MACSI" (for Multiple Active Command Software Interface), is implemented in short I/O. In addition to supporting command queuing, MACSI enables multiple commands to be active simultaneously. The Jaguar accepts commands from the host and queues them internally. It then acts on each command as soon as possible, within the confines of the SCSI bus. As commands are completed, the host is notified of each command's completion, as well as its completion status.

ISSUING COMMANDS

The host submits commands to the Jaguar by making an entry into a circular queue called the Command Queue. Each Command Queue entry is a 12-byte block containing a pointer to the IOPB and other control information.

IOPBs may be built by the host either onboard (in the Jaguar's Host Usable Space in short I/O), or offboard in system memory. Once it builds an IOPB, the host creates an entry for the IOPB in the next available slot in the Command Queue.

EXECUTING COMMANDS

The Jaguar reads the Command Queue, determines which entry is to be executed next, and moves the appropriate Command Queue entry and IOPB into one of its internal work queues. The Jaguar supports up to 15 work queues, numbered 0 through 14. Work Queues 1 - 14 are each intended to be dedicated to a specific SCSI device (or to a printer connected via the optional printer port daughter card). Thus, commands intended for a specific device are sent to the work queue dedicated to that device.

After the Command Queue entry and IOPB have been placed in a work queue, the slot in the Command Queue that was filled by the command becomes available for re-use by the host. As a result, the host virtually always has entries available in the Command Queue for issuing commands. This frees the host from the need to be concerned with any of the intimate timing issues of the Jaguar's Command Queue.

Even in the unlikely case that the Command Queue is full when the host tries to enter a command, the Jaguar provides efficient operation by optionally interrupting the host when an entry becomes available in the Command Queue.

Once the command is moved into the appropriate work queue, the Jaguar executes it at the first opportunity. It then posts completion to the Command Response Block (located in either short I/O or in system memory) and generates an interrupt (if enabled to do so). The host acknowledges the interrupt by writing a word to the Command Response Block, releasing it for further use.

WORK QUEUES

The concept of work queues is integral to the way that MACSI allows multiple commands to be active simultaneously. Information in the Command Queue entry determines the work queue into which a particular command is placed. At any time, there is an In Progress command for each work queue that has at least one entry. The Next command is simply waiting for the In Progress command from that work queue to complete.

Since the SCSI bus allows many tasks to be overlapped on multiple devices, the MACSI interface allows for commands from all work queues to be interspersed. Assuming that the SCSI devices support overlapped activity on the SCSI bus (using Disconnect/Reconnect), up to 14 commands (one In Progress command from each attached SCSI device) can be simultaneously active, resulting in overlapped data streams. Indeed, since the Jaguar has two fully independent SCSI buses, it can support two truly simultaneous data streams. If some devices do not support overlapped activity, they can be relegated to the second port, allowing fully functioning devices on the first port unrestricted operation. The second port can, of course, also support full SCSI functionality.

The Jaguar accommodates up to 14 work queues, not counting a special queue called Work Queue 0. The host fixes each work queue's parameters when it initializes the queue. The host is then responsible for using the work queues in a manner consistent with the initialization scheme. The only restriction is that no more than one work queue can be allocated to a device. The number of entries in the Command Queue, the number of slots in each work queue, the characteristics of these queues, as well as other Jaguar operating parameters, are programmable and must be initialized before use.

MASTER COMMAND ENTRY AND WORK QUEUE 0

In order to initialize the board, as well as to execute very high priority commands, the Jaguar provides two auto-initialized facilities f the Master Command Entry and Work Queue 0.

The Master Command Entry is a 12-byte location in short I/O which has exactly the same form as a Command Queue entry (i.e. control information and a pointer to an IOPB). It acts like a single-entry Command Queue. Commands issued through the Master Command Entry are executed immediately.

Likewise, the Work Queue 0 is a single-slot work queue capable of accepting one command at a time. It is highest priority work queue, so any command sent to Work Queue 0 is executed immediately. Its length (one slot) cannot be changed by the host.

Work Queue 0 is defined to have a length of 1 so that only one error recovery process can occur at a time. However, it is possible that a command from Work Queue 0 may itself require error recovery. To deal with that situation, certain commands (specifically, SCSI Bus Reset and Flush Work Queue) may always be issued through Work Queue 0. For all other commands, Work Queue 0 has a length of 1.

The Master Command Entry and Work Queue 0 allow you to issue a single command and then wait for its completion before issuing the next one. A typical use for these facilities is, upon power-up, to initialize the rest of the queues and start off normal SCSI operations.

Note that the Master Command Entry and Work Queue 0 are not removed, even after the Command Queue and the other work queues are initialized and normal activity has begun.

SUMMARY OF KEY FEATURES

SCSI CONSIDERATIONS

- One or two single-ended SCSI ports
- Each port supports synchronous SCSI transfers (4 Mbyte/sec. transfer rate)
- Full concurrent operation, including concurrent access to both SCSI busses and concurrent operations on up to 14 attached SCSI devices
- All 8 SCSI phases supported
- Supports variable SCSI block lengths
- All available SCSI devices supported: disks, optical disks, tapes (including 1/2" tape cartridges), printers, etc.

ADDITIONAL ONBOARD FEATURES

- Local intelligence (68000) controls system-level functions
- Easy-to-use software interface (IOPB structure)
- Prefetch caching dynamically controllable on a per-IOPB basis
- Full track caching
- Deep buffer enables application-specific caching algorithms

REFERENCES

ANSI X3. 131-1986 SCSI Specifications

VMEbus Bus Specification, Revision C.1

CONVENTIONS

This section details many of the writing conventions used throughout the manual. In addition, it gives many of the technical conventions.

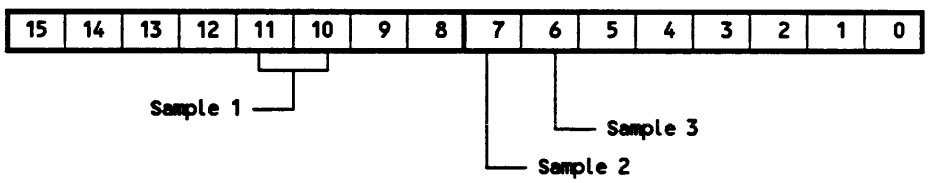
- The SCSI port provided by the motherboard is referred to as **Port 0** or the **primary SCSI bus**. The port provided by a SCSI daughter card (if installed) is called the **Port 1** or the **secondary SCSI bus**.

- "Byte" represents 8 bits; "word" represents 16 bits (2 bytes); and "longword" represents 32 bits (2 words, 4 bytes).

- Binary (single bit) data is represented as either '1' or '0'.
- To represent hexadecimal numbers, the manual adopts the C language notation. Decimal numbers are shown as decimal digits. For example:

  0x29 = 29 hex
  41 = 41 decimal

- When used in the context of a single bit of data, the term "set" means that the bit is a one ('1').
- Similarly, the term "cleared" means that the bit is a zero ('0').
- In many cases, bits, bytes, and words are marked ``RESERVED". If the value of the bit, byte, or word is determined by the host (i.e., sent to the controller), the value must be cleared ('0', 0x00, or 0x0000).
- If the value is returned by the controller, it is reserved for future use by Interphase. The user should not rely on these values to be consistent through different revisions of the product.
- When showing binary representations of bytes or words, the diagrams may have many bits which do not have names. These are RESERVED. As an example:



Bits 10 and 11 are called Sample 1, bit 7 is called Sample 2, and bit 6 is called Sample 3. All other bits are RESERVED.

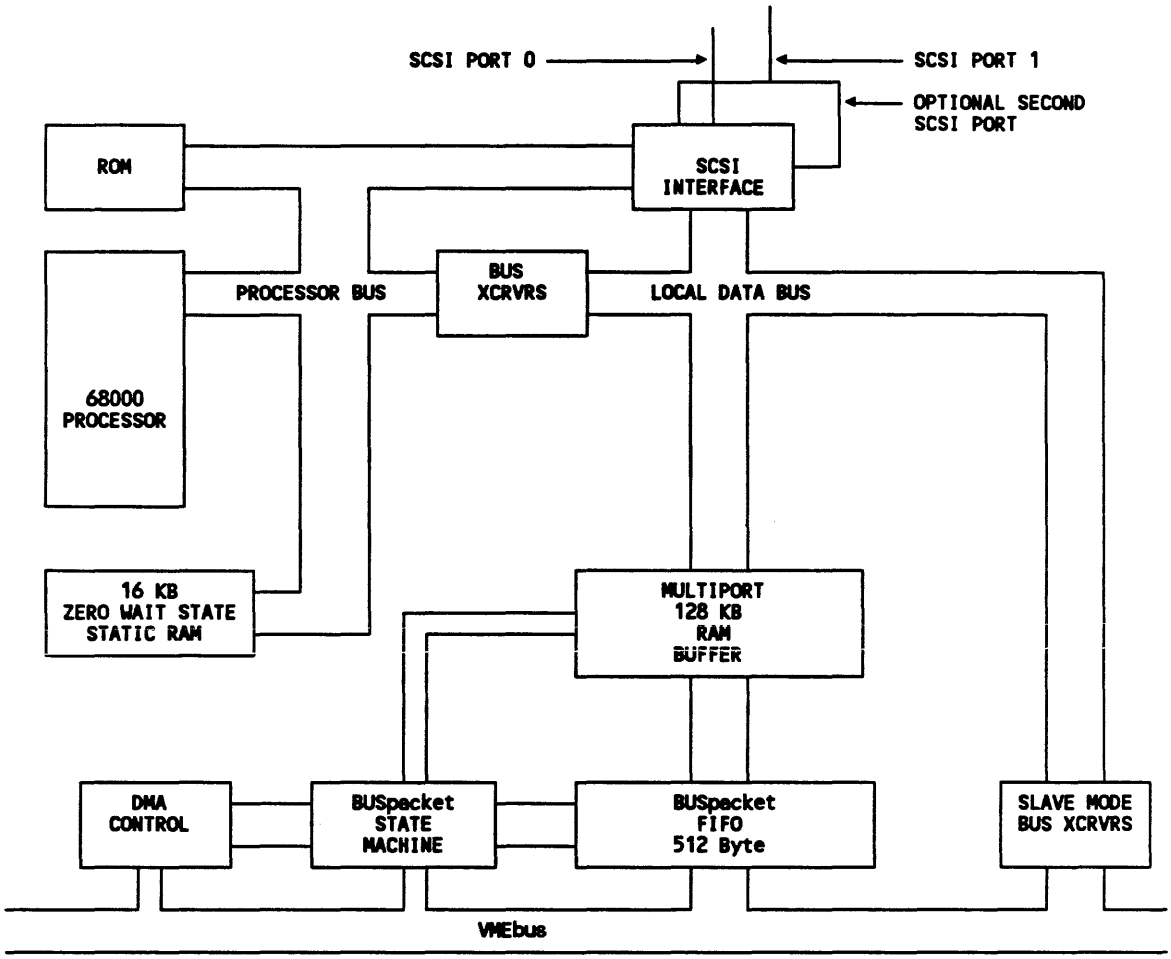


Figure 1-1. V/SCSI 4210 Jaguar Block Diagram

CHAPTER 2
INSTALLATION

OVERVIEW

Before attempting installation, read this chapter thoroughly to insure the safe installation of the Jaguar into your system. if you have any questions regarding installation which are not answered in this chapter, please contact Interphase Customer Service at (214) 919-9000.

The Jaguar is installed into the VMEbus system using the following steps:

- Visual Inspection
- Set Onboard Jumpers
- Set Onboard Switches
- Set SCSI Termination
- Power Off System
- Cabling Procedure

When installing the Jaguar, the following **WARNING** must be adhered to.

WARNING

1. Catastrophic DAMAGE can result if improper connections are made. Therefore, those planning to connect power sources to the VMEbus for the purpose of feeding the user-defined 96 pins of P2 (Rows A and C) should FIRST CHECK to ensure that all boards installed are compatible with those connections.

2. Do NOT install or apply power to a damaged board. Failure to observe this warning could result in extensive damage to the board and/or system.

3. Caution! The Jaguar is extremely sensitive to electrostatic discharge (ESD), and the board could be damaged if handled improperly. Interphase ships the board enclosed in a special anti-static bag. Upon receipt of the board, take the proper measures to eliminate board damage due to ESD (i.e., wear a wrist ground strap or other grounding device).

The installation procedure will vary depending on the desired configuration. Variables include:

- One or two SCSI ports (7 SCSI devices per port).
- Single-ended vs. differential SCSI operation for each port.
- Use of P4 connector to interface with a printer.
- Front panel I/O vs. routing SCSI signals off the P2 connector (to determine the location of the connectors, refer to figures 2-1 & 2-2).

The following table summarizes the V/SCSI 4210 products that are available from Interphase to implement various combinations of the above functions.

Table 2-1. V/SCSI 4210 Products

PRODUCT	DESCRIPTION
Single-ended V/SCSI 4210 Jaguar Motherboard (Full P2 connector)	Provides one single-ended SCSI port whose signals can be routed off either P3 or P2. This board uses rows A, B, and C of the P2 connector.
Single-ended V/SCSI 4210 Jaguar Motherboard (Row B connector)	Provides one single-ended SCSI port whose signals can be routed off P3. This board only uses row B of the P2 connector.
Differential V/SCSI 4210 Jaguar Motherboard (Full P2 Connector)	Has one differential SCSI port whose signals can be routed off either P3 or P2. It uses rows A, B, and C of the P2 connector.
Differential V/SCSI 4210 Jaguar Motherboard (Row B Connector)	Has one differential SCSI port whose signals can be routed off P3. It only uses row B of the P2 connector.
Single-ended V/SCSI 4210 Daughter Card	Adds one single-ended SCSI port to any of the above motherboards. The signals from this port may be routed off either P4 or P2 if the card is installed on a motherboard with full P2 I/O. If the card is installed on a motherboard that uses P2 Row B only, its signals can only be routed off P4.
Differential V/SCSI 4210 Daughter Card	Adds one differential SCSI port to any of the above motherboards. If installed on a single-ended motherboard with full P2 I/O, this card's signals can be routed off either P4 or P2. However, if it is installed on any differential motherboard (full P2 or row B only), its signals can only be routed off P4. (This is because there are an insufficient number of pins available on P2 to accommodate two differential SCSI ports.)
V/SCSI 4210 Printer Port Daughter Cards	Adds one printer port to any of the above motherboards. One variation of this card supports Centronics ™ and Dataproducts ●Short Line printers. The other supports Dataproducts ●Long Line printers. The signals from this port can only be routed off P4.
V/SCSI 4210 P2 Adapter Card	Routes SCSI signals off the P2 connector (plugs into the VMEbus backplane)

NOTES:

None of the drivers on the above products are convertible. That is, a board with single-ended SCSI drivers cannot be converted to differential, and vice versa. However, a single-ended motherboard can have a differential daughter card, and a differential motherboard can have a single-ended daughter card.

As noted previously, the SCSI port provided by the motherboard is referred to as **Port 0** or the **primary SCSI bus**. The port provided by a SCSI daughter card (if installed) is called the **Port 1** or the **secondary SCSI bus**.

By referring to the above table, you should be able to determine the different I/O configurations allowed for your setup. For example, assume that you have a single-ended motherboard (full P2 I/O) that has a single-ended daughter card installed. This setup provides two single-ended SCSI ports. Signals from these ports can be routed off P3 and P4 for front panel I/O. Or, if desired, one or both ports could be routed off P2. To determine the location of the connectors, refer to the figure on page 2-4 or 2-5.

As another example, assume that you have purchased a differential motherboard (full P2 I/O) that has a printer port daughter card installed. You may route signals for the differential SCSI port off either P3 or P2. The printer must be connected to P4.

If you plan to route SCSI signals off the P2 connector, you may wish to refer to the discussion on pages 2-19 & 2-20 before proceeding with the installation.

VARIATIONS IN BOARD LAYOUT

From an installation standpoint, there are three basic variations in the layout of the Jaguar motherboard. These versions differ in both the number and placement of jumpers and switches on the boards.

To determine which version of the board you have, examine the 12-character artwork code printed on edge of the solder side of the motherboard. The artwork code has the following format: PB-*xxxx-xxx-xxx*, where '*x*' is an alphanumeric character.

- If the code is PB-0770-*xxx-xxx* or PB-0910-*xxx*-XOA, then your board has the layout shown in the figure on page 2-4.

- If the code is PB-0773-*xxx-xxx*, then your board has the layout shown on page 2-5.

The drawings on the next three pages depict the three board layouts. These layouts provide information that you will need in order to install your board, including the location of the jumpers, switch blocks, cable connectors, and daughter card (if installed).

The figure on page 2-7 depicts three of the four Jaguar daughter cards - single-ended, differential, and Centronics/Dataproducts Short Line printer port. (The fourth daughter card, which provides a printer port for Dataproducts Long Line printers, does not have any settings that can be changed.)

(Artwork versions PB-0770-xxx-xxx and PB-0910-xxx-XOA)

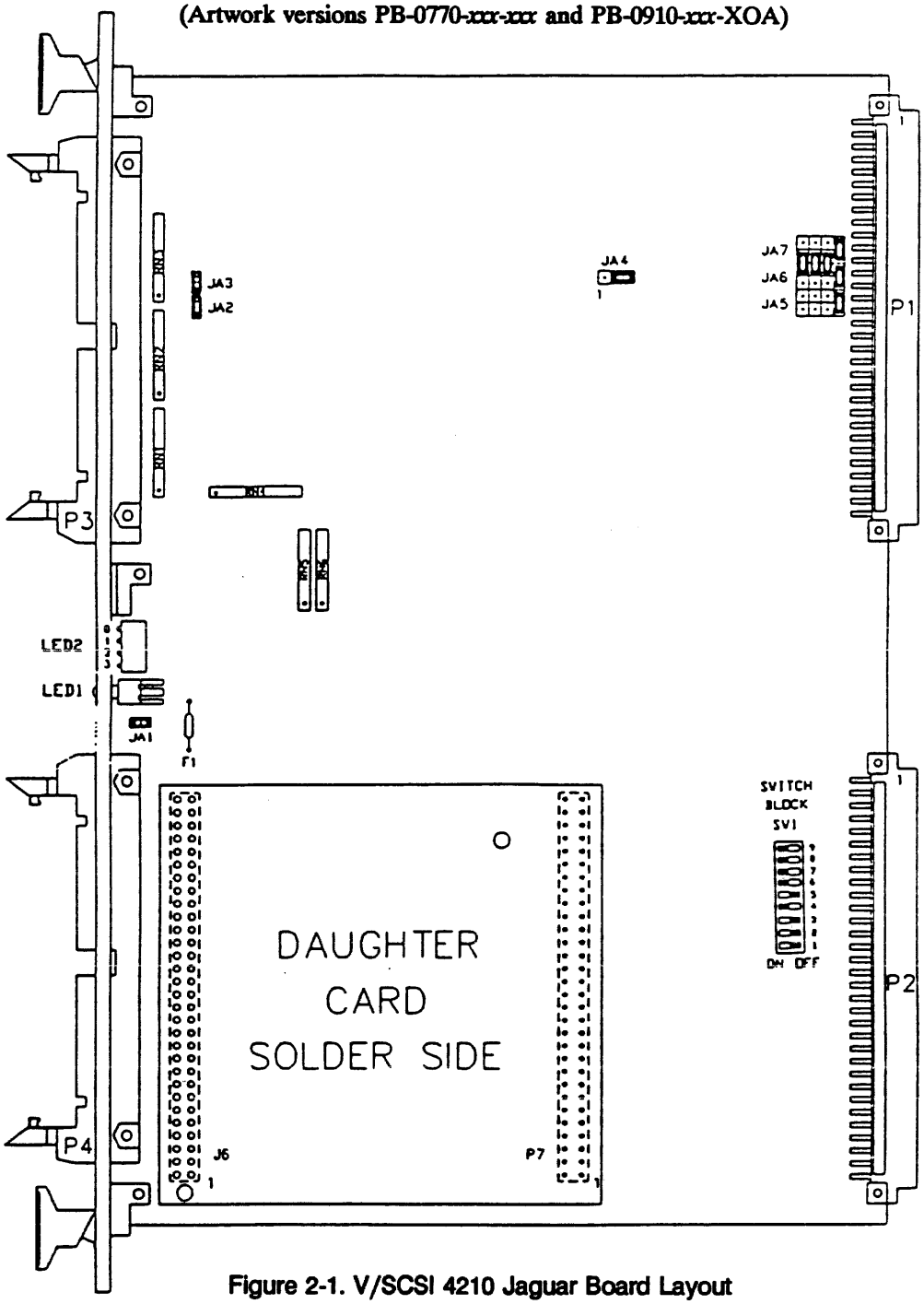


Figure 2-1. V/SCSI 4210 Jaguar Board Layout

NOTES: The above drawing depicts typical jumper and switch settings. Please note that the settings on your board may be different from those shown above.

On boards with PB-0910-xxx-XOA artwork, the fuse (F1) is horizontal, not vertical as shown above. However, it is located in the same area of the board.

The actual PCB locator for "Switch Block SW1" is UN3 on boards with PB-0770-xxx-xxx artwork and UR5 on boards with PB-0910-xxx-XOA artwork. This switch block is referred to as Switch Block SW1 throughout this chapter to simplify the discussion of the switch settings.

(Artwork version PB-0773-xxx-xxx)

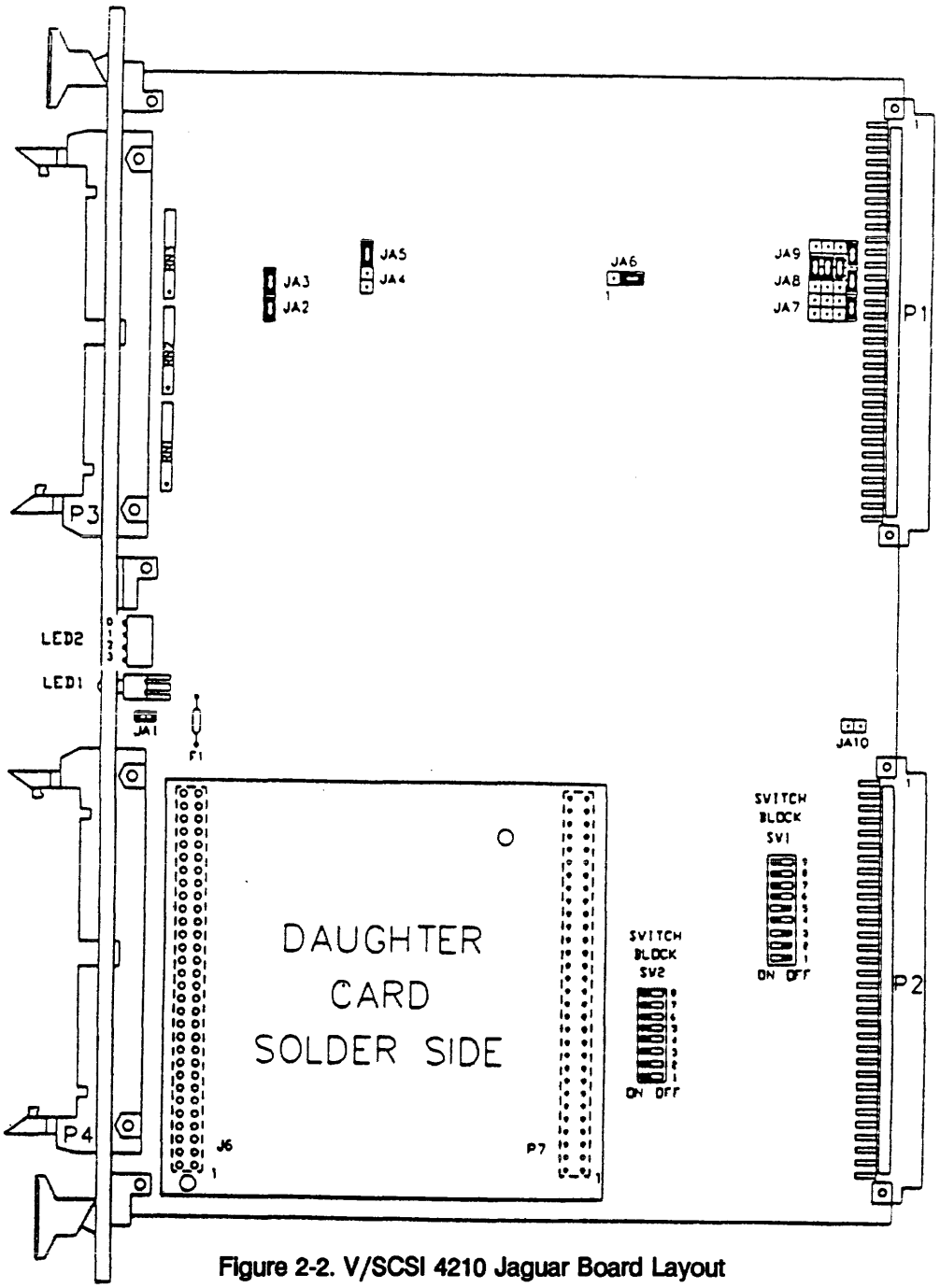


Figure 2-2. V/SCSI 4210 Jaguar Board Layout

NOTES: The above drawing depicts typical jumper and switch settings. Please note that the settings on your board may be different from those shown above.

The actual PCB locator for "Switch Block SW1" on boards with PB-0773-xxx-xxx artwork is UN3. The actual locator for "Switch Block SW2" is UK2. These switch blocks are referred to as Switch Blocks SW1 and SW2 throughout this chapter to simplify the discussion of the switch settings.

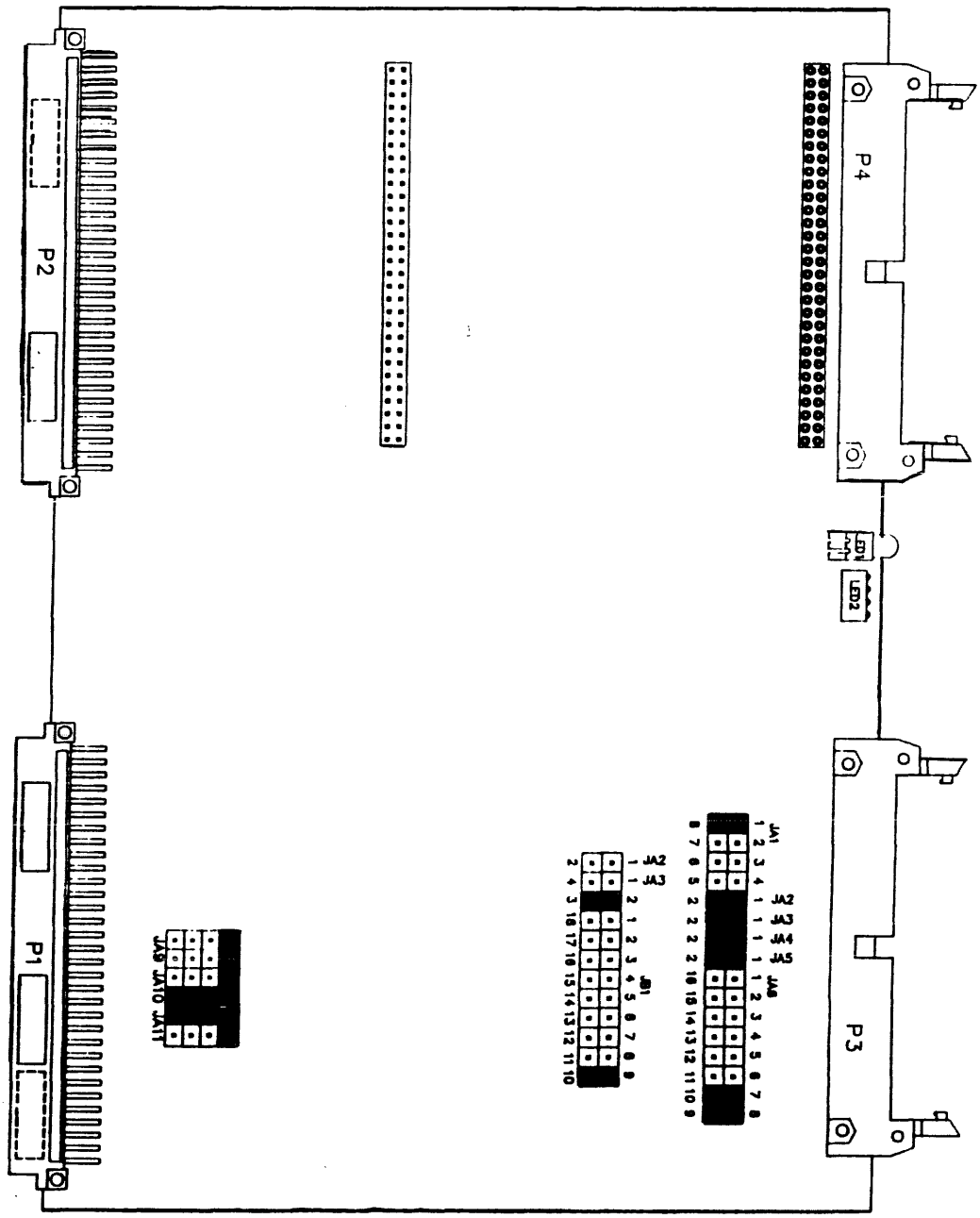
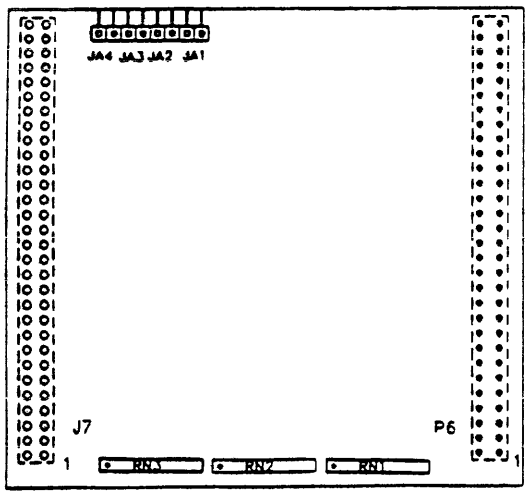
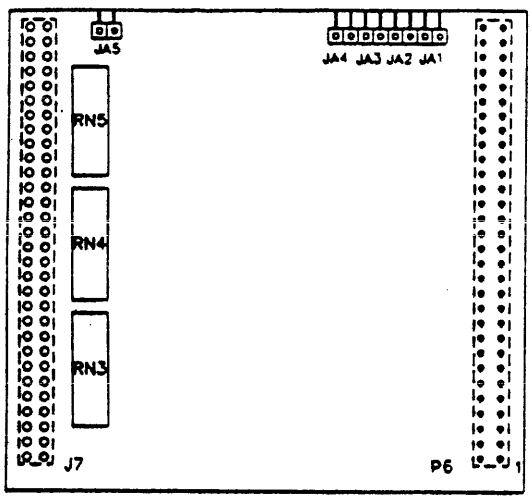


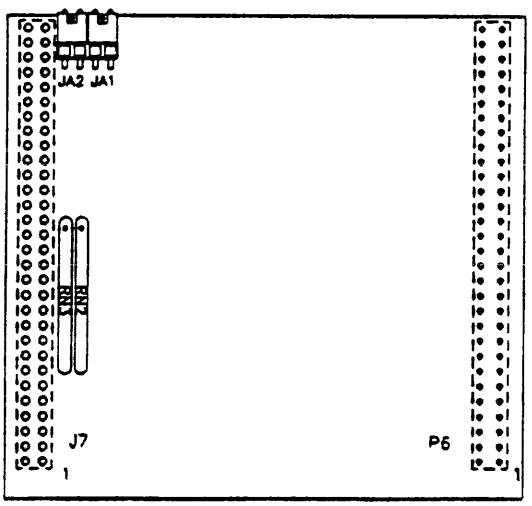
Figure 2-3. V/SCSI 4210 SMT Jaguar Board Layout



SINGLE-ENDED
DAUGHTER CARD



DIFFERENTIAL
DAUGHTER CARD



CENTRONICS/DATAPRODUCTS
SHORT LINE DAUGHTER CARD

NOTE: The Dataproducts Long Line daughter card does not have any jumpers or terminating resistors that the user should change. Therefore, it is not shown on this page.

Figure 2-4. V/SCSI 4210 Jaguar Daughter Cards

INSTALLATION PROCEDURE

For proper installation, it is imperative that you follow the steps below:

STEP 1. VISUAL INSPECTION

Before attempting the installation of this board, make sure you are wearing an anti-static or grounding device. Remove the Jaguar board from the anti-static bag, and visually inspect it to ensure no damage has occurred during shipment. A visual inspection usually is sufficient, since each board is thoroughly checked at Interphase just prior to shipment.

If the board is undamaged and all parts are accounted for, proceed with the installation.

STEP 2. SET ONBOARD JUMPERS

Set all onboard jumpers so that the Jaguar is properly configured for operation within your system. The board layouts on pages 2-4 - 2-6 show the location of the jumpers. To determine which board layout you have, please refer to the discussion "Variations in Board Layout" (page 2-4).

MOTHERBOARD JUMPER SETTINGS

TERMINATOR POWER TO PRIMARY SCSI BUS

On all Jaguar board layouts, **JA1** is used to connect terminator power to the primary SCSI bus. Placing a jumper in JA1 connects the power. The Jaguar is shipped with a jumper installed in JA1 (factory default setting).

OSCILLATOR TEST JUMPERS

The jumpers used for oscillator testability differ from one board layout to another. **In all cases, however, they should be left in their factory default settings.** The jumpers are as follows:

- On the PB-0770-*xxx*-*xxx* and PB-910-*xxx*-XOA board layout, **JA2** and **JA3** are oscillator test jumpers. **Both must be left in their factory default settings (jumpers installed).**

- On the PB-0773-*xxx*-*xxx* board layout, **JA2**, **JA3**, **JA4**, and **JA5** are oscillator test jumpers. **All must be left in their factory default settings (jumpers installed in JA2, JA3, and JA5; no jumper in JA4).**

EPROM SIZE SELECTION

The jumper used for EPROM size also varies depending on the board layout. **In all cases, however, it should be left in its factory default setting.** The jumper used to set EPROM size on the various motherboards is as follows:

- On the PB-0770-*xxx*-*xxx* and PB-910-*xxx*-XOA board layout, **JA4** selects the EPROM size. Jumpering together 1↔2 selects a 27512 64K EPROM. Jumpering 2↔ together selects a 27256 32K EPROM. The factory default setting is 2↔3. **Do not change this setting.**

- On the PB-0773-xxx-xxx board layout, JA6 selects the EPROM size. Jumpering together 1↔2 selects a 27512 64K EPROM. Jumpering 2↔3 together selects a 27256 32K EPROM. The factory default setting is 2↔3. **Do not change this setting.**

VMEbus REQUEST LEVEL

The Jaguar's VMEbus request level can be set from 0 (lowest) to 3 (highest).

- On the PB-0770-xxx-xxx and PB-910-xxx-XOA board layouts, JA5, JA6, and JA7 are used to set the VMEbus request level. The factory default setting is for bus request level 3. To change this setting to a different level, refer to the jumper settings depicted below.

- On the PB-0773-xxx-xxx board layout, JA7, JA8, and JA9 are used to set the VMEbus request level. The factory default setting is for bus request level 3. This can be changed. To do so, refer to the jumper settings shown below.

NOTE

If you are installing the Jaguar in a Sun system, the Bus Request level must be left in its default setting (level 3).

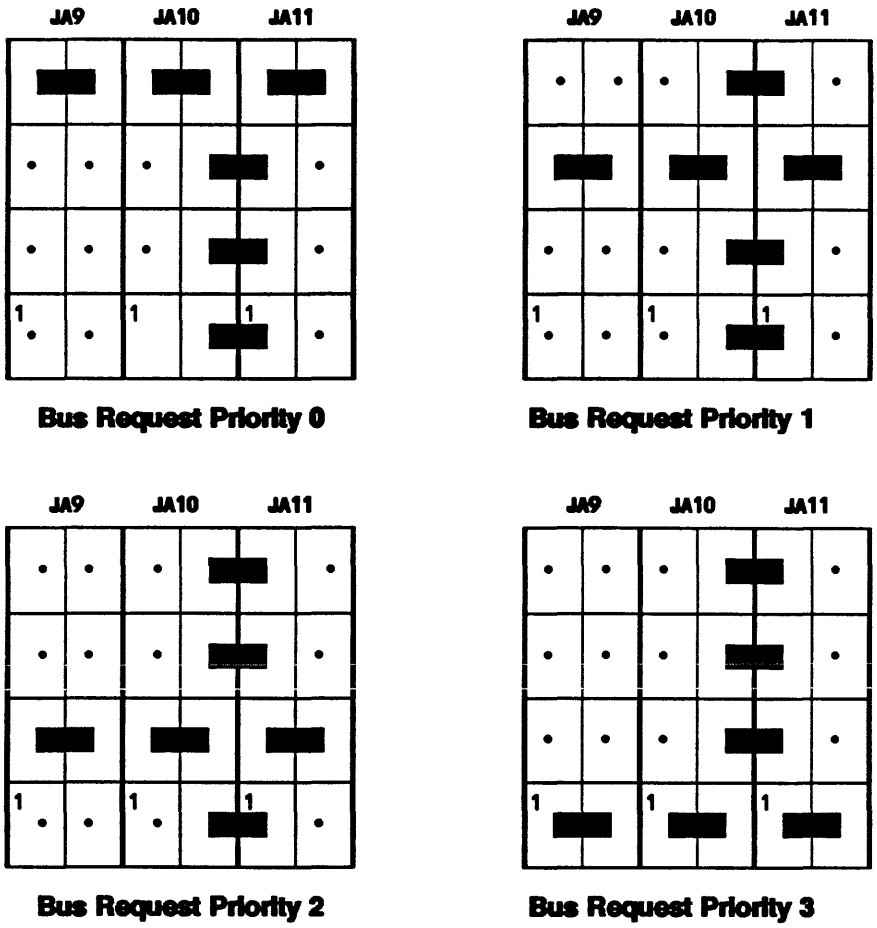


Figure 2-5. VMEbus Request Priority Jumper Settings (Motherboard)

EARLY RELEASE OF VMEbus BBSY*

This feature is only provided on the PB-0773-*xxx*-*xxx* board layout. The **JA10** jumper block determines whether the Jaguar will use standard or early release VMEbus arbitration when it is the bus master. If the jumper is set for standard release (jumper IN), the VMEbus signal BBSY* is released **after** the last cycle is completely finished. If the jumper is set for early release (jumper OUT), BBSY* is released **at the start** of the last cycle to allow for rearbitration during the last cycle.

The -0773 is shipped with no jumper in JA10. This factory default setting selects early release of BBSY*. Placing a jumper in JA10 selects standard release of BBSY*.

NOTE

Jaguars with the PB-0770-xxx-xxx and PB-0910-xxx-XOA board layout provide standard release of BBSY*. (The feature is not jumper-selectable on these boards.)

DAUGHTER CARD JUMPER SETTINGS

If your setup includes a daughter card, it may also be necessary to set some jumpers on the card. To determine the location of the jumpers, refer to the figure on page 2-6. Note that the Dataproducts Long Line Daughter Card does not appear in the figure, since it does not have any settings that can be changed.

For clarity, the daughter card jumpers are grouped according to the type of daughter card, instead of the jumper function.

JUMPERS USED ON SINGLE-ENDED AND DIFFERENTIAL SCSI DAUGHTER CARDS

On both the single-ended and differential daughter cards, **JA1**, **JA2**, and **JA3** are used to set the SCSI Bus ID of Port 1. JA3 is the most significant bit of the address and JA1 is the least significant bit. The factory default setting is SCSI Address 0.

Placing a jumper in JA1, JA2, or JA3 selects a "1" (ON) for that bit. Leaving a jumper out selects a "0" (OFF) for that bit. The following table shows the possible combinations:

Table 2-2. Setting SCSI Bus ID Of Port 1

SCSI ID	JA3	JA2	JA1
0	OFF	OFF	OFF
1	OFF	OFF	ON
2	OFF	ON	OFF
3	OFF	ON	ON
4	ON	OFF	OFF
5	ON	OFF	ON
6	ON	ON	OFF
7	ON	ON	ON

NOTE

The secondary SCSI bus ID is also specified in the Controller Initialization Block. See "Secondary SCSI Bus ID" for details.
The secondary SCSI bus ID in the Controller Initialization Block can optionally override the jumper-specified SCSI bus ID.

Both the single-ended and differential daughter cards have a jumper used to connect Port 1 to SCSI terminator power. This jumper is **JA4** on the single-ended daughter card and **JA5** on the differential daughter card. Installing a jumper connects the port to the terminator power. Both daughter cards are shipped with terminator power enabled for Port 1 (jumper installed).

The differential daughter card uses **JA4** for testing the oscillator. This jumper should be left in its factory default setting (jumper installed).

JUMPERS USED ON CENTRONICS/DATAPRODUCTS SHORT LINE DAUGHTER CARD

The printer port that supports Centronics and Dataproducts Short Line printers has two jumpers, **JA1** and **JA2**. Jumper **JA1** is used to select the type of printer desired. The card is shipped with a jumper installed in JA1. This configures the card for use with a Centronics printer. To configure the port for use with a Dataproducts Short Line printer, remove the jumper from JA1. **NOTE:** For details on terminating the daughter card correctly for your printer, refer to p. 2-11.

JA2 is used for testing the oscillator and should be left in its default setting (jumper installed).

JUMPER USED ON DATAPRODUCTS LONG LINE DAUGHTER CARD

The printer port that supports Dataproducts Long Line printers has one jumper, **JA1**. It is used for testing the oscillator and should be left in its default setting (jumper installed).

JUMPERS AND SETTINGS USED ON SURFACE MOUNT JAGUAR

Refer to figure 2-6 for the location of jumpers contained on the 4210 Surface Mount (SMT) Jaguar.

JUMPERS:

JA1	1-8	F	12MHz CPU
		0*	16.666 MHz CPU
	2-7	F*	SSPEED0
	3-6	F*	SSPEED1
	4-5	F*	SSPEED2

Table 2-3. Oscillator 2 And JA1 Frequencies

FREQUENCIES	2-7	3-6	4-5
28.302	0	F	0
24.000	F	F	F

JA2	1-2	F	12MHz CPU and 4MB/s SCSI
		0*	Other combinations
JA3	1-2	0*	Terminator power on
		F	No power to terminator
JA4	1-2	0*	Late release
		F	Early release
JA5	1-2	F*	Software switch, reserved
JA6	1-16	F*	Software switch, reserved
	2-15	F*	Software switch, reserved
	3-14	F*	Software switch, reserved
	4-13	F*	Software switch, reserved
	5-12	F*	Software switch, reserved
	6-11	F*	Software switch, reserved
	7-10	0*	DISABLE Extended Power up diagnostic
		F	ENABLE Extended diagnostic on power up
	8-9	0*	SCSI Reset on power up
		F	Disable SCSI Reset on power up
JA7	1-2	0	Noisy DTACK
		F*	No noise =on DTACK
JA8	1-4	F	Address 16 for 27512
	2-3	0*	5V to pin 1 of eproms for 27256
JA9	1-8	F*	Bus Request 0
	2-7	F*	Bus Request 1
	3-6	F*	Bus Request 2
	4-5	0*	Bus Request 3

JA10	1-8	F*	Bus grant out 0
	2-7	F*	BG01
	3-6	F*	BG02
	4-5	0*	BG03
JA11	1-8	F*	Bus grant in 0
	2-7	F*	BG11
	3-6	F*	BG12
	4-5	0*	BG13
JA10-8	J11-1	0*	BG daisy chain
JA10-7	J11-2	0*	BG daisy chain
JA10-6	J11-3	0*	BG daisy chain
JB1	1-18	F*	SW3 SCSI ID 0
	2-17	F*	SW2 SCSI ID 0
	3-16	F*	Sw1 SCSI ID 0
	4-15	0	SW4 Short I/O address 7000
	5-14	F	SW5 addresses
	6-13	F	SW6 addresses
	7-12	F	SW7 addresses
	8-11	0	SW8 addresses
	9-10	0	SW9 Supervisor mode
		F*	User mode

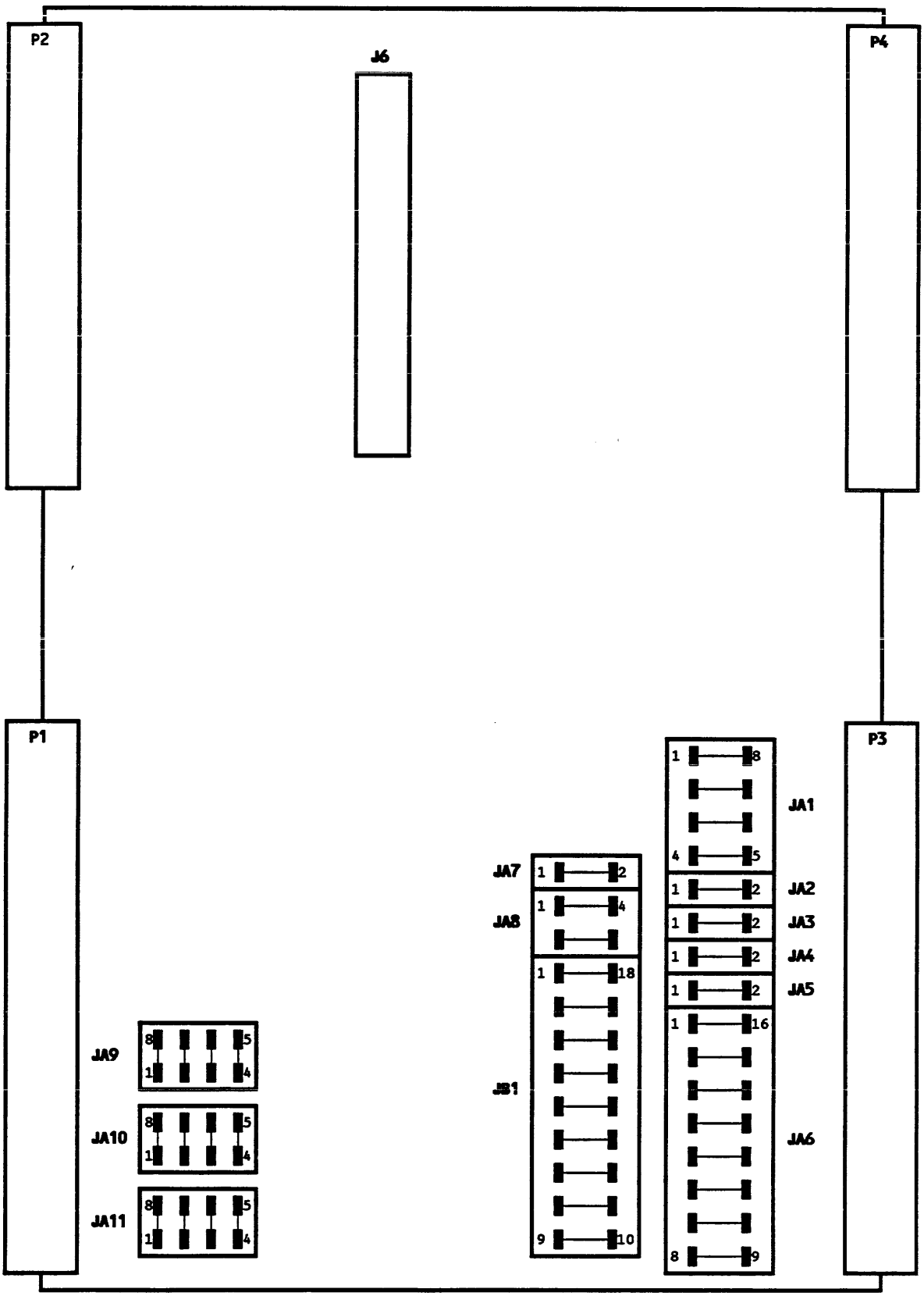
Lengend: 0: ON (Jumper In), F: Off (Jumper Out), * Denotes Default

NOTE

Current Daughter card is not compatible with this 4210 SMT in 16 MHZ mode. The above table applies to the PB4210-002-REVB only.

Table 2-4. Setting SCSI Bus ID of Port 0

SCSI ID	Jumper Settings (SMT)		
	JB1 (1-18)	JB1 (2-17)	JB1 (3-16)
0	OFF	OFF	OFF
1	ON	OFF	OFF
2	OFF	ON	OFF
3	ON	ON	OFF
4	OFF	OFF	ON
5	ON	OFF	ON
6	OFF	ON	ON
7	ON	ON	ON



THIS DRAWING APPLIES TO PB04210-002-REVB ONLY

Figure 2-6. 4210 SMT Jaguar Default Jumper Settings And Locations

STEP 3. SET ONBOARD SWITCHES

THRU-HOLE AVAILABLE SWITCH OPTIONS

The Jaguar motherboard has either one or two switch blocks, depending on which version of the board you have. All Jaguar motherboards have a switch block (referred to in this chapter as "Switch Block SW1") that allows you to set the following parameters:

- Base address of the Jaguar's 2 Kbyte short I/O RAM
- Allowed VMEbus address modifiers
- SCSI bus ID of Port 0

Switch Block SW1 is the only switch block on boards with the layout shown on page 2-4 (artwork codes PB-0770-*xxx*-*xxx* and PB-910-*xxx*-XOA).

Boards with -773 artwork have an additional switch block (referred to in this chapter as "Switch Block SW2") that allows you to specify whether or not the Jaguar will:

- Reset the SCSI bus upon power-up or reset
  Remove SYSFAIL* immediately after coming out of reset *or* perform extended power-up diagnostics before removing SYSFAIL*

NOTE

Jaguars with the PB-0770-xxx-xxx and PB-0910-xxx-XOA board layouts will reset the SCSI bus on power-up. They do not support extended diagnostics. For a discussion of how these boards handle SYSFAIL*, refer to the discussion in Chapter 3.

An "OFF" switch setting equals logic 1. An "ON" setting equals logic 0.

The following sections describe how to set the switches to meet the requirements of your specific installation.

SETTING BASE ADDRESS OF SHORT I/O SPACE RAM

Switches 4 - 8 of Switch Block SW1 are used to set the base address of the 2 Kbytes of short I/O space RAM on the Jaguar. All interaction between the host and the Jaguar takes place in this 2K space.

The switches correspond to VMEbus address lines A15-A11, respectively, as shown below:

Table 2-5. Switches Used For Short I/O Base Address

SWITCH #	ADDRESS BIT
SW1 - 4	A11
SW1 - 5	A12
SW1 - 6	A13
SW1 - 7	A14
SW1 - 8	A15

An OFF switch has a value of '1' and an ON switch has a value of '0'. To determine the ON vs. OFF setting of the switches, refer to the appropriate board layout on pages 2-4 & 2-5.

The short I/O base address must be a multiple of 0x800. The following table shows the switch settings for all possible base addresses.

Table 2-6. Base Address For Short I/O RAM

ADDRESS	SWITCH SETTINGS 8 7 6 5 4
0000	0 0 0 0 0
0800	0 0 0 0 F
1000	0 0 0 F 0
1800	0 0 0 F F
2000	0 0 F 0 0
2800	0 0 F 0 F
3000	0 0 F F 0
3800	0 0 F F F
4000	0 F 0 0 0
4800	0 F 0 0 F
5000	0 F 0 F 0
5800	0 F 0 F F
6000	0 F F 0 0
6800	0 F F 0 F
7000	0 F F F 0
7800	0 F F F F
8000	F 0 0 0 0
8800	F 0 0 0 F
9000	F 0 0 F 0
9800	F 0 0 F F
A000	F 0 F 0 0
A800	F 0 F 0 F
B000	F 0 F F 0
B800	F 0 F F F
C000	F F 0 0 0
C800	F F 0 0 F
D000	F F 0 F 0
D800	F F 0 F F
E000	F F F 0 0
E800	F F F 0 F
F000	F F F F 0
F800	F F F F F

NOTE

0 = ON /CLOSED
F = OFF / OPEN
SW Or Jumper-JB1

SETTING THRU-HOLE ADDRESS MODIFIERS ALLOWED IN SHORT I/O ADDRESS SPACE

Switch 9 in Switch Block SW1 is used to select the address modifiers that are permitted in the short I/O address space. If the switch is on, only short supervisor accesses are permitted (address modifier 0x2D only). If it is off, then both 0x2D and 0x29 address modifiers are allowed.

SETTING SCSI BUS ID Of Port 0

Switches 1 - 3 of Switch Block SW1 are used to set the SCSI Bus ID for the Jaguar's Port 0.

A switch in the ON or CLOSED position selects a '0' for that bit. A switch in the OFF or OPEN position selects a '1' for the bit. The following table shows the possible combinations:

Table 2-7. Setting SCSI Bus ID of Port 0

SCSI ID	Switch Settings (SW1)		
	1	2	3
0	ON	ON	ON
1	OFF	ON	ON
2	ON	OFF	ON
3	OFF	OFF	ON
4	ON	ON	OFF
5	OFF	ON	OFF
6	ON	OFF	OFF
7	OFF	OFF	OFF

NOTE

The primary SCSI bus ID is also specified in the Controller Initialization Block. See "Primary SCSI Bus ID", located in Chapter 5 for details. The primary SCSI bus ID in the Controller Initialization Block can optionally override the switch-specified SCSI bus ID.

SELECTING SCSI BUS RESET AFTER POWER-UP/RESET (PB-0773-*xxx*-*xxx* Board Layout Only)

When Switch 1 in Switch Block SW2 is set to the "ON" position, the Jaguar will reset the SCSI bus whenever the Jaguar is turned on or reset. Setting the switch to the "OFF" position disables this feature. This option may be useful in some multi-host adapter systems.

SELECTING REMOVAL OF SYSFAIL* AFTER RESET / ENABLING EXTENDED DIAGNOSTICS (PB-0773-*xxx*-*xxx* Board Layout Only)

When Switch 2 in Switch Block SW2 is set to the "ON" position, the Jaguar will remove the VMEbus SYSFAIL* signal immediately after coming out of reset. When it is set to "OFF", the Jaguar will execute a series of extended diagnostics before clearing SYSFAIL* Please allow 15 - 20 seconds for the extended diagnostics to complete.

STEP 4. SET TERMINATION

SCSI specifications require the bus to be terminated at both ends of the SCSI cable. No other termination is allowed. Otherwise, a bus impedance mismatch will occur.

The Jaguar's primary port (Port 0) and optional secondary SCSI port (Port 1) are each provided with separate terminating resistors. The following statement applies to either port: If the port is at either end of the SCSI cable, the port's terminating resistors should be left in place. If the port is not at the end of the cable, the termination should be removed.

Note that the optional printer port daughter card has different termination requirements than the SCSI daughter cards. These requirements are described in the subsection on daughter card termination, below.

TERMINATION ON MOTHERBOARD

All versions of the Jaguar motherboard are shipped with termination installed. On single-ended motherboards, these resistor SIPs are labelled RN1, RN2, and RN3. On differential motherboards, these resistor SIPs are labelled RN1, RN2, RN3, RN4, RN5, and RN6. To locate the resistors, refer the appropriate board layout on page 2-4 or 2-5. These resistors provide termination for Port 0. If Port 0 is not at one end of the SCSI cable, remove these resistors from the motherboard (i.e. remove RN1, RN2, and RN3 from a single-ended motherboard, or remove RN1 through RN6 from a differential motherboard).

TERMINATION ON DAUGHTER CARD

The termination on your daughter card (if you have one) depends on the card type. Refer to the figure on page 2-7 to determine the location of the terminating resistors. The different termination schemes are summarized below:

- Single-ended daughter card: Resistors RN1, RN2, and RN3 on the daughter card (*not* the motherboard) provide termination for the secondary SCSI bus (Port 1). If the Jaguar is not at one end of the SCSI cable, these resistor SIPs should be removed.

Differential daughter card: Resistors RN3, RN4, and RN5 on the daughter card provide termination for Port 1. If Port 1 is not at one end of the SCSI cable, these resistor SIPs should be removed.

- Dataproducts Long Line printer port: The terminators are set correctly for a Dataproducts Long Line printer and should not be changed.

- Dataproducts Short Line/Centronics printer port:

  For use with Dataproducts Short Line printer:
  - RN2 and RN3 should both be 390Ω

  For use with Centronics printer:
  - RN3 should be 470Ω
  - RN2 is not used (if RN2 is installed on the card, remove it)

NOTE

The Dataproducts Short Line/Centronics printer port is shipped with 390Ω resistors installed in RN2 and RN3.

STEP 5. POWER OFF SYSTEM

Once the board is configured, ensure that the host system and peripherals are turned OFF.

CAUTION

System power and peripheral power must be turned OFF before attempting to install the Jaguar. Failure to do so may result in severe damage to the board and/or system.

STEP 6. CABLING PROCEDURE

The cabling procedure depends on how you wish to configure the system. Your options are summarized below.

For a complete description of each of the cables mentioned below, please refer to Appendix B. The P2 Adapter is discussed in detail in the next section.

To implement:	Your cabling options are:
A single-ended SCSI bus using Port 0	For front panel I/O, connect a standard, single-ended SCSI cable to P3 (motherboard). For back panel I/O, connect the standard cable to the P4 connector on the P2 adapter.
A single-ended SCSI bus using Port 1	For front panel I/O, connect a standard, single-ended SCSI cable to P4 (motherboard). For back panel I/O, connect the standard cable to the P3 connector on the P2 adapter.
A differential SCSI bus using Port 0	For front panel I/O, connect a standard, differential SCSI cable to P3 (motherboard). For back panel I/O, connect the standard cable to the P3 connector on the P2 adapter.
A differential SCSI bus using Port 1	For front panel I/O, connect a standard, differential SCSI cable to P4 (motherboard). For back panel I/O, connect the standard cable to the P4 connector on the P2 adapter. **NOTE:** As noted previously, if you have a differential daughter card installed on a differential motherboard, the daughter card's signals must be routed off P4. (There are not enough pins available on P2 for two differential ports.)
A printer port	Connect the printer to P4 (motherboard) using the appropriate cable (Centronics, Dataproducts Short Line, or Dataproducts Long Line).

P2 ADAPTER CARD

In order to route SCSI signals off the P2 connector, you will need an Interphase Jaguar P2 Adapter (part no. PB-0870-000-000). The card allows you to route one or both SCSI ports off the backplane. However, as noted above, only one differential SCSI port can be routed off P2, due to the limited number of pins on P2.

The P2 Adapter Card is depicted below:

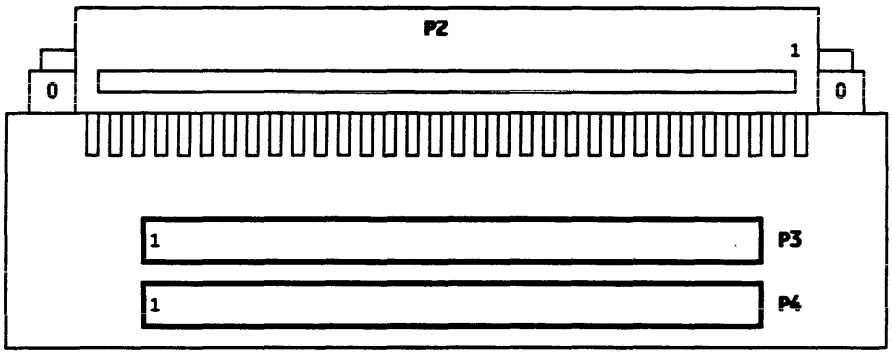


Figure 2-7. Jaguar P2 Adapter

VMEbus P1 AND P2 CONNECTOR CONFIGURATIONS

All versions of the Jaguar have the same VMEbus P1 connector configuration. Certain versions of the Jaguar only utilize row B of the P2 connector, while others use all three rows on P2.

INSTALLING THE CABLE(s) AND BOARD

1. Ensure that you have the correct cables for your configuration. (Refer to "Cabling Procedure", above, and Appendix B.)

2. Make sure that the system and all peripherals are turned OFF.

3. For Front Panel I/O, connect the cable for Port 0 to P3 and the cable for Port 1 (if used) to P4. If you are using the printer port, your printer must be connected to the Jaguar via P4.

   For P2 I/O, plug the P2 Adapter into the VMEbus backplane, on the side *opposite from* the connector into which the Jaguar's P2 connector will be installed. The adapter is keyed to prevent it from being plugged in incorrectly.

   Connect the cable(s) to the adapter as follows:

Type Of Port:	**Plug SCSI Cable Into This Connector On The P2 Adapter:**
Single-ended motherboard, Port 0	P4
Single-ended motherboard, Port 1	P3
Differential motherboard, Port 0	P3
Differential motherboard, Port 1	P4*

   * As noted previously, if you have a Jaguar with two differential SCSI ports, Port 1 must be routed through the front panel.

4. Carefully slide the Jaguar into the VMEbus card slot. It should slide all the way in without any difficulty. If it doesn't, pull it out and check to make sure that there are no cables in the way.

5. Once the board is properly seated in the slot, tighten the captive mounting screws on each end of the board.

6. Connect the SCSI devices to the SCSI cable(s), following the directions given by the device manufacturers. Connect the printer (if printer port is installed) to the printer cable.

CHAPTER 3
JAGUAR SYSTEM INTERFACE

OVERVIEW

The host communicates with the Jaguar through 2048 bytes of short I/O space located on the Jaguar. This memory is mapped into the short I/O space of the VMEbus. Every location can be both written to and read from, physically, by the host at any time, but the protocol of the Jaguar MACSI System Interface puts some restrictions upon when certain areas should be accessed. Also, some areas are logically write only or read only. MACSI partitions this RAM into six major sections:

- Master Control/Status Block (MCSB)
- Master Command Entry (MCE)
- Command Queue (CQ)
- Host Usable Space (HUS)
- Command Response Block (CRB)
- Controller Specific Space (CSS)

The **Master Control/Status Block** is used to pass and receive information relative to the overall operation of the Jaguar. The Master Control/Status Block is 16 bytes long.

The **Master Command Entry** is used to issue commands to the Jaguar before the Command Queue and work queues have been initialized. Typically, it will be used only when initializing the Command Queue and work queues. It does, however, provide a mechanism to issue a command to the Jaguar even if the Command Queue and all work queues are full. The single slot of the MCE has the same 12-byte format as any other Command Queue entry. Space must be reserved in the Host Usable Space (HUS) portion of the short I/O space for the IOPB that is pointed to by the MCE.

The **Command Queue** consists of a user-programed number of Command Queue entries. Each Command Queue entry includes all of the information that is needed for the Jaguar to find, execute, and respond to the commands contained in an IOPB. The Command Queue is circular, and it is up to the host to keep track of the next Command Queue entry that it can use. Because the queue is circular, the Jaguar infers chronological ordering of commands. Each Command Queue entry is "busy" only until the Jaguar can transfer the command to a work queue and then free its slot in the Command Queue. The number of entries in the Command Queue is programmed via the Initialize Controller command. The actual size of the Command Queue equals the number of entries times 12 bytes.

The **Host Usable Space** is free-form memory space accessible to both the host and the controller. It is typically used for IOPBs. However, for multiprocessing applications, this is a convenient place for semaphores between CPUs. The amount of HUS available is determined by the number of Command Queue entries defined when the Command Queue is initialized and by the length of the Command Response Block. For example, if the Command Queue is initialized with 10 entries and the Command Response Block of 76 bytes is defined, there will be 1704 bytes of HUS available. The Master Control/Status Block, Master Command Entry, and the Controller Specific Space always occupy a total of 148 bytes.

The **Command Response Block** is used by the Jaguar to post command completion status. The IOPB itself and related status information are returned to the Command Response Block. In addition, if enabled to do so, the Jaguar uses the CRB to signal that space has become available in the Command Queue to accept new entries. The offset of the Command Response Block is defined during initialization.

The Controller Specific Space is a 120-byte space used by the Jaguar to post the **Configuration Status Block**. The Jaguar uses the Configuration Status Block to report the firmware revision level, information on product number and variations, available buffer space and the SCSI bus IDs that it is using.

Offset From Short I/O Base Address	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
+0x0 To +0xF	Master Control/Status Block															
+0x10 To +0x1B	Master Command Entry															
+0x1C To +0x93	Command Queue															
+0x94 To +0x73B	Host Usable Space															
+0x73C To +0x787	Command Response Block															
+0x788 To +0x7FF	Configuration Status Block															

NOTE:

The above memory map is for a Jaguar that has been initialized with a 10-entry Command Queue and a maximum IOPB length of 64 bytes.

Figure 3-1. Typical Memory Map Of Jaguar Short I/O Space

MASTER CONTROL/STATUS BLOCK (MCSB)

The Master Control/Status Block (MCSB) consists of the Master Status Register (MSR), the Master Control Register (MCR), the Interrupt on Queue Available Register (IQAR), and the Queue Head Pointer (QHP).

Word #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	MASTER STATUS REGISTER															
0x1	MASTER CONTROL REGISTER															
0x2	INTERRUPT ON QUEUE AVAILABLE REGISTER															
0x3	QUEUE HEAD POINTER															
0x4	THAW WORK QUEUE REGISTER															
0x5 To 0x7	RESERVED															

Figure 3-2. Master Control/Status Block (MCSB)

MASTER STATUS REGISTER (MSR)

The Jaguar uses this register to report board level status. From the host point of reference, this is a READ ONLY register. However, the contents of this register are not valid for 100 microseconds following a controller reset. The bits are defined as follows:

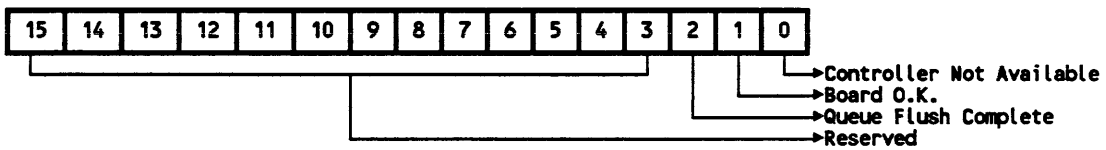


Figure 3-3. Master Status Register (MSR)

Bit 0 Controller Not Available (CNA):

The Jaguar sets this bit to '1' to indicate that it is Not Available to receive a command. This condition can be caused either by a controller reset or by the execution of controller diagnostics. CNA will also be set if a board initialization command fails to complete (see Initialize Controller Command). The Jaguar will clear this bit when it is capable of accepting a command.

Bit 1 Board O.K. (BOK):

The Jaguar sets this bit to '1' when the power-up diagnostics are completed successfully. A '0' indicates that the Jaguar detected a failure during the power-up diagnostics or during a board initialize command.

The host can start polling the Board OK bit 100 microseconds after the board has been powered-up or reset. However, you should allow 5 seconds for normal power-up diagnostics to complete. Or, if extended power-up diagnostics are enabled (see Chapter 2), allow at least 20 seconds for these tests to complete.

Table 3-1. Board OK/Controller Not Available Relationship

BOK	CNA	DESCRIPTION
0	0	The controller has failed to operate and is not capable of accepting a command.
0	1	Controller is Not Available. If the controller is not still executing power-up diagnostics, then it has either failed to execute power-up correctly or it has failed to complete a board initialize command.
1	1	The controller has successfully completed power-up diagnostics but it is not capable of accepting a command, because it is executing the diagnostics command.
1	0	The controller has completed diagnostics and is capable of receiving commands.

Bit 2 Queue Flush Complete (QFC):

The QFC bit is set to 1 by the Jaguar after it performs a flush queue operation. It is cleared by the Jaguar after the Flush Queue bit in the Master Control Register is cleared by the host (see MCR bit descriptions under Master Control Register for more detail).

Bits 3–15 Reserved (RSRV):

These bits are reserved and are cleared to 0 by the Jaguar.

MASTER CONTROL REGISTER (MCR)

All bits in this register are both set and reset by the host. From the Jaguar's point of reference, this is a READ ONLY register. The Jaguar will never set any of these bits. The bits are defined as follows:

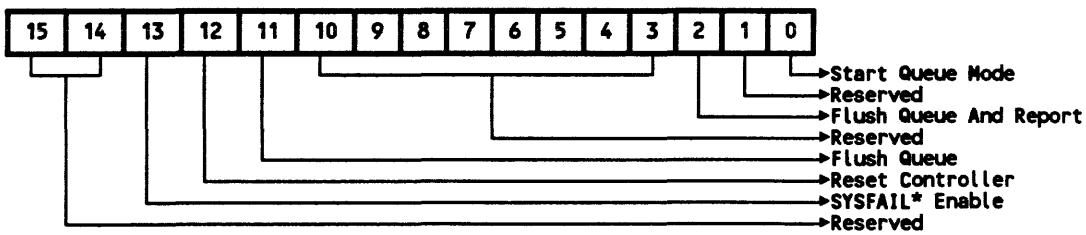


Figure 3-4. Master Control Register (MCR)

Bit 0 Start Queue Mode (SQM):

Until the Command Queue and work queues are initialized, all commands to the Jaguar must be issued to Work Queue 0 through the Master Command Entry. Once the Command Queue and work queues have been initialized, the host starts Queued IOPB operation by setting this bit to '1'. The host sets this bit only after it has initialized both the Command Queue and the work queues. This bit is set only once by the host and is never reset during normal operation. The Jaguar will acknowledge entering Queued IOPB mode by setting the Queue Mode Started bit in the Command Response Status Word to '1' (see Command Response Status Word). No interrupt will be generated.

Bit 1 Reserved (RSRV):

This bit is reserved and must be cleared to 0 by the host.

Bit 2 Flush Queue and Report (FLQR):

The Flush Queue and Report bit causes the Jaguar to clear all In Progress commands and all queued commands from both the Command Queue and the work queues. Any In Progress (currently executing) command will execute normally.

As each command is cleared, a Command Complete Interrupt (with error completion status) is generated. At the completion of the entire Flush Queue and Report operation, a final Command Complete Interrupt is generated. This final Command Complete Interrupt uses the Controller Interrupt Vector. When this interrupt is generated, the Queue Flush Complete bit (QFC) will be set in the Master Status Register. The host should clear the Flush Queue and Report bit before clearing this last interrupt. The host must wait for this final Flush Queue and Report Command Complete Interrupt before entering any new commands, because the Jaguar will continue flushing commands until there are no further commands to flush. Thus, any command entered before the Flush Queue and Report Command Complete Interrupt will be flushed.

NOTE

The host may reset the SCSI bus by issuing a Reset SCSI Bus IOPB. Individual work queues are cleared using the Flush Work Queue command.

Bits 3–10 Reserved (RSRV):

These bits are reserved and must be cleared to 0 by the host.

Bit 11 Flush Queue (FLQ):

Flush Queue operates the same as Flush Queue and Report except that there is no report (Command Complete Interrupt) as each command is flushed. A Flush Queue generates only one Command Complete Interrupt at the completion of the entire operation. The Controller Interrupt Vector Register is used for the Command Complete Interrupt. The host must wait for the Flush Queue Command Complete Interrupt before entering new commands, because the Jaguar will continue flushing commands until there are no further commands.

Bit 12 Reset Controller (RES):

The Reset Controller bit controls the microprocessor hardware reset line. It also causes a RESET on both of the SCSI buses, if the SCSI reset feature is enabled. (The reset feature is available on boards with -0773 artwork. See the discussion of SW2 located in Chapter 2 for more information.)

Obviously, the Reset Controller bit should be used only to recover from extreme error conditions. **To ensure proper operation, the host must leave this bit set for at least 70 microseconds.**

Bit 13 SYSFAIL* Enable (SFEN):

The SYSFAIL* Enable bit enables the Jaguar to drive the SYSFAIL* signal on the VMEbus if it detects an internal failure during power-up diagnostics or if the firmware enters an unused exception vector. If this bit is '0', the Jaguar will not drive the SYSFAIL* signal under any circumstances. The Jaguar initializes this bit to '0' after power-up.

The Jaguar does not read the SYSFAIL* Enable bit until detecting an error in the power-up test. After detecting an error the firmware simply loops on setting the SYSFAIL* line to the level specified by the bit (provided that the Jaguar is sufficiently functional to have the bit cleared).

The host may turn off SYSFAIL* from the Jaguar by clearing this bit. The host may enable SYSFAIL* after the Jaguar has been released from reset. This operation is performed by firmware, and it is possible the Jaguar may clear the bit if it is set too soon after power-up. The host should therefore wait 20 seconds after resetting the Jaguar before enabling this bit.

NOTE

A Jaguar with the board layout shown on page 2-3 always drives SYSFAIL* at system reset. It also immediately clears SYSFAIL* after reset if it has been enabled to do so (i.e. Switch 2 on Switch Block SW2 is in the ON position).

The other version of the board does not have the configuration switch. It randomly either drives SYSFAIL* at reset or doesn't, and then clears SYSFAIL* immediately after reset.

Bits 14–15 Reserved (RSRV):

These bits are reserved and must be cleared to 0 by the host.

INTERRUPT ON QUEUE AVAILABLE REGISTER (IQAR)

As discussed previously, each Command Queue entry only occupies a slot in the Command Queue until it is moved into a work queue. Thus, the host will virtually always have slots available in the Command Queue for issuing commands. In the unlikely event that the Command Queue is full when the host attempts to enter a command, the host must wait until the Jaguar transfers a command from the Command Queue to an internal work queue before it can enter the next command.

The host determines that the Command Queue is full by looking at the Go/Busy bit in the next available Command Queue entry. The Command Queue is full if the Go/Busy bit of the next available Command Queue entry is '1'. If the Command Queue becomes full, the host could simply poll the Go bit, waiting until the next Command Queue entry becomes available. But the Jaguar, through the Interrupt on Queue Available Register, provides for efficient operation by optionally interrupting the host when a entry becomes available in the Command Queue. Thus, even in the unlikely case that the Command Queue is full when the host tries to enter a command, the host need not be concerned with any intimate timing issues of the Jaguar's Command Queue.

The IQAR feature is enabled by setting the Interrupt on Queue Entry Available (IQEA) bit in the register. If the Interrupt on Queue Half Empty Enable bit is also set, the Jaguar will not interrupt until the Command Queue is half empty. Otherwise, the interrupt will occur as soon as the Jaguar detects one empty entry in the Command Queue. The host should wait until encountering the Queue Full condition before setting the IQEA bit. Once the IQEA bit is set, the Jaguar generates an interrupt as soon as the necessary queue conditions are satisfied. Once the interrupt is generated, the Jaguar resets the IQEA bit.

The level and vector for the IQEA interrupt are supplied by the host in the IQAR. When the necessary queue conditions are satisfied, the Jaguar clears the IQEA bit and generates a Command Complete Interrupt with the Queue Entry Available (CQA) bit set in the Command Response Status Word (CRSW) of the Command Response Block (CRB) (see Command Response Status Word). Even though the Jaguar provides for efficient operation by providing this mechanism for interrupting the host when space becomes available in the Command Queue, it is preferable to set up a large enough Command Queue so that the full condition occurs infrequently. The number of entries in the Command Queue is set in the Controller Initialization Block (see Initialize Controller Command).

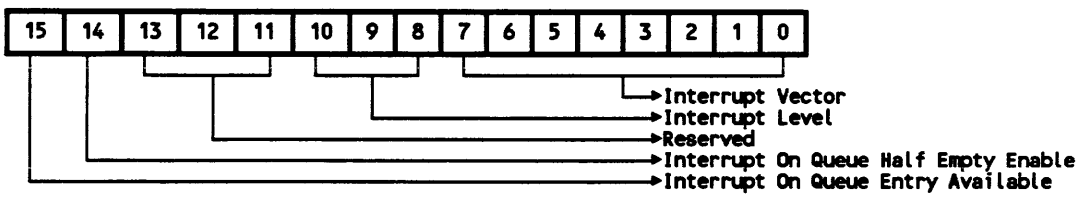


Figure 3-5. Interrupt On Queue Available Register (IQAR)

Bits 0–7 Interrupt Vector for the Interrupt on Queue Available (IV):

The Jaguar uses this byte as the interrupt vector when issuing an Interrupt on Queue Available interrupt. This byte is set by the host and is not modified by the Jaguar. The host must not modify this byte after setting the IQEA bit.

Bits 8–10 Interrupt Level for the Interrupt on Queue Available (IL):

These three bits determine the interrupt level that the Jaguar will use when issuing an Interrupt on Queue Available interrupt. These bits are set by the host and are not modified by the Jaguar. After setting the Interrupt on Queue Entry Available bit, Bit 15, the host must not modify these bits.

Values of '0' through '7' are allowed. An interrupt level of '0' is allowed only when the IQEA bit is reset.

Bits 11–13 Reserved (RSRV):

These bits must be cleared to 0 by the host.

Bit 14 Interrupt on Queue Half Empty Enable (IQHE):

This bit is a flag which causes the Jaguar to generate the Interrupt on Queue Available interrupt when the Command Queue becomes half empty (rather than as soon as one entry becomes available). The Interrupt on Queue Half Empty Enable (IQHE) bit is valid only when the IQEA bit is set. The IQHE bit is set by the host and is not modified by the Jaguar. The host must not modify this bit after it has set the IQEA bit.

Bit 15 Interrupt on Queue Entry Available (IQEA):

This bit is set by the host to request an Interrupt on Queue Entry Available. The interrupt is generated either when the queue is half empty or as soon as one entry is available, depending upon the state of the IQHE bit. The Jaguar clears this bit prior to generating the Interrupt on Queue Available interrupt. After the host sets this bit, requesting an interrupt, it cannot change any of the other bits in the Interrupt on Queue Available Register.

QUEUE HEAD POINTER

The Command Queue is a circular queue and the Jaguar requires that the host use the entries in the Command Queue in order. The Queue Head Pointer provides a convenient method for the host to control the ordering of and the access to the Command Queue. The Queue Head Pointer register provides a place for the host to store the address of the next available entry in the Command Queue.

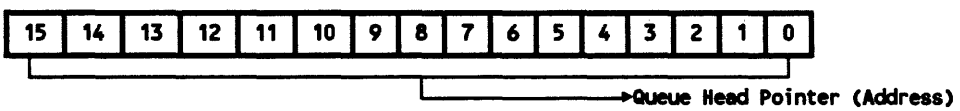


Figure 3-6. Queue Head Pointer/Queue Head Pointer In Use

Bits 0–15 Queue Head Pointer (Address):

This is the address of the next entry in the Command Queue. Since the Jaguar transfers commands out of the Command Queue in circular order as soon as it sees the Go/Busy bit set, this address is not actually used by the Jaguar.

The MACSI interface of the Jaguar relies on the chronological order of the Command Queue. The host must somehow ensure that the entries in the Command Queue are used in chronological order.

THAW WORK QUEUE REGISTER

This field is used to restart a work queue that has been frozen after an error has occurred with Freeze Work Queue on Error enabled. A queue is thawed by writing the appropriate work queue number to the upper byte of the register and then setting Bit 0 (THW). See "Error Recovery Tools" in Chapter 6 for additional information.

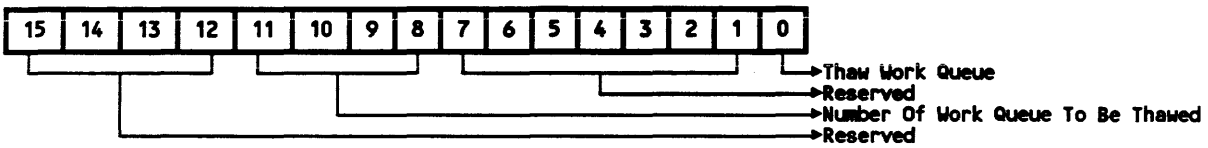


Figure 3-7. Thaw Work Queue Register

Bit 0 Thaw Work Queue (THW):

Setting this bit causes the Jaguar to resume execution of commands in the work queue specified in Bits 8-15. It then clears Bit 0 (THW) to acknowledge that the queue has been thawed.

Bits 1–7 Reserved:

These bits are reserved and must be cleared to 0 by the host.

Bits 8–11 Number of Work Queue to be Thawed:

This field specifies the work queue to be unfrozen. Valid entries in the field are 0x1 - 0xE (for Work Queues 1 - 14, respectively). This value must not change while Bit 0, THW, is set to 1.

Bits 12–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

MASTER COMMAND ENTRY (MCE)

The Master Command Entry (MCE) is used to issue commands to the Jaguar before the Command Queue and work queues have been initialized. Until the Jaguar has been commanded to enter Queue Mode, all commands must be entered through the MCE. Typically, it will be used only when initializing the Command Queue.

It does, however, provide a mechanism to issue a command to the Jaguar even if the Command Queue and all work queues are full. It provides a way to get one command into the Jaguar even when the Command Queue is "locked up."

The Master Command Entry has the same 12-byte format as a Command Queue entry for on-board IOPBs. Its fields also have the same definition. The format is as follows:

Word #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	QUEUE ENTRY CONTROL REGISTER															
0x1	IOPB ADDRESS															
0x2	COMMAND TAG															
0x3	COMMAND TAG															
0x4	IOPB LENGTH								WORK QUEUE NUMBER							
0x5	RESERVED															

Figure 3-8. Master Command Entry

Before you issue a command to the Master Command Entry, the IOPB pointed to by the MCE must already be written to the Host Usable Space (HUS) portion of short I/O space.

COMMAND QUEUE

The Command Queue (CQ) consists of a user-programmed number of Command Queue entries. The entries in the Command Queue is set by the host when it initializes the controller. The Command Queue is circular, but it is up to the host to keep track of the next Command Queue entry that it can use. Because the queue is circular, the Jaguar can infer chronological ordering of commands. The actual size of the Command Queue equals the number of entries times 12 bytes. The Command Queue must have at least one entry.

COMMAND QUEUE ENTRY (CQE)

A Command Queue entry is a 12-byte block containing all of the information needed for the host to find and execute a command. Each entry in the Command Queue is ``busy"only until the Jaguar can transfer the command to a work queue and then free the entry by clearing the Go/Busy bit. This mechanism allows a relatively small Command Queue to handle a large number of commands.

The purpose of the fields in a Command Queue entry will vary depending on whether you are implementing onboard or offboard IOPBs. The format of the two types of Command Queue entries are shown below:

COMMAND QUEUE ENTRY FOR ONBOARD IOPBs:

Word #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	QUEUE ENTRY CONTROL REGISTER															
0x1	IOPB ADDRESS															
0x2	COMMAND TAG															
0x3	COMMAND TAG															
0x4	IOPB LENGTH								WORK QUEUE NUMBER							
0x5	RESERVED															

COMMAND QUEUE ENTRY FOR OFFBOARD IOPBs:

Word #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	QUEUE ENTRY CONTROL REGISTER															
0X1	RSRV				TT		MT		ADDRESS MODIFIER							
0X2	HOST ADDRESS (MSW)															
0X3	HOST ADDRESS (LSW)															
0X4	IOPB LENGTH								WORK QUEUE NUMBER							
0X5	RESERVED															

Figure 3-9. Command Queue Entry Format For Onboard And Offboard IOPBs

CQE WORD 0:
QUEUE ENTRY CONTROL REGISTER

The Queue Entry Control Register (QECR) is used to: 1) kick off command execution, 2) acknowledge a command abort sequence, 3) flag a high priority command, and 4) signal whether a command is located in short I/O (onboard IOPB) or in system memory (offboard IOPB).

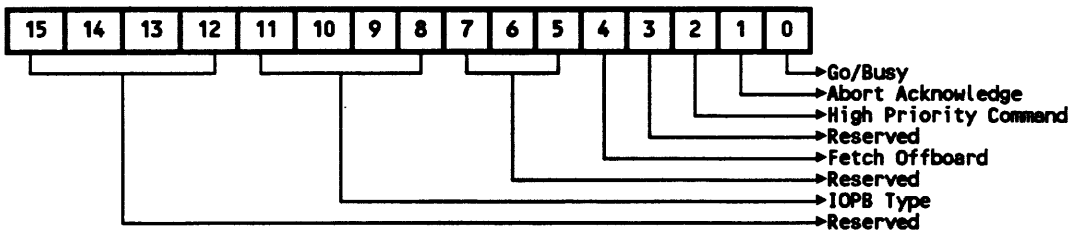


Figure 3-10. Queue Entry Control Register (QECR)

Bit 0 Go/Busy (GO):

The Go/Busy bit is set by the host to initiate action on a Command Queue entry. The host must assemble the IOPB in the Host Usable Space (HUS) and assemble the entire Command Queue entry in the Command Queue before it sets this bit. The Jaguar moves the Command Queue entry and the IOPB into internal memory as soon as it sees the Go/Busy bit set. Once the IOPB and Command Queue entry are in internal memory, the Jaguar will reset the Go/Busy bit to free the Command Queue entry.

Bit 1 Abort Acknowledge (AA):

When a command completes with error, all commands in that work queue can optionally be aborted. In addition, all commands in the Command Queue that are destined for that work queue are also aborted. This option is specified when the work queue is initialized (see Abort Enable bit in the Initialize Work Queue command).

The Abort Acknowledge bit is used to stop aborting commands after this condition occurs. When a command completes with error, a typical response is for the host to re-issue the command that completed in error, with the Abort Acknowledge bit set. Upon successful completion of the command, the host can then re-issue each command that was aborted because of the error. These subsequent commands should not have the Abort Acknowledge bit set.

Bit 2 High Priority Command (HPC):

The High Priority Command (HPC) bit flags a command so that the Jaguar places the command at the top of its work queue. If there are already other commands in the work queue with the HPC bit set, the new command is queued up directly behind the other High Priority Commands. (Thus, there is a FIFO-type ordering of High Priority Commands.)

Bit 3 Reserved (RSRV):

This bit is reserved and must be cleared to 0 by the host.

Bit 4 Fetch Offboard (FOB):

This bit is only used in applications involving offboard IOPBs. If this bit is set, then the corresponding IOPB will be fetched from the host memory. The only other bit in the Queue Entry Control Register that is valid when the FOB bit is set is the Go/Busy bit (Bit 0). For a discussion of offboard IOPBs, refer to the section "Offboard IOPBs" in Chapter 6.

Bits 5–7 (RSRV) Reserved:

These bits are reserved and must be cleared to 0 by the host.

Bits 8–11 IOPB Type:

These bits describe the IOPB type. The Jaguar supports only type zero IOPBs, so this field should be cleared to 0.

Bits 12–15 Reserved (RSRV):

These bits are reserved and must be cleared to 0 by the host.

CQE WORD 1:

For onboard IOPBs, Command Queue Entry Word 1 is used to store the IOPB Address. For offboard IOPBs, it holds the memory type, transfer type, and address modifier used by the Jaguar to DMA the offboard IOPB into onboard memory. These two uses of the field are explained below.

IOPB Address. For an onboard IOPB, Command Queue Entry Word 1 points to the location of the IOPB in short I/O. The value is specified as an offset from the short I/O base address. The Jaguar transfers both the Command Queue entry and the IOPB out of short I/O as soon as it "sees" that the Go/Busy bit is set.

Memory Type/Transfer Type/Address Modifier. For an offboard IOPB, Command Queue Entry Word 1 is used to specify the memory type, transfer type, and address modifier used to transfer the IOPB onboard. This field is identical in format and purpose to the Memory Type/Transfer Type/Address Modifier field in word 7 of the Printer Port IOPB. For a description of the field, refer to Chapter 5.

CQE WORDS 2–3:

For onboard IOPBs, Command Queue Entry Word 2 is used to store a host-assigned command tag. For offboard IOPBs, it holds the physical address of the offboard Command Queue entry/IOPB. These two uses of the field are explained below.

Command Tag. For onboard IOPBs, Command Queue Entry Words 2-3 can be used to store a host-specified command tag. The Jaguar does not use or modify the value stored in this field. It simply returns the Command Tag as part of the Command Response. Thus, in a typical implementation, the host would use a unique value Command Tag for each Command Queue entry so that it can always differentiate one command from another.

Host Address. For offboard IOPBs, Command Queue Entry Words 2-3 are used to store the physical address of the offboard Command Queue entry and its corresponding IOPB in host memory. Word 2 stores the most significant word (MSW) of the address, and Word 3 stores the LSW.

CQE WORD 4:

CQE Word 4 consists of a Work Queue Number field and an IOPB Length field.

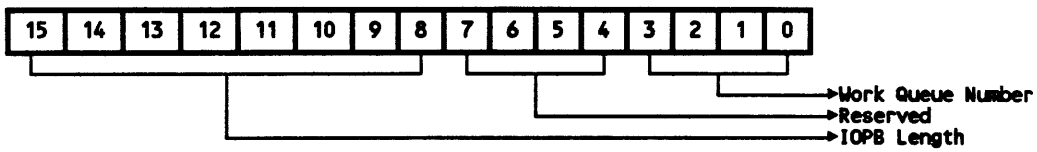


Figure 3-11. IOPB Length/Work Queue Number

Bits 0–3 Work Queue Number:

This byte contains the number of the work queue into which the command is to be placed. Since the Jaguar supports 15 work queues (14 device-specific queues plus Work Queue 0), valid entries in this field are 0x0 to 0xE.

NOTE

Before you can issue a command to Work Queues 1 - 14, that work queue must be initialized using the Initialize Work Queue command. If the specified work queue has not been initialized, the command will be reported as completing with an error (return status = 0x07, Queue Uninitialized).

Bits 4–7 Reserved:

These bits are reserved and must be cleared to 0 by the host.

Bits 8–15 IOPB Length:

The IOPB Length byte specifies the length of the IOPB to which the Command Queue entry is pointing. For onboard IOPBs, writing a '0' to this field indicates that the default length of the IOPB is being used. **This field should only contain a non-zero value if the IOPB involves a vendor-unique SCSI command (Group 6 or 7).** Refer to the SCSI Pass-Through IOPB section for additional information.

CQE WORD 5:

CQE Word 5 is reserved for both onboard and offboard IOPBs. This field should be cleared to 0 by the host.

HOST USABLE SPACE (HUS)

The Host Usable Space (HUS) is freeform memory space accessible to both the host and the controller. No partitioning of the HUS is implied or required by the Jaguar MACSI interface. The manner in which it is used is totally under the control of the host. Typically, the HUS in the Jaguar is used to pass the IOPB portion of a command. In some multiprocessing applications, the HUS is a handy place to post semaphores between CPUs.

The amount of HUS available is determined by two factors: the number of Command Queue entries defined when the Command Queue is initialized, and by the length of the Command Response Block that is defined. For example, if the Command Queue is initialized with ten entries (each Command Queue entry is 12 bytes long) and a Command Response Block of 76 bytes is defined, there will be 1704 bytes of HUS available. The Master Control/Status Block, Master Command Entry, and the Controller Specific Space always occupy a total of 148 bytes.

COMMAND RESPONSE BLOCK (CRB)

The Command Response Block (CRB) is used by the Jaguar to post command completion status. The IOPB itself and related status information are returned to the Command Response Block.

The CRB is also used to return an error status block in the event of a controller interrupt (see Bit 7, Status Change, in the Command Response Status Word of the CRB).

In addition, if enabled to do so, the Jaguar uses the CRB to signal the following conditions:

- Space has become available in the Command Queue to accept new entries. (The Interrupt on Queue Available feature must be enabled.)
- A printer status change has occurred. (Your setup must include a printer port daughter card and status change interrupts must be enabled).

The CRB is made up of the Command Response Status Word (CRSW), the Command Tag, the Work Queue Number, and the Returned IOPB.

The offset of the Command Response Block is defined at initialize time. The length of the Command Response Block can be determined by subtracting the Command Response Block offset from the offset of the Controller Specific Space (+0x788). However, the length of the Command Response Block must be equal to the largest IOPB defined plus 12 bytes.

Offset From Short I/O Base Address	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
+0x750	COMMAND RESPONSE STATUS WORD															
+0x752	RESERVED															
+0x754	COMMAND TAG															
+0x756	COMMAND TAG															
+0x758	IOPB LENGTH								WORK QUEUE NUMBER							
+0x75A	RESERVED															
+0x75C To +0x787	RETURNED IOPB															

NOTE: The above is the memory map of the Command Response Block (CRB) if the CRB offset has been set to +0x750 using the Initialize Controller command. With this setup, the maximum IOPB length is that of a SCSI Pass-Through IOPB used to issue a 12-byte SCSI command (i.e. maximum IOPB length = 44 bytes).

Figure 3-12. Command Response Block (Sample Memory Map)

COMMAND RESPONSE STATUS WORD (CRSW)

The Command Response Status Word (CRSW) is the first word in the Command Response Block (CRB). It describes the nature of the Command Response. It also contains a Handshake bit and the Command Response Block Valid/Clear Interrupt (CRBV) bit. (The CRBV bit synchronizes the command interaction of the Jaguar and the host.) The bits of the Command Response Status Word are defined as follows:

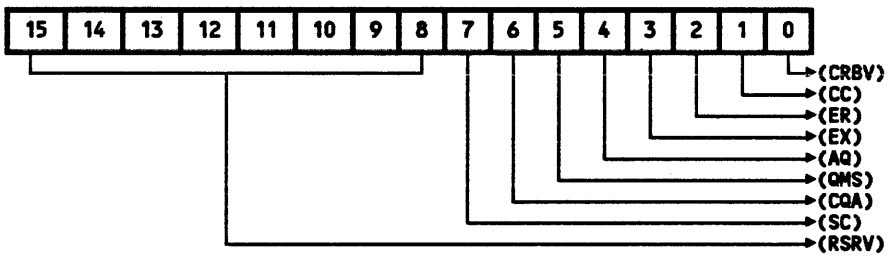


Figure 3-13. Command Response Status Word (CRSW)

Bit 0 Command Response Block Valid/Clear Interrupt (CRBV):

The Command Response Block Valid/Clear Interrupt (CRBV) bit is set by the Jaguar after it loads the returned IOPB, the Work Queue Number, and the Command Tag into the Command Response Block (CRB).

The CRBV bit is also an Interrupt Pending bit because the Jaguar sets it immediately prior to issuing a Command Complete interrupt to the host. The Jaguar keeps the Command Response Block stable while this bit is set.

After it is finished using the information in the Command Response Block, the host clears the interrupt by clearing the CRBV bit. Once this bit is reset, the Jaguar can use the Command Response Block to present the next command response.

Bit 1 Command Complete (CC):

The Command Complete (CC) bit is set by the Jaguar when the Command Response Block is being used to post the response to a Command Completion, as opposed to a Queue Entry Available condition or a Start Queued Mode operation. The CC bit is set even when the command is completed with error or exception. (See Command Response Status Word (CRSW) bits 2 and 3.)

Bit 2 Error (ER):

The Error (ER) bit is set by the Jaguar when the Command Response Block contains an IOPB that has completed with an error status. Examples of conditions that may cause an IOPB to complete with the Error bit set include:

- An incorrectly specified parameter which causes the Jaguar to misinterpret the command
- An invalid address leading to bus errors or timeouts
- A faulty device which causes a timeout

The Error bit will also be set for Pass-Through commands that return any value other than zero in the Pass-Through Status or Controller Status fields.

The Error bit is valid only when Command Complete is active.

Bit 3 Exception (EX):

The Exception (EX) bit is set by the Jaguar when the Command Response Block contains an IOPB that has completed with an exception.

A command completed with exception is one which completed without error, but has some IOPB parameter that has not been completely satisfied. EXAMPLE: The Jaguar completes a Pass-Through SCSI command without transferring all of the data specified in the IOPB's transfer count field. (For many SCSI commands, this is not an error condition, but rather something about which the host probably needs to be notified.)

The Exception bit is valid only when Command Complete is active.

Bit 4 Abort Queue (AQ):

When work queues are initialized by the host, they can be set up (optionally) so that all of the commands in the queue can be aborted after a command completes with an error. (See Initialize Work Queue Command.) The command that was completed with an error is reported just like any other error, with the Error bit set in the Command Response Status Word.

With Abort on Error enabled, the Jaguar, on an error, will abort all commands in the work queue. In addition, all commands in the Command Queue destined for that work queue will be aborted until a command with the Abort Acknowledge bit set in the Queue Entry Control Register is encountered. (See Queue Entry Control Register). All of the

aborted commands are reported in the Command Response Block with the Command Complete, Error, and Abort Queue bits set. The Error Interrupt Vector of the command being aborted will be used to report this condition.

Bit 5 Queue Mode Started (QMS):

The Queue Mode Started (QMS) bit is set by the Jaguar in response to the host setting the Start Queue Mode (SQM) bit in the Master Control Register. (See Master Control Register).

Once the Command Queues and work queues have been initialized, the host starts Queued IOPB operation by setting the SQM bit in the Master Control Register. The Jaguar will acknowledge entering Queued IOPB mode by setting the Queue Mode Started bit in the Command Response Status Word. No interrupt will be generated.

Bit 6 Command Queue Entry Available (CQA):

The Command Queue Entry Available (CQA) bit is set by the Jaguar when the Command Response Block is presented in response to a queue entry available condition. The CQA bit is mutually exclusive with the Command Complete bit.

Bit 7 Status Change (SC):

This bit is set to indicate one of the following conditions:

- A printer status change has occurred.
- A device has connected for which no IOPB exists (IOPB type error).
- An IOPB has timed out.
- A device is requesting more data to be transferred than the IOPB allows.
- A device is requesting a data transfer of the opposite direction specified by the IOPB's direction bit.

If Bit 7 is set, the Jaguar will return an error status block without returning the IOPB that caused the error. Refer to "Controller Error Interrupt and Vector", Chapter 6 for details on this special case.

Bits 8–15 Reserved (RSRV):

These bits are reserved and are cleared to 0 by the Jaguar.

COMMAND TAG

This Command Tag is the same 4-byte value that was provided in the Command Queue Entry when this command was originally issued to the Jaguar. The Jaguar does not use the Command Tag, nor does it modify it. It simply returns the Command Tag as part of the Command Response. The Command Tag is used by the host to determine to which command the Jaguar is responding.

IOPB LENGTH WORK QUEUE NUMBER

The lower byte of this word specifies the number of the work queue to which the command was issued. The upper byte specifies the length of the returned IOPB. A length of zero indicates the IOPB is the default length. The entire IOPB Length/Work Queue Number word is returned from the Command Queue entry exactly as it was originally entered by the host.

RETURNED IOPB

The Returned IOPB field of the Command Response Block is usually an image of the IOPB that was passed with the Command Queue Entry when the command was originally issued to the Jaguar. In some cases, depending upon the specific IOPB, some of the parameters are modified to reflect Command Completion status.

This returned IOPB area is undefined for a response to a Queue Entry Available condition or for any other command response where the original command did not require an IOPB.

CONTROLLER SPECIFIC SPACE

The Jaguar uses the 120-byte Controller Specific Space to post the Configuration Status Block. This space begins at an offset of +0x788 from the short I/O base address.

CONFIGURATION STATUS BLOCK

The Jaguar uses the Configuration Status Block to report its current configuration. This includes such information as the board's firmware revision level, product number and variations, available buffer space, and the SCSI bus IDs that it is using. The format of the Configuration Status Block is shown below:

OFFSET	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
+0x788	RESERVED															
+0x78A	RESERVED								PRODUCT CODE							
+0x78C	PRODUCT CODE															
+0x78E	RESERVED															
+0x790	RESERVED								VARIATION							
+0x792	RESERVED															
+0x794	RESERVED								FIRMWARE REVISON LEVEL							
+0x796	FIRMWARE REVISION LEVEL															
+0x798	RESERVED															
+0x79A To +0x7A1	FIRMWARE RELEASE DATE															
+0x7A2	RESERVED															
+0x7A4	SIZE OF BUFFER															
+0x7A6	RESERVED															
+0x7A8	RESERVED															
+0x7AA	PRIMARY SCSI BUS ID								SECONDARY SCSI BUS ID							
+0x7AC	LAST PRIMARY DEVICE SELECTED								LAST SECONDARY DEVICE SELECTED							
+0x7AE	PRIMARY PHASE SENSE								SEC. PHASE SENSE/PRINT STATUS							
+0x7B0	RESERVED								DAYGHTER BOARD ID							
+0x7B2	RESERVED								SOFTWARE DIP SWITCH							
+0x7B4	RESERVED															
+0x7B6	FROZEN WORK QUEUES REGISTER															
+0x7B8	RESERVED															
+0x7FE	RESERVED															

Figure 3-14. Configuration Status Block

The following is a description of the values found in the Configuration Status Block.

Product Code (3 bytes):

These three bytes are the Interphase product code. This value is represented as a 3-character ASCII string. The most significant character appears first. It is valid after the completion of a controller reset.

Product Variation (1 byte):

This byte is the Interphase product variation code. This value is represented as one ASCII character. This value is valid after the completion of a controller reset.

Firmware Revision Level (3 bytes):

These three bytes are the revision level of the installed firmware. This value is represented as a 3-character ASCII string. The most significant character appears first. This value is valid after the completion of a controller reset.

Firmware Release Date (8 bytes):

These 8 bytes are the release date of the installed firmware. This value is represented as an 8-character ASCII string. The format is MMDDYYYY. For example, a release date of January 15, 1989 would be 01151989. It is valid after the completion of a controller reset.

Size of Buffer (2 bytes):

These 2 bytes are the amount of on-board buffer RAM expressed in 1K increments. This value is represented as a four-digit hexadecimal number. For example, a 128K RAM buffer would be 0080. This value is valid after the completion of a controller reset.

Primary SCSI Bus ID (1 byte):

This byte is the current bus ID for the primary SCSI bus. This value is represented as a 1-digit hexadecimal number. This value will default to the bus ID encoded in the on-board switches at the completion of a controller reset. This value will be updated at the completion of an Initialize Controller command.

Secondary SCSI Bus ID (1 byte):

This 1-digit hexadecimal value is the current bus ID for the secondary SCSI bus. It defaults to the bus ID encoded in the jumpers on the SCSI daughter card at the completion of an Initialize Controller command. (For details on these jumpers, refer to Chapter 2.)

Last Primary Device Selected (1 byte):

This byte contains the SCSI ID of the last primary SCSI bus device selected by the Jaguar. This field is updated every time the Jaguar selects or reselects a device on Port 0.

Last Secondary Device Selected (1 byte):

This byte contains the SCSI ID of the last secondary bus device selected by the Jaguar. This field is updated every time the Jaguar selects or reselects a device on Port 1.

Primary Phase Sense (1 byte):

This byte contains the status of the primary SCSI bus. The primary phase sense register contains a copy of Port 0's Fujitsu 87030 phase sense register. This copy is updated approximately every 27 to 35msec. The signals in the register are shown below:

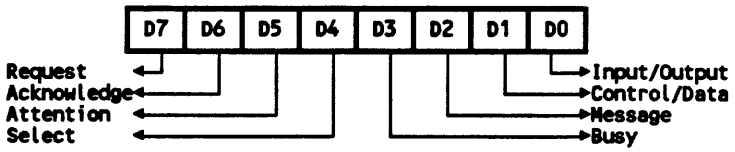


Figure 3-15. SCSI Bus Status Byte

Each of the above bits corresponds to a signal on the SCSI bus. If the bit is set, the corresponding SCSI signal is active. The meaning of the signals is as follows:

Table 3-2. Meaning Of SCSI Signals In 87030 Phase Sense Register

SIGNAL	NAME	DESCRIPTION
REQ	Request	The controller asserts REQ to start an asynchronous bus transfer.
ACK	Acknowledge	The target asserts ACK to indicate that it has sent (or received) data. This signal is used in tandem with REQ to handle all asynchronous data transfers
ATN	Attention	The target asserts ATN to tell the initiator that there is a message waiting for it.
SEL	Select	The initiator asserts SEL to indicate which target is to perform an upcoming operation. The ID of the target is simultaneously sent over the data lines. The 4210 asserts SEL to reconnect during the Reselection phase.
BSY	Busy	This signal is driven by the initiator or target using the bus to indicate that the bus is busy.
MSG	Message	The controller drives this signal when it is transferring a message (as opposed to data).
C/D	Control/Data	The controller uses this signal to indicate the type of information on the bus (asserted = command/message, negated = data).
I/O	Input/Output	The controller drives this signal to control the direction in which data is moving on the bus (asserted = target-to-initiator transfer, negated = initiator-to-target transfer).

For a complete description of the signals, please refer to the SCSI specification or the 87030 user's guide.

Secondary Phase Sense/Printer Status (1 byte):

If your board has a SCSI daughter card, this byte shows the status of the secondary SCSI bus status. If you are using a printer port daughter card, the byte shows the status of the printer. If the former is the case, the byte is an image of the port's Fujitsu 87030 phase sense register. The format of this register is shown in the preceding figure. This copy is updated approximately

every 27 to 35msec. This register is identical in operation to the primary SCSI port register above.

If the printer port is installed, this register contains the printer status. This register will be updated at the completion of any print command or approximately every 27 to 35msec. The bit definition of this register is dependent on whether the interface is Dataproducts or Centronics type. The format of that register is as follows:

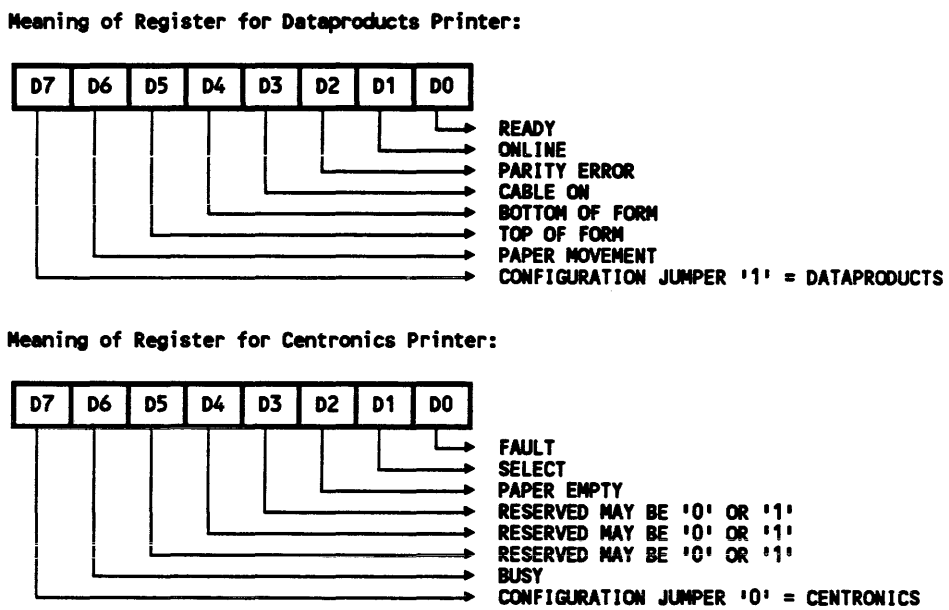


Figure 3-16. Printer Status Register

Daughter Card ID (1 byte):

The daughter card ID field contains a value from 0x0 to 0x7 that indicates the type of daughter board installed (if any). The meaning of the codes is as follows:

Table 3-3. Daughter Card ID

CODE	MEANING
0x7	No daughter card is installed
0x6	SCSI daughter card
0x5	(reserved)
0x4	Printer daughter card
0x3	(reserved)
0x2	(reserved)
0x1	(reserved)
0x0	(reserved)

Software DIP Switch (1 byte):

This field reports the status of features set using Switch Block SW2. This switch block is only provided on Jaguars with the board layout shown in Chapter 2. Boards that do not have the switch will report the value of a location in the firmware that performs the same function. The following functions are presently defined:

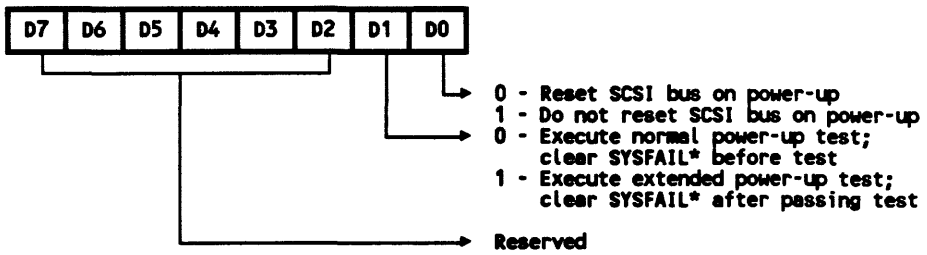
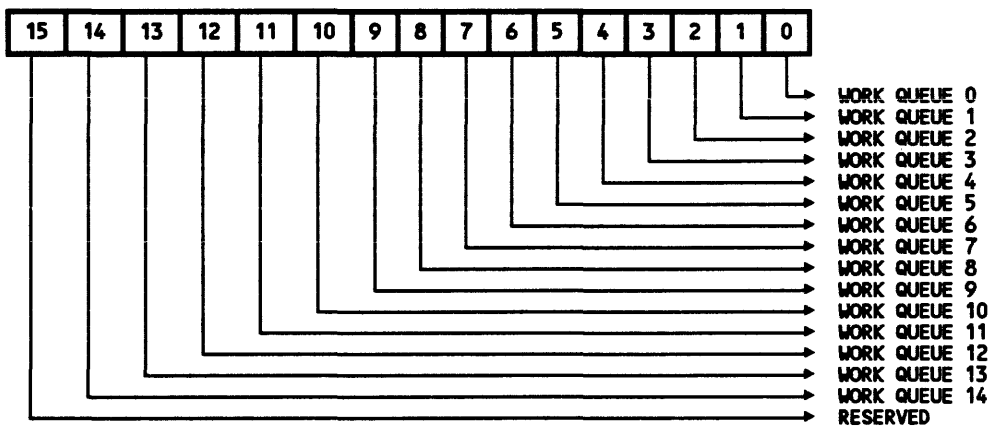


Figure 3-17. Software Configuration Switch Settings Reported In Configuration Status Block

Frozen Work Queues (2 bytes):

This register provides Work Queue frozen status for the Jaguar's 14 Work Queue's, 0 - 14. The Jaguar will set a 1 in the Work Queue's bit position if the queue is frozen. The format of the register is as follows:



NOTE: Work Queue 0 cannot be frozen; therefore, Bit 0 is always cleared.

Figure 3-18. Frozen Work Queues Register

CHAPTER 4
VMEbus INTERRUPTS

OVERVIEW

At the completion of a command (either successful or terminated with an error or with an exception), the Jaguar notifies the host by generating a Command Complete Interrupt on the VMEbus. The Jaguar can respond to the VMEbus Interrupt Acknowledge Cycle with different Interrupt Vectors based on the cause of the interrupt. But for those VMEbus systems that allow only one interrupt vector per device, the host can still determine the source of the interrupt by checking the status bits in the Command Response Status Word and the Work Queue Number found in the Command Response Block.

The hardware driving the VMEbus interrupt line is cleared at the completion of the VMEbus Interrupt Acknowledge Cycle. However, a Clear Interrupt operation must also be executed by the host to notify the Jaguar that the interrupt has been properly serviced by the host and that the Jaguar may now post its next interrupt. The host does this by clearing the CRBV bit in the Command Response Block. (See the Command Response Status Word in the Command Response Block, Chapter 3).

NOTE

Any information that the host needs from the Command Response Block must be accessed before it clears the CRBV bit in the Command Response Status Word.

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CHAPTER 5
I/O PARAMETER BLOCKS AND COMMANDS

OVERVIEW

The MACSI software interface of the Jaguar can handle two distinct types of IOPBs: SCSI IOPBs and Control IOPBs. SCSI IOPBs are commands that are sent to either the attached SCSI devices or to the printer port (if used). Control IOPBs are commands for the Jaguar itself (such as an initialization command) that result in local Jaguar action only.

Table 5-1. Jaguar Command Set

SCSI IOPBs	COMMAND CODE
SCSI Pass-Through	(0x20)
SCSI Reset	(0x22)
Printer Port	(0x23)
CONTROL IOPBs	**COMMAND CODE**
Perform Diagnostics	(0x40)
Initialize Controller	(0x41)
Initialize Work Queue	(0x42)
Dump Initialization Parameters	(0x43)
Dump Work Queue Parameters	(0x44)
Bus Status Inquiry	(0x45)
Command Status Inquiry	(0x46)
Cancel Command Tag	(0x48)
Flush Work Queue	(0x49)
Initialize Printer Port	(0x4A)
Restart Controller	(0x4B)
Device Reinitialize	(0x4C)
Issue Bus Device Reset Message	(0x4D)
Issue Abort Message	(0x4E)

In general, **SCSI IOPBs** are issued to a specific device via its assigned work queue (Work Queue 1 - 14). Each work queue must be separately initialized before commands can be issued to it. **Control IOPBs** must be issued through the Master Command Entry to Work Queue 0.

NOTE

The SCSI Reset command can be issued to either a specific device or through the Master Command Entry. Refer to the command description for details.

VMEbus ADDRESS MODIFIERS

As a slave, the Jaguar responds to either: 1) 0x2D *and* 0x29, or 2) 0x2D only. This depends on how Switch 9 in Switch Block SW1 is set on your motherboard. As a master, the Jaguar will use whatever address modifier is in the IOPB. It is not checked.

SCSI PASS-THROUGH (0x20)

The SCSI Pass-Through IOPB provides all of the information the Jaguar needs to send a command to a specific SCSI peripheral on either of the SCSI buses. The IOPB's size can be adjusted to accommodate different SCSI command lengths.

The figure below shows the format of the SCSI Pass-Through IOPB when used to issue a 12-byte SCSI command.

Word #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND CODE (0x20)															
0x1	COMMAND OPTIONS															
0x2	RETURN STATUS															
0x3	RESERVED															
0x4	NORMAL COMPLETION VECTOR								ERROR COMPLETION VECTOR							
0x5	INTERRUPT LEVEL															
0x6	RESERVED															
0x7	LINK	RESERVED			TT		MT		ADDRESS MODIFIER							
0x8	BUFFER ADDRESS (Or Scatter/Gather List Address *)															
0x9																
0xA	MAXIMUM TRANSFER LENGTH (Or Scatter/Gather element Count *)															
0xB																
0xC	RESERVED (Or Scatter/Gather Total Transfer length *)															
0xD																
0xE	RESERVED															
0xF	UNIT ADDRESS															
0x10	SCSI BYTE 0								SCSI BYTE 1							
0x11	SCSI BYTE 2								SCSI BYTE 3							
0x12	SCSI BYTE 4								SCSI BYTE 5							
0x13	SCSI BYTE 6								SCSI BYTE 7							
0x14	SCSI BYTE 8								SCSI BYTE 9							
0x15	SCSI BYTE 10								SCSI BYTE 11							

* Scatter/gather operations only.

NOTES: Fields set in bold capital letters are returned values. All other values are host provided. Reserved fields must be cleared to 0 by the host.

Figure 5-1. SCSI Pass-Through IOPB For 12-Byte SCSI Command

The size of the SCSI Pass-Through IOPB can be adjusted to accommodate different SCSI command lengths. For example, to issue a 12-byte SCSI command, append the 12-byte Command Descriptor Block starting at word 0x10 of the IOPB.

To determine the length of the SCSI command, the Jaguar examines the Group Code field in Byte 0 of the Command Descriptor Block (CDB). The possible entries in this field are as follows:

Table 5-2. Group Codes For SCSI Commands

GROUP	CDB LENGTH
0	6 Bytes
1	10 Bytes
2	(Reserved)
3	(Reserved)
4	(Reserved)
5	12 Bytes
6	User Defined
7	user Defined

If the command is a Group 0, 1, or 5 SCSI command, the Jaguar will ``know'' the length of the Command Descriptor Block (6, 10, or 12 bytes, respectively). In these cases, clear the IOPB Length field of the corresponding Command Queue entry to ``0''.

If issuing a user-defined SCSI command (Group 6 or 7), you must tell the Jaguar how long the command is. This is done by filling in the IOPB Length field of the corresponding Command Queue entry with the number of words in the IOPB. The Jaguar will then calculate the Command Descriptor Block length by subtracting the overhead of the IOPB (0x10 words) from the length specified in the Command Queue entry.

The remainder of this section describes the function of each field in the SCSI Pass-Through IOPB.

HOST-PROVIDED IOPB FIELDS

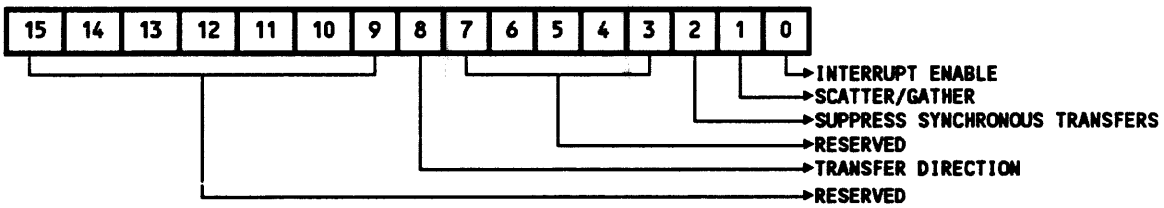
The following information must be provided in the IOPB for the SCSI Pass-Through command:

COMMAND CODE (2 BYTES)

This field must be set to 0x20 to execute the SCSI Pass-Through command.

COMMAND OPTIONS (2 BYTES)

This field contains the options for this command. The bits are defined as follows:



Bit 0 Interrupt Enable (IE):

Setting this bit enables the Jaguar to interrupt the host upon command completion. Clearing the bit disables the Command Complete interrupt.

Bit 1 Scatter/Gather (SG):

This bit should only be set if the command involves a scatter/gather operation. When scatter/gather is enabled, the following fields are defined differently than for non-scatter/gather: Address Modifier/Memory Type/Transfer Type, Buffer Address, Maximum Transfer Length, and the Reserved field at Words 0xC - 0xD. For a detailed discussion, please refer to ``Scatter/Gather Operations,".

Bit 2 Suppress Synchronous Transfers (SS):

Setting this bit in the *first* pass-through command sent to a device causes the Jaguar to disable synchronous transfers with that device. The Jaguar must be reset to re-enable synchronous transfers with that device. This bit is provided as a work around in the event a device does not process the synchronous transfer request message correctly. Thus, the bit should be cleared for normal operations.

Bits 3–7 Reserved:

These bits are reserved and must be cleared to 0 by the host.

Bit 8 VMEbus Transfer Direction (DIR):

This bit specifies the direction of the data transfer over the VMEbus, as follows:

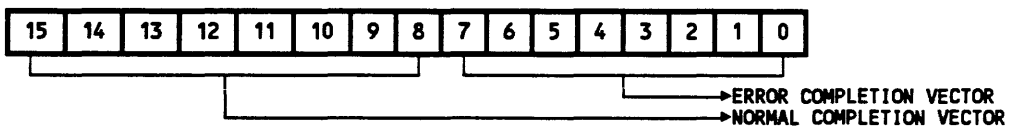
BIT 8	VMEbus DIRECTION
0	Write data to the VMEbus
1	Read data from the VMEbus

Bits 9–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

NORMAL COMPLETION VECTOR/ERROR COMPLETION VECTOR (2 BYTES)

These two bytes specify the VMEbus interrupt vectors that the Jaguar will use to report normal command completion and command completion with error.



Bits 0–7 Error Completion Vector:

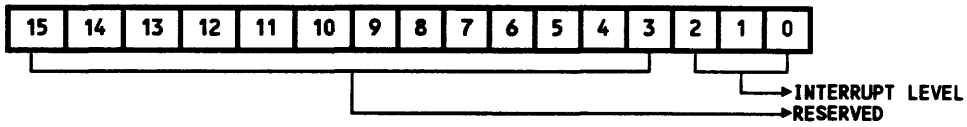
This value specifies the interrupt vector used when notifying the host of command completion with error.

Bits 8–15 Normal Completion Vector:

This value specifies the interrupt vector used when notifying the host that the command completed without error.

INTERRUPT LEVEL (2 BYTES)

This field specifies the VMEbus interrupt level used to notify the host of a command completion (normal or with error).



Bits 0–2 Interrupt Level (LVL):

These bits set the interrupt level used by the Jaguar to assert a Command Complete interrupt on the VMEbus. Values of 0 through 7 are allowed, but a level of 0 is allowed only when interrupts are disabled (Interrupt Enable bit = 0 in the Command Options word).

Bits 3–15 Reserved:

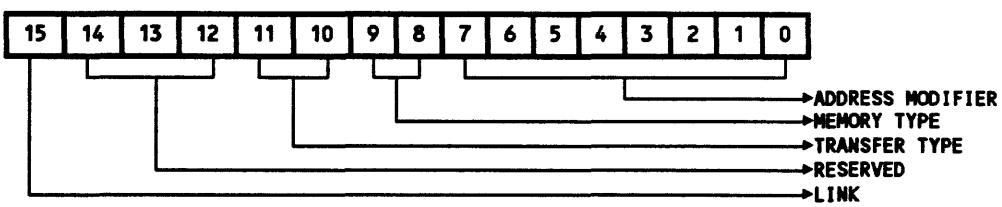
These bits are reserved and must be cleared to 0 by the host.

ADDRESS MODIFIER/MEMORY TYPE TRANSFER TYPE (2 BYTES)

These bytes specify the address modifier, memory type, and transfer type to be used for all VMEbus transfers associated with the command.

NOTE

Some memory systems may not support all of the options discussed for this field. Check the specifications of the target system to verify its capabilities.



Bits 0–7 Address Modifier:

This byte specifies the address modifier to be used by the Jaguar for all VMEbus data transfers associated with this command.

Bits 8–9 Memory Type (MT):

This 2-bit field specifies the width of data transfers. Permitted values are as follows:

Table 5-3. Memory Type For SCSI Pass-Through Command

BIT 9	BIT 8	MEMORY TYPE
0	0	(RESERVED)
0	1	16-BIT TRANSFERS
1	0	32-BIT TRANSFERS
1	1	SCATTER/GATHER LIST RESIDES IN SHORT I/O*

* Valid only for Scatter/Gather operations

Bits 10–11 Transfer Type (TT):

This 2-bit field specifies the type of data transfer to be performed. Permitted values are as follows:

Table 5-4. Transfer Type for SCSI Pass-Through Command

BIT 11	BIT 10	TRANSFER TYPE
0	0	NORMAL TYPE
0	1	BLOCK MODE
1	0	(RESERVED)
1	1	(RESERVED)

Bits 12–14 Reserved (RSRV):

These bits are reserved and must be cleared to 0 by the host.

Bit 15 Link (LNK):

This bit should only be set if you are linking scatter/gather lists. Refer to ``Scatter/Gather List Linking,".

BUFFER ADDRESS (4 BYTES)

This field specifies the address at which the Jaguar will begin the data transfer. If the Jaguar is addressing system memory, the value in the field is a VMEbus address. If the address is in short I/O, the value is an offset from the Jaguar's short I/O base address. If scatter/gather is enabled, this field is the address of the scatter/gather list.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MSW															
							BUFFER ADDRESS								
LSW							(Or Address Of Scatter/Gather List)								

MAXIMUM TRANSFER LENGTH (4 BYTES)

This field specifies the maximum number of bytes that may be transferred by the command. If no data is to be transferred, a Transfer Length of zero should be specified. When scatter/gather is enabled, this field contains the number of scatter/gather elements.

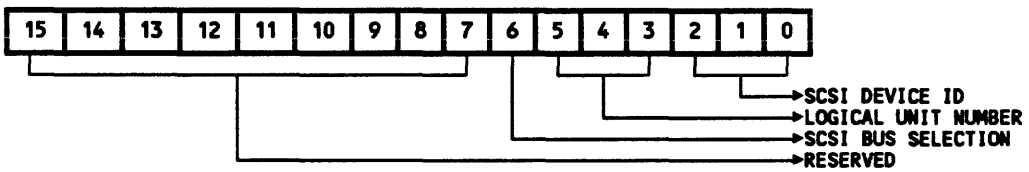
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MSW															
							MAXIMUM TRANSFER LENGTH								
LSW							(Or Scatter/Gather Element Count)								

RESERVED (4 BYTES)

Unless scatter/gather is enabled, words 0xC and 0xD of the SCSI Pass-Through IOPB are reserved and must be cleared by the host. For scatter/gather operations, this field specifies the sum of the individual element entry counts. See ``Scatter/Gather Operations,'' for details.

UNIT ADDRESS (2 BYTES)

This field specifies the SCSI bus and the address of the target device.



Bits 0–2 SCSI Device ID (SCSI ID):

These three bits are the SCSI Bus ID (SCSI ID) of the specified device.

Bits 3–5 Logical Unit Number (LUN):

These bits describe the SCSI Logical Unit Number (LUN) of the specified device.

Bit 6 SCSI Bus Selection (BUS):

The SCSI Bus Selection (BUS) bit selects which of the two SCSI buses the Jaguar uses when executing the command. When the BUS bit is cleared to 0, the Jaguar executes the command over the primary SCSI bus (Port 0). When set to 1, it uses the secondary SCSI bus (Port 1).

Bits 7–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

SCSI COMMAND BYTES

The SCSI Command Bytes specify the bytes that the Jaguar passes unchanged across the SCSI bus to the selected SCSI device. As discussed at the beginning of this section, the Jaguar determines the length of the Command Descriptor Block by looking at the group code in SCSI Byte 0 of the IOPB.

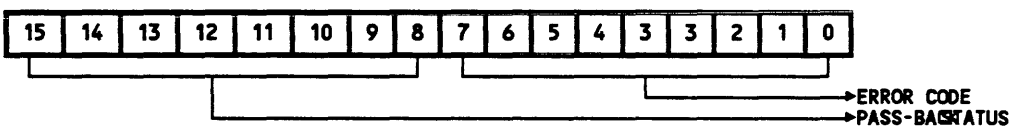
As noted previously, the length of vendor-unique SCSI commands (Group 6 or 7) *must* be specified in the IOPB Length field of the corresponding Command Queue entry. The Jaguar calculates the Command Descriptor Block length by subtracting the overhead of the IOPB (0x10 words) from the length specified in the Command Queue entry.

RETURNED VALUES

Upon command completion, the following information is provided by the Jaguar in the returned IOPB for the SCSI Pass-Through command.

RETURN STATUS (2 BYTES)

This field provides the return status for the command.



Bits 0–7 Error Code:

The Error Code byte describes the status of the controller at the end of the command response. Any non-zero value is an error code. A list of Jaguar error codes is provided in Appendix C.

Bits 8–15 Pass-Back Status:

This value is the SCSI status byte returned by the target device. It is not changed by the Jaguar.

SCSI RESET (0x22)

The SCSI Reset IOPB instructs the Jaguar to reset the SCSI bus identified by the command. It terminates all pending commands on the SCSI bus. A Command Complete with Error will be issued for each command terminated as a result of the SCSI Reset command.

NOTE

It may be necessary for the host to issue a Request Sense to on-line devices after executing the SCSI Reset command. This depends on what the device(s) require after a SCSI bus reset. Consult your device manuals for details.

When the host issues a Reset SCSI Bus IOPB through the Master Command Entry, *all* work queues with commands active on the specified SCSI bus will have those commands returned with a SCSI reset error status. In addition, the work queues corresponding to those commands will be frozen if the Freeze Work Queue on Reset option is enabled. (This option is enabled when the Jaguar is initialized. For details, see the Error Recovery Flags field in the Controller Initialization Block.)

Normally, this command is used only in an to attempt to recover from an unusual error condition.

Word #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND CODE (0x22)															
0x1	COMMAND OPTIONS															
0x2	RETURN STATUS															
0x3	(RESERVED)															
0x4	NORMAL COMPLETION VECTOR								ERROR COMPLETION VECTOR							
0x5	INTERRUPT LEVEL															
0x6 To 0xd	(RESERVED)															
0xE	SCSI BUS ID															

NOTE: Reserved fields must be set to 0 by the host

Figure 5-2. SCSI RESET IOPB

The following section describes the function of each field in the SCSI Reset IOPB.

HOST-PROVIDED IOPB FIELDS

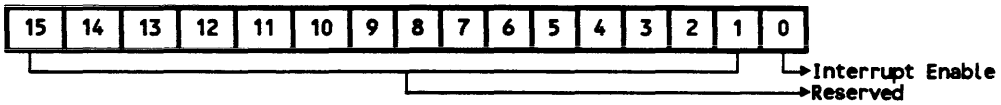
The following information must be provided in the IOPB for the SCSI Reset command:

COMMAND CODE (2 BYTES)

This field must be set to 0x22 to execute the SCSI Reset command.

COMMAND OPTIONS (2 BYTES)

This field contains the options for this command. The bits are defined as follows:



Bit 0 Interrupt Enable (IE):

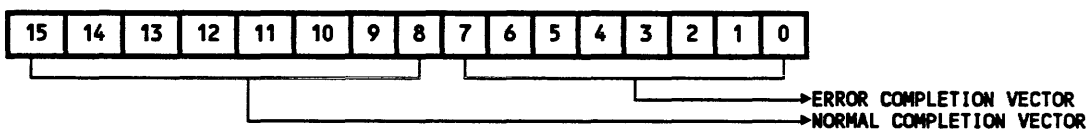
Setting this bit enables the Jaguar to interrupt the host upon command completion. Clearing the bit disables the Command Complete Interrupt.

Bits 1–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

NORMAL COMPLETION VECTOR/ERROR COMPLETION VECTOR (2 BYTES)

These two bytes specify the VMEbus interrupt vectors that the Jaguar will use to report normal command completion and command completion with error.



Bits 0–7 Error Completion Vector:

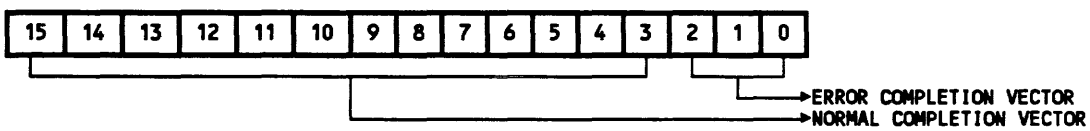
This value specifies the interrupt vector used when notifying the host of command completion with error.

Bits 8–15 Normal Completion Vector:

This value specifies the interrupt vector used when notifying the host that the command completed without error.

INTERRUPT LEVEL (2 BYTES)

This field specifies the VMEbus interrupt level used to notify the host of a command completion (normal or with error).



Bits 0–2 Interrupt Level (LVL):

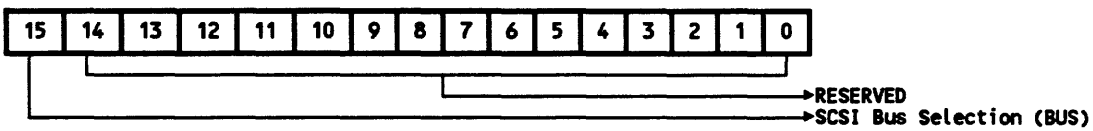
These bits set the interrupt level used by the Jaguar to assert a Command Complete interrupt on the VMEbus. Values of 0 through 7 are allowed, but a level of 0 is allowed only when interrupts are disabled (Interrupt Enable bit = 0 in the Command Options word).

Bits 3–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

SCSI BUS ID (2 BYTES)

This field identifies which bus is to be reset.



Bits 0–14 Reserved:

These bits are reserved and must be cleared to 0.

Bit 15 SCSI Bus Selection (BUS):

The SCSI Bus Selection (BUS) bit selects which of the two SCSI buses the Jaguar uses when executing the command. When the BUS bit is cleared to 0, the Jaguar executes the command over the primary SCSI bus (Port 0). When set to 1, it uses the secondary SCSI bus (Port 1).

RETURNED VALUES

Upon command completion, the following information is provided by the Jaguar in the returned IOPB for the SCSI Reset command:

RETURN STATUS (2 BYTES)

These two bytes hold the returned status of the command. Any non-zero value indicates an error code. A list of valid error codes is provided in Appendix C.

PRINTER PORT IOPB (0x23)

This command is used to issue instructions to a printer connected to the Jaguar's printer port. Before issuing a Printer Port IOPB, the host must initialize the port using the Initialize Printer Port command.

For additional information on the printer port, please refer to Chapter 6.

The format of the Printer Port IOPB is as follows:

Word #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND CODE (0x23)															
0x1	COMMAND OPTIONS															
0x2	**RETURN STATUS**															
0x3	RESERVED															
0x4	NORMAL COMPLETION VECTOR								ERROR COMPLETION VECTOR							
0x5	INTERRUPT LEVEL															
0x6	RESERVED															
0x7	RESERVED						TT		MT	ADDRESS MODIFIER						
0x8	BUFFER ADDRESS															
0x9																
0xA	MAXIMUM TRANSFER LENGTH															
0xB																
0xC	PRINTER TRANSFER LENGTH															
0xD																
0xE	RESERVED								**PRINTER STATUS**							
0xF To 0x15	RESERVED															

NOTES: Fields set in bold capital letters are returned values. All other values are host provided. Reserved fields must be cleared to 0 by the host.

Figure 5-3. Printer Port IOPB

The remainder of this section describes the function of each field in the Printer Port IOPB.

HOST-PROVIDED IOPB FIELDS

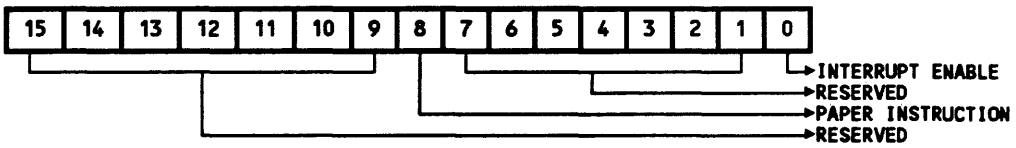
The following information must be provided in the IOPB for the Printer Port command:

COMMAND CODE (2 BYTES)

This field must be set to 0x23 to execute the Printer Port command.

COMMAND OPTIONS (2 BYTES)

This field contains the options for this command. The bits are defined as follows:



Bit 0 Interrupt Enable (IE):

Setting this bit enables the Jaguar to interrupt the host upon command completion. Clearing the bit disables the Command Complete interrupt.

Bits 1–7 Reserved:

These bits are reserved and must be cleared to 0 by the host.

Bit 8 Paper Instruction (PI):

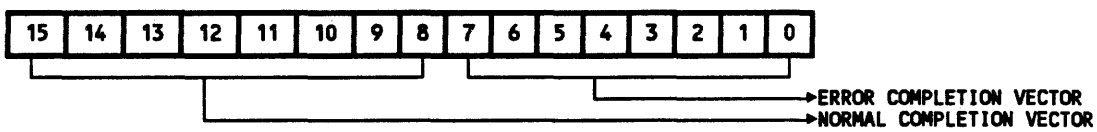
Setting the Paper Instruction bit causes the Jaguar to transfer all of the data specified in this IOPB to the printer with the Paper Instruction interface signal active. The Paper Instruction signal is only supported by Dataproducts printers.

Bits 9–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

NORMAL COMPLETION VECTOR/ERROR COMPLETION VECTOR (2 BYTES)

These two bytes specify the VMEbus interrupt vectors that the Jaguar will use to report normal command completion and command completion with error.



Bits 0–7 Error Completion Vector:

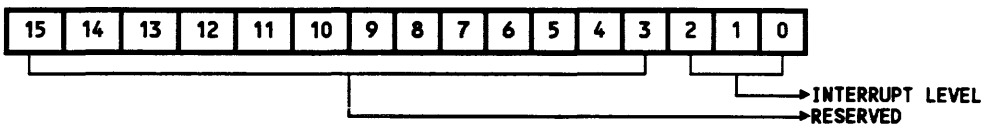
This value specifies the interrupt vector used when notifying the host of command completion with error.

Bits 8–15 Normal Completion Vector:

This value specifies the interrupt vector used when notifying the host that the command completed without error.

INTERRUPT LEVEL (2 BYTES)

This field specifies the VMEbus interrupt level used to notify the host of a command completion (normal or with error).



Bits 0–2 Interrupt Level (LVL):

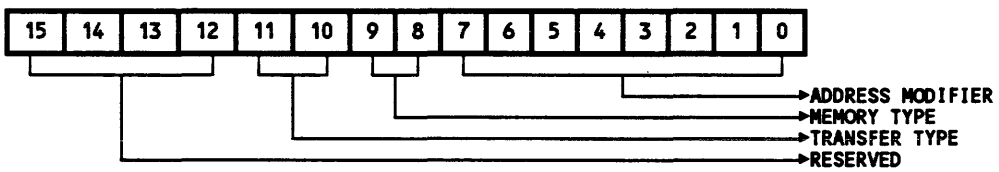
These bits set the interrupt level used by the Jaguar to assert a Command Complete interrupt on the VMEbus. Values of 0 through 7 are allowed, but a level of 0 is allowed only when interrupts are disabled (Interrupt Enable bit = 0 in the Command Options word).

Bits 3–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

ADDRESS MODIFIER/MEMORY TYPE/TRANSFER TYPE (2 BYTES)

These bytes specify the address modifier, memory type, and transfer type to be used for all VMEbus transfers associated with the command.



Bits 0–7 Address Modifier:

This byte specifies the address modifier to be used by the Jaguar for all VMEbus data transfers associated with this command.

Bits 8–9 Memory Type (MT):

This 2-bit field specifies the width of data transfers. Permitted values are as follows:

Table 5-5. Memory Type For Printer Port Command

BIT 9	BIT 8	MEMORY TYPE
0	0	RESERVED
0	1	16-BIT TRANSFERS
1	0	32-BIT TRANSFERS
1	1	RESERVED

Bits 10–11 Transfer Type (TT):

This 2-bit field specifies the type of data transfer to be performed. Permitted values are as follows:

Table 5-6. Transfer Type For Printer Port Command

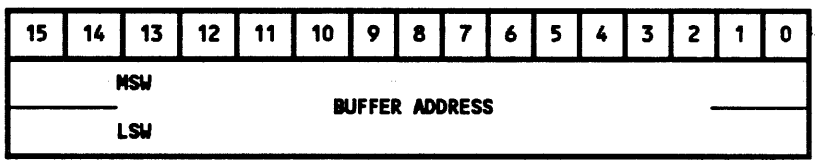
BIT 11	BIT 10	TRANSFER TYPE
0	0	NORMAL MODE
0	1	BLOCK MODE
1	0	RESERVED
1	1	RESERVED

Bits 12–15 Reserved (RSRV):

These bits are reserved and must be cleared to 0 by the host.

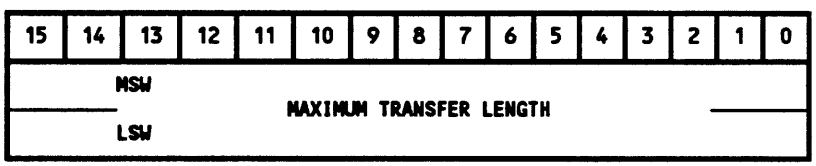
BUFFER ADDRESS (4 BYTES)

This field specifies the address in system memory at which the Jaguar will begin the data transfer.



MAXIMUM TRANSFER LENGTH (4 BYTES)

This field specifies the maximum number of bytes that may be transferred by the command.

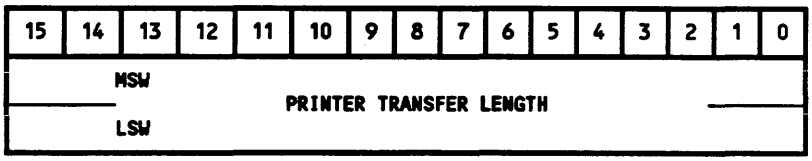


The Jaguar must perform either word (16 bit) or long word (32 bit) transfers across the VMEbus. Therefore, the Maximum Transfer Length field cannot contain an odd number of bytes. It must be rounded up to the nearest word or long word boundary, depending on the size specified in the Memory Type field.

Entering a length of zero in both the Maximum Transfer Length field and in the Printer Transfer Length field causes the Jaguar to return the IOPB with the current printer status.

PRINTER TRANSFER LENGTH (4 BYTES)

Since the Jaguar can not transfer odd-byte-length data across the VMEbus, the Printer Transfer Length field is used to specify the exact number of bytes to be transferred to printer.



The above field must contain the exact count of bytes to be sent to the printer and must be filled in on each IOPB.

RETURNED VALUES

Upon command completion, the following information is provided by the Jaguar in the returned IOPB for the Printer Port command:

RETURN STATUS (2 BYTES)

These two bytes hold the returned status of the command. Any non-zero value indicates an error code. A list of valid error codes is provided in Appendix C.

PRINTER STATUS (1 BYTE)

This field contains the state of the printer status control lines at the completion of the data transfer. Only those lines which were enabled when the printer port was initialized will be reported (Refer "Status Change Interrupt Enable"). The definition of the bits in this field vary depending on the printer type, as listed below.

Table 5-7. Definition Of Printer Status Bits

DATAPRODUCT DEFINITION (ACTIVE HIGH)	
BIT 7	Software Readable Jumper 1 = Dataproducts, 0 = Centronics
BIT 6	Paper Movement
BIT 5	Top Of Form
BIT 4	Bottom Of Form
BIT 3	Cable On
BIT 2	Parity Error
BIT 1	Online
BIT 0	Ready
CENTRONICS STATUS DEFINITION (ACTIVE HIGH)	
BIT 7	Software Readable Jumper 1 = Dataproducts, 0 = Centronics
BIT 6	Busy
BIT 5	Reserved - value returned may be either 0 or 1
BIT 4	Reserved - value returned may be either 0 or 1
BIT 3	Reserved - value returned may be either 0 or 1
BIT 2	Paper Empty
BIT 1	Select
BIT 0	Fault

RETURNED VALUES FOR PRINTER STATUS CHANGE INTERRUPT

If status change interrupts were enabled when the printer port was initialized, the following takes place when a status change occurs. The Jaguar generates an interrupt and posts the information shown below to the Command Response Block.

Word #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0X0	COMMAND RESPONSE STATUS WORD															
0X1 TO 0X5	(RESERVED)															
0x6	PRINTER STATUS								RETURN CODE							

Figure 5-4. Returned Information For Printer Status Change Interrupt

The Status Change bit (Bit 7) in the Command Response Status Word is set, and an image of the printer's status lines is returned. The bits in the Printer Status field have the same definition as in the Printer Status field in the Printer Port IOPB (see above). The value in the Return Code field should be 0x90 (Printer Status Change).

NOTE

More than one status line may change in a single interrupt, so the entire status should be verified by the host.

PERFORM DIAGNOSTICS (0x40)

The Perform Diagnostics command causes the Jaguar to perform a set of pass/fail self-diagnostic tests that are more extensive than those performed during the power-up self test. These self-diagnostic tests include an extensive RAM test (scratchpad, buffer, and event RAM). All of the tests are performed, and then the status of each test is reported back in the Command Response Block. Due to the nature of these tests, the Perform Diagnostics command cannot be executed while the Jaguar is operating. The Jaguar returns an error if this command is issued while ANY other command is queued.

Since it takes 15 - 20 seconds for the Jaguar to complete such a thorough self-diagnostic routine (and due to the relative completeness of the power-up self tests), this command probably should not be used as part of the normal initialization routine in a system driver.

The Perform Diagnostics command must be issued through the Master Command Entry to Work Queue 0.

After executing this command, it is necessary to reset the 4210 before issuing additional commands to it.

WORD #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND CODE (0x40)															
0x1 To 0xD	RESERVED															
0xE	**ROM TEST RESULT**															
0xF	**SCRATCHPAD RAM TEST RESULT**															
0x10	**BUFFER RAM TEST RESULT**															
0x11	**EVENT RAM TEST RESULT**															
0x12	**PRIMARY SCSI PORT REGISTER TEST**															
0x13	**SECONDARY SCSI PORT REGISTER TEST**															

NOTES:
Fields set in bold capital letters are returned values.
All other values are host provided. Reserved fields must be cleared to 0 by the host.

Figure 5-5. Perform Diagnostics IOPB

The remainder of this section describes the function of each field in the Perform Diagnostics IOPB.

HOST-PROVIDED IOPB FIELDS

The following information must be provided in the IOPB for the Perform Diagnostics command:

COMMAND CODE (2 BYTES)

This field must be set to 0x40 to execute the Perform Diagnostics command.

RETURNED VALUES

Upon command completion, the following information is provided by the Jaguar in the returned IOPB for the Perform Diagnostics command:

ROM TEST RESULT (2 BYTES)

These bytes return the status of the ROM Test. A test result of 0xFFFF indicates that the test completed successfully. Any other value indicates that the test failed.

SCRATCHPAD RAM TEST RESULT (2 BYTES)

These bytes return the status of the Scratchpad RAM Test. A test result of 0xFFFF indicates that the test completed successfully. Any other value indicates that the test failed.

BUFFER RAM TEST RESULT (2 BYTES)

These bytes return the status of the Buffer RAM Test. A test result of 0xFFFF indicates that the test completed successfully. Any other value indicates that the test failed.

EVENT RAM TEST RESULT (2 BYTES)

These bytes return the status of the Event RAM Test. A test result of 0xFFFF indicates that the test completed successfully. Any other value indicates that the test failed.

PRIMARY SCSI PORT REGISTER TEST (2 BYTES)

These bytes return the status of the Primary SCSI Port Register Test. A test result of 0xFFFF indicates that the test completed successfully. Any other value indicates that the test failed.

SCSI SECONDARY PORT REGISTER TEST (2 BYTES)

These bytes return the status of the SCSI Secondary Port Register Test. A test result of 0xFFFF indicates that the test completed successfully. Any other value indicates that the test failed.

INITIALIZE CONTROLLER (0x41)

The Initialize Controller command configures the Jaguar for use in a particular system. The host must issue this command before the Jaguar can engage in any activity on the SCSI bus.
This command must be issued through the Master Command Entry to Work Queue 0.

The format of the IOPB for the Initialize Controller command is:

Word #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND CODE (0x41)															
0x1	COMMAND OPTIONS															
0x2	**RETURN STATUS**															
0x3	RESERVED															
0x4	NORMAL COMPLETION VECTOR								ERROR COMPLETION VECTOR							
0x5	INTERRUPT LEVEL															
0x6	RESERVED															
0x7	RESERVED						TT		MT		ADDRESS MODIFIER					
0x8	BUFFER ADDRESS															
0x9																
0xA	MAXIMUM TRANSFER LENGTH															
0xB																
0xC	RESERVED															
0xD																

NOTES:
Fields set in bold capital letters are returned values.
All other values are host provided. Reserved fields must be cleared to 0 by the host.

Figure 5-6. Initialize Controller IOPB

The remainder of this section describes the function of each field in the Initialize Controller IOPB.

HOST-PROVIDED IOPB FIELDS

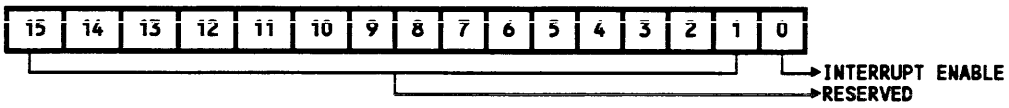
The following information must be provided in the IOPB for the Initialize Controller command:

COMMAND CODE (2 BYTES)

This field must be set to 0x41 to execute the Initialize Controller command.

COMMAND OPTIONS (2 BYTES)

This field contains the options for this command. The bits are defined as follows:



Bit 0 Interrupt Enable (IE):

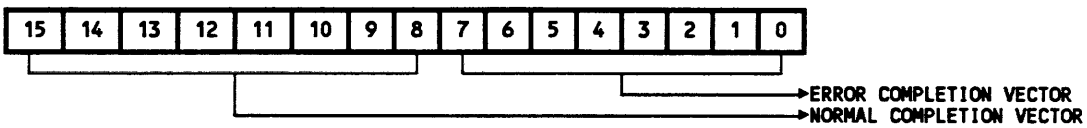
Setting this bit enables the Jaguar to interrupt the host upon command completion. Clearing the bit disables the Command Complete interrupt.

Bits 1–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

NORMAL COMPLETION VECTOR/ERROR COMPLETION VECTOR (2 BYTES)

These two bytes specify the VMEbus interrupt vectors that the Jaguar will use to report normal command completion and command completion with error.



Bits 0–7 Error Completion Vector:

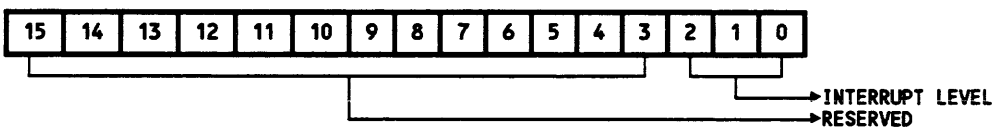
This value specifies the interrupt vector used when notifying the host of command completion with error.

Bits 8–15 Normal Completion Vector:

This value specifies the interrupt vector used when notifying the host that the command completed without error.

INTERRUPT LEVEL (2 BYTES)

This field specifies the VMEbus interrupt level used to notify the host of a command completion (normal or with error).



Bits 0–2 Interrupt Level (LVL):

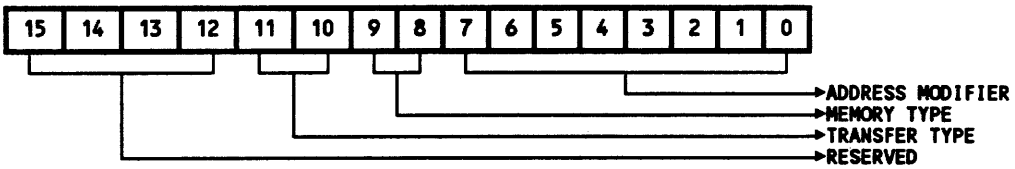
These bits set the interrupt level used by the Jaguar to assert a Command Complete interrupt on the VMEbus. Values of 0 through 7 are allowed, but a level of 0 is allowed only when interrupts are disabled (Interrupt Enable bit = 0 in the Command Options word).

Bits 3–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

ADDRESS MODIFIER/MEMORY TYPE TRANSFER TYPE (2 BYTES)

These bytes specify the address modifier, memory type, and transfer type to be used for all VMEbus transfers associated with the command.



Bits 0–7 Address Modifier:

This byte must be cleared to 0x00 in the Initialize Controller Command.

Bits 8–9 Memory Type (MT):

The only valid entry in this 2-bit field is 0x3 (data is located in short I/O space).

Table 5-8. Memory Type Field For Initialize Controller Command

BIT 9	BIT 8	MEMORY TYPE
0	0	(RESERVED)
0	1	(RESERVED)
1	0	(RESERVED)
1	1	Data is contained in short I/O

Bits 10–11 Transfer Type (TT):

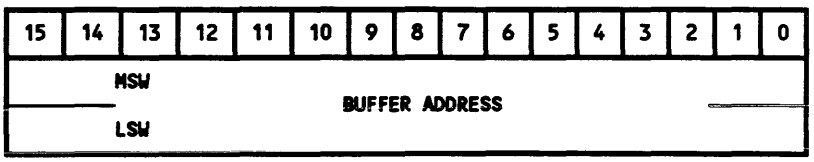
This 2-bit field must be cleared to 0.

Bits 12–15 Reserved (RSRV):

These bits are reserved and must be cleared to 0 by the host.

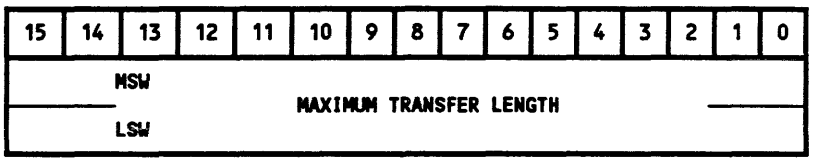
BUFFER ADDRESS (4 BYTES)

This field contains the offset of the Controller Initialization Block from the short I/O base address.



MAXIMUM TRANSFER LENGTH (4 BYTES)

This field specifies the maximum number of bytes that may be transferred by the command.



CONTROLLER INITIALIZATION BLOCK

The Buffer Address of the Initialize Controller IOPB points to a list of initialization parameters called the Controller Initialization Block (CIB). The host must assemble the Controller Initialization Block in the Host Usable Space (HUS) before issuing the Initialize Controller command. Once it issues the Initialize Controller command, the host cannot modify the CIB until it receives a Command Complete interrupt for the initialize command.

The format of the Controller Initialization Block is as follows:

WORD	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	NUMBER OF COMMAND QUEUE ENTRIES IN SHORT I/O															
0x1	DMA BURST COUNT															
0x2	CONTROLLER NORMAL COMPLETION LEVEL/VECTOR															
0x3	CONTROLLER ERROR COMPLETION LEVEL/VECTOR															
0x4	PRIMARY SCSI BUS ID															
0x5	SECONDARY SCSI BUS ID															
0x6	COMMAND RESPONSE BLOCK OFFSET															
0x7	SCSI SELECTION TIMEOUT (IN MILLISECONDS)															
0x8																
0x9	WORK QUEUE 0 COMMAND TIMEOUT															
0xA																
0xB	VMEBUS TIMEOUT (0 = 100msec TIMEOUT)															
0xC																
0xD	RESERVED															
0xE																
0xF	OFFBOARD CRB MEMORY TYPE/TRANSFER TYPE/ADDRESS MOD.															
0x10	HOST MEMORY ADDRESS FOR OFFBOARD COMMAND RESPONSE BLOCK (If offboard CRB is being implemented)															
0x11																
0x12	ERROR RECOVERY FLAGS															
0x13	RESERVED															

Figure 5-7. Controller Initialization Block

The following is a description of each field in the Controller Initialization Block.

NUMBER OF COMMAND QUEUE ENTRIES (2 BYTES)

This field sets the number of entries in the Command Queue. The Command Queue must have at least one entry. The maximum number of entries varies greatly depending on the application. If you are using onboard IOPBs, which require that both the Command Queue entry and its corresponding IOPB be written to Host Usable Space in short I/O, the maximum number of entries is relatively limited. A typical setup for onboard IOPBs is a 10-entry Command Queue. (Note, however, that each CQE/IOPB only resides in short I/O for a very short period of time before being transferred into the appropriate work queue.)

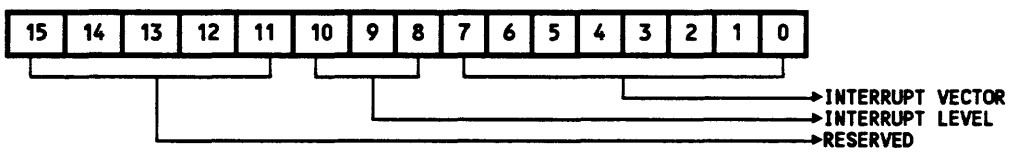
A much larger Command Queue is allowed in applications using offboard IOPBs, in which the Jaguar DMAs IOPBs directly from system memory into the appropriate work queue. (See ``Offboard IOPBs," Chapter 6.) Nevertheless, the size of the Command Queue is still application-dependent. The maximum number of Command Queue entries in a setup using offboard IOPBs typically ranges from 60 to 100 entries.

DMA BURST COUNT (2 BYTES)

The DMA Burst Count specifies, in bytes, the number of VMEbus transfers performed in a single burst before releasing and re-requesting the bus. The maximum burst values are 128 (512 ÷ 4) for 32-bit transfers or 256 (512 ÷ 2) for 16-bit transfers. Setting the burst count to 0 will specify the maximum burst size. VMEbus transfers are either 16-bit or 32-bit; therefore, the burst count should be a byte multiple of the transfer size (i.e. 2,4,6...256 for 16-bit transfers or 4,8,12...128 for 32-bit transfers).

CONTROLLER NORMAL COMPLETION LEVEL/VECTOR (2 BYTES)

This field specifies the interrupt level and vector that the Jaguar will use when reporting the normal completion of the following two commands: 1) Flush All Queues and Report, and 2) Flush All Queues.



Bits 0–7 Interrupt Vector (IV):

These bits set the Interrupt Vector used by the Jaguar when reporting normal controller interrupts.

Bits 8–10 Interrupt Level (IL):

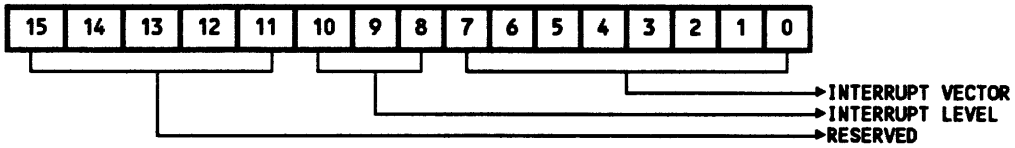
These bits are the interrupt level used by the Jaguar when reporting normal controller interrupts. The host sets these bits and the Jaguar does not modify them.

Bits 11–15 Reserved (RSRV):

Bits 11 through 15 are reserved and should be cleared to 0 by the host.

CONTROLLER ERROR COMPLETION LEVEL/VECTOR (2 BYTES)

This field specifies the interrupt level and vector that the Jaguar will use when reporting a variety of controller errors. Such errors will not generate an interrupt if the interrupt level is set to 0. However, the board will still report such errors to the Command Response Block. For additional information on this field, refer to "Controller Error Interrupt and Vector".



Bits 0–7 Interrupt Vector (IV):

This byte is the Interrupt Vector used by the Jaguar when reporting Controller Error Interrupts.

Bits 8–10 Interrupt Level (IL):

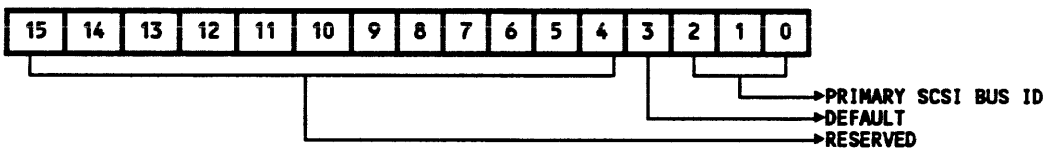
These bits set the Interrupt Level used by the Jaguar when reporting the Controller Error Interrupts.

Bits 11–15 Reserved (RSRV):

Bits 11 through 15 are reserved and should be cleared to 0 by the host.

PRIMARY SCSI BUS ID (2 BYTES)

The Primary SCSI Bus ID specifies the ID the Jaguar uses for the SCSI bus address on Port 0. The Jaguar can either use its default ID or it may use the value given in bits 0 through 2.



Bits 0–2 Primary SCSI Bus ID (ID):

If Bit 3 (DFT) is cleared, the value stored in this field will be used by the Jaguar as the Primary SCSI Bus ID. This field may have any value from 0x0 to 0x7.

Bit 3 Default (DFT):

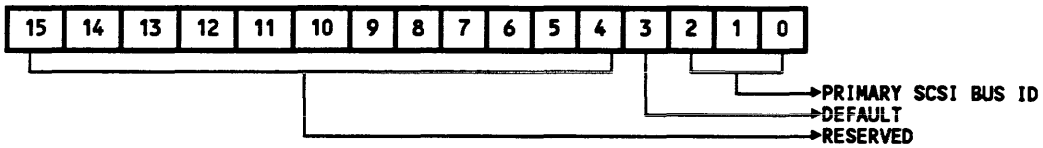
Setting the Default bit to `1'enables the Jaguar to use the default ID specified by Switch Block SW1 . Clearing the Default bit causes the Jaguar to use the ID specified in the ID field (bits 0-2) of this word.

Bits 4–15 Reserved (RSRV):

These bits are reserved and must be cleared to 0 by the host.

SECONDARY SCSI BUS ID (2 BYTES)

The Secondary SCSI Bus ID specifies the ID the Jaguar uses for the SCSI bus address on Port 1. The Jaguar can either use its default ID or it may use the value given in bits 0 through 2.



Bits 0–2 Secondary SCSI Bus ID (ID):

The host uses these 3 bits to specify the SCSI ID the Jaguar is to use for Port 1 when the DFT bit is `0'. This field may have any value from 0x0 to 0x7.

Bit 3 Default (DFT):

Setting the Default bit to `1' enables the Jaguar to use the default ID specified by the SCSI daughter card's jumpers. Clearing the Default bit causes the Jaguar to use the ID specified in the ID field (bits 0-2) of this word.

Bits 4–15 Reserved (RSRV):

These bits are reserved and must be cleared to 0 by the host.

COMMAND RESPONSE BLOCK OFFSET (2 BYTES)

The Command Response Block Offset word specifies the starting address of the Command Response Block. By setting the Command Response Block Offset, the host is also specifying the length of the largest IOPB that can be transferred to the Jaguar. The largest IOPB is equal to the offset of the Controller Specific Space (0x788) minus the Command Response Block Offset, minus 12 bytes. If the Command Response Block Offset is 0x73C, for example, the largest IOPB cannot exceed 64 bytes (0x788 - 0x73C - 0xC).

The Command Response Block Offset must allow for a Command Response Block of at least 18 bytes so that there will always be enough room in the Command Response Block to include the status bytes of the returned IOPB. Attempting to use a Command Response Block Offset that would result in a Command Response Block of less than 18 bytes will result in the Initialize Controller Command completing with an error.

SCSI SELECTION TIMEOUT (4 BYTES)

The selection timeout causes an IOPB to be terminated with an error status if a device does not respond to selection within the programmed period of time. It is specified in increments of 1 millisecond. The same value is used for all devices. A value of `0' specifies an infinite timeout. In general, selection timeouts do not require error handling. They simply prevent the board from becoming locked up by trying to select a device that does not exist.

WORK QUEUE 0 COMMAND TIMEOUT (4 BYTES)

This timeout specifies a timeout value for commands issued through Work Queue 0. This field is specified in increments of approximately 256msec. A value of 0 specifies no timeout. The Jaguar notifies the host of an IOPB timeout by use of the Controller Error interrupt. This interrupt will be used to return error status without returning the IOPB that caused the error. Bit 7 of the Command Response Status Word allows the allows the host to determine the source of the error. Also data returned in the command response block has been defined to specify the type of error that has occurred. Refer to ``Error Recovery Tools" in Chapter 6 for additional details.

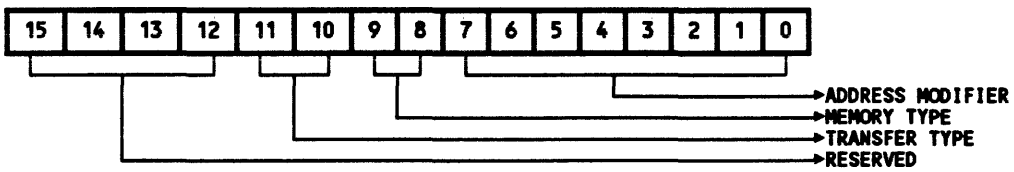
VMEBUS TIMEOUT (4 BYTES)

This long word field specifies the length of time the Jaguar will wait for a VMEbus transfer to complete. A value of '0' specifies a timeout of 100 milliseconds. Any other value specifies a timeout value in increments of approximately 30 milliseconds.

OFFBOARD MEMORY TYPE/TRANSFER TYPE/ADDRESS MODIFIER (2 BYTES)

This field is intended for applications which use the Jaguar's offboard IOPB feature (see ``Offboard iOPBs" in Chapter 6. If this field and the Offboard Command Response Block Address field (below) are '0', the Jaguar will post the Command Response Block to the short I/O space only. If these fields are non-zero, then the Jaguar will also post the Command Response Block to the specified offboard address.

The Offboard Command Response Block Memory Type/Transfer Type/Address Modifier field are used when writing the Command Response Block to system memory. The format of this field is as follows.



Bits 0–7 Address Modifier:

This byte is the address modifier used for writing the Command Response Block to system memory. This byte is not changed by the Jaguar.

Bits 8–9 Memory Type (MT):

This two-bit field specifies the data transfer memory width used to write to the offboard Command Response Block.

Table 5-9. Memory Type Field For Offboard Command Response Block

BIT 9	BIT 8	MEMORY TYPE
0	0	(RESERVED)
0	1	16-BIT TRANSFERS
1	0	32-BIT TRANSFERS
1	1	(RESERVED)

Bits 10–11 Transfer Type (TT):

This two-bit field specifies the type of transfer performed.

Table 5-10. Transfer Type Field For Offboard Command Response Block

BIT 11	BIT 10	TRANSFER TYPE
0	0	NORMAL MODE
0	1	BLOCK MODE
1	0	(RESERVED)
1	1	(RESERVED)

Bits 12–15 Reserved (RSRV):

These bits are reserved and must be cleared to 0 by the host.

HOST MEMORY ADDRESS FOR OFFBOARD CRB (4 BYTES)

This field is intended for applications which use the Jaguar's offboard IOPB feature (see "Offboard IOPBs" in Chapter 6). This address is used to write the Command Response Block to system memory. As noted above, if this field and the Offboard Command Response Block Memory Type/Transfer Type/Address Modifier field are both '0', the Jaguar will post IOPBs to the onboard Command Response Block only.

ERROR RECOVERY FLAGS (2 BYTES)

This field is used to control error recovery features. Currently, one option - Freeze Work Queues on SCSI Reset - is supported:

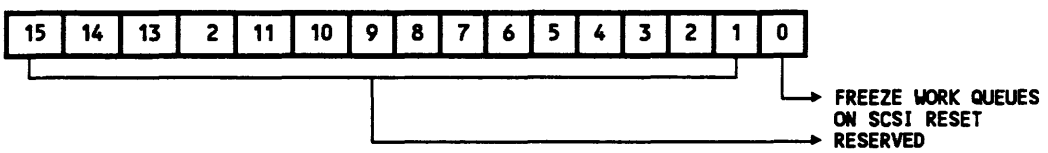


Figure 5-8. Error Recovery Options In Controller Initialization Block

Setting Bit 0 causes the Jaguar to freeze a work queue if a Reset occurs on the SCSI bus while a command is active on the bus from that work queue. With this feature enabled, the host ``knows" the work queue is frozen if a command is returned from the queue with a SCSI bus reset error status. This allows it to decide how to handle the SCSI reset before permitting new commands to be sent to the device. **This is the preferred mode of operation.** In general, the bit should only be cleared if you need to maintain driver compatibility with earlier firmware that did not freeze work queues after a SCSI reset had terminated a command from that queue. Refer to Chapter 6, ``Error Recovery Tools", for more information.

RETURNED VALUES

Upon command completion, the following information is provided by the Jaguar in the returned IOPB for the Initialize Controller command:

RETURN STATUS (2 BYTES)

These two bytes hold the returned status of the command. Any non-zero value indicates an error code. A list of valid error codes is provided in Appendix C.

INITIALIZE WORK QUEUE (0x42)

The Initialize Work Queue command is used to configure Work Queues 1 - 14. Each work queue must be initialized with a separate Initialize Work Queue command.

This command must be issued through the Master Command Entry to Work Queue 0.

NOTE

Work Queue 0 is auto-initialized by the Jaguar upon power-up and cannot be reinitialized.

The format of the Initialize Work Queue IOPB is as follows:

WORD	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND CODE (0x42)															
0x1	COMMAND OPTIONS															
0x2	RETURN STATUS															
0x3	RESERVED															
0x4	NORMAL COMPLETION VECTOR								ERROR COMPLETION VECTOR							
0x5	INTERRUPT LEVEL															
0x6 To 0xD	RESERVED															
0xE	WORK QUEUE NUMBER															
0xF	WORK QUEUE OPTIONS															
0x10	NUMBER OF WORK QUEUE SLOTS															
0x11	RESERVED															
0x12	COMMAND TIMEOUT															
0x13	RESERVED															

NOTES:
Fields set in bold letters are returned values.
All other values are host provided. Reserved fields must be cleared to 0 by the host.

Figure 5-9. Initialize Work Queue IOPB

The remainder of this section describes the function of each field in the Initialize Work Queue IOPB.

HOST-PROVIDED IOPB FIELDS

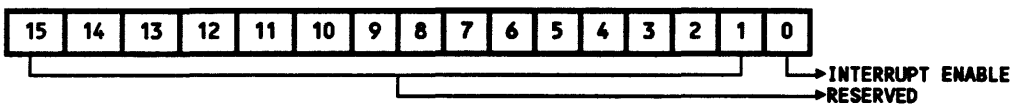
The following information must be provided in the IOPB for the Initialize Work Queue command:

COMMAND CODE (2 BYTES)

This field must be set to 0x42 to execute the Initialize Work Queue command.

COMMAND OPTIONS (2 BYTES)

This field contains the options for this command. The bits are defined as follows:



Bit 0 Interrupt Enable (IE):

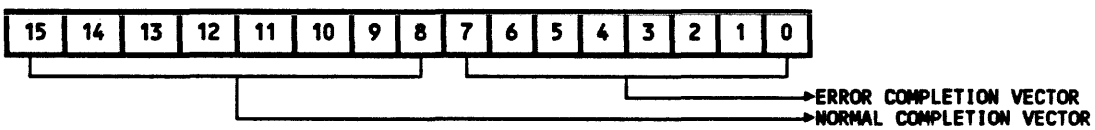
Setting this bit enables the Jaguar to interrupt the host upon command completion. Clearing the bit disables the Command Complete interrupt.

Bits 1–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

NORMAL COMPLETION VECTOR/ERROR COMPLETION VECTOR (2 BYTES)

These two bytes specify the VMEbus interrupt vectors that the Jaguar will use to report normal command completion and command completion with error.



Bits 0–7 Error Completion Vector:

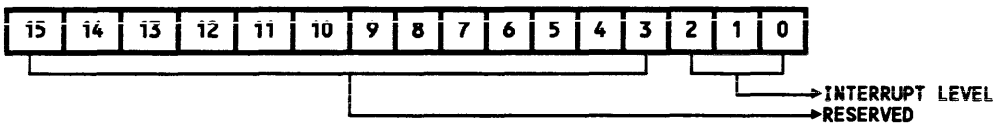
This value specifies the interrupt vector used when notifying the host of command completion with error.

Bits 8–15 Normal Completion Vector:

This value specifies the interrupt vector used when notifying the host that the command completed without error.

INTERRUPT LEVEL (2 BYTES)

This field specifies the VMEbus interrupt level used to notify the host of a command completion (normal or with error).



Bits 0–2 Interrupt Level (LVL):

These bits set the interrupt level used by the Jaguar to assert a Command Complete interrupt on the VMEbus. Values of 0 through 7 are allowed, but a level of 0 is allowed only when interrupts are disabled (Interrupt Enable bit = 0 in the Command Options word).

Bits 3–15 Reserved:

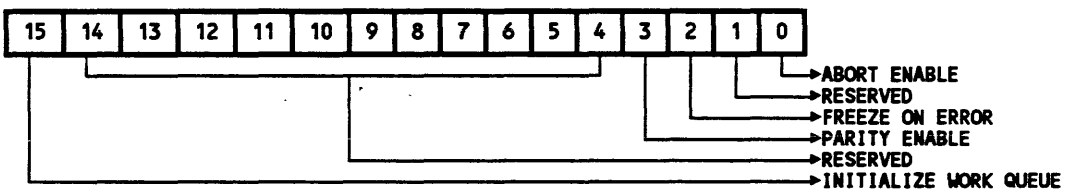
These bits are reserved and must be cleared to 0 by the host.

WORK QUEUE NUMBER (2 BYTES)

This number identifies which work queue to initialize. Each work queue must be assigned a unique number. Valid entries in this field are 0x1 - 0xE to initialize Work Queues 1 - 14, respectively.

WORK QUEUE OPTIONS (2 BYTES)

This field is used to set a variety of options this work queue.



Bit 0 Abort Enable (AE):

Setting Bit 0 enables the Jaguar to abort all IOPBs in the work queue, and all IOPBs in the Command Queue entry destined for the work queue, when an IOPB from this queue completes with an error.

Clearing the bit disables the aborting of remaining queue entries when one command terminates with an error. (See Queue Entry Control Register, Abort Acknowledge bit).

Bit 1 Reserved (RSRV):

This bit is reserved and must be cleared to 0 by the host.

Bit 2 Freeze on Error (FZE):

The Freeze Work bit (FZE) is set during the Work Queue Init command. This attribute will be in effect for that queue only. All commands that do not return a good status will freeze the queue. When the host sees a command return from a work queue that has Freeze on Error enabled with a SCSI device error, the host must unfreeze (thaw) the work queue after taking the error handling steps needed for that particular error.

The frozen work queue is unfrozen by selecting that work queue number in the Thaw Queue Register and then setting Bit 0 of that register. The Jaguar will clear the register to acknowledge the thawing of the work queue. The Thaw Work Queue Status Register is located in the fourth word of the Master Control/Status Block.

Refer to Chapter 6, "Error Recovery Tools", for a discussion of freeze/thaw work queue operation.

Bit 3 Parity Enable (PE):

The Parity Enable bit enables SCSI bus parity checking for commands issued from the work queue.

Bits 4 – 14 Reserved:

These bits are reserved and must be cleared to 0 by the host.

Bit 15 Initialize Work Queue (IWQ):

The Initialize Work Queue (IWQ) bit causes the Jaguar to initialize the work queue even if it has been previously initialized. If commands are pending when the Jaguar attempts to execute an Initialize Work Queue command, the Initialize Work Queue IOPB will not be executed and the IOPB will return with an error status.

NUMBER OF SLOTS (2 BYTES)

This field contains the number of slots in the work queue. Each work queue can have as many slots as you want. However, if the total number of commands queued-up in the Jaguar's internal work queues reaches a certain number (approx. 100), the board will not accept additional commands from the Command Queue until work queue space is freed up. No error message is generated.

COMMAND TIMEOUT (2 BYTES)

This value specifies the maximum time that a command issued to this work queue should take to execute after the device has been selected. This allows each work queue (i.e. SCSI device) to run a unique timeout value. The timeout value is used from the successful completion of the selection phase until the completion of the command on the SCSI bus. This timeout includes all disconnect periods. The timeout is specified in increments of approximately 256msec. That is, a value of 0x1 in this field specifies a timeout period of approximately 256msec. **NOTE:** The actual value may vary between 220 and 280msec.

If the timeout value is non-zero, the Jaguar will issue a Controller Error Interrupt when the timeout period expires. The Jaguar notifies the host of the command timeout by use of the Controller Error Interrupt. This interrupt returns an error status without returning the IOPB that caused the error. Bit 7 of the Command Response Status Word allows the allows the host to determine the source of the error. Also, data returned in the Command Response Block can be used to help determine the type of error that has occurred. Refer to ``Command Timeout" in Chapter 6 for additional information.

RETURNED VALUES

Upon command completion, the following information is provided by the Jaguar in the returned IOPB for the Initialize Work Queue command.

RETURN STATUS (2 BYTES)

These two bytes hold the returned status of the command. Any non-zero value indicates an error code. A list of valid error codes is provided in Appendix C.

DUMP INITIALIZATION PARAMETERS (0x43)

The Dump Initialization Parameters command causes the Jaguar to report its current initialization/setup information to the host. This command is intended to be used primarily for diagnostic purposes.

This command must be issued through the Master Command Entry to Work Queue 0.

The format of the IOPB for the Dump Initialization Parameters command is shown below:

WORD #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND CODE (0x43)															
0x1	COMMAND OPTIONS															
0x2	RETURN STATUS															
0x3	RESERVED															
0x4	NORMAL COMPLETION VECTOR								ERROR COMPLETION VECTOR							
0x5	INTERRUPT LEVEL															
0x6	RESERVED															
0x7	RESERVED						TT		MT		ADDRESS MODIFIER					
0x8	BUFFER ADDRESS															
0x9																
0xA	MAXIMUM TRANSFER LENGTH															
0xB																
0xC	RESERVED															
0xD																

NOTES:
Fields set in bold capital letters are returned values.
All other values are host provided. Reserved fields must be cleared to 0 by the host.

Figure 5-10. Dump Initialization Parameters IOPB

The remainder of this section describes the function of each field in the Dump Initialization Parameters IOPB.

HOST-PROVIDED IOPB FIELDS

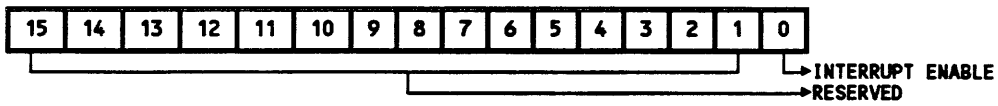
The following information must be provided in the IOPB for the Dump Initialization Parameters command:

COMMAND CODE (2 BYTES)

This field must be set to 0x43 to execute the Dump Initialization Parameters command.

COMMAND OPTIONS (2 BYTES)

This field contains the options for this command. The bits are defined as follows:



Bit 0 Interrupt Enable (IE):

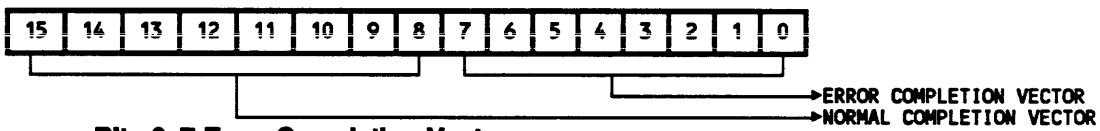
Setting this bit enables the Jaguar to interrupt the host upon command completion. Clearing the bit disables the Command Complete interrupt.

Bits 1–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

NORMAL COMPLETION VECTOR/ERROR COMPLETION VECTOR (2 BYTES)

These two bytes specify the VMEbus interrupt vectors that the Jaguar will use to report normal command completion and command completion with error.



Bits 0–7 Error Completion Vector:

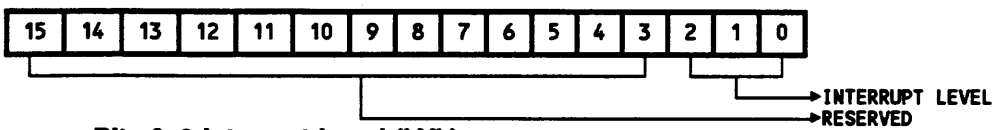
This value specifies the interrupt vector used when notifying the host of command completion with error.

Bits 8–15 Normal Completion Vector:

This value specifies the interrupt vector used when notifying the host that the command completed without error.

INTERRUPT LEVEL (2 BYTES)

This field specifies the VMEbus interrupt level used to notify the host of a command completion (normal or with error).



Bits 0–2 Interrupt Level (LVL):

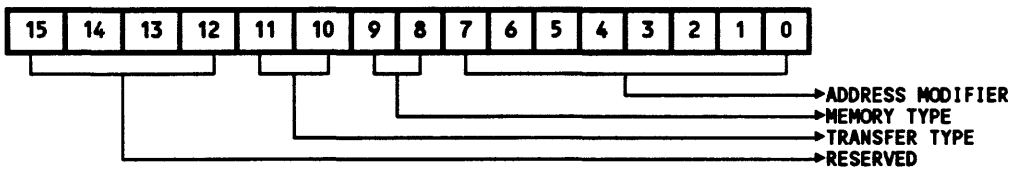
These bits set the interrupt level used by the Jaguar to assert a Command Complete interrupt on the VMEbus. Values of 0 through 7 are allowed, but a level of 0 is allowed only when interrupts are disabled (Interrupt Enable bit = 0 in the Command Options word).

Bits 3–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

MEMORY TYPE/TRANSFER TYPE/ADDRESS MODIFIER (2 BYTES)

This specifies the memory type and address modifier to be used for any VMEbus transfers associated with the Dump Initialization Parameters command.



Bits 0–7 Address Modifier:

This byte must be cleared for the Dump Initialization Parameters command.

Bits 8–9 Memory Type (MT):

The only valid entry in this 2-bit field is 0x3, indicating that the data for this command is located in short I/O.

Table 5-11. Memory Type (MT) Field For Dump Initialization Parameters Command

BIT 9	BIT 8	MEMORY TYPE
0	0	(RESERVED)
0	1	(RESERVED)
1	0	(RESERVED)
1	1	Data is contained in short I/O

Bits 10–11 Transfer Type (TT):

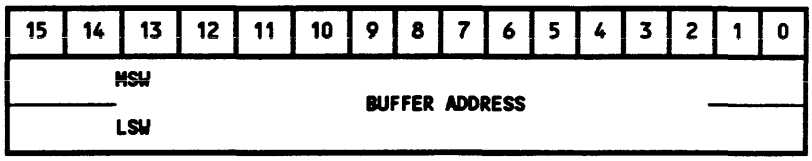
These bits must be cleared to 0.

Bits 12–15 Reserved (RSRV):

These bits are reserved and must be cleared to 0 by the host.

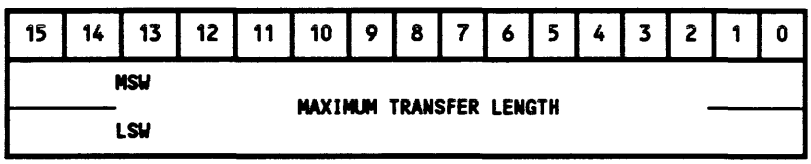
BUFFER ADDRESS (4 BYTES)

This field specifies the offset into short I/O at which the Jaguar is to start writing the initialization parameter list. **NOTE:** The list should be written into Host Usable Space.



MAXIMUM TRANSFER LENGTH (4 BYTES)

This field specifies the maximum number of bytes that may be transferred by the command.



RETURNED VALUES

Upon command completion, the following information is provided by the Jaguar in the returned IOPB for the Dump Initialization Parameters command:

RETURN STATUS (2 BYTES)

These two bytes hold the returned status of the command. Any non-zero value indicates an error code. A list of valid error codes is provided in Appendix C.

The Jaguar also writes the initialization parameters to the section of short I/O specified by the host, as discussed on the next page.

DUMP INITIALIZATION PARAMETERS BLOCK

When it executes the Dump Initialization Parameters command, the Jaguar writes the parameter list into short I/O, starting at the offset provided in the Buffer Address field of the IOPB.

The parameter list, which has the same format as the Controller Initialization Block, is depicted below:

WORD #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	NUMBER OF COMMAND QUEUE ENTRIES IN SHORT I/O															
0x1	DMA BURST COUNT															
0x2	CONTROLLER NORMAL COMPLETION LEVEL/VECTOR															
0x3	CONTROLLER ERROR COMPLETION LEVEL/VECTOR															
0x4	PRIMARY SCSI BUS ID															
0x5	SECONDARY SCSI BUS ID															
0x6	COMMAND RESPONSE BLOCK OFFSET															
0x7	SCSI SELECTION TIMEOUT (IN MILLISECONDS)															
0x8																
0x9	WORK QUEUE 0 COMMAND TIMEOUT															
0xA																
0xB	VMEBUS TIMEOUT (0 = 100msec TIMEOUT)															
0xC																
0xD	RESERVED															
0xE																
0xF	OFFBOARD CRB MEMORY TYPE/TRANSFER TYPE/ADDRESS MOD.															
0x10	HOST MEMORY ADDRESS FOR OFFBOARD COMMAND RESPONSE BLOCK (If offboard CRB is being implemented)															
0x11																
0x12	ERROR RECOVERY FLAGS															
0x13	RESERVED															

Figure 5-11. Dump Initialization Parameter Block

For an explanation of the fields in the Dump Initialization Parameters Block, please refer to the Controller Initialization Block.

DUMP WORK QUEUE PARAMETERS (0x44)

The Dump Work Queue Parameters command causes the Jaguar to report the current parameters of an individual work queue to the host. The host provides the work queue number. Note that a work queue must be initialized before its parameters can be dumped.

This command must be issued through the Master Command Entry to Work Queue 0.

The format of the IOPB for the Dump Work Queue Parameters command is shown below:

WORD	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND CODE (0x44)															
0x1	COMMAND OPTIONS															
0x2	**RETURN STATUS**															
0x3	RESERVED															
0x4	NORMAL COMPLETION VECTOR								ERROR COMPLETION VECTOR							
0x5	INTERRUPT LEVEL															
0x6 To 0xD	RESERVED															
0xE	WORK QUEUE NUMBER															
0xF	**WORK QUEUE OPTIONS**															
0x10	**NUMBER OF WORK QUEUE SLOTS**															
0x11	RESERVED															
0x12	**COMMAND TIMEOUT**															
0x13	RESERVED															

NOTES:
Fields set in bold letters are returned values.
All other values are host provided. Reserved fields must be cleared to 0 by the host.

Figure 5-12. Dump Work Queue Parameters IOPB

The remainder of this section describes the function of each field in the Dump Work Queue Parameters IOPB.

HOST-PROVIDED IOPB FIELDS

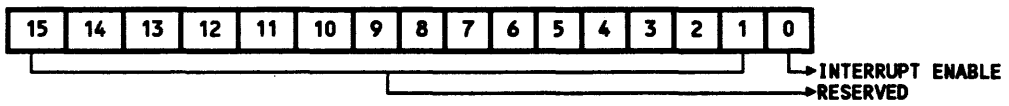
The following information must be provided in the IOPB for the Dump Work Queue Parameters command:

COMMAND CODE (2 BYTES)

This field must be set to 0x44 to execute the Dump Work Queue Parameters command.

COMMAND OPTIONS (2 BYTES)

This field contains the options for this command. The bits are defined as follows:



Bit 0 Interrupt Enable (IE):

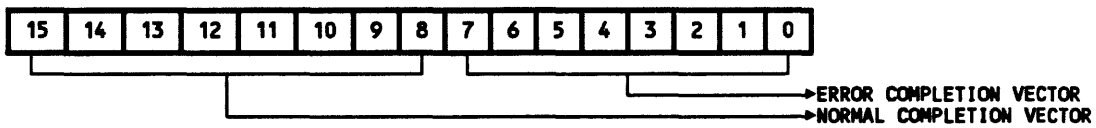
Setting this bit enables the Jaguar to interrupt the host upon command completion. Clearing the bit disables the Command Complete interrupt.

Bits 1–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

NORMAL COMPLETION VECTOR/ERROR COMPLETION VECTOR (2 BYTES)

These two bytes specify the VMEbus interrupt vectors that the Jaguar will use to report normal command completion and command completion with error.



Bits 0–7 Error Completion Vector:

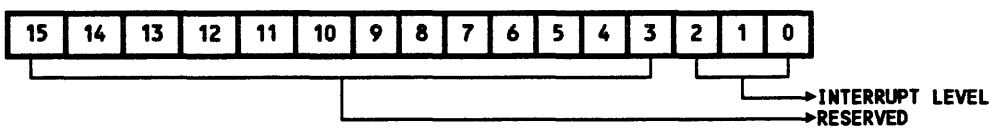
This value specifies the interrupt vector used when notifying the host of command completion with error.

Bits 8–15 Normal Completion Vector:

This value specifies the interrupt vector used when notifying the host that the command completed without error.

INTERRUPT LEVEL (2 BYTES)

This field specifies the VMEbus interrupt level used to notify the host of a command completion (normal or with error).



Bits 0–2 Interrupt Level (LVL):

These bits set the interrupt level used by the Jaguar to assert a Command Complete interrupt on the VMEbus. Values of 0 through 7 are allowed, but a level of 0 is allowed only when interrupts are disabled (Interrupt Enable bit = 0 in the Command Options word).

Bits 3–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

WORK QUEUE NUMBER (2 BYTES)

This number identifies the work queue whose parameters are to be dumped. Legal values in the field are 0x1 - 0xE (for Work Queues 1 - 14, respectively). If you specify an uninitialized work queue, the command will complete with an error and an illegal parameter status.

RETURNED VALUES

Upon command completion, the following information is provided by the Jaguar in the returned IOPB for the Dump Work Queue Parameters command:

RETURN STATUS (2 BYTES)

These two bytes hold the returned status of the command. Any non-zero value indicates an error code. A list of valid error codes is provided in Appendix C.

WORK QUEUE OPTIONS (2 BYTES)

This field contains the work queue options specified by the host when it initialized the work queue.

NUMBER OF WORK QUEUE SLOTS (2 BYTES)

This field contains the number of work queue slots specified by the host when it initialized the work queue.

COMMAND TIMEOUT (2 BYTES)

This field contains the command timeout specified by the host when it initialized the work queue.

BUS STATUS INQUIRY (0x45)

The Bus Status Inquiry command returns the command tag of any IOPB currently executing on the selected SCSI bus (Port 0 or Port 1). In addition it returns the command tags of any in-progress IOPBs. An in-progress IOPB is one which has been sent to a device but is not completed yet. Information in the returned IOPB can be used to identify which IOPB and device is causing an error condition.

During execution of this command, the Jaguar will stop all internal operations so that the response will reflect the state of the board at the time the Bus Status Inquiry IOPB is executed.

This command must be issued through the Master Command Entry to Work Queue 0.

The format of the Bus Status Inquiry IOPB is as follows:

WORD #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND CODE (0x45)															
0x1	COMMAND OPTIONS															
0x2	**RETURN STATUS**															
0x3	RESERVED															
0x4	NORMAL COMPLETION VECTOR								ERROR COMPLETION VECTOR							
0X5	INTERRUPT LEVEL															
0x6	**ACTIVE COMMAND TAG**															
0x7																
0x8 To 0xE	BUSY COMMAND TAGS															
0xF	BUS SELECTION / **BUSY COMMAND TAGS (cont.)**															
0x10 To 0x15	**BUSY COMMAND TAGS (cont.)**															

NOTES: Fields set in bold capital letters are returned values. All other values are host provided. Note that word 0xF in the above IOPB is issued with a host-provided value, but returned with a Jaguar-provided value. Reserved fields must be cleared to 0 by the host.

Figure 5-13. Bus Status Inquiry IOPB

The remainder of this section describes the function of each field in the Bus Status Inquiry IOPB.

HOST-PROVIDED IOPB FIELDS

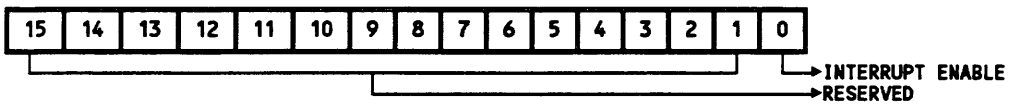
The following information must be provided in the IOPB for the Bus Status Inquiry command:

COMMAND CODE (2 BYTES)

This field must be set to 0x45 to execute the Bus Status Inquiry command.

COMMAND OPTIONS (2 BYTES)

This field contains the options for this command. The bits are defined as follows:



Bit 0 Interrupt Enable (IE):

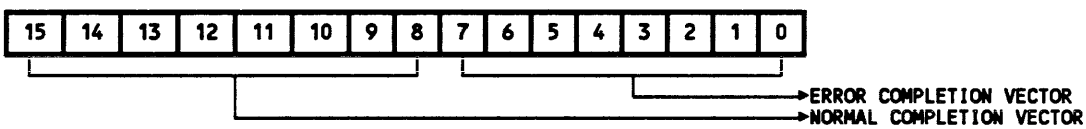
Setting this bit enables the Jaguar to interrupt the host upon command completion. Clearing the bit disables the Command Complete interrupt.

Bits 1–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

NORMAL COMPLETION VECTOR/ERROR COMPLETION VECTOR (2 BYTES)

These two bytes specify the VMEbus interrupt vectors that the Jaguar will use to report normal command completion and command completion with error.



Bits 0–7 Error Completion Vector:

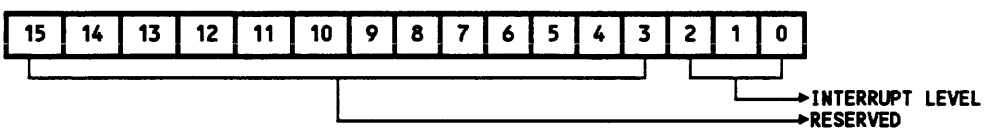
This value specifies the interrupt vector used when notifying the host of command completion with error.

Bits 8–15 Normal Completion Vector:

This value specifies the interrupt vector used when notifying the host that the command completed without error.

INTERRUPT LEVEL (2 BYTES)

This field specifies the VMEbus interrupt level used to notify the host of a command completion (normal or with error).



Bits 0–2 Interrupt Level (LVL):

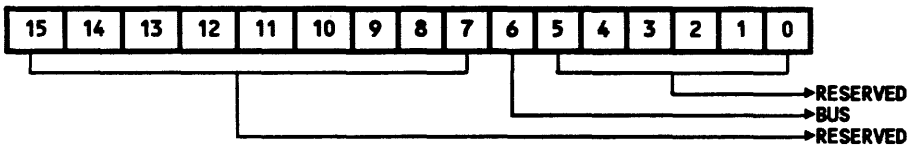
These bits set the interrupt level used by the Jaguar to assert a Command Complete interrupt on the VMEbus. Values of 0 through 7 are allowed, but a level of 0 is allowed only when interrupts are disabled (Interrupt Enable bit = 0 in the Command Options word).

Bits 3–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

BUS SELECTION (2 BYTES)

This field specifies which SCSI bus is the subject of the bus status inquiry.



Bits 0–5 Reserved:

These bits are reserved and must be cleared to 0 by the host.

Bit 6 Bus:

Clearing the Bus bit selects the primary SCSI bus (Port 0). Setting the bit selects the secondary SCSI bus (Port 1).

Bits 7–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

RETURNED VALUES

Upon command completion, the following information is provided by the Jaguar in the returned IOPB for the Bus Status Inquiry command:

RETURN STATUS (2 BYTES)

These two bytes hold the returned status of the command. Any non-zero value indicates an error code. A list of valid error codes is provided in Appendix C.

ACTIVE COMMAND TAG (4 BYTES)

The Active Command Tag field contains the command tag of a SCSI Pass-Through IOPB, if the command is being executed on the bus at the time that the Bus Status Inquiry is issued.

BUSY COMMAND TAGS

The Busy Command Tags fields will contain any other currently "in-progress" IOPBs that may not be able to complete due to the "hung" active command. There can be up to seven busy commands per port. (words 0x8 - 0x9, 0xA - 0xB, 0xC - 0xD, 0xE - 0xF, 0x10 - 0x11, 0x12 - 0x13, 0x14 - 0x15). **NOTE:** The host-provided value in word 0xF (Bus Selection) will be overwritten.

COMMAND STATUS INQUIRY (0x46)

This IOPB returns the state of a previously issued IOPB based on the command tag field. If the IOPB specified by the command tag is active on the bus, information will be returned to help identify the state of the SCSI activity. The Jaguar will suspend hardware operations until the status of the command is found and posted.

This command must be issued through the Master Command Entry to Work Queue 0.

The format of the IOPB is as follows:

WORD #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND CODE (0x46)															
0x1	COMMAND OPTIONS															
0x2	**RETURN STATUS**															
0x3	RESERVED															
0x4	NORMAL COMPLETION VECTOR								ERROR COMPLETION VECTOR							
0X6 To 0xF	RESERVED															
0x10	COMMAND TAG															
0x11																
0x12	**COMMAND STATUS FIELD**															
0x13	**LAST COMMAND ISSUED**															
0x14	**PHASE SENSE**															
0x15	RESERVED															

NOTES:
Fields set in bold capital letters are returned values. All other values are host provided. Reserved fields must be cleared to 0 by the host.

Figure 5-14. Command Status Inquiry IOPB

The remainder of this section describes the function of each field in the Command Status Inquiry IOPB.

HOST-PROVIDED IOPB FIELDS

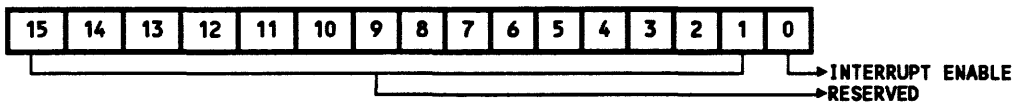
The following information must be provided in the IOPB for the Command Status Inquiry:

COMMAND CODE (2 BYTES)

This field must be set to 0x46 to execute the Command Status Inquiry command.

COMMAND OPTIONS (2 BYTES)

This field contains the options for this command. The bits are defined as follows:



Bit 0 Interrupt Enable (IE):

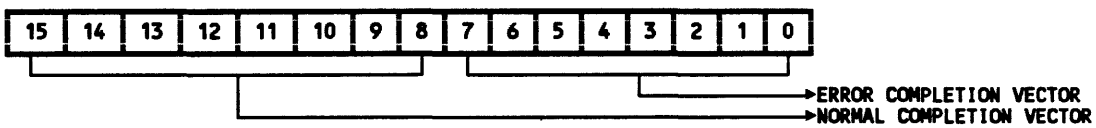
Setting this bit enables the Jaguar to interrupt the host upon command completion. Clearing the bit disables the Command Complete interrupt.

Bits 1–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

NORMAL COMPLETION VECTOR ERROR COMPLETION VECTOR (2 BYTES)

These two bytes specify the VMEbus interrupt vectors that the Jaguar will use to report normal command completion and command completion with error.



Bits 0–7 Error Completion Vector:

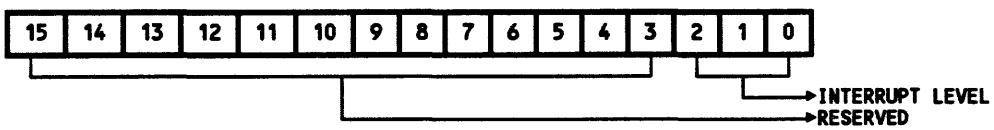
This value specifies the interrupt vector used when notifying the host of command completion with error.

Bits 8–15 Normal Completion Vector:

This value specifies the interrupt vector used when notifying the host that the command completed without error.

INTERRUPT LEVEL (2 BYTES)

This field specifies the VMEbus interrupt level used to notify the host of a command completion (normal or with error).



Bits 0–2 Interrupt Level (LVL):

These bits set the interrupt level used by the Jaguar to assert a Command Complete interrupt on the VMEbus. Values of 0 through 7 are allowed, but a level of 0 is allowed only when interrupts are disabled (Interrupt Enable bit = 0 in the Command Options word).

Bits 3–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

RETURNED VALUES

Upon command completion, the following information is provided by the Jaguar in the returned IOPB for the Command Status Inquiry:

RETURN STATUS (2 BYTES)

These two bytes hold the returned status of the command. Any non-zero value indicates an error code. A list of valid error codes is provided in Appendix C.

COMMAND STATUS FIELD AND ACTIVE COMMAND INFORMATION (6 BYTES)

Word 0x12 contains the returned command status. If the command is active, additional information is returned in words 0x13 and 0x14, as shown below:

WORD #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x12	COMMAND STATUS CODE															
0x13	LAST COMMAND ISSUED															
0x14	PHASE SENSE															
0x15	RESERVED															

Figure 5-15. Returned Fields for Command Status Inquiry

Valid returned values for the Command Status Field (CSF) are as follows:

Table 5-12. Returned Values for Command Status Field

CODE	EXPLANATION
0x0001	Command not found (command tag did not match)
0x0002	Command not in work queue (not executing yet)
0x0003	Command currently active (currently on SCSI bus)
0x0004	Command busy (currently disconnected)
0x0005	Command on Done Queue (The command is on the Jaguar' internal Done Queue and will have been received by the host before the response to the inquiry)
0x0006	Command in command queue (still in short I/O)

ACTIVE COMMAND ADDITIONAL INFORMATION FIELDS

If the command inquired about is currently active (0x03), the state of the controller and the SCSI bus is also reported back in two additional fields - LCMD (Last Command Issued to the Jaguar's SCSI Controller (Fujitsu 87030) and PSNS (phase sense).

Last Command Issued. This field indicates the last command issued to the Jaguar's SCSI controller (Fujitsu 87030). Valid returned values are shown below:

Table 5-13. Returned Values in Last Command Field

CODE	EXPLANATION
0x0000	Bus Release
0x0001	Select Device
0x0002	Reset Attention
0x0003	Set Attention
0x0004	Transfer Data
0x0005	Transfer Data Pause
0x0006	Reset SCSI Handshake Line
0x0007	Set SCSI Handshake Line

Phase Sense. This field indicates the current SCSI bus status. Valid returned values are shown below:

Table 5-14. Returned Values in Phase Sense Field

CODE	EXPLANATION
0x0007	Request
0x0006	Acknowledge
0x0005	Attention
0x0004	Select
0x0003	Busy
0x0002	Message
0x0001	Command/Data
0x0000	Input/Output

CANCEL COMMAND TAG (0x48)

This IOPB cancels the execution of a previously issued IOPB, based on the command tag specified in words 10-11 of the Cancel Command Tag IOPB. Issuing the command causes the Jaguar to find and cancel the *first* command tag that matches the one given in the IOPB. If multiple IOPBs exist with the same command tag, only the first one found will be canceled. If the Jaguar is unable to locate a command whose tag matches the one in the IOPB, it will return the Cancel Command Tag IOPB with an error.

This command must be issued through the Master Command Entry to Work Queue 0.

If an IOPB is canceled and subsequent SCSI activity attempts to complete the command, the Jaguar will return a controller error indicating that a device has connected for which there is no IOPB.

NOTE

Use of this command implies that the host uses unique command tags for all IOPBs residing on the board.

The format of the Cancel Command Tag IOPB is shown below.

WORD #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND CODE (0x48)															
0x1	COMMAND OPTIONS															
0x2	**RETURN STATUS**															
0x3	RESERVED															
0x4	NORMAL COMPLETION VECTOR								ERROR COMPLETION VECTOR							
0x6 To 0xF	RESERVED															
0x10	COMMAND TAG															
0x11																
0x12 To 0x15	RESERVED															

NOTES:
Fields set in bold capital letters are returned values. All other values are host provided. Reserved fields must be cleared to 0 by the host.

Figure 5-16. Cancel Command Tag IOPB

The remainder of this section describes the function of each field in the Cancel Command Tag IOPB.

HOST-PROVIDED IOPB FIELDS

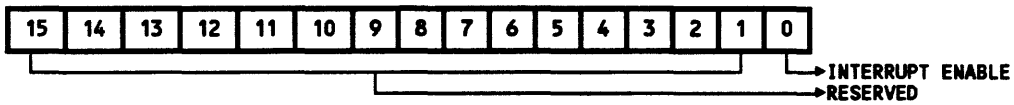
The following information must be provided in the IOPB for the Cancel Command Tag command:

COMMAND CODE (2 BYTES)

This field must be set to 0x48 to execute the Cancel Command Tag command.

COMMAND OPTIONS (2 BYTES)

This field contains the options for this command. The bits are defined as follows:



Bit 0 Interrupt Enable (IE):

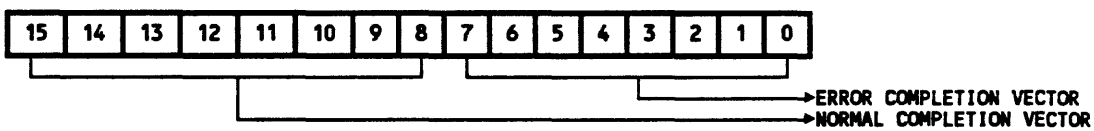
Setting this bit enables the Jaguar to interrupt the host upon command completion. Clearing the bit disables the Command Complete interrupt.

Bits 1–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

NORMAL COMPLETION VECTOR/ERROR COMPLETION VECTOR (2 BYTES)

These two bytes specify the VMEbus interrupt vectors that the Jaguar will use to report normal command completion and command completion with error.



Bits 0–7 Error Completion Vector:

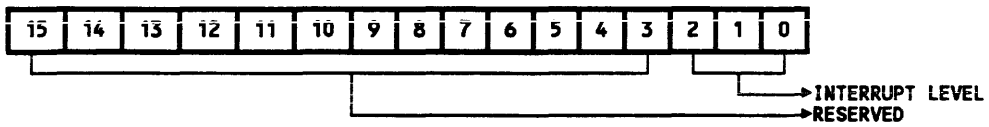
This value specifies the interrupt vector used when notifying the host of command completion with error.

Bits 8–15 Normal Completion Vector:

This value specifies the interrupt vector used when notifying the host that the command completed without error.

INTERRUPT LEVEL (2 BYTES)

This field specifies the VMEbus interrupt level used to notify the host of a command completion (normal or with error).



Bits 0–2 Interrupt Level (LVL):

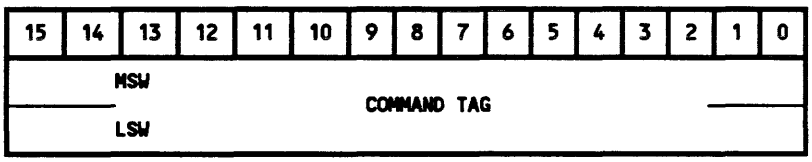
These bits set the interrupt level used by the Jaguar to assert a Command Complete interrupt on the VMEbus. Values of 0 through 7 are allowed, but a level of 0 is allowed only when interrupts are disabled (Interrupt Enable bit = 0 in the Command Options word).

Bits 3–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

COMMAND TAG (4 BYTES)

This field specifies command tag of the IOPB which is to be canceled.



RETURNED VALUES

Upon command completion, the following information is provided by the Jaguar in the returned IOPB for the Cancel Command Tag command:

RETURN STATUS (2 BYTES)

These two bytes hold the returned status of the command. Any non-zero value indicates an error code. A list of valid error codes is provided in Appendix C.

FLUSH WORK QUEUE (0x49)

The Flush Work Queue command flushes all commands that have been placed in the work queue, as well as any commands in the Command Queue destined for the work queue. (This is different from the Flush Queue bits in the Master Control Register. This command flushes only the specified work queue; the Flush Queue bits in the MCR flush all the queues.) This command specifies the work queue number and has, as an option, the ability to report completion of each entry in the queue.

This command must be issued through the Master Command Entry to Work Queue 0.

At the completion of the Flush Work Queue command, the number of entries flushed from the queue will be returned. The returned IOPB will also report whether any commands were ``InProgress'' when the Flush Work Queue command was executed.

If any of the flushed commands are ``InProgress'', it may be necessary to reset the SCSI bus in order to clear the effects of the command out of the target. To do so, issue a Reset SCSI Bus IOPB.

The format of the IOPB is as follows:

WORD #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND CODE (0x49)															
0x1	COMMAND OPTIONS															
0x2	**RETURN STATUS**															
0x3	RESERVED															
0x4	NORMAL COMPLETION VECTOR								ERROR COMPLETION VECTOR							
0x5	INTERRUPT LEVEL															
0x6 To 0xD	RESERVED															
0xE	WORK QUEUE NUMBER															
0xF	SIP	PIP	NUMBER OF ENTRIES FLUSHED													

NOTES:
Fields set in bold capital letters are returned values. All other values are host provided. Reserved fields must be cleared to 0 by the host.

Figure 5-17. Flush Work Queue IOPB

The remainder of this section describes the function of each field in the Flush Work Queue IOPB.

HOST-PROVIDED IOPB FIELDS

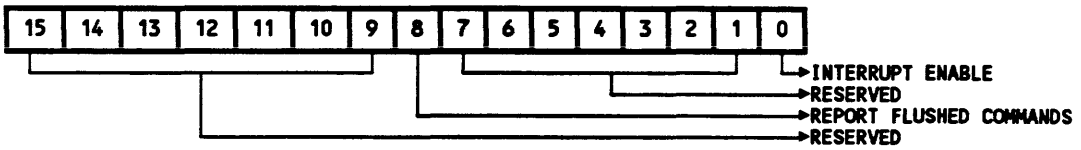
The following information must be provided in the IOPB for the Flush Work Queue command:

COMMAND CODE (2 BYTES)

This field must be set to 0x49 to execute the Flush Work Queue command.

COMMAND OPTIONS (2 BYTES)

This field contains the options for this command. The bits are defined as follows:



Bit 0 Interrupt Enable (IE):

Setting this bit enables the Jaguar to interrupt the host upon command completion. Clearing the bit disables the Command Complete interrupt. Note that it is not necessary to enable this bit in order to use Bit 8 (RPT), below.

Bits 1–7 Reserved:

These bits are reserved and must be cleared to 0 by the host.

Bit 8 Report Flushed Commands (RPT):

Setting this bit causes the Jaguar to report each command as it is flushed with a Command Complete Interrupt and an Error Status. Clearing the bit disables this function. **NOTE:** Only the commands that have the Interrupt Enable bit set in the Command Options word of their individual IOPBs will generate an interrupt as they are flushed.

Bits 9–15 Reserved:

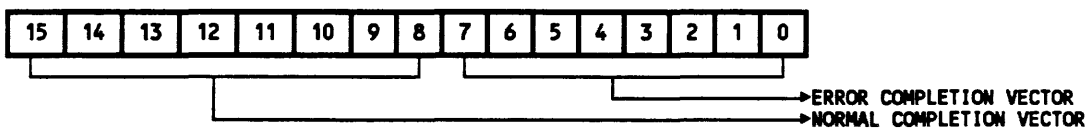
These bits are reserved and must be cleared to 0 by the host.

WORK QUEUE NUMBER (2 BYTES)

This is the number of the work queue to be flushed. The host can also flush all of the work queues and the Command Queue by setting the Flush Queue bits in the Master Control Register (see Master Control Register).

NORMAL COMPLETION VECTOR/ERROR COMPLETION VECTOR (2 BYTES)

These two bytes specify the VMEbus interrupt vectors that the Jaguar will use to report normal command completion and command completion with error.



Bits 0–7 Error Completion Vector:

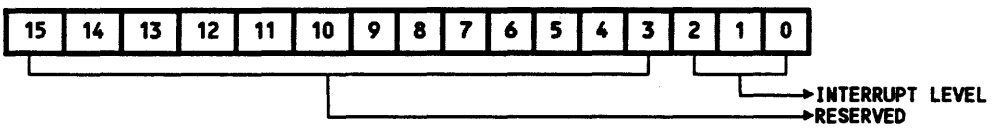
This value specifies the interrupt vector used when notifying the host of command completion with error.

Bits 8–15 Normal Completion Vector:

This value specifies the interrupt vector used when notifying the host that the command completed without error.

INTERRUPT LEVEL (2 BYTES)

This field specifies the VMEbus interrupt level used to notify the host of a command completion (normal or with error).



Bits 0–2 Interrupt Level (LVL):

These bits set the interrupt level used by the Jaguar to assert a Command Complete interrupt on the VMEbus. Values of 0 through 7 are allowed, but a level of 0 is allowed only when interrupts are disabled (Interrupt Enable bit = 0 in the Command Options word).

Bits 3–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

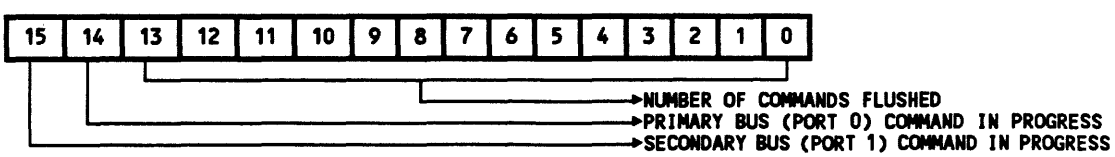
RETURNED VALUES

Upon command completion, the following information is provided by the Jaguar in the returned IOPB for the Flush Work Queue command:

RETURN STATUS (2 BYTES)

These two bytes hold the returned status of the command. Any non-zero value indicates an error code. A list of valid error codes is provided in Appendix C.

NUMBER OF COMMANDS FLUSHED/FLUSHED IN PROGRESS COMMAND (2 BYTES)



Bits 0–13 Numbers of Entries Flushed:

This is the number of entries that were flushed from the work queue.

Bit 14 Primary Bus (Port 0) Command In Progress (PIP):

The Jaguar sets this bit in the returned IOPB when an In Progress command is present on the primary SCSI bus. There can never be more than one In Progress command for any one work queue, but because the SCSI bus allows targets to disconnect, there can be multiple In Progress commands on each SCSI bus.

Bit 15 Secondary Bus (Port 1) Command In Progress (SIP):

The Jaguar sets this bit in the returned IOPB when an In Progress command is present on the secondary SCSI bus.

INITIALIZE PRINTER PORT (0x4A)

The Initialize Printer Port command is used to configure the printer port for the interface being used (Dataproducts or Centronics). In addition, it enables/disables status change interrupts. **NOTE:** The vector used for status change interrupts is stored in word 0x2 of the Controller Initialization Block (the lower byte of the Controller Normal Completion Level/Vector field).

As discussed in Chapter 6, the printer port requires a separate work queue. You must therefore create a work queue for the printer port using the Initialize Work Queue command *before* attempting to initialize the port. Initialize Printer Port is the first command that should be sent to this work queue.

The Initialize Printer Port command can be issued at any time to reset the printer port. The command is issued with the reset bit set to clear the printer port hardware. It should never be necessary to reset the hardware.

The command may also be issued at any time to assert a buffer clear to the printer. Since the time required for holding this signal varies from printer to printer, the Jaguar will leave the line set until the host issues another Initialize Printer Port command with the bit cleared.

The format of the Initialize Printer Port IOPB is as follows:

WORD #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND CODE (0x4A)															
0x1	COMMAND OPTIONS															
0x2	**RETURN STATUS**															
0x3	RESERVED															
0x4	NORMAL COMPLETION VECTOR								ERROR COMPLETION VECTOR							
0x5	INTERRUPT LEVEL															
0x6 To 0xD	RESERVED															
0xE	PRINTER OPTIONS															
0xF To 0x15	RESERVED															

NOTES:
Fields set in bold capital letters are returned values. All other values are host provided. Reserved fields must be cleared to 0 by the host.

Figure 5-18. Initialize Printer Port IOPB

The remainder of this section describes the function of each field in the Initialize Printer Port IOPB.

HOST-PROVIDED IOPB FIELDS

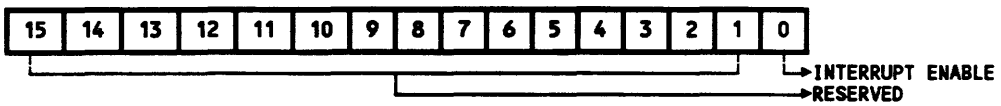
The following information must be provided in the IOPB for the Initialize Printer Port command:

COMMAND CODE (2 BYTES)

This field must be set to 0x4A to execute the Initialize Printer Port command.

COMMAND OPTIONS (2 BYTES)

This field contains the options for this command. The bits are defined as follows:



Bit 0 Interrupt Enable (IE):

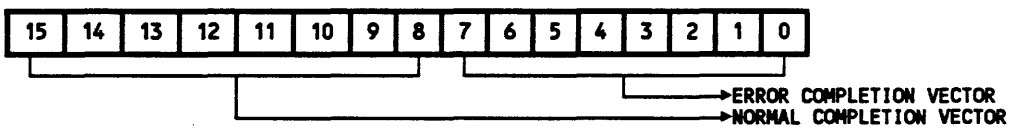
Setting this bit enables the Jaguar to interrupt the host upon command completion. Clearing the bit disables the Command Complete interrupt.

Bits 1–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

NORMAL COMPLETION VECTOR/ERROR COMPLETION VECTOR (2 BYTES)

These two bytes specify the VMEbus interrupt vectors that the Jaguar will use to report normal command completion and command completion with error.



Bits 0–7 Error Completion Vector:

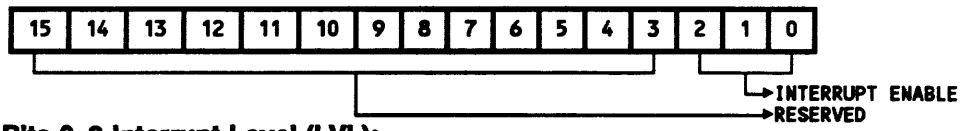
This value specifies the interrupt vector used when notifying the host of command completion with error.

Bits 8–15 Normal Completion Vector:

This value specifies the interrupt vector used when notifying the host that the command completed without error.

INTERRUPT LEVEL (2 BYTES)

This field specifies the VMEbus interrupt level used to notify the host of a command completion (normal or with error).



Bits 0–2 Interrupt Level (LVL):

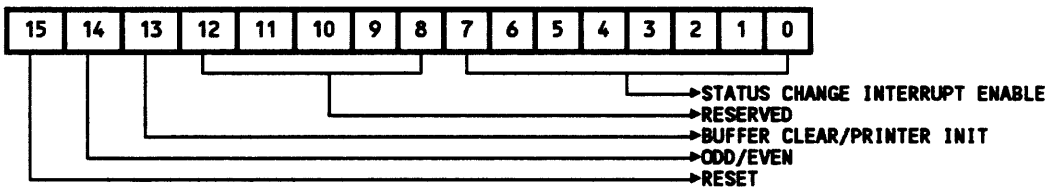
These bits set the interrupt level used by the Jaguar to assert a Command Complete interrupt on the VMEbus. Values of 0 through 7 are allowed, but a level of 0 is allowed only when interrupts are disabled (Interrupt Enable bit = 0 in the Command Options word).

Bits 3–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

PRINTER OPTIONS (2 BYTES)

The field provides the following options:



Bits 0–7 Status Change Interrupt Enable:

This field is used to enable interrupts from the printer status lines which the host is to monitor. To enable a specific status line, set the appropriate bit. The field's bit definitions vary depending the printer type, as listed below:

Table 5-15. Printer Status Change Interrupt Field

Dataproducts Printers:	Centronics Printers:
Bit 7 - Reserved - 0	Bit 7 - Reserved - 0
Bit 6 - Reserved - 0	Bit 6 - Reserved - 0
Bit 5 - Reserved - 0	Bit 5 - Reserved - 0
Bit 4 - Reserved - 0	Bit 4 - Reserved - 0
Bit 3 - Cable On	Bit 3 - Reserved - 0
Bit 2 - Parity Error	Bit 2 - Paper Empty
Bit 1 - Online	Bit 1 - Select
Bit 0 - Ready	Bit 0 - Fault

NOTE: These signals are active high.

Bits 8–12 Reserved:

These bits are reserved and must be cleared to 0 by the host.

Bit 13 Buffer Clear/Printer Init (BC):

Issuing the Initialize Printer Port command with this bit set causes the Jaguar to assert a Buffer Clear to a Dataproducts printer or a Print Init to a Centronics printer.

NOTE

After using Bit 13 to issue a Buffer Clear/Print Init instruction, the host must issue another Initialize Printer Port command with Bit 13 cleared to return to normal printer operations.

Bit 14 Odd/Even (O/E):

This bit applies to **Dataproducts printers only**. It specifies the parity polarity, as follows:

0 = Even Parity
1 = Odd Parity

Bit 15 Reset (RST):

Issuing the Initialize Printer Port command with this bit set causes the Jaguar to reset the printer port. The port will be ready to receive new print commands after the completion status has been returned to the host.

RETURNED VALUES

Upon command completion, the following information is provided by the Jaguar in the returned IOPB for the Initialize Printer Port command:

RETURN STATUS (2 BYTES)

These two bytes hold the returned status of the command. Any non-zero value indicates an error code. A list of valid error codes is provided in Appendix C.

RESTART CONTROLLER (0x4B)

The Restart Controller command provides a method of resetting the controller and bypassing the power-up diagnostics. This command is analogous to a soft reset that tells the board to clear all current operations.

The first action the board takes is to reset the SCSI ports. It then flushes all internal commands, with the exception of the Restart Controller command. Next, the Command Queue pointer is reset to the base of the Command Queue. Finally, the Restart Controller command is returned to the Command Response Block.

All Controller Initialization Block parameters remain intact, and the board remains in Queue Mode (if it was in Queue Mode when the command was issued).

This command must be issued through the Master Command Entry to Work Queue 0.

NOTE

It may be necessary for the host to issue a Request Sense to on-line devices after executing the Restart Controller command. This depends on what the devices require after a SCSI bus reset. Consult your device manuals for details.

The format of the IOPB is as follows:

WORD #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND CODE (0x4B)															
0x1	COMMAND OPTIONS															
0x2	**RETURN STATUS**															
0x3	RESERVED															
0x4	NORMAL COMPLETION VECTOR								ERROR COMPLETION VECTOR							
0x5	INTERRUPT LEVEL															
0x6 To 0x15	RESERVED															

NOTES:
Fields set in bold capital letters are returned values.
All other values are host provided. Reserved fields must be cleared to 0 by the host.

Figure 5-19. Restart Controller IOPB

The remainder of this section describes the function of each field in the Restart Controller IOPB.

HOST-PROVIDED IOPB FIELDS

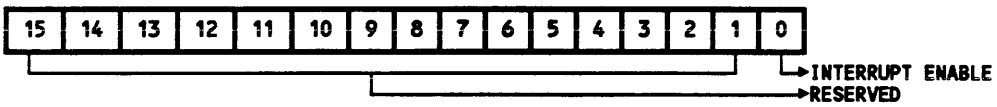
The following information must be provided in the IOPB for the Restart Controller command:

COMMAND CODE (2 BYTES)

This field must be set to 0x4B to execute the Restart Controller command.

COMMAND OPTIONS (2 BYTES)

This field contains the options for this command. The bits are defined as follows:



Bit 0 Interrupt Enable (IE):

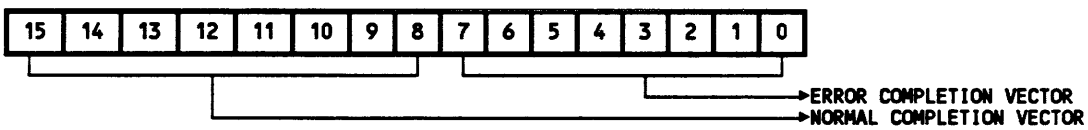
Setting this bit enables the Jaguar to interrupt the host upon command completion. Clearing the bit disables the Command Complete interrupt.

Bits 1–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

NORMAL COMPLETION VECTOR/ERROR COMPLETION VECTOR (2 BYTES)

These two bytes specify the VMEbus interrupt vectors that the Jaguar will use to report normal command completion and command completion with error.



Bits 0–7 Error Completion Vector:

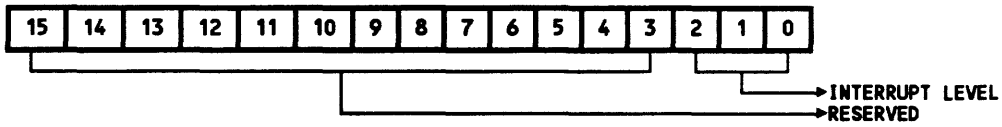
This value specifies the interrupt vector used when notifying the host of command completion with error.

Bits 8–15 Normal Completion Vector:

This value specifies the interrupt vector used when notifying the host that the command completed without error.

INTERRUPT LEVEL (2 BYTES)

This field specifies the VMEbus interrupt level used to notify the host of a command completion (normal or with error).



Bits 0–2 Interrupt Level (LVL):

These bits set the interrupt level used by the Jaguar to assert a Command Complete interrupt on the VMEbus. Values of 0 through 7 are allowed, but a level of 0 is allowed only when interrupts are disabled (Interrupt Enable bit = 0 in the Command Options word).

Bits 3–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

RETURNED VALUES

Upon command completion, the following information is provided by the Jaguar in the returned IOPB for the Restart Controller command:

RETURN STATUS (2 BYTES)

These two bytes hold the returned status of the command. Any non-zero value indicates an error code. A list of valid error codes is provided in Appendix C.

DEVICE REINITIALIZE (0x4C)

The Device Reinitialize command clears the first connection (synchronous negotiation state) of a device. This causes the Jaguar to retry the synchronous message on the next selection to the target. This command is only necessary when a device has been disconnected from a bus and power cycled without the Jaguar having any information about this action.

The format of the IOPB is as follows:

WORD #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND CODE (0x4C)															
0x1	COMMAND OPTIONS															
0x2	**RETURN STATUS**															
0x3	RESERVED															
0x4	NORMAL COMPLETION VECTOR								ERROR COMPLETION VECTOR							
0x5	INTERRUPT LEVEL															
0x6 To 0xE	RESERVED															
0xF	UNIT ADDRESS															
0x10 To 0x15	RESERVED															

NOTES:
Fields set in bold capital letters are returned values.
All other values are host provided. Reserved fields must be cleared to 0 by the host.

Figure 5-20. Device Reinitialize IOPB

The remainder of this section describes the function of each field in the Device Reinitialize IOPB.

HOST-PROVIDED IOPB FIELDS

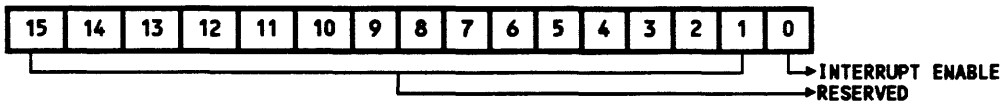
The following information must be provided in the IOPB for the Device Reinitialize command:

COMMAND CODE (2 BYTES)

This field must be set to 0x4C to execute the Device Reinitialize command.

COMMAND OPTIONS (2 BYTES)

This field contains the options for this command. The bits are defined as follows:



Bit 0 Interrupt Enable (IE):

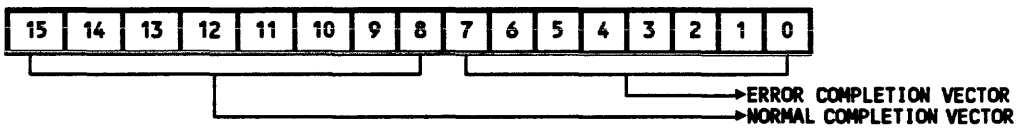
Setting this bit enables the Jaguar to interrupt the host upon command completion. Clearing the bit disables the Command Complete interrupt.

Bits 1–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

NORMAL COMPLETION VECTOR/ERROR COMPLETION VECTOR (2 BYTES)

These two bytes specify the VMEbus interrupt vectors that the Jaguar will use to report normal command completion and command completion with error.



Bits 0–7 Error Completion Vector:

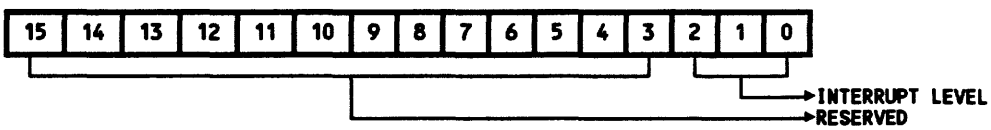
This value specifies the interrupt vector used when notifying the host of command completion with error.

Bits 8–15 Normal Completion Vector:

This value specifies the interrupt vector used when notifying the host that the command completed without error.

INTERRUPT LEVEL (2 BYTES)

This field specifies the VMEbus interrupt level used to notify the host of a command completion (normal or with error).



Bits 0–2 Interrupt Level (LVL):

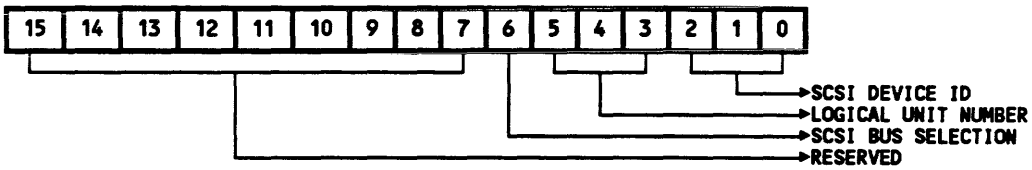
These bits set the interrupt level used by the Jaguar to assert a Command Complete interrupt on the VMEbus. Values of 0 through 7 are allowed, but a level of 0 is allowed only when interrupts are disabled (Interrupt Enable bit = 0 in the Command Options word).

Bits 3–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

UNIT ADDRESS (2 BYTES)

This field specifies the SCSI bus and the address of the target device.



Bits 0–2 SCSI Device ID (SCSI ID):

These three bits are the SCSI Bus ID (SCSI ID) of the specified device.

Bits 3–5 Logical Unit Number (LUN):

These bits describe the SCSI Logical Unit Number (LUN) of the specified device.

Bit 6 SCSI Bus Selection (BUS):

The SCSI Bus Selection (BUS) bit selects which of the two SCSI buses the Jaguar uses when executing the command. When the BUS bit is cleared to 0, the Jaguar executes the command over the primary SCSI bus (Port 0). When set to 1, it uses the secondary SCSI bus (Port 1).

Bits 7–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

RETURNED VALUES

Upon command completion, the following information is provided by the Jaguar in the returned IOPB for the Device Reinitialize command:

RETURN STATUS (2 BYTES)

These two bytes hold the returned status of the command. Any non-zero value indicates an error code. A list of valid error codes is provided in Appendix C.

ISSUE BUS DEVICE RESET MESSAGE (0x4D)

This message is sent from the initiator to direct a target to clear all current commands on that SCSI device. This message forces the SCSI device to an initial state with no operations pending for any initiator. Upon recognizing this message, the target goes to the Bus Free phase.

This command enables the host to reset individual devices on the bus. The host should issue this command after insuring that no commands are currently being executed on this device.

This command must be issued through the Master Command Entry to Work Queue 0.

NOTE

It may be necessary for the host to issue a Request Sense to on-line devices after executing an Issue Bus Device Reset Message IOPB. This depends on what the devices require after a SCSI bus reset. Consult your device manuals for details.

The format of the IOPB is as follows:

WORD #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND CODE (0x4D)															
0x1	COMMAND OPTIONS															
0x2	**RETURN STATUS**															
0x3	RESERVED															
0x4	NORMAL COMPLETION VECTOR								ERROR COMPLETION VECTOR							
0x5	INTERRUPT LEVEL															
0x6 To 0xE	RESERVED															
0xF	UNIT ADDRESS															
0x10 To 0x15	RESERVED															

NOTES:
Fields set in bold capital letters are returned values.
All other values are host provided. Reserved fields must be cleared to 0 by the host.

Figure 5-21. Issue Bus Device Reset Message IOPB

The remainder of this section describes the function of each field in the Issue Bus Device Reset Message IOPB.

HOST-PROVIDED IOPB FIELDS

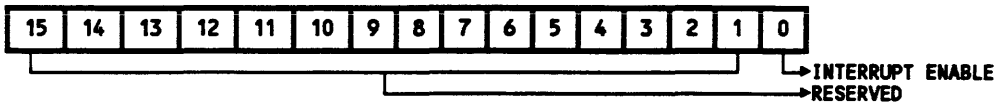
The following information must be provided in the IOPB for the Issue Bus Device Reset Message command:

COMMAND CODE (2 BYTES)

This field must be set to 0x4D to execute the Issue Bus Device Reset Message command.

COMMAND OPTIONS (2 BYTES)

This field contains the options for this command. The bits are defined as follows:



Bit 0 Interrupt Enable (IE):

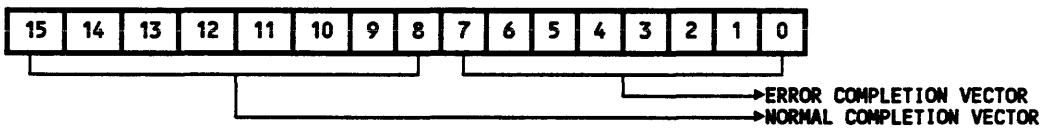
Setting this bit enables the Jaguar to interrupt the host upon command completion. Clearing the bit disables the Command Complete interrupt.

Bits 1–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

NORMAL COMPLETION VECTOR/ERROR COMPLETION VECTOR (2 BYTES)

These two bytes specify the VMEbus interrupt vectors that the Jaguar will use to report normal command completion and command completion with error.



Bits 0–7 Error Completion Vector:

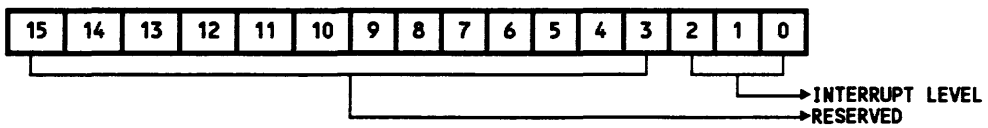
This value specifies the interrupt vector used when notifying the host of command completion with error.

Bits 8–15 Normal Completion Vector:

This value specifies the interrupt vector used when notifying the host that the command completed without error.

INTERRUPT LEVEL (2 BYTES)

This field specifies the VMEbus interrupt level used to notify the host of a command completion (normal or with error).



Bits 0–2 Interrupt Level (LVL):

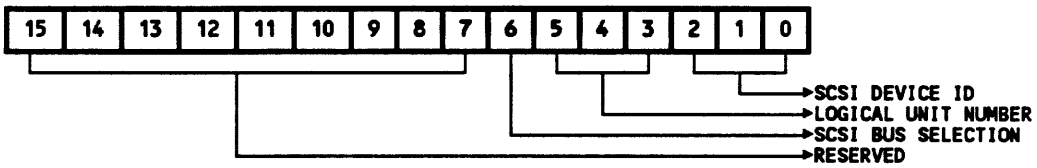
These bits set the interrupt level used by the Jaguar to assert a Command Complete interrupt on the VMEbus. Values of 0 through 7 are allowed, but a level of 0 is allowed only when interrupts are disabled (Interrupt Enable bit = 0 in the Command Options word).

Bits 3–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

UNIT ADDRESS (2 BYTES)

This field specifies the SCSI bus and the address of the target device.



Bits 0–2 SCSI Device ID (SCSI ID):

These three bits are the SCSI Bus ID (SCSI ID) of the specified device.

Bits 3–5 Logical Unit Number (LUN):

These bits describe the SCSI Logical Unit Number (LUN) of the specified device.

Bit 6 SCSI Bus Selection (BUS):

The SCSI Bus Selection (BUS) bit selects which of the two SCSI buses the Jaguar uses when executing the command. When the BUS bit is cleared to 0, the Jaguar executes the command over the primary SCSI bus (Port 0). When set to 1, it uses the secondary SCSI bus (Port 1).

Bits 7–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

RETURNED VALUES

Upon command completion, the following information is provided by the Jaguar in the returned IOPB for the Issue Bus Device Reset Message command:

RETURN STATUS (2 BYTES)

These two bytes hold the returned status of the command. Any non-zero value indicates an error code. A list of valid error codes is provided in Appendix C.

ISSUE ABORT MESSAGE (0x4E)

This message is sent from the initiator to direct a target to clear the present operation. If a logical unit has been identified, all pending status for the issuing initiator from the affected logical unit is cleared, and the target goes to the Bus Free phase. Pending data and status for other initiators is not cleared. If a logical unit has not been identified, the target goes to the Bus Free phase. No status or ending message is sent for the operation.

It is not an error to issue this message to a logical unit that is not currently performing an operation for the initiator. This command can be used to terminate an operation that is no longer required (killing a Format command to a drive, for example).

This command must be issued through the Master Command Entry to Work Queue 0.

The format of the IOPB is as follows:

WORD #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND CODE (0x4E)															
0x1	COMMAND OPTIONS															
0x2	**RETURN STATUS**															
0x3	RESERVED															
0x4	NORMAL COMPLETION VECTOR								ERROR COMPLETION VECTOR							
0x5	INTERRUPT LEVEL															
0x6 To 0xE	RESERVED															
0xF	UNIT ADDRESS															
0x10 To 0x15	RESERVED															

NOTES:
Fields set in bold capital letters are returned values.
All other values are host provided. Reserved fields must be cleared to 0 by the host.

Figure 5-22. Issue Abort Message IOPB

The remainder of this section describes the function of each field in the Issue Abort Message IOPB.

HOST-PROVIDED IOPB FIELDS

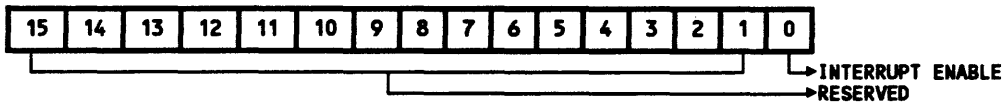
The following information must be provided in the IOPB for the Issue Abort Message command:

COMMAND CODE (2 BYTES)

This field must be set to 0x4E to execute the Issue Abort Message command.

COMMAND OPTIONS (2 BYTES)

This field contains the options for this command. The bits are defined as follows:



Bit 0 Interrupt Enable (IE):

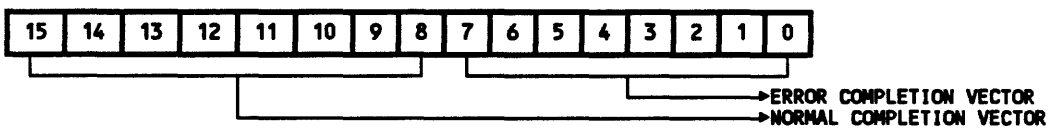
Setting this bit enables the Jaguar to interrupt the host upon command completion. Clearing the bit disables the Command Complete interrupt.

Bits 1–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

NORMAL COMPLETION VECTOR/ERROR COMPLETION VECTOR (2 BYTES)

These two bytes specify the VMEbus interrupt vectors that the Jaguar will use to report normal command completion and command completion with error.



Bits 0–7 Error Completion Vector:

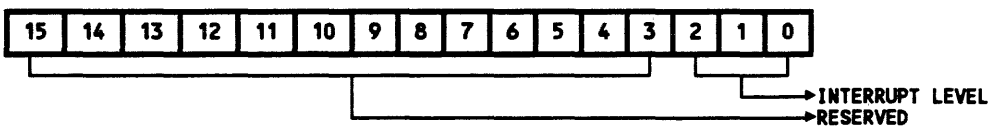
This value specifies the interrupt vector used when notifying the host of command completion with error.

Bits 8–15 Normal Completion Vector:

This value specifies the interrupt vector used when notifying the host that the command completed without error.

INTERRUPT LEVEL (2 BYTES)

This field specifies the VMEbus interrupt level used to notify the host of a command completion (normal or with error).



Bits 0–2 Interrupt Level (LVL):

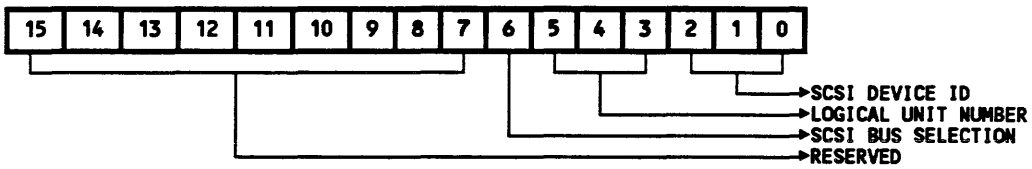
These bits set the interrupt level used by the Jaguar to assert a Command Complete interrupt on the VMEbus. Values of 0 through 7 are allowed, but a level of 0 is allowed only when interrupts are disabled (Interrupt Enable bit = 0 in the Command Options word).

Bits 3–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

UNIT ADDRESS (2 BYTES)

This field specifies the SCSI bus and the address of the target device.



Bits 0–2 SCSI Device ID (SCSI ID):

These three bits are the SCSI Bus ID (SCSI ID) of the specified device.

Bits 3–5 Logical Unit Number (LUN):

These bits describe the SCSI Logical Unit Number (LUN) of the specified device.

Bit 6 SCSI Bus Selection (BUS):

The SCSI Bus Selection (BUS) bit selects which of the two SCSI buses the Jaguar uses when executing the command. When the BUS bit is cleared to 0, the Jaguar executes the command over the primary SCSI bus (Port 0). When set to 1, it uses the secondary SCSI bus (Port 1).

Bits 7–15 Reserved:

These bits are reserved and must be cleared to 0 by the host.

RETURNED VALUES

Upon command completion, the following information is provided by the Jaguar in the returned IOPB for the Issue Abort Message command:

RETURN STATUS (2 BYTES)

These two bytes hold the returned status of the command. Any non-zero value indicates an error code. A list of valid error codes is provided in Appendix C.

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CHAPTER 6
APPLICATION NOTES

This chapter contains application notes on the following topics:

- Error Recovery Tools
- Scatter/Gather Operations
- Printer Port Operation
- Offboard IOPBs
- Considerations For Maximizing SCSI Synchronous Data Transfers

ERROR RECOVERY TOOLS

The Jaguar supports a variety of tools for dealing with two basic types of errors that can occur - SCSI device errors and controller errors. These error recovery tools are described in the following subsections. They are also documented where appropriate in the MACSI and IOPB sections of the manual (Chapters 3 and 5).

SCSI DEVICE ERRORS

A SCSI device error is defined to be the completion of a SCSI Command with a status byte of any value other than 0x0. Since a device may have many commands queued for it at the time an error occurs, SCSI device errors require some mechanism which allows the host to alter the order in which commands are being executed. The means provided by the Jaguar for this purpose are the Freeze/Thaw Work Queue and Abort Work Queue on Error options.

NOTE

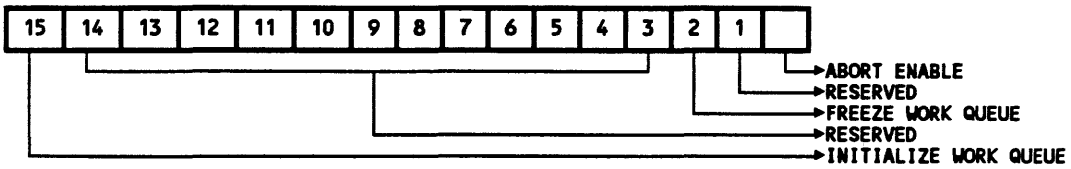
The Freeze/Thaw Work Queue and Abort Work Queue on Error options are mutually exclusive. That is, a given work queue cannot be both frozen *and* aborted in the event of an error.

FREEZE/THAW WORK QUEUE AND ABORT WORK QUEUE ON ERROR

FREEZE WORK QUEUE

The Freeze Work Queue option provides a mechanism for freezing the state of a work queue when an error occurs. Error handling can be accomplished by passing one or more corrective commands to the device (such as Request Sense or a diagnostic command). Such commands must be issued to the device through the Master Command Entry via Work Queue 0. After the error handling has been completed, the work queue can be unfrozen.

The Freeze Work Queue option is enabled on a per queue basis when the queues are initialized. To enable the Freeze option for a given queue, set Bit 2 (FZE) in the Work Queue Options field of the Initialize Work Queue IOPB.



(Word 0xF In thThe Initialize Work Queue IOPB)
Figure 6-1. Freeze Work Queue Option

If enabled, the Freeze bit halts all further commands to a device when any Pass-Back status other than ``good"(status 0x00) is received from that device. In addition, a bit will be set in the Frozen Work Queues Register of the Configuration Status Block (see discussion below).

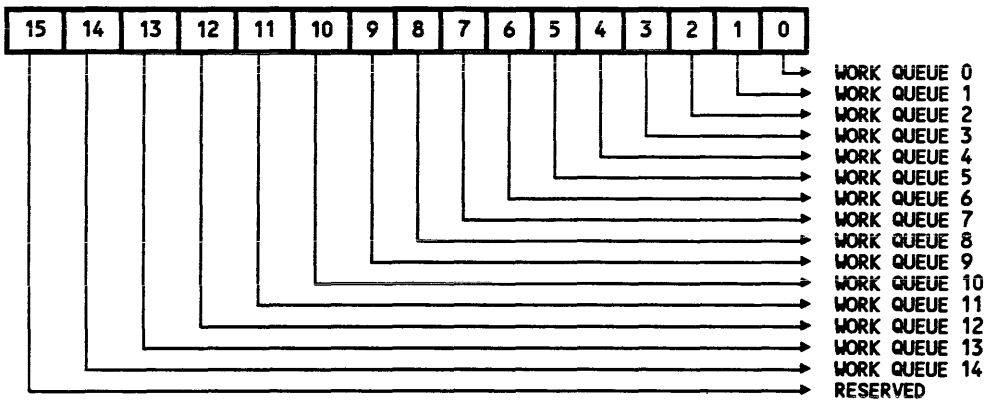
Commands sent to a ``frozen"work queue will not be executed until the work queue is ``thawed,"as discussed below. Since the Freeze Work Queue option is intended to support error handling as a part of normal SCSI operations, queues are not frozen for controller errors.

The Freeze Work Queue operation may be optionally changed using the Initialize Controller command to freeze a work queue that has an active command upon receiving a SCSI reset. The host will ``know"a Work Queue is frozen if it receives a command returned from the queue with a SCSI bus reset error status. **It is recommended that you enable this option when initializing the Jaguar.** The default setting (i.e. do not freeze queue if command is returned with SCSI bus reset status) is provided for backward compatibility.

NOTE

The Freeze Work Queue on Error bit is *not* enabled for Work Queue 0. This is because it is defined to have a length of 1. This is done to ensure that only one error recovery process occurs at a time. However, it is possible that a command from Work Queue 0 may require error recovery itself. To allow this to take place, the SCSI Bus Reset and Flush Work Queue commands may always be issued through the Master Command Entry to Work Queue 0. For all other commands Work Queue 0 has a length of one.

FROZEN WORK QUEUES REGISTER. Located in the Configuration Status Block, this register identifies which work queues are frozen (if any). For Work Queues 1 to 14, if a given queue is frozen, then the corresponding bit position is set in the register. As noted before, Work Queue 0 cannot be frozen. The format of the register is repeated below for your reference:

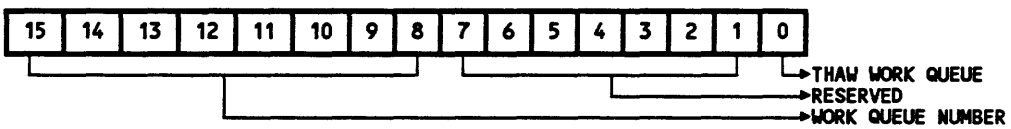


NOTE: Work Queue 0 cannot be frozen. Therefore, Bit 0 in the Frozen Work Queues Register is always cleared.

Figure 6-2. Frozen Work Queues Register

THAW WORK QUEUE. After the SCSI error condition has been cleared, the queue can be unfrozen by use of the Thaw bit in the MCSB. Execution of commands in the frozen queue is restarted by setting the least significant bit of the Thaw Work Queue Register.

The frozen work queue is unfrozen by writing the appropriate work queue number into the upper byte of the Thaw Work Queue Register and then setting Bit 0 (THW) of that register. The Jaguar will clear Bit 0 of the register to acknowledge the thawing of the work queue. The Thaw Work Queue Register is defined as follows:



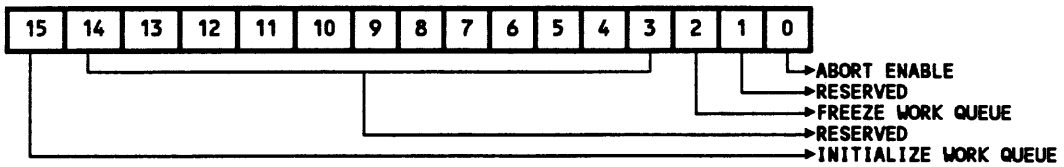
(Word 0x4 in the Master Control/Status Block)

Figure 6-3. Thaw Work Queue Register

ABORT WORK QUEUE ON ERROR

The Abort Work Queue on Error option causes the Jaguar to abort all commands for that work queue until a command is issued with the Abort Acknowledge bit set to 1 in the command's Queue Entry Control Register. This option is mutually exclusive with the freeze/thaw work queue feature described in the preceding subsections (a given work queue cannot be both frozen and aborted in the event of an error).

The register is depicted below:



(Word 0xF in the Initialize Work Queue IOPB)
Figure 6-4. Abort Work Queue On Error Option

To enable Abort Work Queue on Error for a given work queue, set Bit 0 of the Work Queue Options field when you initialize the work queue.

When a SCSI Device error occurs, the failing IOPB will be returned with the bad (non-zero) pass-back status. All other commands for that work queue will be returned with a Command Complete and Abort Queue set to 1 in the Command Response Word. This will continue until a command is found with the Abort Acknowledge bit set to 1 in the command's Queue Entry Control Register. This applies not only to the commands in the queue when the abort was activated, but to all commands issued to that queue until the abort is acknowledged.

REGISTERS FOR DETERMINING SCSI BUS STATUS AND LAST DEVICE ON BUS

The Configuration Status Block contains two registers that provide the current SCSI bus status. Information in these registers can be used in conjunction with the Command Status Inquiry and Bus Status Inquiry commands to determine the type of error that has occurred.

ID OF LAST DEVICE CONNECTED TO SCSI BUS. The Last Device ID bytes contain the SCSI Bus IDs of the last devices connected to Port 0 and Port 1. The Bits 8-15 contain the Primary SCSI Bus ID last connected. The Bits 0-7 contain the Secondary Bus ID last connected.

SCSI BUS STATUS. The SCSI Bus Status field describes the status of the primary and secondary SCSI buses. Bits 8-15 contain the primary bus status. Bits 0-7 contain the status of the secondary bus (if used). Both bytes are images of the Fujitsu 87030 phase sense register. The format of that register is as follows:

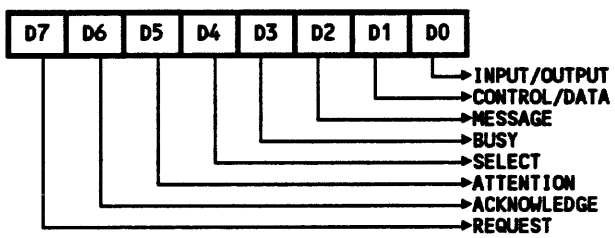


Figure 6-5. SCSI Bus Status Byte

Each of the above signals is active high and corresponds to a specific SCSI bus signal.

The signals of most importance are BSY and SEL. When BSY is a `1', the Jaguar is connected to the SCSI bus. When SEL is a `1', it indicates that someone on the bus is attempting to select or reselect another device. For additional information on the signals, see Chapter 3.

The SCSI Bus Status bytes are updated every 27 to 35msec. If the host is attempting to use this register to determine if the bus is hung, it should allow at least twice that period before making a decision. The actual amount of time required is dependent on the system. In general, it should be longer than the longest data transfer that might occur in the system.

ERROR RECOVERY COMMANDS

Normal SCSI check condition errors are handled very simply via SCSI protocol. However, there are other types of errors from which it can be difficult to recover, such as errors due to a bad device or bug in the device driver program.

The Jaguar provides three commands that can be used to determine what type of error has occurred without having to reset the board. They are:

- The **Command Status Inquiry** IOPB reports the status of a command, identified by its command tag.

- The **Bus Status Inquiry** IOPB reports the state of all IOPBs requesting the SCSI Bus. It is used to find the command that is active on the bus at the time an IOPB timeout (discussed below) has occurred. This is important because a command may cause another command to time out by blocking use of the SCSI bus by other devices.

- **Cancel Command Tag** removes an IOPB from the board. This command is provided for systems that can reset devices in error without resetting the SCSI bus.

The above commands must be issued through the Master Command Entry to Work Queue 0. They may be issued at any time.

For additional information on the above three commands, refer to the descriptions of the individual commands in Chapter 5.

SELECTION AND COMMAND TIMEOUTS

The Jaguar provides two features to signal unusual errors - selection timeout and command timeout. Selection timeouts prevent the board from becoming locked up by trying to select a device that does not exist. Command timeouts let the Jaguar notify the host that a user-programmed period of time has expired since a device was successfully selected.

SELECTION TIMEOUT

The selection timeout causes an IOPB to be terminated with an error status if a device does not respond to selection within the programmed period of time. The same value is used for all devices. This value is specified in the Controller Initialization Block. This timeout has a resolution of 1msec.

COMMAND TIMEOUT

The command timeout is specified in the Initialize Controller command for Work Queue 0, and in the Initialize Work Queue command for all other queues. All IOPBs issued through a work queue will use the timeout value specified for that work queue.

- For Work Queue 0, the ninth word of the Controller Initialization Block is used for Work Queue 0 command timeouts. This field (word 9) is specified in increments of 256 msec. A value of 0 specifies no timeout.

- The timeout values used for commands issued through Work Queues 1 - 14 are set when the queues are initialized. The twelfth word of the Initialize Work Queue command contains the timeout value, which is specified in increments of approximately 256msec. Thus, each work queue (device) is able to run a unique timeout value. A value of 0 specifies no timeout.

To determine whether or not a command has timed out, the Jaguar measures how much time has elapsed between the successful completion of the selection phase to the completion of the command on the SCSI bus (including all disconnect periods).

When a command timeout occurs, the Jaguar uses the Controller Error Interrupt and Vector to inform the host of the condition (see discussion in next subsection). This mechanism returns an error status without returning the IOPB that caused the error. Command timeouts invoke a Controller Error Vector Status Block with Error Code 0xC1 (IOPB Timeout) in the Error Code field. If the command subsequently completes correctly, the original IOPB will complete properly. The host may attempt to cancel the IOPB with the Cancel Command Tag IOPB. This will cause the Jaguar to terminate any further execution. The cancelled IOPB will not be posted back to the host. If the IOPB is active on the SCSI bus, the command cannot be cancelled and the host must either reset the SCSI bus or remove the device from the bus in some external manner. The command will then be posted with a Canceled Due to Bus Reset Status or Invalid Sequence error if it abruptly disconnects from the bus.

The Jaguar *must* retain the IOPB which caused the timeout until the error condition has been cleared. This is necessary for two reasons. First, it allows the command to be completed if the device responds before error recovery can take place. Second, it prevents new commands from being issued from the queue until the host can handle the error condition.

The usual technique for clearing errors is to issue a Reset SCSI Bus IOPB. This causes all of the commands currently active on that bus to be returned with a bus reset status. However, if your system is capable of removing individual devices from the bus, you have an alternative to resetting the entire bus. The alternative is to remove the device in error and then issue a Cancel Command Tag IOPB to clear the IOPB which is waiting for a response from the removed device.

If a command other than the command that timed out is active on the bus, it will be necessary to determine which command actually caused the error. There are a number of methods for determining the device in error. One technique is to have the host wait an additional period of time and check the board again to see that the state is the same as the previous check. This type of error is due either to incorrect programming or to a failed device and should be a rare occurrence.

CONTROLLER ERROR INTERRUPT AND VECTOR

Controller errors are generated when an error occurs on the Jaguar that is not related to a specific IOPB. This can be due to a variety of unusual board-related conditions. They may also be generated if the host issues an IOPB that lacks the proper information needed for the command to be processed normally.

The interrupt level and vector used to signal such errors are set in the Controller Error Completion Level/Vector field of the Controller Initialization Block (see page ?).

Controller errors will not generate an interrupt if the controller error interrupt level is cleared to 0 in the Initialize Controller IOPB. However, the board will report controllers errors to the Command Response Block even if interrupts are not enabled.

The Jaguar flags a controller error by setting the following bits in the Command Response Status Word: bit 7 (Status Change), bit 2 (Error), and bit 0 (Command Response Block Valid). Thus, the Command Response Status Word will read 0x0085 to signal the error.

The Controller Error Vector enables the host to determine the source of a variety of errors. These include:

- Errors associated with three bit-type commands (Start Queue Mode, Flush Work Queue, and Flush Queue and Report)
- IOPB type error
- IOPB timeout
- A device has connected for which no IOPB exists
- A device is requesting a data transfer of the opposite direction specified by the direction bit of the IOPB

With the exception of the bit commands (Start Queue Mode, Flush Work Queue, and Flush Queue and Report), the above-listed error conditions cause the Jaguar to return a Controller Error Vector Status Block to the Command Response Block. This returned structure does not contain an IOPB. Instead, it contains an error code indicating what has happened, along with information from the Command Queue Entry that was being executed when the error occurred (command tag, IOPB length, and work queue number).

WORD #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	COMMAND RESPONSE STATUS WORD															
0x1	IOPB TYPE								RESERVED							
0x2	COMMAND TAG															
0x3																
0x4	IOPB LENGTH								WORK QUEUE NUMBER							
0x5	RESERVED															
0x6	RESERVED								ERROR CODE							

Figure 6-6. Controller Error Vector Status Block

CONTROLLER ERROR CODES

The valid error codes which may be returned in word 6 of the above block are as follows:

Table 6-1. Returned Error Codes For Controller Error Vector

CODE	DEFINITION
0xC0	IOPB Type Error
0xC1	IOPB Timeout
0x82	A target has reconnected for which no IOPB exists.
0x83	A target is requesting more data to be transferred than the IOPB transfer count allows.
0x84	A target is requesting a data transfer of the opposite direction specified in the direction bit of the IOPB

NOTE

These Error Codes will not freeze the work queue.

IOPB TYPE ERROR (0xC0). The Jaguar only supports type zero IOPBs. If the IOPB type field (bits 8 - 11 in word 0 of the Command Queue entry) contains any value other than 0, the Jaguar will not ``know"the overall structure of the IOPB and will therefore be unable to process it. This error code indicates that the Command Queue entry contains invalid information.

IOPB TIMEOUT ERROR (0xC1). An IOPB has timed out. The IOPB will remain active until it completes properly or is cancelled explicitly. The status of the IOPB may be inquired about with the Command Status Inquiry IOPB. With this error code, the Controller Error Vector Status Block information is valid.

UNKNOWN DEVICE RECONNECTION (0x82). A SCSI device for which no current IOPB exists has re-selected the Jaguar. This code indicates that the Controller Error Vector Status Block contains invalid information.

DATA TRANSFER COUNT MISMATCH (0x83). Data counters have been exhausted, but the device is requesting more data than the current IOPB can transfer. With this error code, the Controller Error Vector Status Block information is valid.

DATA DIRECTION ERRORS (0x84). The direction bit in the IOPB does not match the data transfer direction requested on the SCSI bus. This error code indicates that the Controller Error Vector Status Block information is valid.

SUGGESTED ERROR RECOVERY SEQUENCE

The following is a suggested series of steps which may be taken by the host to recover from an error:

- The host issues a Bus Status Inquiry to examine the status of commands executing on the bus. This enables the host to determine which command caused the error. Note that the command which timed out may not be one that is actually blocking the SCSI bus. The command that is most likely in error will be the one active on the bus when the Bus Status Inquiry is executed.

- If a device is found to be connected on the SCSI bus indefinitely, there is no way to clear the error without resetting the bus. When this is the case, the host should issue the Reset SCSI Bus IOPB through the Master Command Entry. All work queues with commands active on the bus will have those commands returned with a SCSI Reset Error status, and the work queue will be frozen (if the Freeze Work Queue on Reset option was selected in the Initialize Controller Command).

- The device which caused the error should either be removed or tested before restarting normal operation. The host can then reissue the commands and unfreeze the work queues.

- For systems that have the ability to power down individual devices, the Flush Work Queue command can be used to prevent new commands from being issued to the device after the error has been cleared. It is not mandatory to flush the work queue before restoring the device, but be aware that the Jaguar will begin processing the commands from the queue as soon as: 1) the bus becomes available, and 2) the command that was being executed is cleared.

  After powering down the device, the host should issue a Cancel Command Tag IOPB to clear the command which caused the error (i.e. the IOPB that was not completed by either a normal SCSI completion or by a SCSI reset).

NOTE

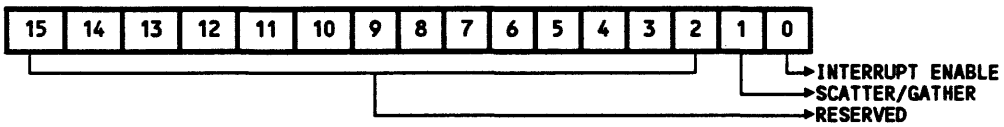
The Flush Work Queue Command does not flush commands that are presently active on the bus. These may only be canceled by: 1) a normal command completion, 2) a SCSI reset, or 3) a Cancel Command Tag IOPB.

SCATTER/GATHER OPERATIONS

The scatter/gather option allows contiguous peripheral data to be written to non-contiguous areas in system memory (``scatter"),or moved from non-contiguous blocks of system memory into contiguous ones (``gather"). Scatter/gather operations can only be performed with SCSI peripheral data. They cannot be used in conjunction with the printer port.

By allowing multiple blocks of data to be transferred using only one command, scatter/gather frees the host from having to process multiple transactions when transferring non-contiguous blocks. This improves system performance by minimizing both the number of VMEbus interrupts and the number of bus transactions associated with common peripheral activity.

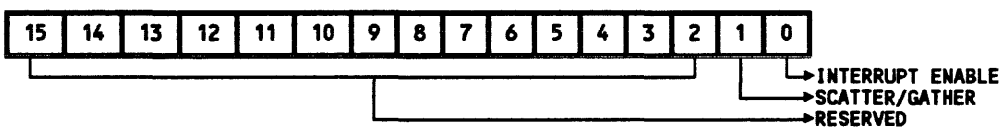
To enable scatter/gather, set bit 1 of the Command Options word in the SCSI Pass-Through IOPB.



(Word 0x1 in The SCSI Pass-Through IOPB)

Figure 6-7. Command Options Word In The SCSI Pass-Through IOPB

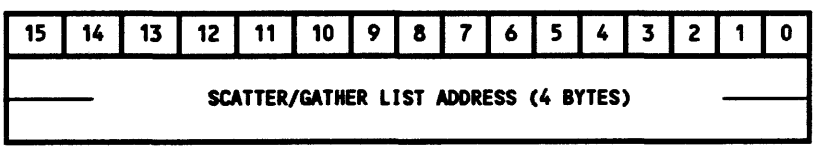
With scatter/gather enabled, the following three IOPB fields reference the Scatter/Gather Element List: 1) Memory Type/Transfer Type/Address Modifier, 2) Buffer Address, and 3) Transfer Length. The Memory Type/Transfer Type/Address Modifier field has the same definition as it does for IOPBs which do not perform scatter/gather operations, except for the Link bit (Bit 15). For an explanation of this bit, see ``Scatter/GatheList Linking", below.



(Word 0x7 In The SCSI Pass-Through IOPB)

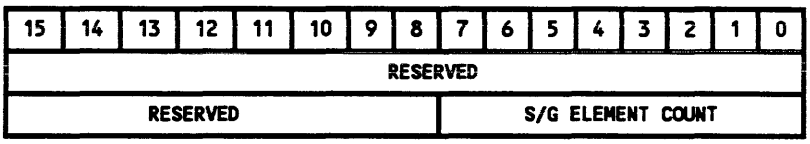
Figure 6-8. Memory Type/Transfer Type/Address Modifier Field For Scatter/Gather Operations

When scatter/gather is used, words 0x8 - 0x9 of the IOPB contain the address of the scatter/gather list. If the Memory Type is 0x1 or 0x2, the value is interpreted as an address in system memory.



(Words 0x8 - 0x9 In The SCSI Pass-Through IOPB)
Figure 6-9. Scatter/Gather List Address

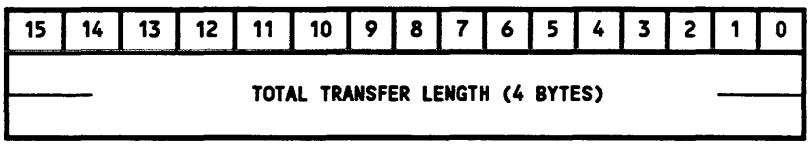
Words 0xA - 0xB contain the number of elements in the scatter/gather list. Valid entries in this field are 1 to 64 (decimal).



(Words 0xA - 0xB In The SCSI Pass-Through IOPB)

Figure 6-10. Scatter/Gather Element Count

Words 0xC - 0xD of the IOPB specify the sum of the individual element entry counts.



(Words 0xC - 0xD Of The SCSI Pass-Through IOPB)

Figure 6-11. Total Transfer Length For Scatter/Gather Operations

NOTE

If the Total Transfer Length field is '0', the Jaguar will calculate this value internally. This feature is provided for compatibility with early firmware revisions. All new applications should provide a specific value in this field.

SCATTER/GATHER LIST

The scatter/gather option uses a list of elements to control the scatter/gather operation. Each element in the list specifies the byte count, address, memory type, and address modifier for each block of data in system memory that is to be transferred by one SCSI Pass-Through command. Each element in the list is an 8-byte entry. The format is as follows:

WORD #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	ELEMENT 1 BYTE COUNT (2 BYTES)															
1 2	ELEMENT 1 BUFFER ADDRESS (4 BYTES)															
3	LNK	RESERVED			TT		MT		ADDRESS MODIFIER							

WORD #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
n*4	ELEMENT N BYTE COUNT (2 BYTES)															
(n*4) +1 (n*4) +2	ELEMENT N BUFFER ADDRESS (4 BYTES)															
+3	LNK	RESERVED			TT		MT		ADDRESS MODIFIER							

Figure 6-12. Scatter/Gather Element List Format

This scatter/gather list can have from 1 to 64 elements. Using scatter/gather for lists with just one element, however, would be inefficient.

SCATTER/GATHER LIST LINKING

To facilitate larger scatter/gather lists, any element in the scatter/gather list may contain a LINK bit. When LINK (bit 15) is set, the element structure will contain information that points to the next group of scatter/gather elements. An element that forms a link should have the following structure:

WORD #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	RESERVED								SCATTER/GATHER COUNT							
0x1 0x2	SCATTER/GATHER LIST ADDRESS															
0x3	LNK	RESERVED					TT		MT		ADDRESS MODIFIER					

LNK == 1

Figure 6-13. Link Element Structure

The scatter/gather count field contains the number of elements in the next link to be gathered by the Jaguar. Valid Counts are 1 to 64.

If scatter/gather list linking is used, all lists must be built at the time the IOPB is issued. In addition, the Total Transfer Count field in the IOPB must be contain the sum of all individual data element counts. (It should not contain the link element counts.)

PRINTER PORT OPERATION

The Jaguar's printer port allows the host to transfer data to either a Centronics or Dataproducts short line interface printer. A version is also available for use with a Dataproducts longline interface.

The printer port is a daughter card that attaches to the Jaguar. To execute a print command, the host issues an IOPB to Port 1 in much the same fashion as it would to a SCSI device. With the printer port installed, Port 1 is dedicated to the printer and cannot be used for SCSI transactions.

When sending data to the printer, the Jaguar DMAs the printer data from host memory, transfers it to the printer via Port 1, and then returns a completion status. Printer status may be monitored asynchronously at any time by the host. The host may also request that the Jaguar interrupt the host when a status change occurs. The printer port does not affect the normal operation of the primary SCSI port (Port 0).

VERIFYING PRINTER PORT INSTALLATION

Once the host has initialized the Jaguar, it can verify that the printer port is installed by checking the Daughter Card ID field in Configuration Status Block. The printer port identification code (0x04) should be stored in this field. For information on setting the port's jumpers and termination, refer to the installation chapter.

INITIALIZING THE PORT

The printer port requires a separate work queue. It will therefore be necessary to create a work queue for it using the Initialize Work Queue command, just as you would for a SCSI device. This work queue must be exclusively used for the printer port.

The first command to the printer work queue should be the Initialize Printer Port command (p. ?). This command sets a variety of parameters, including: 1) the polarity of parity for Dataproducts printers, and 2) which printer status lines may generate a status change interrupt.

The Initialize Printer Port command can be issued at any time to reset the printer port. The command is issued with the reset bit set to clear the printer port hardware. It should never be necessary to reset the hardware. The command may also be issued at any time to assert a buffer clear to the printer. Since the time required for holding this signal varies from printer to printer, the Jaguar will leave the line set until the host issues another Initialize Printer Port command with the bit cleared.

ISSUING PRINTER COMMANDS

The Jaguar will queue printer commands (see Printer Port IOPB, Chapter 5) as received and work on each command in a FIFO manner as the previous command completes. When the Go/Busy bit for a printer command is set, the command will be copied from short I/O space into the internal printer port work queue. After the IOPB has been parsed for correctness, the data will be simultaneously DMA'd from system memory. When all the data has been transferred to the printer, a copy of the IOPB modified with the current printer status and return code will be placed in the Command Response Block.

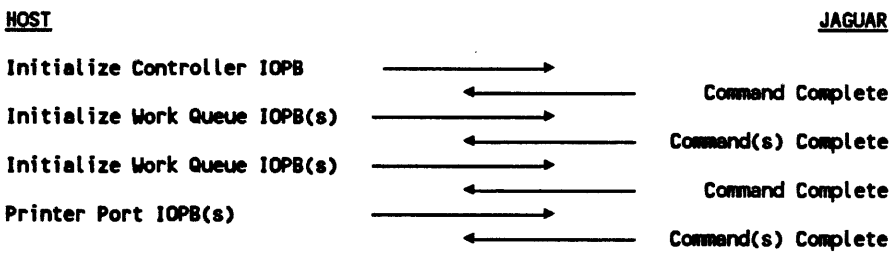


Figure 6-14. Example Of Printer Port Operation

If the printer port is configured for the Dataproducts interface, the host may want to send special font or control characters to the printer using the Paper Instruction control line of the Dataproducts interface. The Jaguar supports this with the Paper Instruction option in the IOPB. When the Paper Instruction option is set to 1, the Jaguar will transfer all of the data specified in this IOPB to the printer with the Paper Instruction interface signal active. Paper Instruction is only supported by Dataproducts printers.

STATUS REPORTING

The printer status may be accessed in three ways from the Jaguar:

- The state of the status lines is updated periodically in Configuration Status Block for asynchronous monitoring by the host. This status is stored in the Secondary Phase Sense/Printer Status field of the Configuration Status Block. For a Dataproducts interface, this byte is updated whenever Online, Ready, Parity Error, or Cable On changes state. For a Centronics interface, it is updated anytime Select, Fault, or Paper Empty changes state. For all interfaces, it is also updated approximately every 30 msec, as well as at the completion of a print command.

- The second method is for the Jaguar to use the Controller Normal Interrupt Vector specified in word 0x2 of the Controller Initialization Block. The host may select which status lines can generate an interrupt in the Initialize Printer Port IOPB. An interrupt is generated when an enabled status line (except parity) toggles either active or inactive. Parity error is only reported when it becomes active. The complete status word will be updated in Configuration Status Block, and a Command Response Block will be posted. This returned structure is shown in Chapter 5.

- The third method for accessing printer information is to issue a Printer Port IOPB with both the Maximum Transfer Length and the Printer Transfer Length fields set to zero. This causes the printer port to update the Printer Status field of the IOPB and immediately return it as command completed.

OFFBOARD IOPBs

The Jaguar's MACSI interface is optimum for systems that have quick host access to the VME short I/O space. In some systems, however, reading and writing data to/from this space can be quite time consuming. To speed up I/O in such systems, the Jaguar supports a technique that enables the host to control the Jaguar with just two reads and two writes into the Jaguar's short I/O space for each command. This technique involves building offboard Command Queue entries, IOPBs, and an offboard Command Response Block.

NOTE

In order execute offboard IOPBs, the Jaguar must be able to access the host memory using its DMA facility.

OVERVIEW

In order to implement offboard IOPBs, you will need to allocate one or more blocks of system memory for sole use by these structures. The Jaguar's onboard Command Queue entries can then initialized to point to these fixed areas of memory. **These pointers should not be changed once normal board operation has begun.**

The host builds offboard IOPBs and Command Queue entries in this space. The only time it accesses the Jaguar's onboard Command Queue entry is to set the Go/Busy bit.
The Jaguar then DMAs the offboard Command Queue entry/IOPB onboard and executes the command. Upon completion of this command fetch, the Jaguar clears the Go/Busy bit in the onboard Command Queue entry.

BUILDING OFFBOARD IOPBs

To build an offboard IOPB, set the Fetch Offboard IOPB bit (bit 4) in the Queue Entry Control Register. This is the first word of the onboard Command Queue entry. Setting this bit changes the purpose of the fields within the Command Queue entry, but it does not change the size of the Command Queue entry.

When bit 4 is set, the Jaguar interprets the address in the onboard Command Queue entry as a pointer to a block of offboard memory consisting of an external Command Queue and one or more Command Queue entries.

Offboard Command Queue entries and IOPBs have the same structure as their onboard counterparts, except that the IOPB Address field in an offboard Command Queue entry has no meaning.

The format of an offboard Command Queue entry is shown below:

WORK #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0	QUEUE ENTRY CONTROL REGISTER															
0x1	RESERVED						TT		MT		ADDRESS MODIFIER					
0x2 0x3	HOST MEMORY ADDRESS															
0x4	IOPB LENGTH								RESERVED							
0x5	RESERVED															

Figure 6-15. Format Of Offboard Command Queue Entry

Note the following important restrictions when building offboard Command Queue entries/IOPBs:

- Each offboard Command Queue entry must be contiguous with its corresponding offboard IOPB in system memory (with the Command Queue entry residing in the *lower* portion of the block of memory).
- Because a single DMA operation of the Jaguar cannot cross nonadjacent page boundaries, an offboard Command Queue entry and its corresponding IOPB cannot be spread across two nonadjacent pages in physical memory.

The host may mix onboard and offboard commands by setting (or clearing) the FOB Bit in the Queue Entry Control Register of individual commands. However, this is not recommended for normal operation. It may be useful for handling errors or when operating the Jaguar in a standalone fashion.

INITIALING OFFBOARD COMMANDS

To initiate a command, the host: 1) reads the Go/Busy bit of the next Command Queue entry to ensure that the entry is available, and 2) sets that same Go/Busy bit after it has assembled the offboard Command Queue entry and IOPB.

If there is no external memory at the location specified in the Command Queue entry, the Jaguar will get a VME bus error (BERR*) when it tries to read the offboard Command Queue entry/IOPB. In this event, the Jaguar uses the default Error Level/Vector in the Controller Initialization Block and places the Command Queue entry/IOPB at the normal Command Response Block (CRB) location in short I/O.

OFFBOARD COMMAND RESPONSE BLOCK

In order for the Jaguar to write a returned IOPB offboard, you need to designate a block of system memory for use as an offboard Command Response Block. Then, write a pointer to the block in the Controller Initialization Block, and execute the Initialize Controller command. Any non-zero value in the pointer field instructs the Jaguar to write returned IOPBs to the offboard address.

Refer to the sections on the Command Response Block (Chapter 3) and Controller Initialization Block (Chapter 5) for additional information.

Once you have initialized the Jaguar to write command responses to an offboard Command Response Block, all responses will be written to this structure unless a bus error occurs during the write operation.

POSTING COMMAND COMPLETION

If the pointer to the external Command Response Block in the Controller Initialization Block is zero, then the Jaguar posts command response information in the Command Response Block section of its own short I/O space.

Once it completes a command, the Jaguar DMAs the command response information into external memory and then generates a Command Complete Interrupt.

Before reading the command response information in its own memory, the host should first read error status in the Jaguar's onboard Command Response Block. (This information is inaccessible once the Jaguar's CRBV bit is cleared.) If an error occurs, the location of the Command Response Block will depend on the type of error. If the error is a SCSI device error, the Command Response Block/returned IOPB will be written offboard to the address specified in the Controller Initialization Block.

On the other hand, if the error status shows that a bus error (BERR*) occurred when attempting to move the information into the offboard Command Response Block, then the host can find the Command Response Block and IOPB in short I/O at the address specified in Word 6 of the Controller Initialization Block (Command Response Block offset).

After checking the error status, the host can respond to the interrupt by clearing the CRBV bit (Command Response Block Valid) in the Command Response Status Word of the Jaguar's onboard Command Response Block.

CONSIDERATIONS FOR MAXIMIZING SCSI SYNCHRONOUS DATA TRANSFERS

Synchronous data throughput in a SCSI system can be significantly improved by better matching the data transfer rates of the host adapter and SCSI devices. This is because SCSI devices support specific data transfer rates within the broad SCSI spectrum.[1] When a synchronous data transfer takes place between two SCSI devices, these devices must negotiate between themselves to select a compatible transfer rate. If the devices have incompatible transfer rates, the result is significantly lower cable bandwidth.

This paper describes the key factors determining the actual speed at which two SCSI devices will perform a synchronous data transfer (as opposed to the rated maximum speeds of the individual devices). Since SCSI data transfer rates are negotiated in terms of *nanoseconds per period* instead of *frequency*, this discussion uses the SCSI transfer period to describe transfer rates. The SCSI transfer period is measured in 4ns increments. A resolution of 4 nanoseconds results in some strange and difficult to read numbers when converted to the equivalent frequency. Just remember that a smaller period means a higher frequency, and a larger period means a lower frequency.

NEGOTIATION PROCESS FOR SYNCHRONOUS TRANSFER RATES

As noted above, the host adapter and target negotiate the maximum transfer rate that may be used in data transfers. The negotiation process, which usually occurs the first time the host adapter communicates with a target, is essentially as follows:

1. The host adapter tells the target the smallest transfer period at which the host adapter is able to operate.

2. The target evaluates the received value.

   - If the proposed value is acceptable, the target returns it to the host adapter and the negotiation process is finished.

   - If the value is less than the target can handle, the target sends the host adapter the smallest transfer period at which it can function. The host adapter then accepts that as the correct value, and the negotiation is finished.

Once a data transfer rate has been determined, all subsequent data transfers between the host adapter and target have a transfer period greater than or equal to the agreed-upon value.

For example, consider a 4 Mbyte/sec. host adapter connected to a 4 Mbyte/sec. disk drive. A problem arises in that a 250ns period is not evenly divisible into the 4ns increments required by SCSI. Therefore, some devices express this value as 248ns, while others use 252ns.

Assume that both devices use a 248ns period. In this case, the pair will communicate at 4 Mbytes/sec., because both devices are allowed to transfer at a period greater than the agreed-upon value.

[1]The SCSI specification allows cable transfer rates ranging from roughly 1 Mbyte/sec. to 5 Mbyte/sec., measured in 4ns increments.

On the other hand, if the host adapter uses 248ns and the drive uses 252ns, the cable rate must be less than 4 Mbytes/sec. The 4-nanosecond difference in periods is significant because devices do not actually support 4ns steps in transfer rates. The transfer rate is usually determined by some division of the oscillator which drives the SCSI controller of the device. Assuming that the SCSI controller is driven by a frequency that is twice the agreed-upon transfer rate, the next lower rate will be three times the input oscillator. In the example we are currently considering, this would mean that the host adapter must operate at 375ns periods or 2.66 Mbytes/sec. — considerably less than the 4 Mbyte/sec. maximum rate.

The matching of device data transfer rates becomes particularly important when using the same cable to interconnect targets that have different maximum speeds. With this setup, the overall system transfer rate is determined by the transfer rates negotiated between the host adapter and each of the devices connected to it. The table below lists a variety of "typical" SCSI drives and host adapters, along with their associated transfer rates. It is followed by examples of the actual transfer rates that would be negotiated between different host adapters and drives in the table.

Transfer Periods Of Example SCSI Host Adapters And Drives

SCSI Device	Maximum Transfer Rate of Device	Transfer Rate If Target Device Cannot Transfer at Maximum Rate
Drive 1	212ns (4.72 Mhz)	252ns (3.97 Mhz)
Drive 2	208ns (4.81 Mhz)	248ns (4.03 Mhz)
Host Adapter 1	248ns (4.03 Mhz)	375ns (2.66 Mhz)
Host Adapter 2	200ns (5.00 Mhz)	300ns (3.33 Mhz)
Host Adapter 3	208ns (4.81 Mhz)	312ns (3.21 Mhz)
Host Adapter 4	212ns (4.72 Mhz)	318ns (3.14 Mhz)

EXAMPLE 1: Host Adapter 1, Drive 1 Transfer Rate 252ns
The host adapter requests 248ns, which the drive accepts as this is greater than the drive's minimum 212ns period. The actual transfer rate paced by the drive is 252ns.

EXAMPLE 2: Host Adapter 1, Drive 2 transfer rate 248ns
The host adapter requests 248ns, which the drive accepts as this is greater than the drive's minimum 208ns period. The actual transfer rate paced by the drive is 248ns.

EXAMPLE 3: Host Adapter 2, Drive 1 transfer rate 300ns
The host adapter requests 200ns, which the drive rejects as this is less than the drive's minimum 212ns period. The drive responds with 212ns. The host adapter must then transfer at its next greater period of 300ns.

EXAMPLE 4: Host Adapter 2, Drive 2 transfer rate 300ns
The host adapter requests 200ns, which the drive rejects as this is less than the drive's minimum 208ns period. The drive then responds with 208ns. The host adapter must then transfer at its next greater period of 300ns.

The resulting transfer rates for the remaining combinations are as follows:

- Host Adapter 3, Drive 1 transfer rate 312ns
- Host Adapter 3, Drive 2 transfer rate 208ns
- Host Adapter 4, Drive 1 transfer rate 212ns
- Host Adapter 4, Drive 2 transfer rate 248ns

The above examples show that it is possible to achieve similar performance from the two example drives with a 4 Mbyte/sec. host adapter. However, if the speed of the host adapter is increased, it is not possible to achieve greater performance from both drives on the same cable. Some combinations actually hurt performance for some drives.

This problem is the result of devices having a finite number of actual transfer rates while the SCSI specification allows a large number of legal values. It is therefore very important that the system integrator carefully choose devices with compatible transfer rates to achieve maximum performance.

APPENDIX A
SPECIFICATIONS

VMEbus SPECIFICATIONS

DTB Master	A24, A32, D16, D32
DTB Slave	A16, D8, D16
Requester	Any of R(0-3), Static
Interrupter	Any of I(1-7), Dynamic

SCSI BUS SPECIFICATIONS

Peripheral Data Rate	Up to 4Mbytes/sec synchronous Up to 1.5Mbytes/sec asynchronous

POWER REQUIREMENTS

Single-Ended V/SCSI 4210 Motherboard	4.67 A typical @ +5V DC (+/- 5%) 6.85 A maximum @ +5V DC (+/- 5%)
Single-ended V/SCSI 4210 Daughter Card	0.75 A typical @ +5V DC (+/- 5%) 1.25 A maximum @ +5V DC (+/- 5%)
Differential V/SCSI 4210 Motherboard	5.27 A typical @ +5V DC (+/- 5%) 7.62 A maximum @ +5V DC (+/- 5%)
Differential V/SCSI 4210 Daughter Card	1.35 A typical @ +5V DC (+/- 5%) 2.04 A maximum @ +5V DC (+/- 5%)

MECHANICAL (Nominal)

Length	233 mm
Width	160 mm
Thickness	20 mm
Weight	.45 Kg

OPERATING ENVIRONMENT

Temperature	0-55 degrees Centigrade
Relative Humidity	10% - 90% Noncondensing

FUSE

The Jaguar has a 1-amp fuse (F1) used to protect the SCSI terminator power when provided by the Jaguar. Its part number is Littlefuse PN 251001. To determine the location of the fuse on the board, refer to the appropriate board layout .

DIAGNOSTIC LEDs

The Jaguar has 2 LED displays (LED1 and LED2) behind the panel that may provide useful diagnostic information. To locate the LEDs, refer to either Jaguar board layout (page ? or ?). The placement and use of the LEDs are identical for both board layouts.

LED1: This single-LED display is green when the Board O.K. bit (bit 1 in the Master Status Register) is set. For a description of the Board O.K. bit, please refer to p. ?. If the LED turns red, one of the following conditions has occurred: 1) the board is being reset, or, 2) the board has failed.

LED2: This display consists of four LEDs, numbered 1 through 4. The meaning of the LEDs is as follows:

LED:	Explanation:
0	VMEbus Busy (System) - This LED is active when the VMEbus BBSY* signal is active.
1	VMEbus Busy (Jaguar) - This LED is active when the Jaguar is driving BBSY*.
2	SCSI Busy (Port 0) - This LED is active when Port 0's SCSI BSY* signal is active.
3	This LED is not used.

RELIABILITY

MTBF per MIL STD 217E	68,400 hours

APPENDIX B
CONNECTOR PINOUTS AND CABLING

OVERVIEW

This appendix contains the connector pinouts and cabling information needed for various Jaguar configurations. The tables in this appendix are listed below, along with the page number on which each table appears:

SCSI Ports

- Table B-1. Single-ended SCSI port pinouts
- Table B-2. Differential SCSI port pinouts

Printer Port

- Table B-3. Dataproducts Short Line printer cable pinouts
- Table B-4. Dataproducts Long Line printer cable pinouts
- Table B-5. Centronics printer cable pinouts

P1 and P2 Connectors

- Table B-6. P1 connector
- Table B-7.† P2 connector, rows A and C. This table lists the SCSI signals provided by a single-ended motherboard with no daughter card.
- Table B-8.† P2 connector, rows A and C. This table lists the SCSI signals provided by a differential motherboard with no daughter card.
- Table B-9.† P2 connector, rows A and C. This table lists the SCSI signals provided by a single-ended motherboard with a single-ended daughter card.
- Table B-10.† P2 connector, rows A and C. This table lists the SCSI signals provided by a single-ended motherboard with a differential daughter card.
- Table B-11.† P2 connector, rows A and C. This table lists the SCSI signals provided by a differential motherboard with a single-ended daughter card.
- Table B-12. P2 connector, row B. This table lists signals for motherboards which use P2 Row B only.

† These tables apply only to versions of the Jaguar which use P2 rows A and C.

DESCRIPTION OF SCSI CABLE

All possible SCSI bus configurations on the Jaguar (single-ended vs. differential, and routed off P2, P3, or P4) require the same standard SCSI cable. A standard SCSI cable is either a 50-conductor flat cable or a 25-signal twisted-pair cable. The cable is one-to-one, with 50-pin connectors on both ends. As per SCSI specifications, the cable can be up to 20 feet long (6 meters) for a single-ended SCSI bus and 82 feet long (25 meters) for a differential one.

Below is a list of sample part numbers which you may find to be useful in cabling your system. **Interphase assumes no responsibility regarding the functionality of the parts listed below. If you need more information concerning the parts, contact the manufacturer directly.**

Component	Sample Part No.
Flat Cable	3M-3365-50
Connectors	
• End of cable connector	
• Without strain relief; no center key	3M-3425-7000
• With strain relief; no center key	3M-3425-7050
• Without strain relief; with center key	Dupont 66900-290
• Daisy Chain	
• Without strain relief; no center key	3M-3425-6000
• With strain relief; no center key	3M-3425-6050
• Without strain relief; with center key	Dupont 66900-250

SINGLE-ENDED SCSI CABLE PINOUT

The following pinout applies to all Jaguar connectors which provide a single-ended SCSI port, whether the port is routed off P2, P3, or P4.

Table B-1. Single-Ended SCSI Port Pinouts

Pin	Mnemonic	Pin	Mnemonic
1	GND	2	DB0-
3	GND	4	DB1-
5	GND	6	DB2-
7	GND	8	DB3-
9	GND	10	DB4-
11	GND	12	DB5-
13	GND	14	DB6-
15	GND	16	DB7-
17	GND	18	DBP-
19	GND	20	GND
21	GND	22	GND
23	GND	24	GND
25		26	TERMPWR
27	GND	28	GND
29	GND	30	GND
31	GND	32	ATN-
33	GND	34	GND
35	GND	36	BSY-
37	GND	38	ACK-
39	GND	40	RST-
41	GND	42	MSG-
43	GND	44	SEL-
45	GND	46	C/D-
47	GND	48	REQ-
49	GND	50	I/O-

NOTE: If no signal is referenced, then the Jaguar does not use that pin.

DIFFERENTIAL SCSI CABLE PINOUT

The following pinout applies to all Jaguar connectors which provide a differential SCSI port, whether the port is routed off P2, P3, or P4.

Table B-2. Differential SCSI Port Pinouts

Pin	Mnemonic	Pin	Mnemonic
1	SHIELD	2	GND
3	DB0+	4	DB0-
5	DB1+	6	DB1-
7	DB2+	8	DB2-
9	DB3+	10	DB3-
11	DB4+	12	DB4-
13	DB5+	14	DB5-
15	DB6+	16	DB6-
17	DB7+	18	DB7-
19	DBP+	20	DBP-
21	DIFFSENS	22	GND
23	GND	24	GND
25	TERMPWR	26	TERMPWR
27	GND	28	GND
29	ATN+	30	ATN-
31	GND	32	GND
33	BSY+	34	BSY-
35	ACK+	36	ACK-
37	RST+	38	RST-
39	MSG+	40	MSG-
41	SEL+	42	SEL-
43	C/D+	44	C/D-
45	REQ+	46	REQ-
47	I/O+	48	I/O-
49	GND	50	GND

DATAPRODUCTS PRINTER CABLING

Table B-3. Cable Pinouts for P4 Connector to Dataproducts Short Line Printer

4210 P4	Dataproducts (Short Line)	Functions	4210 P4	Dataproducts (Short Line)	Function
6	19	DATA 1	11	37	RETURN
7	3	RETURN	42	31	BUFFER CLEAR
9	20	DATA 2	43	15	RETURN
10	4	RETURN	34	12	+5V (NOT SUPPLIED)
1	1	DATA 3	15	22	READY
4	2	RETURN	16	6	RETURN
23	41	DATA 4	12	21	ON LINE
20	40	RETURN	13	5	RETURN
2	34	DATA 5	18	23	DEMAND
3	18	RETURN	19	7	RETURN
29	43	DATA 6	30	27	PARITY ERROR
26	42	RETURN	31	11	RETURN
8	36	DATA 7	24	25	BOTTOM OF FORM
5	35	RETURN	25	9	RETURN
33	28	DATA 8	27	26	PAPER MOVING
32	44	RETURN	28	10	RETURN
36	29	DATA PARITY	17	39	GROUND
37	13	RETURN	21	24	TOP OF FORM
39	30	PAPER INSTRUCTION	22	8	RETURN
40	14	RETURN	38	46	INTERFACE CONNECTED
14	38	DATA STROBE	35	45	INTERFACE CONNECTED RETURN

NOTE: If no signal is referenced, then that pin is not used.

Table B-4. Cable Pinouts for P4 Connector to Dataproducts Long Line Printer

4210 P4	Dataproducts (Long Line)	Functions	4210 P4	Dataproducts (Long Line)	Function
6	19	DATA 1+	11	37	DATA STROBE-
7	3	DATA 1-	42	31	BUFFER CLEAR+
9	20	DATA 2+	43	15	BUFFER CLEAR-
10	4	DATA 2-	34	12	+5V (NOT SUPPLIED)
1	1	DATA 3+	15	22	READY+
4	2	DATA 3-	16	6	READY-
23	41	DATA 4+	12	21	ON LINE+
20	40	DATA 4-	13	5	ON LINE-
2	34	DATA 5+	18	23	DEMAND+
3	18	DATA 5-	19	7	DEMAND-
29	43	DATA 6+	30	27	PARITY ERROR+
26	42	DATA 6-	31	11	PARITY ERROR-
8	36	DATA 7+	24	25	BOTTOM OF FORM+
5	35	DATA 7-	25	9	BOTTOM OF FORM-
33	28	DATA 8+	27	26	PAPER MOVING+
32	44	DATA 8-	28	10	PAPER MOVING-
36	29	DATA PARITY+	17	39	GROUND
37	13	DATA PARITY-	21	24	TOP OF FORM+
39	30	PAPER INSTRUCTION+	22	8	TOP OF FORM-
40	14	PAPER INSTRUCTION-	38	46	INTERFACE CONNECTED
14	38	DATA STROBE+	35	45	INTERFACE CONNECTED RETURN

NOTE: If no signal is referenced, then that pin is not used.

DATAPRODUCTS CABLE DESCRIPTION

Both short and long line Dataproducts printer configurations require a 50-conductor flat ribbon cable. Below is a list of sample part numbers which you may find to be useful in cabling your system. **Interphase assumes no responsibility regarding the functionality of the parts listed below. If you need more information concerning the parts, contact the part manufacturer directly.**

Component	Sample Part No.
Flat Cable	3M-3365-50
Connectors	
• Jaguar End	
• Without strain relief; no center key	3M-3425-7000
• With strain relief; no center key	3M-3425-7050
• Without strain relief; with center key	Dupont 66900-290
• Dataproducts End	T&B Ansley 609-50P*

* The connector type needed for your specific Dataproducts printer may be different from that given above. Be sure to verify your printer's connector requirements before making the cable.

CENTRONICS PRINTER CABLING

Table B-5. Cable Pinouts For P4 Connector to Centronics Printer

4210 P4	Centronics	Function	4210 P4	Centronics	Function
6	2	DATA 1	11	19	RETURN
7	20	RETURN	42	31	PRINTER INITIALIZE
9	3	DATA 2	43	30	RETURN
10	21	RETURN	34	NU	NOT USED
1	4	DATA 3	15	32	FAULT
4	22	RETURN	16	NU	NOT USED
23	5	DATA 4	12	13	SELECT
20	23	RETURN	13	NU	NOT USED
2	6	DATA 5	18	10	ACKNOWLEDGE
3	24	RETURN	19	28	RETURN
29	7	DATA 6	30	12	PAPER ENTRY
26	25	RETURN	31	NU	NOT USED
8	8	DATA 7	24	NU	NOT USED
5	26	RETURN	25	NU	NOT USED
33	9	DATA 8	27	11	BUSY
32	27	RETURN	28	29	RETURN
36	NU	NOT USED	17	NU	NOT USED
37	NU	NOT USED	21	NU	NOT USED
39	NU	NOT USED	22	NU	NOT USED
40	NU	NOT USED	38	NU	NOT USED
14	1	DATA STROBE	35	NU	NOT USED

P1 CONNECTOR

Table B-6. P1 Connector Signal Descriptions (All Versions)

Pin	Row A Signal Mnemonic	Row B Signal Mnemonic	Row C Signal Mnemonic
1	D00	BBSY*	D08
2	D01	BCLR*	D09
3	D02	ACFAIL*	D10
4	D03	BG0IN*	D11
5	D04	BG0OUT*	D12
6	D05	BG1IN*	D13
7	D06	BG1OUT*	D14
8	D07	BG2IN*	D15
9	GND	BG2OUT*	GND
10	SYSCLK	BG3IN*	SYSFAIL*
11	GND	BG3OUT*	BERR*
12	DS1*	BR0*	SYSRESET*
13	DS0*	BR1*	LWORD*
14	WRITE	BR2*	AM5
15	GND	BR3*	A23
16	DTACK	AM0	A22
17	GND	AM1	A21
18	AS*	AM2	A20
19	GND	AM3	A19
20	IACK	GND	A18
21	IACKIN*		A17
22	IACKOUT*		A16
23	AM4	GND	A15
24	A07	IRQ7*	A14
25	A06	IRQ6*	A13
26	A05	IRQ5*	A12
27	A04	IRQ4*	A11
28	A03	IRQ3*	A10
29	A02	IRQ2*	A09
30	A01	IRQ1*	A08
31			+12V DC
32	+5V DC	+5V DC	+5V DC

NOTES: If no signal is referenced, then the Jaguar does not use that pin. A "*" denotes an active low signal.

SCSI SIGNALS ON P2 CONNECTOR

The tables on the next five pages list the SCSI signals which are routed to P2 by the following Jaguar configurations:

- A single-ended motherboard with no daughter card.
- A differential motherboard with no daughter card.
- A single-ended motherboard with a single-ended daughter card.
- A single-ended motherboard with a differential daughter card.
- A differential motherboard with a single-ended daughter card.

To determine the full P2 pinout of your version of the Jaguar, combine the SCSI signal description for your motherboard/daughter card configuration with the Row B VMEbus signals shown in table B-12.

As noted previously in this manual, if you have a differential daughter card installed on a differential motherboard, only the primary SCSI bus (Port 0) can be routed off P2.

The following table lists the SCSI signals routed to P2 rows A and C by a single-ended motherboard with no daughter card. (Assumes the motherboard uses P2 rows A and C.)

Table B-7. P2 Connector SCSI Signal Descriptions (Single-Ended Motherboard, No Daughter Card)

Pin	Row A Signal Mnemonic	Row B Signal Mnemonic	Row C Signal Mnemonic
1			I/O-
2			REQ-
3			
4			C/D-
5			
6			SEL-
7			
8			MSG-
9			
10			RST-
11			
12			ACK-
13			
14			
15			BSY-
16			
17			ATN-
18			
19			
20			
21			TERMPWR
22			
23			
24			DBP-
25			DB7-
26			DB6-
27			DB5-
28			DB4-
29			DB3-
30			DB2-
31			DB1-
32			DB0-

NOTE: Signals from the single-ended motherboard (Port 0) are set in shaded type These signals are routed off the P4 connector on the P2 adapter.

The following table lists the SCSI signals routed to P2 rows A and C by a differential motherboard with no daughter card. (Assumes the motherboard uses P2 rows A and C.)

Table B-8. P2 Connector SCSI Signal Descriptions (Differential Motherboard, No Daughter Card)

Pin	Row A Signal Mnemonic	Row B Signal Mnemonic	Row C Signal Mnemonic
1	GND		
2	I/O-		
3	REQ-		I/O+
4	C/D-		
5	SEL-		REQ+
6	MSG-		
7	RST-		C/D+
8	ACK-		
9	BSY-		SEL+
10	GND		
11	ATN-		MSG+
12	TERMPWR		
13	DBP-		RST+
14	DB7-		ACK+
15	DB6-		
16	DB5-		BSY+
17	DB4-		
18	DB3-		ATN+
19	DB2-		
20	DB1-		TERMPWR
21	DB0-		
22	GND		DIFFSENS
23			DBP+
24	DB7+		
25	DB6+		
26	DB5+		
27	DB4+		
28	DB3+		
29	DB2+		
30	DB1+		
31	DB0+		
32			

NOTE: Signals from the differential motherboard (Port 0) are set in shaded type. These signals are routed off the P3 connector on the P2 adapter.

The following table lists the SCSI signals routed to P2 rows A and C by a single-ended motherboard with a single-ended daughter card. (Assumes the motherboard uses P2 rows A and C.)

Table B-9. P2 Connector SCSI Signal Descriptions (Single-Ended Motherboard, Single-Ended Daughter Card)

Pin	Row A Signal Mnemonic	Row B Signal Mnemonic	Row C Signal Mnemonic
1	I/O-		I/O-
2	REQ-		REQ-
3	C/D-		GND
4	SEL-		C/D-
5	MSG-		GND
6	RST-		SEL-
7	ACK-		GND
8	BSY-		MSG-
9	GND		GND
10	ATN-		RST-
11	GND		GND
12	TERMPWR		ACK-
13	GND		GND
14	DBP-		GND
15	DB7-		BSY-
16	DB6-		GND
17	DB5-		ATN-
18	DB4-		GND
19	DB3-		
20	DB2-		
21	DB1-		TERMPWR
22	DB0-		GND
23			GND
24	GND		DBP-
25	GND		DB7-
26	GND		DB6-
27	GND		DB5-
28	GND		DB4-
29	GND		DB3-
30	GND		DB2-
31	GND		DB1-
32	GND		DB0-

NOTES: Signals from the single-ended motherboard (Port 0) are set in shaded type. These signals are routed off the P4 connector on the P2 adapter.

Signals from the single-ended daughter card (Port 1) are set in regular (non-shaded) type. These signals are routed off the P3 connector on the P2 adapter.

The following table lists the SCSI signals routed to P2 rows A and C by a single-ended motherboard with a differential daughter card. (Assumes the motherboard uses P2 rows A and C.)

Table B-10. P2 Connector SCSI Signal Descriptions (Single-Ended Motherboard, Differential Daughter Card)

Pin	Row A Signal Mnemonic	Row B Signal Mnemonic	Row C Signal Mnemonic
1	GND		I/O-
2	I/O-		REQ-
3	REQ-		I/O+
4	C/D-		C/D-
5	SEL-		REQ+
6	MSG-		SEL-
7	RST-		C/D+
8	ACK-		MSG-
9	BSY-		SEL+
10	GND		RST-
11	ATN-		MSG+
12	TERMPWR		ACK-
13	DBP-		RST+
14	DB7-		ACK+
15	DB6-		BSY-
16	DB5-		BSY+
17	DB4-		ATN-
18	DB3-		ATN+
19	DB2-		
20	DB1-		TERMPWR
21	DB0-		TERMPWR
22	GND		DIFFSENS
23			DBP+
24	DB7+		DBP-
25	DB6+		DB7-
26	DB5+		DB6-
27	DB4+		DB5-
28	DB3+		DB4-
29	DB2+		DB3-
30	DB1+		DB2-
31	DB0+		DB1-
32			DB0-

NOTES: Signals from the single-ended motherboard (Port 0) are set in shaded type. These signals are routed off the P4 connector on the P2 adapter.

Signals from the differential daughter card (Port 1) are set in regular (non-shaded) type. These signals are routed off the P3 connector on the P2 adapter.

The following table lists the SCSI signals routed to P2 rows A and C by a differential motherboard with a single-ended daughter card. (Assumes the motherboard uses P2 rows A and C.)

Table B-11. P2 Connector SCSI Signal Descriptions (Differential Motherboard, Single-Ended Daughter Card)

Pin	Row A Signal Mnemonic	Row B Signal Mnemonic	Row C Signal Mnemonic
1	GND		I/O-
2	I/O-		REQ-
3	REQ-		I/O+
4	C/D-		C/D-
5	SEL-		REQ+
6	MSG-		SEL-
7	RST-		C/D+
8	ACK-		MSG-
9	BSY-		SEL+
10	GND		RST-
11	ATN-		MSG+
12	TERMPWR		ACK-
13	DBP-		RST+
14	DB7-		ACK+
15	DB6-		BSY-
16	DB5-		BSY+
17	DB4-		ATN-
18	DB3-		ATN+
19	DB2-		
20	DB1-		TERMPWR
21	DB0-		TERMPWR
22	GND		DIFFSENS
23			DBP+
24	DB7+		DBP-
25	DB6+		DB7-
26	DB5+		DB6-
27	DB4+		DB5-
28	DB3+		DB4-
29	DB2+		DB3-
30	DB1+		DB2-
31	DB0+		DB1-
32			DB0-

NOTES: Signals from the differential motherboard (Port 0) are set in shaded type. These signals are routed off the P3 connector on the P2 adapter.

Signals from the single-ended daughter card (Port 1) are set in regular (non-shaded) type. These signals are routed off the P4 connector on the P2 adapter.

P2 CONNECTOR ROW B ONLY VERSION

Table B-12. P2 Connector for Motherboards which only Use P2 Row B

Pin	Row A Signal Mnemonic	Row B Signal Mnemonic	Row C Signal Mnemonic
1		+5V DC	
2		GND	
3			
4		A24	
5		A25	
6		A26	
7		A27	
8		A28	
9		A29	
10		A30	
11		A31	
12		GND	
13		+5V DC	
14		D16	
15		D17	
16		D18	
17		D18	
18		D20	
19		D21	
20		D22	
21		D23	
22		GND	
23		D24	
24		D25	
25		D26	
26		D27	
27		D28	
28		D29	
29		D30	
30		D31	
31		GND	
32		+5V DC	

NOTE: If no signal is referenced, then the Jaguar does not use that pin.

APPENDIX C
ERROR CODES

The Jaguar Controller Error Codes field returns information pertaining to the operation of the IOPB returned in the Command Response Block. Statuses have been separated into five groups: MACSI/Controller, General, Error Recovery, VME, and SCSI errors. The V/SCSI 4210 Jaguar controller status definitions are reported in hexadecimal format.

MACSI/CONTROLLER ERROR CODES

HEX CODE	DESCRIPTION
0x00	GOOD STATUS: The controller has completed the command and no errors were detected. The Pass-Back status field contains the Pass-Through status.
0x01	QUEUE FULL: The work queue specified for this command is full and cannot receive another entry. The command is not executed and is moved directly to the Command Response Block with this status set. The queue can receive another entry after a currently active command has completed or if the queue is flushed.
0x02	WORK QUEUE INITIALIZATION ERROR: The work queue specified has not been initialized. The command is not executed and is moved directly to the Command Response Block with this status set. The Work Queue should be initialized with an Initialize Work Queue Command.
0x03	FIRST COMMAND ERROR: The first command sent to the board was not an Initialize Controller command. The board should be reset, and the first command issued should be the Initialize Controller command in order to set up the MACSI operating parameters.
0x04	COMMAND CODE ERROR: The command field contains an invalid command type. Either a SCSI IOPB type or a Control IOPB type must be specified.
0x05	QUEUE NUMBER ERROR: The work queue number specified in the Command Queue entry is invalid. Valid work queue numbers are 0 to 14.
0x06	QUEUE ALREADY INITIALIZED: The work queue specified to be initialized has already been initialized. To re-initialize a queue, set the IWQ bit in the options field.

0x07 QUEUE UNINITIALIZED:

An IOPB was issued to a work queue that has not been initialized. Work queues must be initialized with operating parameters before usage.

0x08 QUEUE MODE NOT READY:

The Start Queue Mode bit was set before the Initialize Controller Command was issued. The Initialize Controller Command should be the first board operation after power up to configure the MACSI interface.

0x09 COMMAND UNAVAILABLE:

The command specified has not been implemented in the current firmware.

0x0B INVALID BURST COUNT:

This error indicates that the requested burst size in the Controller Initialization Block is odd, or is greater than 256.

GENERAL ERROR CODE INFORMATION

HEX CODE	DESCRIPTION

0x10 RESERVED FIELD ERROR:

A reserved field in the IOPB has non-zero data in it.

0x11 RESET BUS STATUS:

The SCSI Reset IOPB has executed successfully and generated a Reset on the bus.

0x12 SECONDARY PORT UNAVAILABLE:

An IOPB has been issued to the secondary port (Port 1), but the port is not installed.

0x13 SCSI ID ERROR:

The SCSI device ID requested is the Jaguar's own device ID. All devices on the bus require unique SCSI IDs.

0x14 SCSI BUS RESET STATUS:

The command could not execute because the SCSI bus is held in the reset state. This may be caused by an un-powered device on the bus, improper termination, or an inverted cable.

0x15 COMMAND ABORTED BY RESET:

The command has been aborted due to a SCSI reset condition received during execution of the command.

0x16 PAGE SIZE ERROR:

The page size specified in the Page Size field of the Controller Initialization Block (words 0xD - 0xE) is invalid. For most applications, this field must be 0. Contact Interphase for special applications.

0x17 INVALID COMMAND TAG:

Command tags must be non-zero for successful searches.

0x18 BUSY COMMAND TAG:

Command is on the bus.

VMEbus ERRORS

HEX CODE	DESCRIPTION

0x20 VMEbus BUS ERROR:

This error indicates that a bus error occurred during the DMA transfer of the data to or from the buffer or the bus.

0x21 VMEbus TIMEOUT:

This error indicates that bus acquisition was not completed within the programmed timeout period. This error is typically caused by a nonexistent address or address modifier in the IOPB.

0x23 VMEbus ILLEGAL ADDRESS:

For 16-bit transfers, the starting address of the VMEbus buffer must fall on a word boundary (even address). For 32-bit transfers, the starting address of the VMEbus buffer must fall on a long word boundary (multiple of 4).

0x24 VMEbus ILLEGAL MEMORY TYPE:

An illegal memory type has been specified.

0x25 ILLEGAL COUNT SPECIFIED:

The maximum transfer length specified is not an even number. All transfer counts must be even since the controller can only perform word or long word transfers. If an odd count is to be transferred across the SCSI bus, the count specified in the maximum length field must be padded by `1'to round up the VMEbus transfer count to a word or long word multiple.

0x26 VMEbus FETCH ERROR:

A VMEbus error occurred during an offboard IOPB fetch.

0x27	VMEbus FETCH TIMEOUT:
	A VMEbus timeout occurred on an offboard IOPB fetch.
0x28	VMEbus POST ERROR:
	A VMEbus error occurred on an offboard Command Response Block post.
0x29	VMEbus POST TIMEOUT:
	A VMEbus timeout occurred on an offboard Command Response Block post.
0x2A	VMEbus ILLEGAL FETCH ADDRESS:
	Illegal address on an offboard IOPB fetch.
0x2B	VMEbus ILLEGAL POST ADDRESS:
	Illegal address on an offboard Command Response Block post.
0x2C	VMEbus SCATTER/GATHER FETCH:
	VMEbus error on scatter/gather list fetch.
0x2D	VMEbus SCATTER/GATHER TIMEOUT:
	VMEbus timeout error on scatter/gather list fetch.
0x2E	INVALID SCATTER/GATHER COUNT:
	An invalid number of scatter/gather elements has been specified. Valid element counts are 1 to 64.

SCSI ERRORS

HEX CODE	DESCRIPTION
0x30	SCSI SELECTION TIMEOUT ERROR:
	The selection phase of the SCSI device has failed. The error may occur due to an incorrect Target ID.
0x31	SCSI DISCONNECT TIMEOUT ERROR:
	A disconnected device has not re-selected the board in the timeout period. This may be caused by a hardware error, or a command that may take a very long period of time to execute.
0x32	ABNORMAL SCSI SEQUENCE:
	The SCSI operation did not complete successfully due to a hardware error or an abnormal operation sequence.

0x33 SCSI DISCONNECT ERROR:

An invalid SCSI bus sequence has been detected. This usually indicates a device has disconnected without either issuing the disconnect or command complete message.

0x34 SCSI TRANSFER COUNT EXCEPTION:

The SCSI Transfer Count of Data did not match the count specified in the maximum count length field. The amount of data actually transferred on the SCSI bus will be returned in the maximum count length field. This status may not be considered an error for commands that intentionally allocate more buffer than the SCSI command uses.

0x35 SCSI PARITY ERROR:

A parity error occurred during the Information Transfer phase on the SCSI bus.

SCATTER/GATHER ERRORS

HEX CODE	DESCRIPTION
0x40	ILLEGAL SCATTER/GATHER COUNT
	Odd byte count in scatter/gather list.
0x41	ILLEGAL SCATTER/GATHER MEMORY TYPE
	Illegal memory type in scatter/gather list.
0x42	ILLEGAL SCATTER/GATHER ADDRESS
	Illegal address in scatter/gather list.

ERROR HANDLING CODES

HEX CODE	DESCRIPTION
0x50	READ/WRITE BUFFER COUNT ERROR:
	Buffer count is too large.
0x51	ILLEGAL READ/WRITE:
	Can't execute because of offboard Command Response Block.
0x80	FLUSH ON ERROR IN PROGRESS:
	This status is set when the IOPB is flushed because an error condition has occurred and the work queue has the abort enable option set. This causes all queued IOPBs to be flushed until the abort acknowledge has been received.

0x81 FLUSH WORK QUEUE STATUS:

The queued IOPB is being flushed in response to a Flush Work Queue Command.

0x82 MISSING COMMAND:

A device has reselected the 4210 for which there is no currently pending command.

0x83 COUNTER EXHAUSTED:

The transfer counter has exhausted but more data is being requested by the target device.

0x84 DATA DIRECTION ERROR:

A data phase is being requested opposite of the direction set in the IOPB.

PRINTER PORT ERRORS

HEX CODE	DESCRIPTION

0x90 PRINTER STATUS CHANGE:

A printer port status change interrupt is being posted.

0x91 PRINTER COUNT TOO SHORT:

The value in the Maximum Transfer Length field must be greater than or equal to the Printer Transfer Length field.

0x92 BAD DATA LENGTH FIELD:

The Maximum Transfer Length field is set to 0, but the Printer Transfer Length field is not.

0x93 PRINTER UNAVAILABLE:

The printer port is not installed or is not initialized.

0x99 SCATTER/GATHER SELECTED FOR PRINTER PORT:

Scatter/gather mode is not available for use with the printer port.

OTHER ERRORS

HEX CODE	DESCRIPTION

0xC0 BAD IOPB TYPE:

The IOPB type field does not match a currently supported IOPB type.

0xC1 IOPB TIMEOUT ERROR

The IOPB has timed out due to some type of serious error.

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APPENDIX D
MACSI DATA STRUCTURES

```
/*
 *   VJ_struct.h : V/SCSI 4210 Jaguar MACSI header.
 *
 */

typedef unsigned char    BYTE;     /* 8 bit unsigned       */
typedef unsigned char    UBYTE;    /* 8 bit unsigned       */
typedef unsigned short   UWORD;  /* 16 bit unsigned      */
typedef unsigned int     UINT;     /* 32 bit unsigned      */
typedef unsigned int     ULONG;    /* 32 bit unsigned      */

/****************     Master Control Status Block (MCSB) ******************/
typedef struct mcsb {                /* Master control/Status Block        */
    UWORD       mcsb_MSR;            /* Master status register             */
    UWORD       mcsb_MCR;            /* Master Control register            */
    UWORD       mcsb_IQAR;           /* Interrupt on Queue Available Reg   */
    UWORD       mcsb_QHDP;           /* Queue head pointer                 */
    UWORD       mcsb_THAW;           /* Thaw work Queue                    */
    UWORD       mcsb_RES0;           /* Reserved word 0                    */
    UWORD       mcsb_RES1;           /* Reserved word 1                    */
    UWORD       mcsb_RES2;           /* Reserved word 2                    */
} VJ_MCSB;

/***************     Controller Initialization Block (CIB)****************/
typedef struct cib {                 /* Controller Initialization Block    */
    UWORD   cib_NCQE;                /* Number of Command Queue Entries    */
    UWORD   cib_BURST;               /* DMA Burst count                    */
    UWORD   cib_NVECT;               /* Normal Completion Vector           */
    UWORD   cib_EVECT;               /* Error Completion Vector            */
    UWORD   cib_PID;                 /* Primary SCSI Bus ID                */
    UWORD   cib_SID;                 /* Secondary SCSI Bus ID              */
    UWORD   cib_CRBO;                /* Command Response Block Offset      */
    ULONG   cib_SELECT;              /* Selection timeout in milli-second  */
    ULONG   cib_WQ0_TIMEOUT;         /* Work Q 0 timeout in 256msec ticks  */
    ULONG   cib_VME_TIMEOUT;         /* VMEbus Timeout 0 = 100msec timeout */
    ULONG   cib_PAGE_SIZE;           /* Page size - RESERVED for most applications */
    UWORD   cib_CRB_ADRMOD;          /* Offboard Command Response Block memtype    */
    UINT    cib_CRB_ADDRESS;         /* Offboard Command Response Block address    */
    UWORD   cib_CRB_ERTFLAGS;        /* Reserved words                     */
} VJ_CIB;

/****************     Command Queue Entry (CQE)          ******************/
typedef struct cqe {                 /* Command Queue Entry                */
    UWORD       cqe_QECR;            /* Queue Entry Control Register       */
    UWORD       cqe_IOPB_ADDR;       /* IOPB Address                       */
    ULONG       cqe_CTAG;            /* Command Tag                        */
    UBYTE       cqe_IOPB_LENGTH;     /* IOPB Length                        */
    UBYTE       cqe_WORK_QUEUE;      /* Work Queue Number                  */
    UWORD       cqe_RES0;            /* Reserved word                      */
} VJ_CQE;
```

```
/*****************     IOPB Format (IOPB)                    ********************/
typedef struct iopb {
    UWORD   iopb_CMD;           /* IOPB Command code                    */
    UWORD   iopb_OPTION;        /* IOPB Option word                     */
    UWORD   iopb_STATUS;        /* IOPB Return Status word              */
    UWORD   iopb_RES0;          /* IOPB Reserved word                   */
    UBYTE   iopb_NVCT;          /* IOPB Normal completion Vector        */
    UBYTE   iopb_EVCT;          /* IOPB Error  completion Vector        */
    UWORD   iopb_LEVEL;         /* IOPB Interrupt Level                 */
    UWORD   iopb_RES1;          /* IOPB Reserved word                   */
    UWORD   iopb_ADDR;          /* IOPB Address type and modifier       */
    ULONG   iopb_BUFF;          /* IOPB Buffer Address                  */
    ULONG   iopb_LENGTH;        /* IOPB Max-Transfer Length             */
    ULONG   iopb_SG_LENGTH;     /* IOPB Length in bytes of S/G request */
    UWORD   iopb_RES4;          /* IOPB Reserved word                   */
    UWORD   iopb_UNIT;          /* IOPB Unit address on SCSI bus        */
    UWORD   iopb_SCSI[6];       /* IOPB SCSI words for pass through     */
} VJ_IOPB;

/*****************     Command Response Block (CRB)          ********************/
typedef struct crb {                /* Command Response Block           */
    UWORD       crb_CRSW;           /* Command Response Status Word     */
    UWORD       crb_RES0;           /* Reserved word                    */
    ULONG       crb_CTAG;           /* Command Tag                      */
    UBYTE       crb_IOPB_LENGTH;    /* IOPB Length                      */
    UBYTE       crb_WORK_QUEUE;     /* Work Queue Number                */
    UWORD       crb_RES1;           /* Reserved word                    */
    VJ_IOPB     crb_IOPB;           /* Returned IOPB                    */
} VJ_CRB;

/*****************     Configuration Status Block (CSB)      ********************/
typedef struct csb {                /* Configuration Status Block 120 bytes*/
    UWORD   csb_RES0;               /* Reserved word                    */
    UBYTE   csb_RES1;               /* Reserved byte                    */
    char    csb_PCODE[3];           /* Product Code                     */
    UWORD   csb_RES2;               /* Reserved word                    */
    UBYTE   csb_RES3;               /* Reserved byte                    */
    char    csb_PVAR;               /* Product Variation                */
    UWORD   csb_RES4;               /* Reserved word                    */
    UBYTE   csb_RES5;               /* Reserved byte                    */
    char    csb_FREV[3];            /* Firmware Revision level          */
    UWORD   csb_RES6;               /* Reserved word                    */
    char    csb_FDATE[8];           /* Firmware Release date            */
    UWORD   csb_RES7;               /* Reserved word                    */
    UWORD   csb_BSIZE;              /* Buffer size in Kbytes            */
    UWORD   csb_RES8[2];            /* Reserved word                    */
    UBYTE   csb_PID;                /* Primary SCSI Bus ID              */
    UBYTE   csb_SID;                /* Secondary SCSI Bus ID            */
    UBYTE   csb_PRI_SLCTD;          /* Primary Port (Port 0) Last Device Selected   */
    UBYTE   csb_SEC_SLCTD;          /* Secondary Port (Port 1) Last Device Selected */
    UBYTE   csb_PRI_PSNS;           /* Primary Port (Port 0) Phase Sense Shadow     */
    UBYTE   csb_SEC_PSNS;           /* Secondary Port (Port 1) Phase Sense Shadow   */
    UBYTE   csb_RSRVD9;             /* Reserved byte                    */
    UBYTE   csb_DB_ID;              /* Daughter Board ID                */
    UBYTE   csb_RSRVD10;            /* Reserved byte                    */
    UBYTE   csb_DIP_SW;             /* Software Dip Switch Setting      */
    UINT    csb_FRZ_BITS;           /* Show Which Queues are Frozen     */
} VJ_CSB;

/*****************     Initialize Work Queue Command Format (WQCF)**********/
typedef struct wqcf {               /* Initialize Work Queue Command Format*/
    UWORD   wqcf_CMD;               /* Command Normally (0x42)          */
    UWORD   wqcf_OPTION;            /* Command Options                  */
    UWORD   wqcf_STATUS;            /* Return Status                    */
    UWORD   wqcf_RES0;              /* Reserved word                    */
    UBYTE   wqcf_NVCT;              /* Normal Completion Vector         */
    UBYTE   wqcf_EVCT;              /* Error Completion Vector          */
    UWORD   wqcf_ILVL;              /* Interrupt Level                  */
    UWORD   wqcf_GROUP;             /* Number of commands to group together*/
```

```
    UWORD   wqcf_RES1[7];           /* Reserved words                       */
    UWORD   wqcf_WORKQ;             /* Work Queue Number                    */
    UWORD   wqcf_WOPT;              /* Work Queue Options                   */
    UWORD   wqcf_SLOTS;             /* Number of slots in the Work Queues   */
    UWORD   wqcf_PRIORITY;          /* Priority Level                       */
    UINT    wqcf_TIMEOUT;           /* Command Time-Out for this Queue      */
    UWORD   wqcf_SEC_WQ;            /* Secondary Work Queue Number mirror   */
} VJ_WQCF;

/*****************   OFFBOARD COMMAND QUEUE ENTRY/IOPB     ******************/
typedef struct offbd_iopb {
        VJ_CQE      copycqe;
        VJ_IOPB     copyiopb;
}OFFBD_IOPB;

/****************** Scatter/Gather Descriptor block ************************/
typedef struct {
    UWORD   sg_bcount;              /* Byte Count for transfer              */
    ULONG   sg_paddr;               /* Physical Address                     */
    UWORD   sg_addrmod;             /* IOPB Address type and modifier       */
} VJ_SG;
```

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APPENDIX E
ACRONYMS USED IN THIS MANUAL

AA	Abort Acknowledge
AE	Abort Enable
AQ	Abort Queue
BOK	Board OK
BUS	SCSI Bus Selection
CC	Command Complete
CIB	Controller Initialization Block
CNA	Controller Not Available
CQ	Command Queue
CQA	Command Queue Entry Available
CQE	Command Queue Entry
CRB	Command Response Block
CRBV/CI	Command Response Block Valid/Clear Interrupt
CRSW	Command Response Status Word
CSS	Controller Specific Space
DFT	Default
DIR	VMEbus Transfer Direction
ER	Error
EX	Exception
EXT	Extended Addressing Enable
FLQ	Flush Queue
FLQR	Flush Queue and Report
FZE	Freeze Enable
GO	Go/Busy
HPC	High Priority Command
HUS	Host Usable Space
IE	Interrupt Enable
IL	Interrupt Level for the Interrupt on Queue Available
IOPB	Input/Output Parameter Block
IQAR	Interrupt on Queue Available Register
IQEA	Interrupt on Queue Entry Available
IQHE	Interrupt on Queue Half Empty Enable
IV	Interrupt Vector for Interrupt on Queue Available
IWQ	Initialize Work Queue
LUN	Logical Unit Number
LVL	Interrupt Level
MACSI	Multiple Active Command Software Interface
MCE	Master Command Entry
MCR	Master Control Register
MCSB	Master Control/Status Block
MSR	Master Status Register
MT	Memory Type
PIP	Primary Bus (Port 0) Command In Progress
QECR	Queue Entry Control Register
QFC	Queue Flush Complete
QMS	Queue Mode Started

RES	Reset Controller
RPT	Report Flushed Commands
RSRV	Reserved
SCSI ID	SCSI Device ID
SFEN	SYSFAIL Enable
SG	Scatter/Gather
SIP	Secondary Bus (Port 1) Command In Progress
SQM	Start Queue Mode
THW	Thaw Work Queue
TT	Transfer Type

UPDATE

TO

V/SCSI 4210 User's Guide

Revision UG-0770-000-X0F, Rev. B

ADDENDUM - May 25, 1989

ERROR RECOVERY OF FIRMWARE REVISION X0W TO XAD AND BEYOND

Three new features have been added to firmware revisions X0W through XAD, which improves software interface for error recovery:

- Work Queue Zero's length has been redefined to allow error recovery of commands in Work Queue Zero.
- Located in the Controller Specific Space, a register for each port has been added to report the last SCSI ID selected.
- Additionally, a register has been added for each port to periodically report the SCSI bus status, also, located in the Controller Specific Space.

These changes do not affect compatibility with earlier revisions.

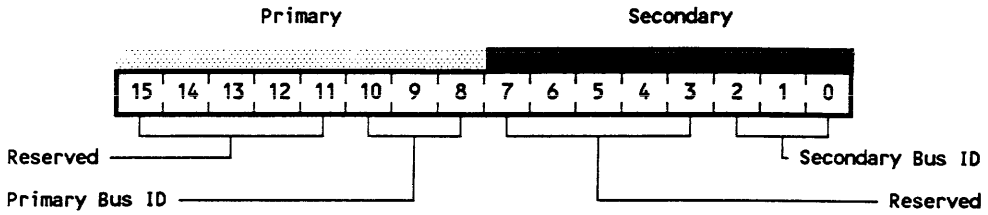
Work Queue Zero Length Change

Work Queue Zero is defined to have a length of one. This is done with the intention that only one error recovery process can occur at a time. However, it is possible that a command from Work Queue Zero may require error recovery itself. To allow this to take place, certain commands may always be issued through Work Queue Zero. SCSI Bus Reset and Flush Work Queue commands may always be issued through Work Queue Zero. For all other commands Work Queue Zero will still have a length of one.

Controller-Specific Space Changes

New SCSI status has been added to the Controller-Specific Space of the Jaguar 4210. This information is useful for determining the status of the SCSI bus during error conditions.

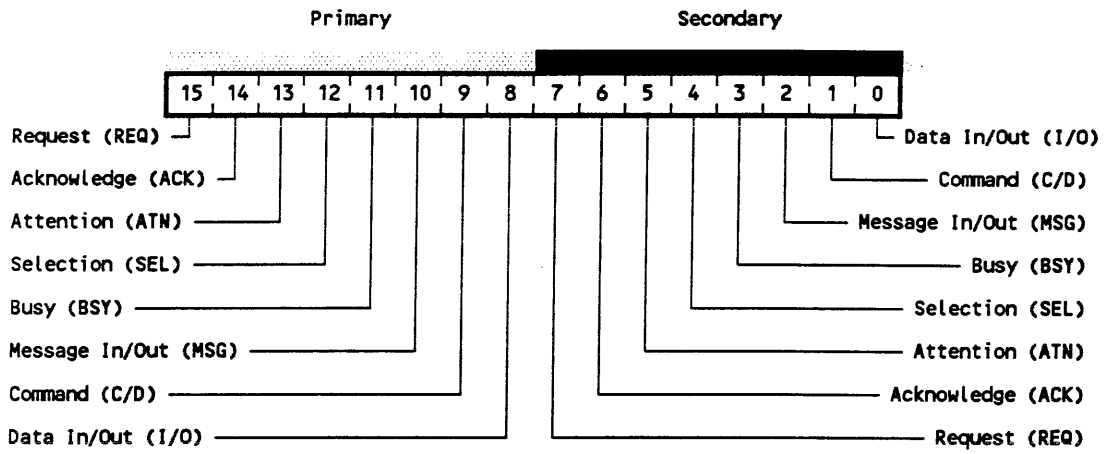
Address offset 0x7AC contains two bytes that describe the last device ID connected on both the primary and secondary ports. The Bits 8-10 contain the Primary Bus ID last connected. The Bits 0-2 contain the Secondary bus last connected.



Update Figure 1. Bus Offset 0x7AC

Address offset 0x7AE contains two bytes that describe the SCSI status. The SCSI status bytes are updated approximately every 32 msec. They are used to determine the SCSI bus status during error conditions. Bits 8-15 contain the Primary bus status. Bits 0-7 contain the Secondary bus status.

The bus status byte for each bus is an image of the Fujitsu 87030 Phase Sense register. The format of that register is as follows.



Update Figure 2. Phase Sense Register Offset 0x7AE

Each of these signals are active high. They each correspond to a signal on the SCSI bus. For a complete description of each signal, see the SCSI specification or the 87030 user's guide.

The signal of most importance is BSY. When BSY is a 1, the Jaguar is connected to the SCSI bus. This signal is updated approximately every 32 msec so a long period of time should be allowed to pass with no responses from the Jaguar before this byte is considered valid.

ADDITIONAL HARDWARE OPTIONS FOR PB-0773-A08-000

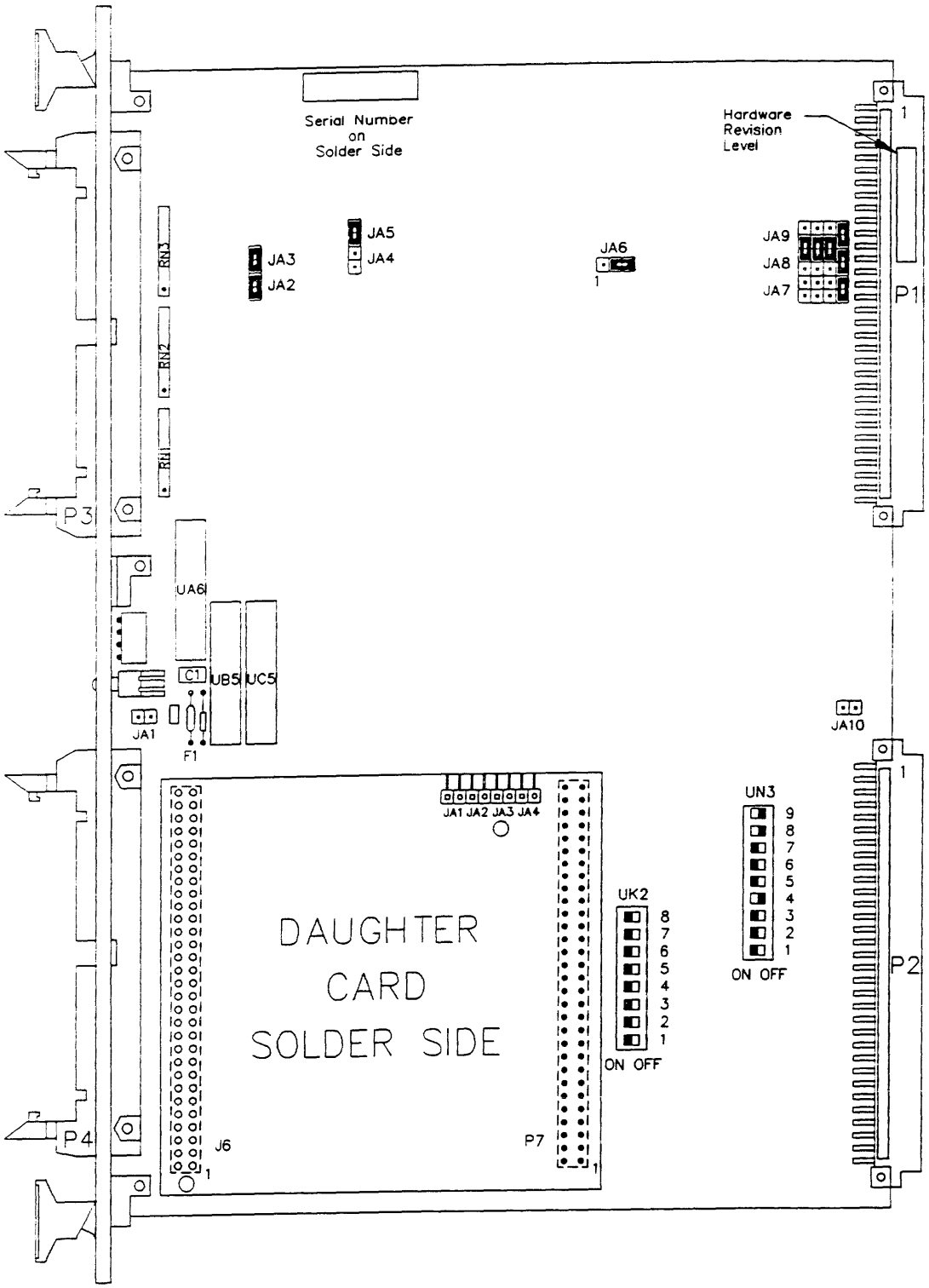
This version of the PCB (Update Figure 3. Optional Jumper and Switch Setting) supports jumper selectable selection of early or standard release of the VME busy* signal. A software option switch is also added to select features previously implemented with special firmware versions.

This artwork has a different oscillator jumpering scheme to support possible future options. These jumpers are set at the factory and should not be changed.

JA1	This jumper connects Terminator Power to the SCSI Bus. JA1 is located next to P4, the secondary SCSI Bus Connector. This jumper is not installed at the factory.
F1 - FUSE	This fuse protects the SCSI Terminator Power when provided by the Jaguar. The fuse is a Littlefuse PN 251001.
SCSI TERMINATION	RN1, RN2, and RN3 provide termination for the primary SCSI Bus when installed. When the Jaguar is not at one end of the cable, these resistor SIPs should be removed. Termination is installed at the factory.
JA10	This jumper selects early or standard release of the VME busy* signal when the Jaguar is operating as a master. No jumper installed selects early release. The jumper is not installed at the factory.

The jumpers listed below are for factory use and should not be changed.

JA2,JA3,JA4,JA5	These four jumpers are for oscillator testability. JA2, JA3, and JA5 must be in place for proper Jaguar operation.
JA6	This jumper is used to select the EPROM size. It is set at the factory and should not be moved. 1-2 64K byte EPROM (27512) 2-3 32K byte EPROM (27256). This is the factory setting.



Update Figure 3. Optional Jumper and Switch Settings
(Board layout of Artwork PB-0773-A08-000)

Default Operation - Switch Location UK2

This switch (refer to Update Figure 3. Optional Jumper and Switch Settings) presently provides the selection of two firmware options. Default operation of the board is provided by setting switch 1 - 8 to the "ON" position.

Switch 1 This switch when set to the "ON" position causes the SCSI bus to be reset after the Jaguar has been power-up or reset. Setting this switch to the "OFF" position disables this SCSI reset. This option may be useful in some multi-host adapter systems.

Switch 2 This switch when set to the "ON" position causes the Jaguar to remove the VME SYSFAIL* signal immediately after coming out of reset. When set to the "OFF" position the Jaguar will not clear this signal until the board has completed an extended self test and is ready to accept commands. The extended self-test takes approximately four seconds to execute.

Switch 3-8 These switches are reserved and should be set to the "ON" position to ensure compatiblity with future firmware releases.

Base Address Switch - Location UN3

To clarify the information for optional switch settings which determine the base address of the 4210 (refer to page 75). Page 75 of the manual incorectly states that Switch 8 of switch block SW1 controls supervisor/user access. In actuality, Switch 9 on SW1 controls this selection. Note, however, that Figure A1. on Page 75 is correct. The following chart has been supplied to assist in setting the base address:

Update Table 1. Base Address Switch Settings for the 4210

Address	Switch Setting 8 7 6 5 4	Address	Switch Setting 8 7 6 5 4
0000	O O O O O	8000	F O O O O
0800	O O O O F	8800	F O O O F
1000	O O O F O	9000	F O O F O
1800	O O O F F	9800	F O O F F
2000	O O F O O	A000	F O F O O
2800	O O F O F	A800	F O F O F
3000	O O F F O	B000	F O F F O
3800	O O F F F	B800	F O F F F
4000	O F O O O	C000	F F O O O
4800	O F O O F	C800	F F O O F
5000	O F O F O	D000	F F O F O
5800	O F O F F	D800	F F O F F
6000	O F F O O	E000	F F F O O
6800	O F F O F	E800	F F F O F
7000	O F F F O	F000	F F F F O
7800	O F F F F	F800	F F F F F

NOTE: O = ON/CLOSED
F = OFF/OPEN

"C" Language Structure of the Controller Specific Space.

The following is a 'C' language structure that describes the Controller Specific Space of the Jaguar 4210:

```
/*
 *  VJ_struct.h : V/SCSI 4210 Jaguar MACSI header.
 *
 */

typedef unsigned char   BYTE;           /* 8 bit unsigned                */
typedef unsigned char   UBYTE;          /* 8 bit unsigned                */
typedef unsigned short  UWORD;          /* 16 bit unsigned               */
typedef unsigned int    UINT;           /* 32 bit unsigned               */
typedef unsigned int    ULONG;          /* 32 bit unsigned               */


/****************** Scatter/Gather Descriptor block ************************/
typedef struct {
        UWORD       sg_bcount;          /* Byte Count for transfer       */
        ULONG       sg_paddr;           /* Physical Address              */
        UWORD       sg_addrmod;         /* IOPB Address type and modifer */
} VJ_SG;


/****************     Master Control Status Block (MCSB) ******************/
typedef struct mcsb {                   /* Master control/Status Block   */
        UWORD       mcsb_MSR;           /* Master status register        */
        UWORD       mcsb_MCR;           /* Master Control register       */
        UWORD       mcsb_IQAR;          /* Interrupt on Queue Available Reg */
        UWORD       mcsb_QHDP;          /* Queue head pointer            */
        UWORD       mcsb_THAW;          /* Thaw work Queue               */
        UWORD       mcsb_RES0;          /* Reserved word 0               */
        UWORD       mcsb_RES1;          /* Reserved word 1               */
        UWORD       mcsb_RES2;          /* Reserved word 2               */
} VJ_MCSB;


/***************     Controller Initialization Block (CIB)*****************/
typedef struct cib {                    /* Controller Initialization Block */
        UWORD       cib_NCQE;           /* Number of Command Queue Entries */
        UWORD       cib_BURST;          /* DMA Burst count               */
        UWORD       cib_NVECT;          /* Normal Completion Vector      */
        UWORD       cib_EVECT;          /* Error Completion Vector       */
        UWORD       cib_PID;            /* Primary SCSI Bus ID           */
        UWORD       cib_SID;            /* Secondary SCSI Bus ID         */
        UWORD       cib_CRBO;           /* Command Response Block Offset */
        ULONG       cib_SELECT;         /* Selection timeout in milli-second */
        ULONG       cib_WQ0_TIMEOUT;    /* Work Q 0 timeout in 256 ms ticks */
        ULONG       cib_VME_TIMEOUT;    /* VME Timeout 0 = 100ms timeout */
        ULONG       cib_PAGE_SIZE;      /* Page size on controller in bytes */
        UWORD       cib_CRB_ADRMOD;     /* Off board CRB memtype         */
        UINT        cib_CRB_ADDRESS;    /* CRB off board address         */
        UWORD       cib_CRB_ERTFLAGS;   /* Reserved words                */
} VJ_CIB;
```

```
/****************   Command Queue Entry (CQE)          ******************/
typedef struct cqe {                                    /* Command Queue Entry          */
        UWORD       cqe_QECR;                           /* Queue Entry Control Register */
        UWORD       cqe_IOPB_ADDR;                      /* IOPB Address                 */
        ULONG       cqe_CTAG;                           /* Command Tag                  */
        UBYTE       cqe_IOPB_LENGTH;                    /* IOPB Length                  */
        UBYTE       cqe_WORK_QUEUE;                     /* Work Queue Number            */
        UWORD       cqe_RES0;                           /* Reserved word                */
} VJ_CQE;

/****************   IOPB Format (IOPB)                 ******************/
typedef struct iopb {
        UWORD       iopb_CMD;                           /* IOPB Command code                        */
        UWORD       iopb_OPTION;                        /* IOPB Option word                         */
        UWORD       iopb_STATUS;                        /* IOPB Return Status word                  */
        UWORD       iopb_RES0;                          /* IOPB Reserved word                       */
        UBYTE       iopb_NVCT;                          /* IOPB Normal completion Vector            */
        UBYTE       iopb_EVCT;                          /* IOPB Error  completion Vector            */
        UWORD       iopb_LEVEL;                         /* IOPB Interrupt Level                     */
        UWORD       iopb_RES1;                          /* IOPB Reserved word                       */
        UWORD       iopb_ADDR;                          /* IOPB Address type and modifer            */
        ULONG       iopb_BUFF;                          /* IOPB Buffer Address                      */
        ULONG       iopb_LENGTH;                        /* IOPB Max-Transfer Length                 */
        ULONG       iopb_SG_LENGTH;                     /* IOPB Length in bytes of S/G request      */
        UWORD       iopb_RES4;                          /* IOPB Reserved word                       */
        UWORD       iopb_UNIT;                          /* IOPB Unit address on SCSI bus            */
        UWORD       iopb_SCSI[6];                       /* IOPB SCSI words for pass through         */
} VJ_IOPB;

/****************   Command Response Block (CRB)       ******************/
typedef struct crb {                                    /* Command Response Block       */
        UWORD       crb_CRSW;                           /* Command Response Status Word */
        UWORD       crb_RES0;                           /* Reserved word                */
        ULONG       crb_CTAG;                           /* Command Tag                  */
        UBYTE       crb_IOPB_LENGTH;                    /* IOPB Length                  */
        UBYTE       crb_WORK_QUEUE;                     /* Work Queue Number            */
        UWORD       crb_RES1;                           /* Reserved word                */
        VJ_IOPB     crb_IOPB;                           /* Returned IOPB                */
} VJ_CRB;
```

```
/****************    Configuration Status Block (CSB)  ******************/
typedef struct csb {                                /* Configuration Status Block 120 bytes   */
        UWORD       csb_RES0;                       /* Reserved word                          */
        UBYTE       csb_RES1;                       /* Reserved byte                          */
        char        csb_PCODE[3];                   /* Product Code                           */
        UWORD       csb_RES2;                       /* Reserved word                          */
        UBYTE       csb_RES3;                       /* Reserved byte                          */
        char        csb_PVAR;                       /* Product Variation                      */
        UWORD       csb_RES4;                       /* Reserved word                          */
        UBYTE       csb_RES5;                       /* Reserved byte                          */
        char        csb_FREV[3];                    /* Firmware Revision level                */
        UWORD       csb_RES6;                       /* Reserved word                          */
        char        csb_FDATE[8];                   /* Firmware Release date                  */
        UWORD       csb_RES7;                       /* Reserved word                          */
        UWORD       csb_BSIZE;                      /* Buffer size in Kbytes                  */
        UWORD       csb_RES8[2];                    /* Reserved word                          */
        UBYTE       csb_PID;                        /* Primary Bus ID                         */
        UBYTE       csb_SID;                        /* Secondary Bus ID                       */
        UBYTE       csb_PRI_SLCTD;                  /* Primary Port Last Device Selected      */
        UBYTE       csb_SEC_SLCTD;                  /* Secondary Port Last Device Selected    */
        UBYTE       csb_PRI_PSNS;                   /* Primary Port Phase Sense Shadow        */
        UBYTE       csb_SEC_PSNS;                   /* Secondary Port Phase Sense Shadow      */
        UBYTE       csb_RSRVD9;                     /* Reserved byte                          */
        UBYTE       csb_DB_ID;                      /* Daughter Board ID                      */
        UBYTE       csb_RSRVD10;                    /* Reserved byte                          */
        UBYTE       csb_DIP_SW;                     /* Software Dip Switch Setting            */
        UINT        csb_FRZ_BITS;                   /* Show Which Queues are Frozen           */
} VJ_CSB;

/****************    Initialize Work Queue Command Format (WQCF)***********/
typedef struct wqcf {                               /* Initialize Work Queue Command Format   */
        UWORD       wqcf_CMD;                       /* Command Normally (0x42)                */
        UWORD       wqcf_OPTION;                    /* Command Options                        */
        UWORD       wqcf_STATUS;                    /* Return Status                          */
        UWORD       wqcf_RES0;                      /* Reserved word                          */
        UBYTE       wqcf_NVCT;                      /* Normal Completion Vector               */
        UBYTE       wqcf_EVCT;                      /* Error  Completion Vector               */
        UWORD       wqcf_ILVL;                      /* Interrupt Level                        */
        UWORD       wqcf_GROUP;                     /* Number of commands to group together   */
        UWORD       wqcf_RES1[7];                   /* Reserved words                         */
        UWORD       wqcf_WORKQ;                     /* Work Queue Number                      */
        UWORD       wqcf_WOPT;                      /* Work Queue Options                     */
        UWORD       wqcf_SLOTS;                     /* Number of slots int the Work Queues    */
        UWORD       wqcf_PRIORITY;                  /* Priority Level                         */
        UINT        wqcf_TIMEOUT;                   /* Command Time-Out for this Queue        */
        UWORD       wqcf_SEC_WQ;                    /* Secondary Work Queue Number mirror     */
} VJ_WQCF;

/****************  OFF BOARD CQE/IOPB    *********************************/
typedef struct offbd_iopb {
        VJ_CQE      copycqe;
        VJ_IOPB     copyiopb;
}OFFBD_IOPB;
```

V/SCSI 4210 ERROR RECOVERY STRATEGY

OVERVIEW

Normal SCSI check condition errors are handled very simply by the SCSI protocol. There are other types of errors though that can be difficult to recover from. These errors may be due to a bad device or possibly due to programmer error. The 4210 Error Recovery Tools reduces the possibility of ever having to reset the Jaguar to recover from errors. To allow recovery from conditions that cause the controller to stop executing commands, methods of determining the state of the Jaguar and recovery commands are provided.

The first step in recovering from unusual errors is knowing they exist. The Jaguar provides two features to signal errors. The first, selection timeouts, generally require no further error handling but they prevent the board from becoming locked up by trying to select a device that does not exist. The second, command timeouts, lets the Jaguar notify the host that a user programmed period of time has expired since a device was successfully selected.

SELECTION TIMEOUT

The selection timeout causes an IOPB to be terminated with an error status if a device does not respond to selection within the programmed period of time. The same value is used for all devices. This value is specified in the controller initialization block. This timeout has a resolution of 1ms.

COMMAND TIMEOUT

The command timeout value is set for each Work Queue. All commands from the Work Queue use that timeout value. The timeout value is used from the successful completion of the selection phase until the completion of the command on the SCSI bus. This timeout includes all disconnect periods. The resolution is in increments of approximately 256ms.

The Jaguar notifies the host of the IOPB timeout by use of the Controller Error interrupt. This interrupt will be used to return error status without returning the IOPB that caused the error. Bit 7 of the Command Response Status Word allows the allows the host to determine the source of the error. Also data returned in the command response block has been defined to specify the type of error that has occurred.

ERROR CLEARING

The Jaguar must retain an IOPB that causes a command timeout to occur until the error condition has been cleared. Normally the host will simply issue a Reset SCSI Bus IOPB to the bus the command timeout on. This will cause all of the commands currently active on that bus to be returned with a bus reset status.

CANCEL COMMAND TAG IOPB

Some systems may find it undesirable to reset the entire bus however. If a system has the ability to individually remove a device from the bus a method is required to clear the IOPB waiting for a response from the removed device. The error is cleared by issuing a Cancel Command Tag IOPB for the IOPB in error.

ERROR DETERMINATION

Once the host is aware that an error exists it will be required to identify the type of error so that the correct error recovery can take place. Two commands are provided that assist the host in determining the state of the Jaguar.

These are:

- Command Status Inquiry

  Reports the status of a command, identified by its command tag.

- Bus Status Inquiry

  Reports the state of all IOPBs requesting the SCSI Bus.

In addition to the above commands a register has been added to the controller specific space of the Jaguar that provides the SCSI bus status. These commands and the bus status can be used in an error condition to determine the state of the Jaguar.

Proposed Error Recovery Sequence

The host becomes aware of an error conditon, either from an IOPB or other host generated timeout. The host may then execute a recovery sequence similar to the following.

1. The host may issue a Bus Status Inquiry to examine the status of commands executing on the bus. This is required to determine the actual command that has caused the error. The command that timed out may not be the command that is blocking the SCSI bus. The command that is most likely in error will be the one active on the bus when the Bus Status Inquiry is executed.

2. Normally, if a device is found to be connected on the SCSI bus indefinitely there is no way to clear the error without resetting the bus. When this is the case the Host should issue the Reset SCSI bus IOPB through the MCE. All work queues with commands active on the bus will have those commands returned with a SCSI reset error status and the work queue will be frozen (if the freeze work queue on reset option was selected in the Initialize Controller Command). The Host will then reissue the commands and unfreeze the work queues. The device which caused the error should either be removed or tested before restarting normal operation on other drives.

3. For systems that have the ability to power a device down to avoid resetting the entire bus, the Host may issue a Flush Work Queue command to prevent new commands from being issued to the drive after the error has been cleared, but before the Host has properly restored the device. Flushing the queue is not required but the Jaguar will begin processing the commands from the queue after the bus becomes available and the command being executed is cleared. The Host may, after powering the device down, issue the Cancel Command Tag IOPB to clear the IOPB that was not completed by a normal SCSI completion or by a SCSI reset. The Flush Work Queue Command does not flush commands that are presently active on the bus. These may only be canceled by command completion, by a SCSI reset, or by issuing the Cancel Command Tag IOPB.

Jaguar Software Interface Error Recovery Considerations

Several areas of the software interface that affect Error Recovery have been modified. Controller initialization and Work Queue initialization commands have new fields to specify timeout values. The Freeze Work Queue operation may be optionally changed in the Initialize Controller Command to freeze a Work Queue that has an active command upon receiving a SCSI reset. (This is the recommended mode of operation. The default setting is provided for backward compatibility). Work Queue 0's length is normally one. Certain error recovery commands may always be issued through it however. The Controller Error Interrupt is used to report several command error conditions.

IOPB TIMEOUT INITIALIZATION

The IOPB timeout is specified in the initialize controller command for Work Queue 0, and in the initialize work queue command for all other queues. All IOPB's issued through a work queue will use the timeout value specified for that work queue.

Work Queue Zero

The ninth word of the Controller Initialization Block will be used for Work Queue 0 command timeouts. This field (word 9) is specified in increments of approximately 256mSecs. A value of 0 specifies no timeout.

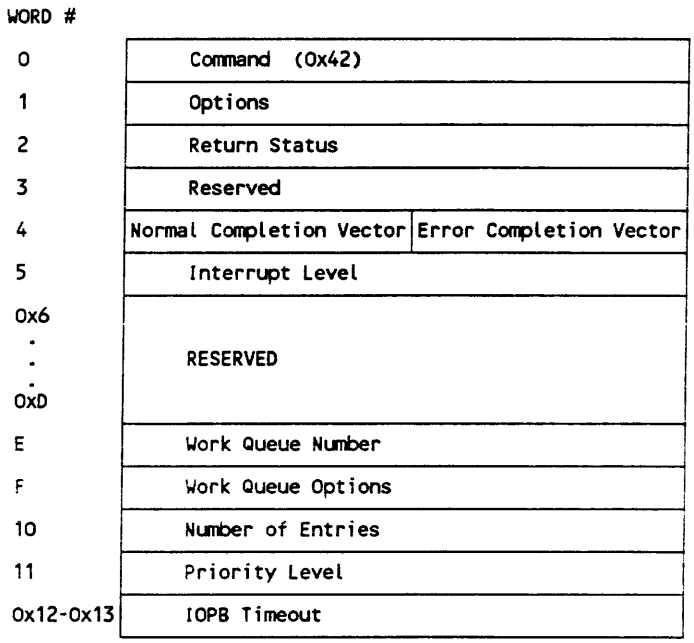
Work Queues 1 - 15

The twelfth word of the Initialize Work Queue command contains the timeout value for commands issued through that work queue. Each work queue (device) will then be able to run a unique timeout value. This field is specified in increments of approximately 256mSecs. A value of 0 specifies no timeout.

The Controller Initialization Block and Initialize Work Queue Command are reproduced here for clarity.

WORD #	
0	Number of Command Queue Entries
1	DMA Burst Count
2	Controller Normal Completion Vector
3	Controller Error Completion Vector
4	Primary SCSI Bus ID
5	Secondary SCSI Bus ID
6	Command Response Block Offset
7-8	SCSI Selection Timeout
9-OxA	SCSI Work Queue Zero Command Timeout
OxB-OxC	VME Bus Timeout
OxD-OxE	Reserved
OxF	Off Boar CRB Memory Type
0x10-11	Off Boarc CRB Address
0x12	Error Recovery Flags

Update Figure 4. Controller Initialization Block



Update Figure 5. Initialize Work Queue Command

FREEZE WORK QUEUE ON SCSI RESET

The Freeze Work queue operation may be enabled to freeze Work Queues when a SCSI reset occurs and that work queue had a command active on the SCSI bus. This allows the host to decide how to handle the SCSI reset before allowing commands to continue executing. The host will know a Work Queue is frozen if it receives a command returned from the queue with a SCSI bus reset error status.

Work Queue Zero Length

Work Queue Zero is defined to have a length of 1. This is done with the intention that only one error recovery process can occur at a time. However, it is possible that a command from Work Queue zero may require error recovery itself. To allow this to take place, certain commands may always be issued through Work Queue zero. SCSI Bus Reset and Flush Work Queue commands may always be issued through Work Queue zero. For all other commands Work Queue Zero will still have a length of one.

CONTROLLER ERROR INTERRUPT

When a command timeout occurs the Jaguar must retain the IOPB until the error is cleared so that the command may be completed if the device responds before error recovery can take place. This also prevents new commands from being issued from the queue until the host can handle the error condition. To notify the host of a command timeout the Controller Error Interrupt will be used.

CONTROLLER ERROR VECTOR

The controller error vector is used for bit type commands. These are Start Queue Mode, Flush, and Flush and Report. It is also used for the following conditions:

- IOPB type error
- IOPB timeout
- a device has connected for which no IOPB exists
- a device is requesting more data to be transferred than the IOPB allows
- a device is requesting a data transfer of the opposite direction specified by the direction bit of the IOPB.

A bit (BIT 7) is set in the Command Response Status Word to indicate the response is due to one of the above conditions.

The following status block is returned for the above errors. The bit commands do not return this information. This block is as follows:

Word DEC	Even Byte								Odd Byte							
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Command Response Status Word															
1	IOPB Type								Reserved							
2	Command Tag															
3	Command Tag															
4	IOPB Length								Work Queue Number							
5	Reserved															
6	Reserved								Error Code							

Update Figure 6. Controller Interrupt Response Block

The defined error codes are as follows.

Error Code	Definition
OxCO	IOPB Type Error
OxC1	IOPB Timeout

Update Figure 7. Generic MACSI Error Codes

Error Code	Definition
0x82	A target has reconnected for which no IOPB exists.
0x83	A target is requesting more data to be transferred than the IOPB transfer count allows.
0x84	A target is requesting a data transfer of the opposite direction specified in the direction bit of the IOPB.

Update Figure 8. V/SCSI 4210 Specific Error Codes

COMMANDS ADDED TO SUPPORT ERROR RECOVERY

Three commands are provided specifically for error recovery. Two of the commands, Bus Status Inquiry and Command Status Inquiry, are provided to find the status of commands on the board. The Cancel Command Tag IOPB is provided to remove an IOPB from the board. This command is provided for systems that can reset devices in error without resetting the SCSI bus.

Command : Bus Status Inquiry
Command Code : 0x45
Function :

This IOPB returns the Command Tag of any IOPB currently executing on the selected SCSI bus. In addition it will return Command Tags of any in progress IOPBS. An in-progress IOPB is one which has been sent to a drive but is not completed yet. This IOPB is used to find the command that is active on the bus at the time an IOPB timeout has occurred. This is important because a command may cause another command to timeout by blocking use of the SCSI bus by other devices. If a command other than the command that timed out is active on the bus, it will be necessary to determine which command actually caused the error. A number of methods for determining the device in error may exist. One method would be to wait an additional period of time and check the board again to see that the state is the same as the previous check. This type of error is due either to incorrect programming or to a failed device and should be a rare occurrence.

During execution of this command, the board will stop all internal operations so that the response will reflect the state of the board at the time the Bus Status Inquiry IOPB is executed.

This command must be issued to Work Queue 0. Information in the returned IOPB should be used to identify which IOPB and device has caused the error condition.

This command can be issued to either the primary or the secondary Port by selecting the bus in the Unit Address field.

WORD #								
0	Command (0x45)							
1	Options							
2	Return Status							
3	Reserved							
4	Normal Completion Vector							Error Completion Vector
5	Interrupt Level							
6-0xE	Reserved							
F	Reserved						BUS	Reserved

BUS is located in Bit 3.
BUS = 0 : Primary Bus
BUS = 1 : Secondary Bus

Returned Fields

6-7	Active Command Tag							
8-0xF	Busy Commands Tags							

Update Figure 9. Bus Status Inquiry IOPB

The ACTIVE COMMAND TAG field contains the COMMAND TAG of a Pass-Through IOPB if at that point in time the command is presently being executed on the bus.

The BUSY COMMAND TAGS fields will contain any other currently "in-progress" IOPBS that may not be able to complete because they are in a disconnected state and being held off by the "hung" ACTIVE COMMAND. There could potentially be 7 BUSY COMMANDS per port. (WORDS 8,9 A,B C,D E,F 10,11 12,13 14,15)

Command : Command Status Inquiry
Command Code : 0x46
Function :

This IOPB returns the state of a previously issued IOPB based on the command tag field. If the IOPB specified by the command tag is active on the bus information will be returned to help indentify the state of the SCSI activity. The Command Status Inquiry IOPB must be issued to Work Queue 0. The Jaguar will suspend hardware operations until the status of the command is found and posted.

WORD #		
0	Command (0x46)	
1	Options	
2	Return Status	
3	Reserved	
4	Normal Completion Vector	Error Completion Vector
5	Interrupt Level	
6-0xF	Reserved	
10-11	Command Tag	

Returned Information:

12	Reserved	Command State Field
13	Reserved	Last Command
14	Reserved	Phase Sense
15	Reserved	

Update Figure 10. Command Status Inquiry IOPB

Returned Information is posted in these fields.

A. Command State Field (CSF)

0x01 Command not found (Command Tag did not match)
0x02 Command in Work Queue (Not executing yet)
0x03 Command Currently Active (Currently on SCSI Bus)
0x04 Command Busy (Currently Disconnected)
0x05 Command on Done Queue (The command is on the internal done queue and will have been received by the host before the response to the Bus Inquiry)
0x06 Command in Command Queue (Still in Short I/O)
0xnn Other States (May include VME bus status)

B. Active Command Additional Information Fields

If the Command inquired about is Currently Active (0x03), the state of the controller and the SCSI bus is also reported back in two additional fields.

1. (LCMD -- last command)

   Last Command Issued to the Jaguar's SCSI Controller (Fujitsu 87030)

   0x00 Bus Release
   0x01 Select Device
   0x02 Reset Attention
   0x03 Set Attention
   0x04 Transfer Data
   0x05 Transfer Data Pause
   0x06 Reset SCSI Handshake Line
   0x07 Set SCSI Handshake Line

2. (PSNS -- phase sense)

Current SCSI Bus Status

Bits 7 - 0 Hold the state of the SCSI Bus Signals the SCSI bus the command is active on. (1 = active)

7 - Request
6 - Acknowledge
5 - Attention
4 - Select
3 - Busy
2 - Message
1 - Command / Data
0 - Input / Output

Command : Cancel Command Tag
Command Code : 0x48
Function :

This IOPB cancels the execution of a previously issued IOPB based on the command tag field. This command must be issued to Work Queue 0. If an IOPB is cancelled and subsequent SCSI activity attempts to complete the command the Jaguar will return a controller error with the information that a device has connected for which there is no IOPB.

If the Jaguar does not have a command with a command tag that matches the Jaguar will return the Cancel Command Tag IOPB with an error.

Use of this command implies that the host use unique command tags for all IOPB's residing on the board. The Jaguar will find the first command tag that matches the one given in the IOPB and cancel that one. If multiple IOPB's exist with the same command tag, only the first one found will be canceled.

WORD #		
0	Command (0x48)	
1	Options	
2	Return Status	
3	Reserved	
4	Normal Completion Vector	Error Completion Vector
5	Interrupt Level	
6-0xF	Reserved	
10-11	Command Tag	
12-15	Reserved	

Update Figure 11. Cancel Command Tag IOPB

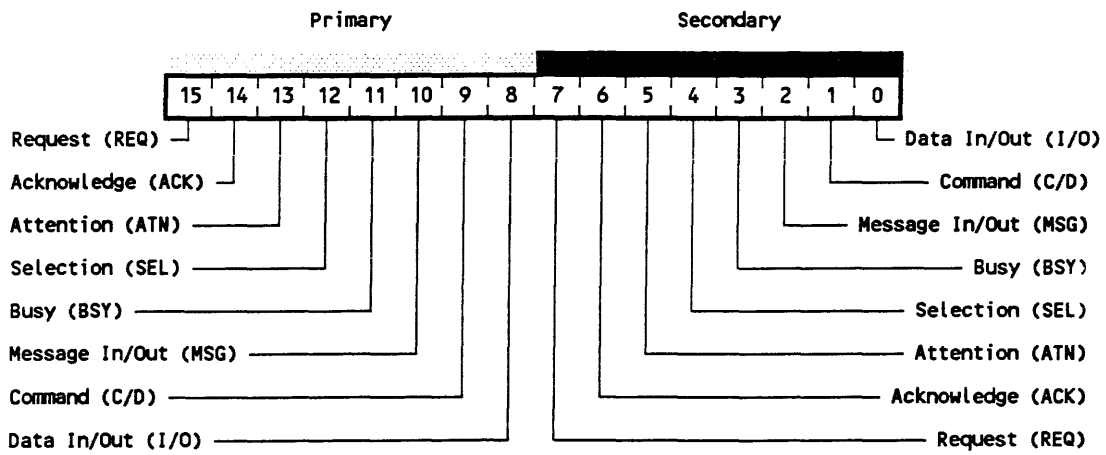
JAGUAR CONTROLLER SPECIFIC SPACE

Several registers in the Controller Specific Space provide information that is useful for determining the status of the SCSI bus during error conditions.

Address offset 0x7AC contains two bytes that describe the last device ID connected on both the primary and secondary ports. The Bits 8-15 contain the Primary Bus ID last connected. The Bits 0-7 contain the Secondary bus last connected.

Address offset 0x7AE contains two bytes that describe the SCSI status. These bytes are only updated approximately every 32msec. They are only useful in general for determining SCSI bus error conditions. Bits 8-15 contain the Primary bus status. Bits 0-7 contain the Secondary bus status.

The bus status byte for each bus is an image of the Fujitsu 87030 phase sense register. The format of that register is as follows.



Update Figure 12. Phase Sense Register Offset 0x7AE

Each of these signals are active high. They each correspond to a signal on the SCSI bus. For a complete description of each signal see the SCSI spec or the 87030 users guide.

The signals of most importance are BSY and SEL. When BSY is a 1 the Jaguar is connected to the SCSI bus. When SEL is a '1' it indicates that someone on the bus is attempting to select or reselect another device. These signals are updated every 27 to 35 milli-seconds. If the host is attempting to use this register to determine if the bus is hung it should allow at least twice that period before making a decision. The actual amount of time required is dependent on the system. In general it should be longer than the longest data transfer that might occur in the system.

FROZEN WORK QUEUES REGISTER

This register will have a one set for any work queue that is frozen. The Jaguar supports 15 work queues (0 through 14). For queues 1 to 14 if the queue is currently frozen the corresponding bit position is set in this long word. For instance, if Work Queue 1 is frozen the Freeze Status will equal 0x00000002. Work Queue 0 cannot be frozen.

The following is a "C" language structure that describes the Controller Specific Space.

```
/*****************     Configuration Status Block (CSB)   *********/

typedef struct csb {       /* Configuration Status Block 120 bytes*/
    UWORD   csb_RES0;      /* Reserved word                       */
    UBYTE   csb_RES1;      /* Reserved byte                       */
    char    csb_PCODE[3];  /* Product Code                        */
    UWORD   csb_RES2;      /* Reserved word                       */
    UBYTE   csb_RES3;      /* Reserved byte                       */
    char    csb_PVAR;      /* Product Variation                   */
    UWORD   csb_RES4;      /* Reserved word                       */
    UBYTE   csb_RES5;      /* Reserved byte                       */
    char    csb_FREV[3];   /* Firmware Revision level             */
    UWORD   csb_RES6;      /* Reserved word                       */
    char    csb_FDATE[8];  /* Firmware Release date               */
    UWORD   csb_RES7;      /* Reserved word                       */
    UWORD   csb_BSIZE;     /* Buffer size in Kbytes               */
    UWORD   csb_RES8[2];   /* Reserved word                       */
    UBYTE   csb_PID;       /* Primary Bus ID                      */
    UBYTE   csb_SID;       /* Secondary Bus ID                    */
    UBYTE   csb_PRI_SLCTD;/* Primary Port Last Device Selected    */
    UBYTE   csb_SEC_SLCTD;/* Secondary Port Last Device Selected */
    UBYTE   csb_PRI_PSNS;  /* Primary Port Phase Sense Shadow     */
    UBYTE   csb_SEC_PSNS;  /* Secondary Port Phase Sense Shadow   */
    UBYTE   csb_RSRVD9;    /* Reserved byte                       */
    UBYTE   csb_DB_ID;     /* Daughter Board ID                   */
    UBYTE   csb_RSRVD10;   /* Reserved byte                       */
    UBYTE   csb_DIP_SW;    /* Software Dip Switch Setting         */
    ULONG   csb_FRZ_BITS   /* Queue Frozen Statuses               */
} VJ_CSB;
```

ADDITIONAL ERT INFORMATION

1. ERT Command Issuance Rules

All ERT commands must be issued through the MCE to Work Queue 0. They may be issued at any time.

2. Controller Error Clarification

Controller Errors are generated for unusual situations that may occur on the board but are not related to a specific IOPB. They may also be generated due to the fact that an IOPB may not have the proper information required to be processed normally, or some unusual intermediate conditions exist. The returned

structure in the CRB does not contain an IOPB. Instead the Command Response block contains an error code indicating what has happened and CQE information (command tag, iopb length, work queue number) if it is valid.

For these defined errors a bit is defined in the CRSW called the Status Change bit (SC == bit 7). This bit will be set along with the ER bit to indicate these errors. The CRSW will read 0x0085. (SC,ER,CRBV bits are set)

Controller Errors will not generate an interrupt if the controller error interrupt level is set to 0 in the Initialize Controller IOPB. The board will still return the status in the Command Response Block and will set the CRBV bit in the Command Response Status Word.

DEFINED CONTROLLER ERRORS --- (elaboration of the ERT spec.)

A. IOPB Type Error --

If the IOPB type field is invalid the overall structure of the IOPB is not known and therefore continued processing on it can not be executed.

Error Code 0xC0 CQE information -- invalid.

B. IOPB Time-Out Error --

An IOPB's timer has completed and the controller is notifying the host of the condition. The IOPB will remain active until it completes properly or is cancelled explicitly. The status of the IOPB may be inquired about with the Command Status Inquiry IOPB.

Error Code 0xC1 CQE information -- valid.

C. Unknown Device Reconnection

A SCSI device has re-selected the Jaguar for which no current IOPB exists.

Error Code 0x82 CQE information -- invalid.

D. Data Transfer Count Mismatch

Data Counters have been exhausted but the device is requesting more data than the current IOPB can transfer.

Error Code 0x83 CQE information -- valid.

E. Data Direction Errors

The direction bit in the IOPB does not match the data transfer direction requested on the SCSI bus.

Error Code 0x84 CQE information -- valid.

3. **Command Time-Out Situations**

Command time-outs invoke the controller error response (B) from above. If the command subsequently completes correctly, the original IOPB will complete properly. The host may attempt to cancel the IOPB with the Cancel Command Tag IOPB. This will cause the Jaguar to terminate any further execution. The cancelled IOPB will not be posted back to the host. If the IOPB is active on the SCSI bus, the command cannot be cancelled and the host must either reset the SCSI bus or remove the device from the bus in some external manner. The command will then be posted with a canceled due to bus reset status or invalid sequence error if it abruptly disconnects from the bus.

JAGUAR PRINTER PORT DESCRIPTION

INTRODUCTION

The Printer Port allows a system to transfer data to either a Centronics or Data Products interface printer. A version is also available to use with a Data Products long-line interface. The printer port is a daughter card that attaches to the V/SCSI 4210 Jaguar. The Printer Port is commanded in much the same fashion as a SCSI device. Printer Port control has been integrated into the Jaguar/MACSI interface, therefore the user should be familiar with the Jaguar manual. The Jaguar will DMA the printer data from Host memory, transfer the data to the printer, and return a completion status. Printer status may be monitored asynchronously at any time by the host. The host may also request that the Jaguar interrupt the Host when a status change occurs. The printer port does not affect the normal operation of the primary SCSI channel.

HOW TO USE THE PRINTER PORT:

PRINTER PORT CONFIGURATION JUMPER INSTALLATION:

The user must ensure that the Printer Port is physically configured for the type of printer being used. When the jumper at JA1 is installed, the Printer Port is configured to interface with a Centronics printer. When this jumper is removed, the Printer Port is configured to interface with a Data Products printer. The jumper configuration can be determined by software from the Printer Status byte. The Data Products long line interface version has no jumper and appears to the system software as a standard board configured for a Data Products interface.

INITIALIZATION:

After the Host has performed the usual Jaguar initialization procedures, the Daughter-board ID may be verified in Controller Specific Space to ensure the Printer Port is installed. The Printer Port ID is 0x04 and is located at the board base address plus an offset of 0x7B1. A separate work queue for the Printer Port must be initialized using the Initialize Work Queue command. The work queue initialization is the same as for a SCSI device. The work queue must be used exclusively used for the printer port.

The first command to the printer work queue should be the Initialize Printer Port command. This command sets the polarity of parity for Data Products printers and specifies which printer status lines may generate a status change interrupt.

The Initialize Printer Port command can be issued at any time to reset the Printer Port. The command is issued with the reset bit set to clear the printer port hardware. It should never be necessary to reset the hardware.

The Initialize Printer Port command may also be ssued at any time to assert a buffer clear to the printer. Since the time required for holding this signal varies from printer to printer the Jaguar will leave the line set until the host issues another Initialize Printer Port command with the bit cleared.

NOTE: The work queue initialized for the printer must be used exclusively for the Printer Port. This is consistent with work queue usage for SCSI devices.

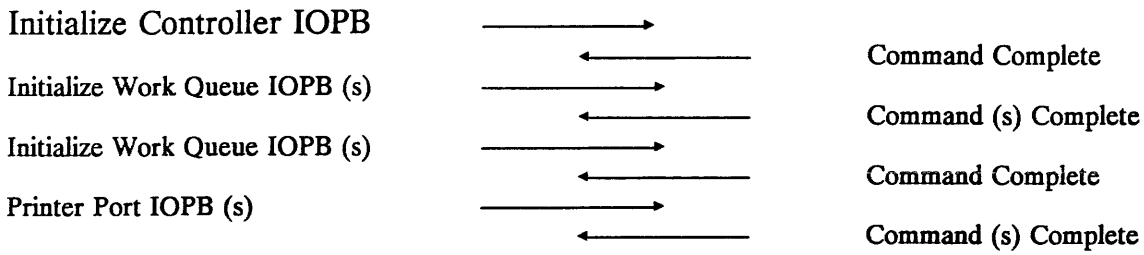
PRINTER COMMANDS:

The Printer Port can now receive Printer Port Commands. The Jaguar will queue printer commands as received and work on each command in a FIFO manner as the previous command completes. When a the GO bit for a printer command is set the command will be copied from Short I/O space into the internal Printer Port work queue. After the IOPB has been parsed for correctness the data will be simultaneously DMA'd from system memory and transferred to the printer. The Maximum Transfer Length field is used to specify the length of the VMEbus transfer. Since the Jaguar can not transfer odd byte length data across the VME bus a second field specifies the actual amount of data to transfer to the printer. The VME transfer length must be rounded up to the nearest word (16 bit) or long word (32 bit) boundary. The Printer Transfer Length field specifies the exact number of bytes to be transferred to printer. When all the data has been transferred to the printer, a copy of the IOPB modified with the current printer status and return code will be placed in the CRB.

If the printer port is configured for the Data Products interface the Host may want to send special font or control characters to the printer using the Paper Instruction control line of the Data Products interface. The Jaguar supports this with the Paper Instruction option in the IOPB. When the Paper Instruction option is set to 1, the Jaguar will transfer all of the data specified in this IOPB to the printer with the Paper Instruction interface signal active. Paper Instruction is only supported by Data Products printers.

NOTE: The Maximum Transfer Length field cannot contain an odd number of bytes. It must be rounded up to the nearest word or long word boundary depending on the transfer size specified.

EXAMPLE PRINTER PORT OPERATION



STATUS REPORTING:

The printer status may be accessed in three ways from the Jaguar.

First, the state of the status lines will be updated periodically in Controller Specific Space for asynchronous monitoring by the Host. This status byte is located at the board base address plus an offset of 0x7AF. This byte is updated whenever On-line, Ready, Parity Error, Cable On changes state for a Data Products interface. It is updated anytime Select, Fault, or Paper Empty changes state for a Centronics interface. Otherwise it is updated at the completion of a print command and roughly every 30Msec. The second method is for the Jaguar to use the Controller Interrupt Vector specified in the Initialize Controller IOPB. The Host may select which status lines can generate an interrupt in the Initialize Printer Port IOPB. An interrupt is generated when an enabled status line (except parity) toggles either active or inactive. Parity error is only reported when it becomes active.

The complete status word will be updated in Controller Specific Space and a Command Response Block will be posted.

The third method is initiated by the Host issuing a Printer Port IOPB with both the Maximum Transfer Length and the Printer Transfer Length fields set to zero. This will cause the Printer Port to update the Printer Status field of the IOPB and immediately return it as command completed.

DETAILED COMMAND AND STATUS REPORTING STRUCTURE DESCRIPTIONS:

INITIALIZE PRINTER PORT IOPB:

The Initialize Printer Port IOPB is used to configure the printer port for the interface being used and to enable/disable status change interrupts. A Status Change Interrupt vector must be supplied in the Initialize Controller command to allow status change interrupts. This IOPB can also be issued at any time to reset the Printer Port or to issue a buffer clear to the printer.

WORD #								
0	Command (0x4A)							
1	Options							
2	Return Status							
3	Reserved							
4	Normal Completion Vector							Error Completion Vector
5	Interrupt Level							
6-0xD	Reserved							
0xE	RST	O/E	B/C	Reserved				Status Change Int. Enable
0xF-15	Reserved							

Update Figure 13. Initialize Printer Port IOPB

Options:

Bit 1-15 - Reserved - 0
Bit 0 - Interrupt Enable

Return Status:

0 = Normal execution

All existing generic error codes.

Reset (RST):

The Initialize Printer Port command can be issued at any time to reset the Printer Port. The Jaguar will reset the printer hardware and will be ready to receive new print commands after the completion status has been returned to the host.

1 = Reset Printer Port

Odd/Even (O/E): (Data Products printers ONLY)

This bit specifies the parity polarity.

0 = Even Parity
1 = Odd Parity

Buffer Clear (BC):

(Data Products - Buffer Clear)
(Centronics - Printer Init)

The Initialize Printer Port command can be issued at any time to assert a buffer clear to the printer. The Host must issue another Initialize Printer Port command with the buffer clear bit set to 0 to clear the condition.

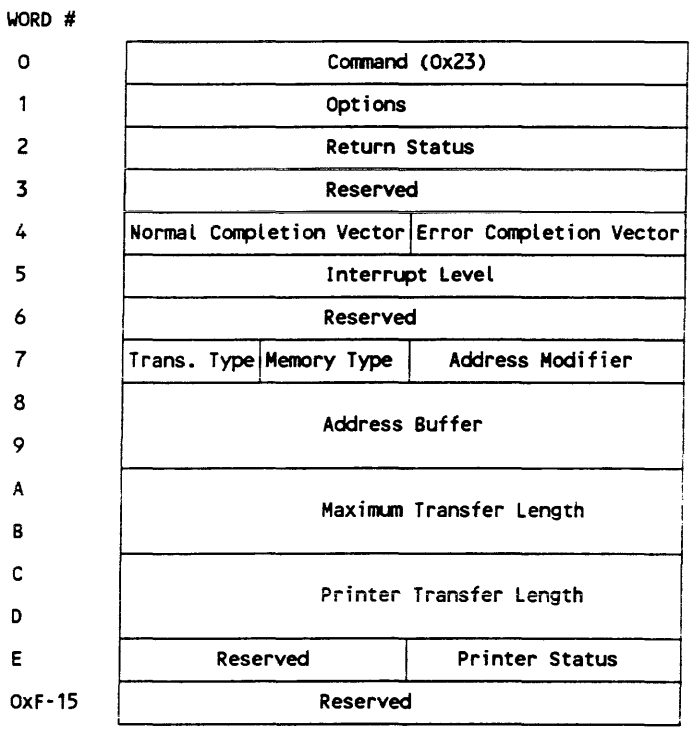
0 = Buffer Clear/Printer Init inactive
1 = Buffer Clear/Printer Init active

Status Change Interrupt Enable Definitions (active high):

Data Products Printers:	Centronics Printers:
Bit 7 - Reserved - 0	Bit 7 - Reserved - 0
Bit 6 - Reserved - 0	Bit 6 - Reserved - 0
Bit 5 - Reserved - 0	Bit 5 - Reserved - 0
Bit 4 - Reserved - 0	Bit 4 - Reserved - 0
Bit 3 - Cable On	Bit 3 - Reserved - 0
Bit 2 - Parity Error	Bit 2 - Paper Empty
Bit 1 - Online	Bit 1 - Select
Bit 0 - Ready	Bit 0 - Fault

PRINTER PORT IOPB

The Printer Port IOPB is a modified version of the Generic IOPB format described in the Jaguar manual. A new command code of 0x23 is defined and a new transfer length field has been created. All fields not specified below will be the same as the Generic IOPB.



Update Figure 14. Printer Port IOPB

Options:

Bit 9-15 - Reserved - 0
Bit 8 - Paper Instruction
Bit 7 -1 - Reserved - 0
Bit 0 - Interrupt Enable

When the Paper Instruction option is set to 1, the Jaguar will transfer all of the data specified in this IOPB to the printer with the Paper Instruction interface signal active. Paper Instruction is only supported by Data Products printers.

Return Status:

All existing generic error codes and:

0x91 Maximum Transfer Length must be greater than or equal to the Printer Transfer Length.
0x92 Maximum Transfer Length was set to zero, but Printer Transfer Length was not zero.
0x93 Printer Port not present or not initialized.
0x99 Scatter Gather not supported for this device.

Memory Type:

Long word (32 bit) and (16 bit) word transfers will be supported.

Maximum Transfer Length and Printer Data Transfer Length Fields:

The Printer Transfer Length field is used in conjunction with the Maximum Transfer Length Field to handle odd-byte transfer operation.

Printer Transfer Length field:

The Printer Transfer Length field must contain the exact count of bytes to be sent to the printer and must be filled in on each IOPB.

Maximum Transfer Length field:

The 4210 must perform either word (16 bit) or long word (32 bit) transfers across the VMEbus. To handle odd byte transfers the Maximum Transfer Length field must be rounded up to pad the transfer out to a word or long word boundary.

Requesting status:

A length of zero in the Maximum Transfer Length field and in the Printer Data transfer Length Field will cause the Jaguar to return the IOPB with the current printer status.

PRINTER STATUS:

Data Products Status Definition (Active High):

Bit 7 - Software Readable Jumper 1 = Data Products, 0 = Centronics
Bit 6 - Paper Movement
Bit 5 - Top of Form
Bit 4 - Bottom of Form
Bit 3 - Cable On
Bit 2 - Parity Error
Bit 1 - Online
Bit 0 - Ready

Centronics Status Definition (Active High):

Bit 7 - Software Readable Jumper 1 = Data Products, 0 = Centronics
Bit 6 - Busy
Bit 5 - Reserved - value returned may be either 0 or 1
Bit 4 - Reserved - value returned may be either 0 or 1
Bit 3 - Reserved - value returned may be either 0 or 1
Bit 2 - Paper Empty
Bit 1 - Select
Bit 0 - Fault

COMMAND RESPONSE BLOCK DEFINITION

If status change interrupts have been enabled the following Command Response Block will be posted and the Host is interrupted when a status change occurs. The Status Change bit in the Command Response Status Word is set and an image of the printer's status lines is returned. More than one status line may change in a single interrupt so the entire status should be verified by the Host.

Word DEC	Even Byte								Odd Byte							
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Command Response Status Word															
1 . . . 5	Reserved															
6	Reserved								Error Code							

Update Figure 15. Command Response Status Word

Command Response Status Word:

All existing CRSW bits and:

Bit 7 - Status Change

Printer Status:

Same as defined in the Printer Port IOPB (Data Products Status Definition (Active High) and Centronics Status Definition (Active High).

Return Code:

0x90 - Printer Status Change Interrupt

CONNECTOR

The printer interface is available on connector P4 only. The pinout allows for a flat ribbon cable to be used to connect to a Data Products printer. A Centronics printer will require a cable that connects the correct pins from the boards 50 pin connecter to the printer's 36 pin connector. The following tables describe the pinouts for the Data Products and Centronics printers.

Update Table 2. Data Products Short Line Interface (P99)

4210 P4	Data Products	Functions	4210 P4	Data Products	Function
6	19	DATA 1	11	37	RETURN
7	3	RETURN	42	31	BUFFER CLEAR
9	20	DATA 2	43	15	RETURN
10	4	RETURN	34	12	+5V (NOT SUPPLIED)
1	1	DATA 3	15	22	READY
4	2	RETURN	16	6	RETURN
23	41	DATA 4	12	21	ON LINE
20	40	RETURN	13	5	RETURN
2	34	DATA 5	18	23	DEMAND
3	18	RETURN	19	7	RETURN
29	43	DATA 6	30	27	PARITY ERROR
26	42	RETURN	31	11	RETURN
8	36	DATA 7	24	25	BOTTOM OF FORM
5	35	RETURN	25	9	RETURN
33	28	DATA 8	27	26	PAPER MOVING
32	44	RETURN	28	10	RETURN
36	29	DATA PARITY	17	39	GROUND
37	13	RETURN	21	24	TOP OF FORM
39	30	PAPER INSTRUCTION	22	8	RETURN
40	14	RETURN	38	46	INTERFACE CONNECTED
14	38	DATA STROBE	35	45	INTERFACE CONNECTED RETURN

Update Table 3. Centronics Interface (P99)

4210 P4	Centronics	Function	4210 P4	Centronics	Function
6	2	DATA 1	11	19	RETURN
7	20	RETURN	42	31	PRINTER INITIALIZE
9	3	DATA 2	43	30	RETURN
10	21	RETURN	34	NU	NOT USED
1	4	DATA 3	15	32	FAULT
4	22	RETURN	16	NU	NOT USED
23	5	DATA 4	12	13	SELECT
20	23	RETURN	13	NU	NOT USED
2	6	DATA 5	18	10	ACKNOWLEDGE
3	24	RETURN	19	28	RETURN
29	7	DATA 6	30	12	PAPER ENTRY
26	25	RETURN	31	NU	NOT USED
8	8	DATA 7	24	NU	NOT USED
5	26	RETURN	25	NU	NOT USED
33	9	DATA 8	27	11	BUSY
32	27	RETURN	28	29	RETURN
36	NU	NOT USED	17	NU	NOT USED
37	NU	NOT USED	21	NU	NOT USED
39	NU	NOT USED	22	NU	NOT USED
40	NU	NOT USED	38	NU	NOT USED
14	1	DATA STROBE	35	NU	NOT USED

Update Table 4. Data Products Long Line Interface (P106)

4210 P4	Data Products	Functions	4210 P4	Data Products	Function
6	19	DATA 1+	11	37	DATA STROBE-
7	3	DATA 1-	42	31	BUFFER CLEAR+
9	20	DATA 2+	43	15	BUFFER CLEAR-
10	4	DATA 2-	34	12	+5V (NOT SUPPLIED)
1	1	DATA 3+	15	22	READY+
4	2	DATA 3-	16	6	READY-
23	41	DATA 4+	12	21	ON LINE+
20	40	DATA 4-	13	5	ON LINE-
2	34	DATA 5+	18	23	DEMAND+
3	18	DATA 5-	19	7	DEMAND-
29	43	DATA 6+	30	27	PARITY ERROR+
26	42	DATA 6-	31	11	PARITY ERROR-
8	36	DATA 7+	24	25	BOTTOM OF FORM+
5	35	DATA 7-	25	9	BOTTOM OF FORM-
33	28	DATA 8+	27	26	PAPER MOVING+
32	44	DATA 8-	28	10	PAPER MOVING-
36	29	DATA PARITY+	17	39	GROUND
37	13	DATA PARITY-	21	24	TOP OF FORM+
39	30	PAPER INSTRUCTION+	22	8	TOP OF FORM-
40	14	PAPER INSTRUCTION-	38	46	INTERFACE CONNECTED
14	38	DATA STROBE+	35	45	INTERFACE CONNECTED RETURN

DEFICIENCIES

The following lists cite KNOWN deficiencies, potential improvements and the most current fixes and improvements within the X0U firmware described in the V/SCSI 4210 Jaguar User's Guide, Rev # X0F.

- Linked Commands are not supported.
- Multiple Logical Units on the same SCSI device are not supported.
- Extended Diagnostics command is not implemented.

POTENTIAL IMPROVEMENTS

Potential improvements are recommended additions/enhancements to the XAD firmware product not specifically described in the User's Guide, Rev # X0F. These may or may not be implemented in future releases of the firmware.

- Target mode operation of the SCSI port.

FIXES AND IMPROVEMENTS

This is a summary of bugs corrected and improvements added to date.

- High priority command operation.
- Synchronous offset operation.
- Board lock-up on write commands that cause an internal buffer wrap condition but do not transfer any data (i.e., terminate in a check condition status).
- Commands that take a long time to return data resulted in a false Bus Error (0x20) status return for the command.
- Lock-up when an invalid address was intentionally requested. This error is dependent on SCSI device speed.
- Secondary port odd byte transfer operation.
- Scatter/gather limited to total transfer lengths equal to the total buffer space divided by the number of work queues. Otherwise, error is returned.
- X0P firmware did not allow group 1 and 5 commands.

- By-pass SCSI bus reset on power up.
- Parity errors on message transfers.
- Daughter card support.
- VME/SCSI transfer count mismatches.
- External SCSI Reset operation.
- 2 byte window problem on Fujitsu 87030.
- Freeze/thaw work queue operation.

V/SCSI 4210 BOARD SPECIFICATIONS

The following table cites design parameters specific to the V/SCSI 4210 board.

VMEbus SPECIFICATIONS

DTB Master	A24, A32, D16, D32
DTB Slave	A16, D8, D16
Requester	Any of R(0-3), Static
Interrupter	Any of I(1-7), Dynamic

SCSI bus SPECIFICATION

Peripheral Data Rate	Up to 4Mbytes/sec synchronous Up to 1.5Mbytes/sec asynchronous

OPERATING ENVIRONMENT

Temperature	0-55 degrees Centigrade
Relative Humidity	10% - 90% Noncondensing

POWER REQUIREMENT (Single-ended drivers)

V/SCSI 4210 Jaguar	4.67 A typical @ +5VDC (+/- 5%) 6.85 A maximum @ +5VDC (+/- 5%)
V/SCSI 4210-DC Option SCSI port	0.75 A typical @ +5VDC (+/- 5%) 1.25 A maximum @ +5VDC (+/- 5%)

MECHANICAL (nominal)

Length	233 mm
Width	160 mm
Thickness	20 mm
Weight	.45 Kg

RELIABILITY

MTBF per MIL STD 217E	68,400 hours

ERRATA CORRECTIONS

Page 10. Replace the following text:

Bit 0 Start Queue Mode (SQM):

The Jaguar will acknowledge entering Queued IOPB mode by issuing a Command Complete Interrupt with the Queue Mode Started bit in the Command Response Status Word set to '1' (see Command Response Status Word). The interrupt will use the Controller Interrupt Vectors, which should also be initialized before setting Start Queue Mode (See Initialize Controller Command).

WITH

Bit 0 Start Queue Mode (SQM):

The Jaguar will acknowledge entering Queued IOPB mode by setting the Queue Mode Started bit in the Command Response Status Word set to '1' (see Command Response Status Word). No interrupt will be generated.

Page 11. 'Bit 2: Flush Queue and Report'

The description of the Flush Queue and Report bit incorrectly states that the Jaguar will reset the SCSI bus if a command has been issued to a device. The host may reset the SCSI bus by issuing the Reset SCSI Bus IOPB.

Page 24. Replace the following text:

Bit 5 Queue Mode Started (QMS):

The Jaguar acknowledges entering Queued IOPB mode by issuing a Command Complete Interrupt with the QMS bit set in the Command Response Status Word. The interrupt will use the Controller Interrupt Vectors, which should also be initialized before setting Start Queue Mode. (See Initialize Controller Command).

WITH

Bit 5 Queue Mode Started (QMS):

The Jaguar will acknowledge entering Queued IOPB mode by setting the Queue Mode Started bit in the Command Response Status Word set to '1' (see Command Response Status Word). No interrupt will be generated.

Page 59. Add the following text after the heading:

Controller Normal Completion Vector (2 bytes):

The Controller Vector is used by the Jaguar when reporting the completion of the following commands: Flush All Queues and Report, and Flush All Queues. The Controller Vector is also used for support of the Error Recovery tools. See the appendix on Error Recovery Tools for more information.

Page 59. Replace the following text

Bits 0-7 Interrupt Vector (IV):

These bits set the Interrupt Vector used by the Jaguar when reporting the normal completion of any Initialize Controller Command.

Bits 8-10 Interrupt Level (IL):

These bits set the Interrupt Level used by the Jaguar when reporting the normal completion of any Initialize Controller command.

WITH

Bits 0-7 Interrupt Vector (IV):

These bits set the Interrupt Vector used by the Jaguar when reporting normal controller interrupts.

Bits 8-10 Interrupt Level (IL):

These bits are the Interrupt Level used by the Jaguar when reporting normal controller interrupts.

Page 60. Replace the following text:

Controller Error Completion Vector (2 bytes):

The Controller Error Vector is used by the Jaguar when reporting the error completion of the following commands: Start Queue Mode, Flush All Queues and Report, and Flush All Queues.

Bits 0-7 Interrupt Vector (IV):

These bits set the Interrupt Vector used by the Jaguar when reporting the error completion of any Initialize Controller Command. The host sets this byte and it is not modified by the Jaguar.

Bits 8-10 Interrupt Level (IL):

These bits set the Interrupt Level used by the Jaguar when reporting the error completion of any Initialize Controller command. The host sets these bits and the Jaguar does not modify them.

WITH

Controller Error Completion Vector (2 bytes):

The Controller Error Vector is used by the Jaguar when reporting the error completion of the following commands: Flush All Queues and Report, and Flush All Queues. The Controller Error Vector is also used for conditions related to the Error Recovery Tools. See the appendix on Error Recovery tools for that information.

Bits 0-7 Interrupt Vector (IV):

This byte is the Interrupt Vector used by the Jaguar when reporting Controller Error Interrupts.

Bits 8-10 Interrupt Level (IL):

These bits set the Interrupt Level used by the Jaguar when reporting the Controller Error Interrupts.

Page 71. 'Flush Work Queue Command'

The Reset SCSI Bus on Command In Progress (RIP) bit will not be implemented. The host may reset the SCSI bus by issuing the Reset SCSI Bus IOPB.

Page 97. 'Figure D5 Total Transfer Count'

The correct offset for the location of the total scatter/gather transfer count is word 0x0C and word 0x0D of the IOPB. The manual incorrectly specifies words 0x0A and 0x0B.

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