V/SCSI 4210 Jaguar

High-performance
VMEbus Dual SCSI
Host Adapter
User's Guide

1
INTRODUCTION TO THE V/SCSI 4210

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 – 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.

CONVENTIONS USED IN THIS MANUAL

When numeric values are used, number base 10 may be assumed unless preceded by the characters "0x" for base 16 (hexadecimal).

Binary numbers are represented as "1" and "0".

"Words" are 16-bit entities.

Signal names followed by the character "*" are active low (i.e., 0 = true, 1 = false).

When individual bits are discussed in the text, "set" means "1" and "clear" means "0".

References

ANSI X3T9.2 SCSI Specifications

VMEbus Bus Specification, Revision C.1

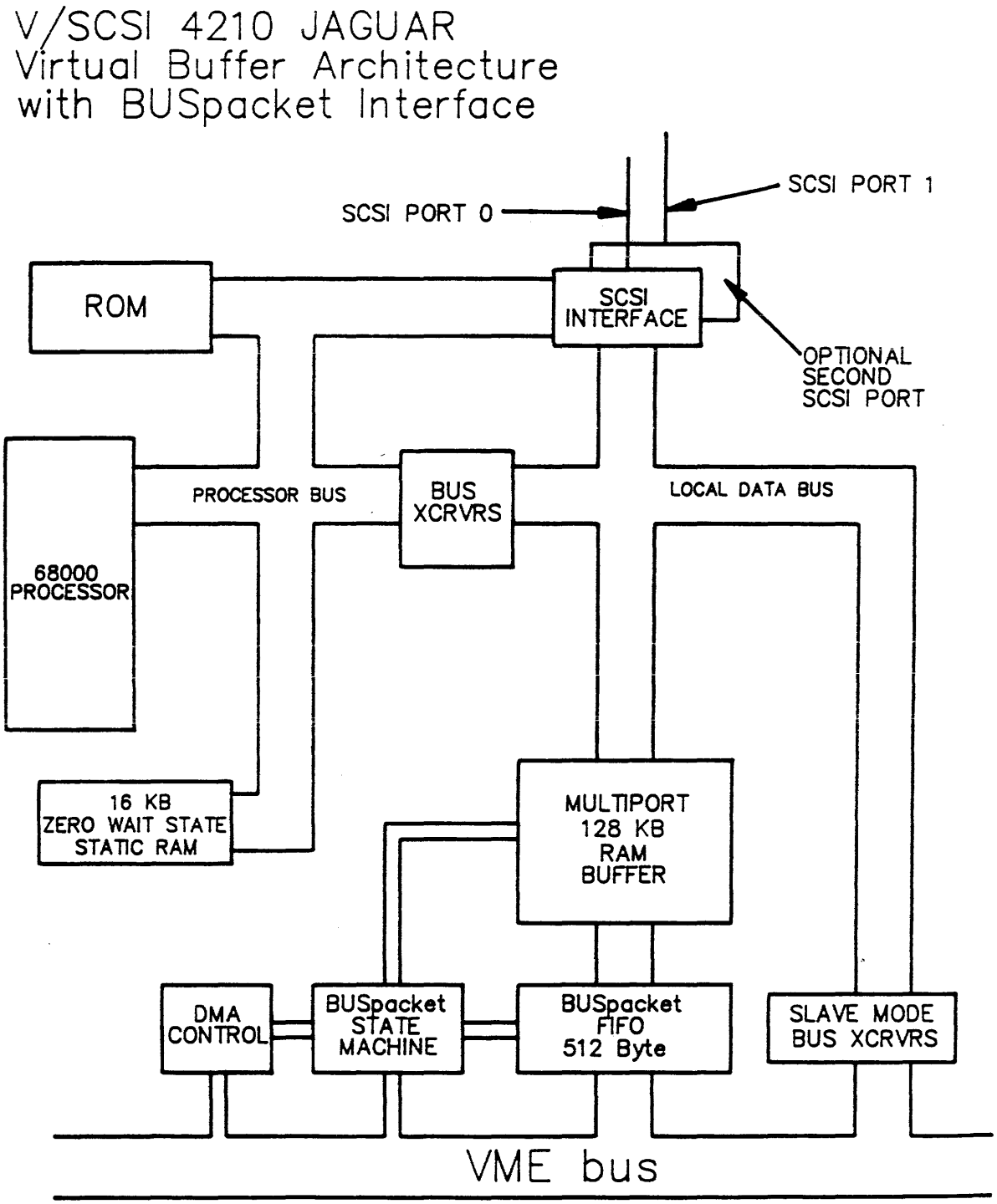


Figure 1. V/SCSI 4210 Jaguar Block Diagram

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) 350-9000.

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 Fig. 2 or 3)

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

Table 1. V/SCSI 4210 Products

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 8 or 9.

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 20 – 21 before proceeding with the installation.

VARIATIONS IN BOARD LAYOUT

From an installation standpoint, there are two 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 8.

- If the code is PB-0773-xxx-xxx, then your board has the layout shown on page 9

The drawings on the next two pages depict the two 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 10 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.)

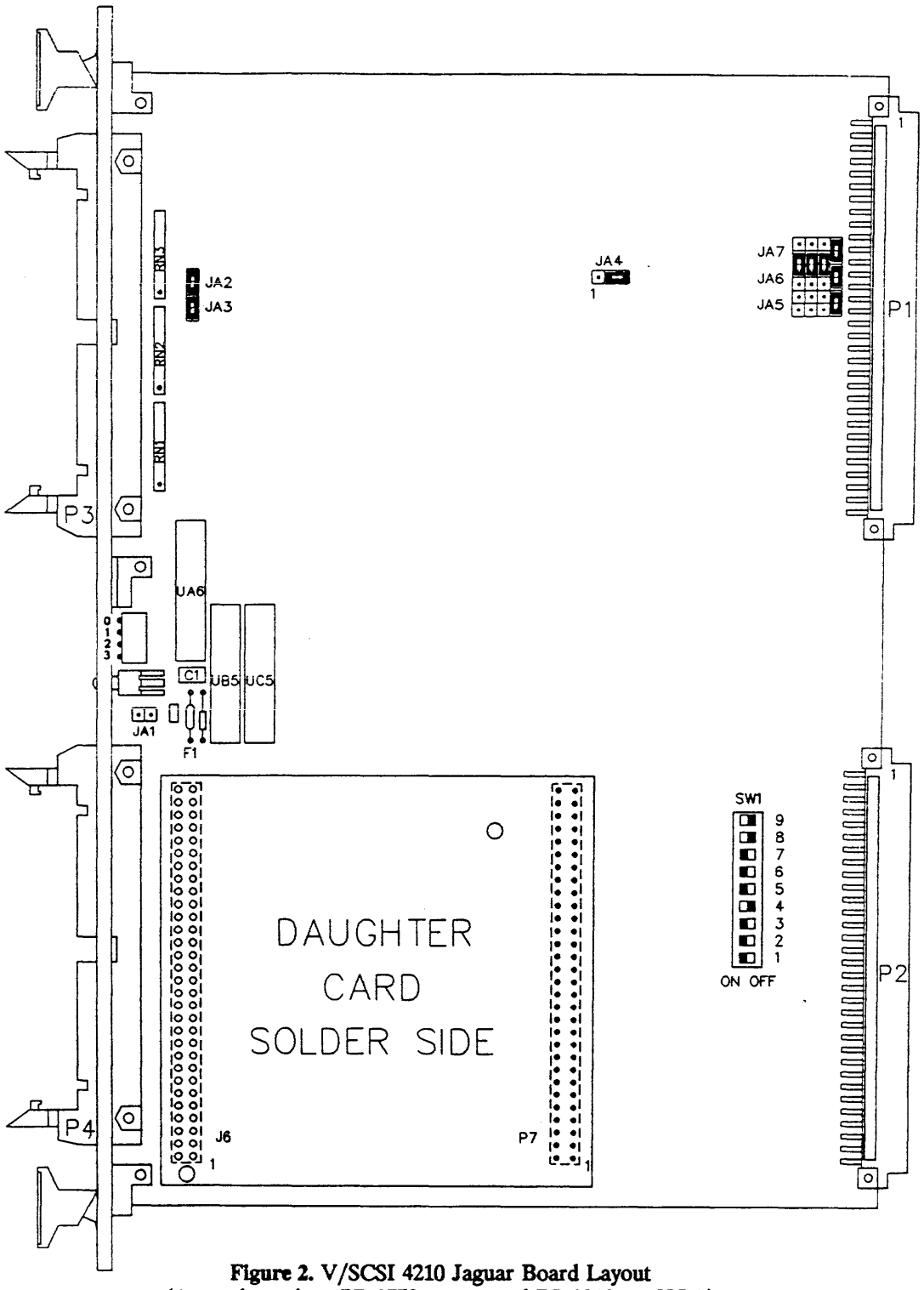


Figure 2. V/SCSI 4210 Jaguar Board Layout
(Artwork versions PB-0770-xxx-xxx and PB-0910-xxx-XOA)

NOTE: 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.

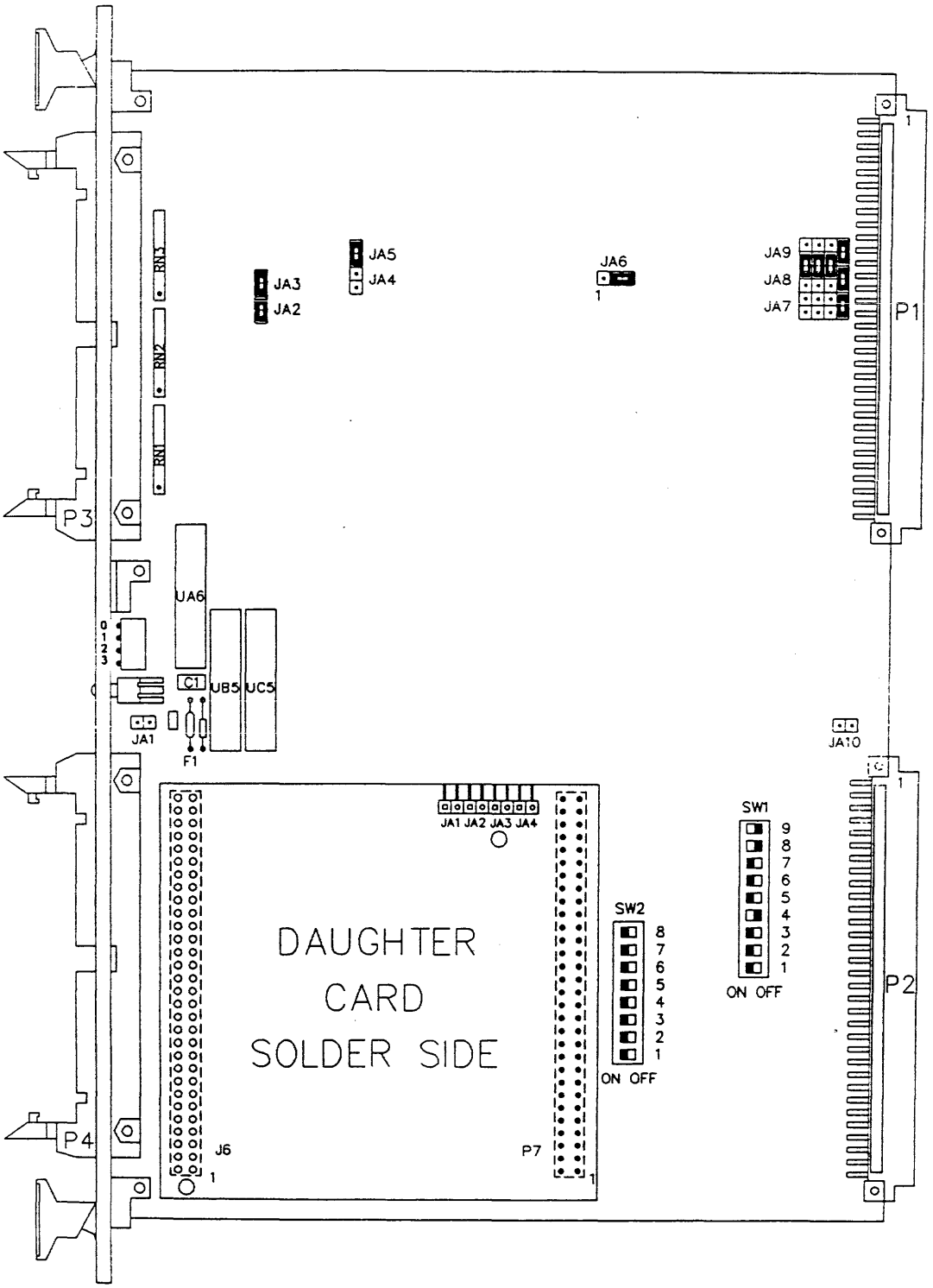
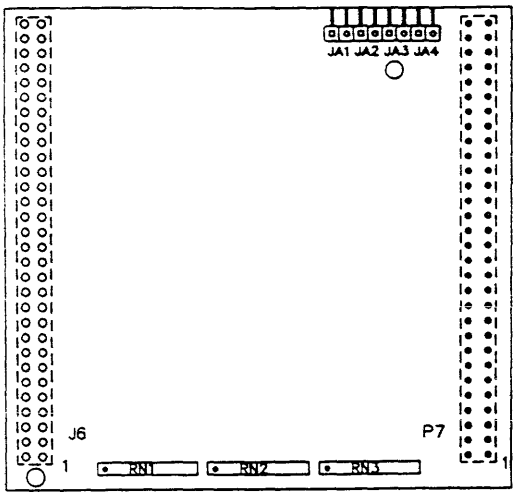
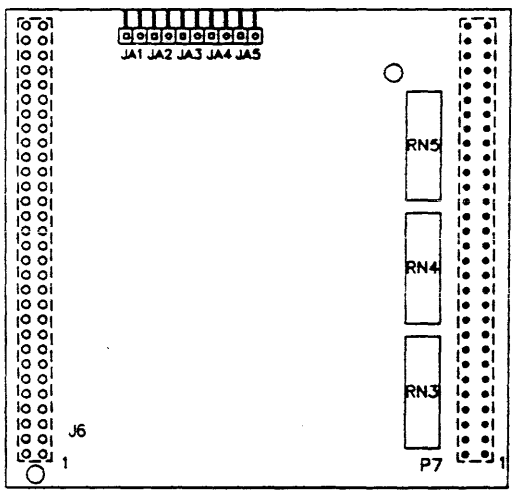


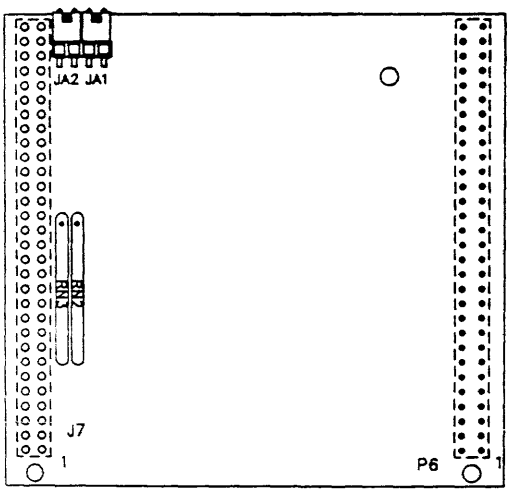
Figure 3. V/SCSI 4210 Jaguar Board Layout
(Artwork version PB-0773-xxx-xxx)



SINGLE-ENDED
DAUGHTER CARD



DIFFERENTIAL
DAUGHTER CARD



CENTRONICS/DATAPRODUCTS
SHORT LINE DAUGHTER CARD

Figure 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 8 – 10 show the location of the jumpers. To determine which board layout you have, please refer to the discussion "Variations in Board Layout" (page 7).

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 factory default setting for JA1 is no jumper.

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↔3 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 1 (highest) to 3 (lowest).

- 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).

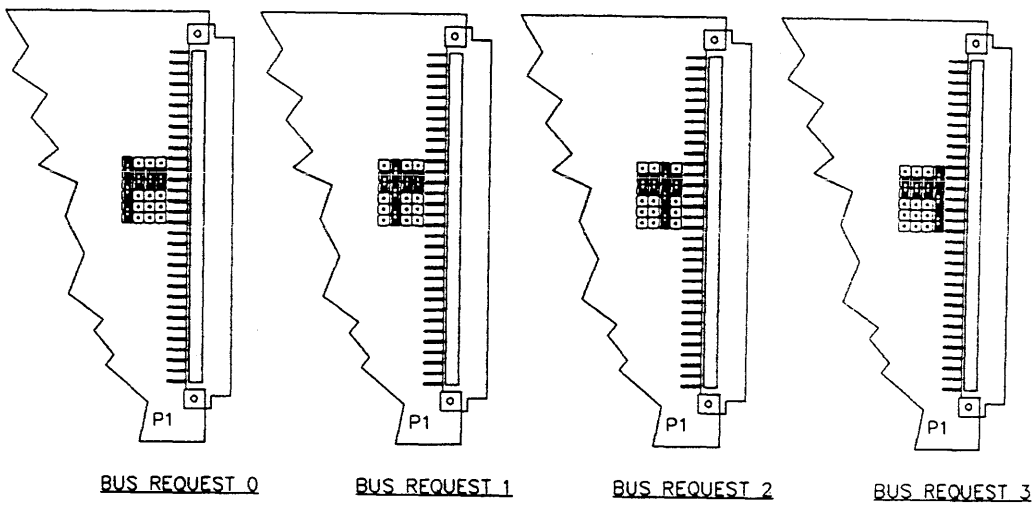


Figure 5. . VMEbus Request Priority Jumper Settings (Motherboard)

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 are available in versions which provide either standard or early 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 Figure 4. on page 10. 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. 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

Both the single-ended and differential daughter cards have a jumper (**JA4**) used to connect Port 1 to SCSI terminator power. Installing a jumper in JA4 connects the port to the terminator power. Both daughter cards are shipped with no jumper installed in JA4.

The differential daughter card has an additional jumper, **JA5**. This jumper is used for testing the oscillator and should be left in its factory default setting (jumper installed).

Jumpers Used on Centronics/Dataproducts Short Line Daughter Card. On the printer port that supports Centronics and Dataproducts Short Line printers, jumpers **JA1** and **JA2** are used to select the type of printer desired. The card is shipped with a jumper installed in JA2. This configures the card for use with a Dataproducts Short Line

printer. To configure the port for use with a Centronics printer, remove the jumper from JA2 and install a jumper in JA1.

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).

Step 3. Set Onboard Switches

Variations in 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 (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 8 (artwork codes PB-0770-xxx-xxx and PB-910-xxx-XOA).

Boards with -773 artwork have an additional 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

NOTE: The SCSI reset feature is also available on Jaguars with the PB-0770-xxx-xxx and PB-0910-xxx-XOA board layouts. However, the parameter is not switch-selectable. It must be specified when ordering the board from Interphase. For a discussion of how these boards handle SYSFAIL*, refer to the discussion on page 28.

Default Switch Settings

The factory default switch settings are shown below. An "OFF" setting equals logic 1. An "ON" setting equals logic 0.

Switch Block SW1 †

Function	Primary SCSI Bus ID			Short I/O Address A11	A12	A13	A14	A15	Addr. Mod.
Switch #	1	2	3	4	5	6	7	8	9
Setting	ON	ON	ON	OFF	ON	ON	ON	OFF	OFF

Switch Block SW2 ‡

Function	Reset Enable	Remove SYSFAIL*						
Switch #	1	2	3	4	5	6	7	8
Setting	ON	ON	ON	ON	ON	ON	ON	ON

† Switch block SW1 is provided on all Jaguar motherboards.

‡ Switch block SW2 is provided on -0773 motherboards only. Switches 3 through 8 on SW2 are not used and should be left in their default settings.

Figure 6. . Factory Default Switch Settings

The default switch settings on SW1 set the following parameters on the Jaguar:

- Base address of the 2 Kbyte short I/O space is set at 0x8800 (using VMEbus address lines A11 – A15).
- Only short supervisor accesses (0x2D) are permitted.
- The SCSI bus ID of Port 0 is 0x0.

The default switch settings on SW2 (provided on -0773 Jaguars only) set the following parameters:

- The SCSI bus is reset after the Jaguar has been power-up or reset (Switch 1 in SW2).
- The Jaguar removes the VMEbus SYSFAIL* signal immediately after coming out of reset (Switch 2 in SW2).

The following sections describe how to change the default switch settings to meet the requirements of your specific installation.

Setting Base Address of Short I/O Space RAM

Switches 4 – 8 of SW1 are used to set the base address of the 2 Kbytes of short I/O space RAM on the Jaguar. As noted in the introduction, 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 3. Switches Used for Short I/O Base Address

Switch #	Address Bit
SW1 — 4	A11
" — 5	A12
" — 6	A13
" — 7	A14
" — 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 8 - 9.

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 4. Base Addresses 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

Setting Address Modifiers Allowed in Short I/O Address Space

Switch 9 in 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 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 5. 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

Selecting SCSI Bus Reset after Power-up/Reset (PB-0773-xxx-xxx board layout only)

When Switch 1 in SW2 is set in its default position (ON), 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 (PB-0773-xxx-xxx board layout only)

When Switch 2 in SW2 is set in its default position (ON), the Jaguar will remove the VMEbus SYSFAIL* signal immediately after coming out of reset. When it is set to "OFF", the Jaguar will not clear SYSFAIL* 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.

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. These resistor SIPs are labelled RN1, RN2, and RN3 (see the board layouts on pages 8 and 9). These resistors provide termination for the Port 0. If Port 0 is not at one end of the SCSI cable, remove these resistors from the 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 10 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.

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 host 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.

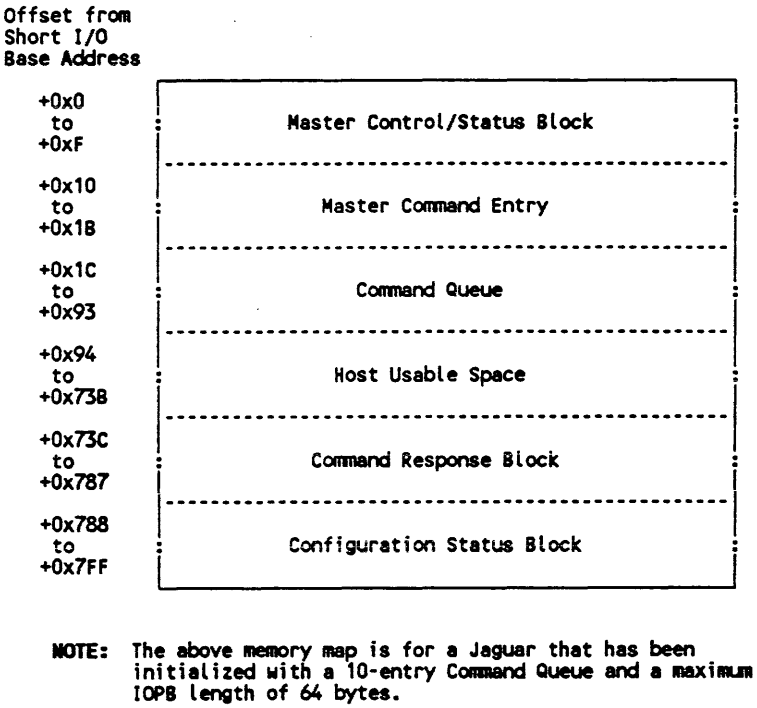


Figure 8. Typical Memory Map of Jaguar Short I/O Space

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).

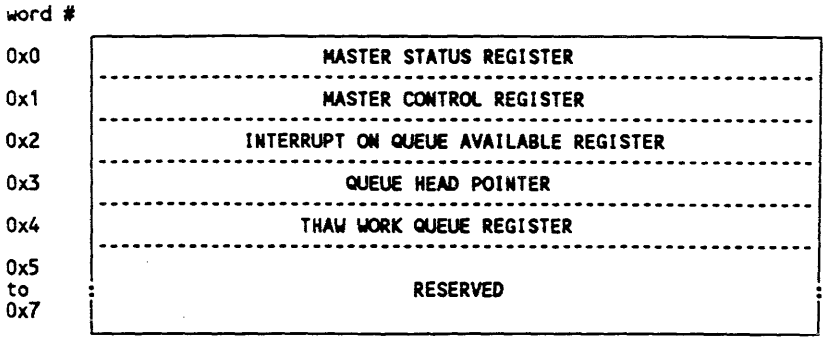


Figure 9. Master Control/Status Block (MCSB)

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:

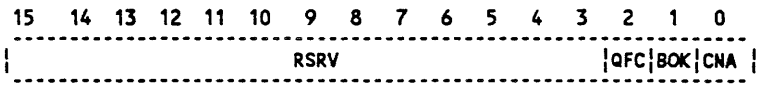


Figure 10. Master Status Register (MSR)

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 BOK bit is not valid for 100 microseconds after a controller reset.

Table 6. 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 diagnostics 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 Command 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:

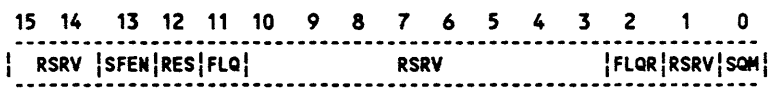


Figure 11. Master Control Register (MCR)

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 (see the discussion of SW2 on p. 14).

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 50 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 9 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 (p. 8) 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 Interrupt on Queue Available is enabled by setting the Interrupt on Command Queue Available bit in the Interrupt on Queue Available Register (IQAR). 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).

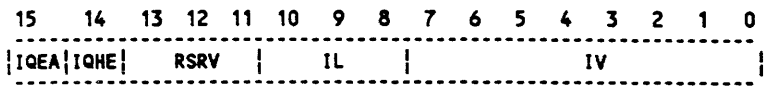


Figure 12. Interrupt on Queue Available Register (IQAR)

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 resets 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.

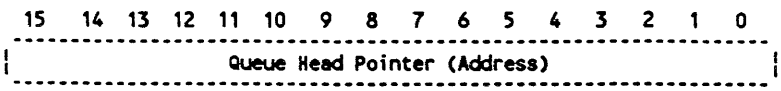


Figure 13. Queue Head Pointer/Queue Head Pointer In Use

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.

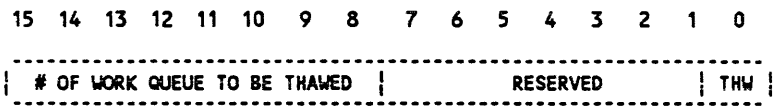


Figure 14. Thaw Work Queue Register

Bit 0 Thaw Work Queue (THW):

Setting this bit causes the Jaguar to: 1) resume execution of commands in the work queue specified in Bits 8-15, and 2) clear the entire Thaw Work Queue Register 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 8-15 Number of Work Queue to be Thawed:

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

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:

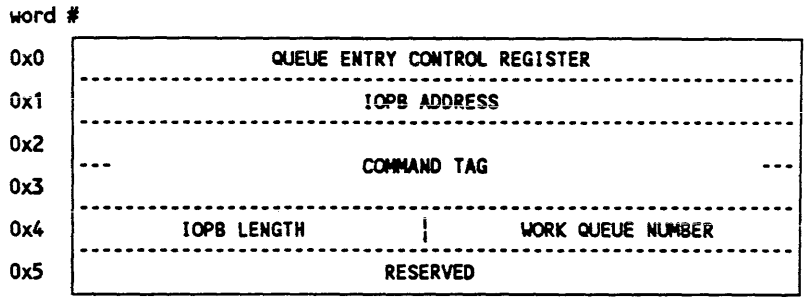


Figure 15. Master Command Entry

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

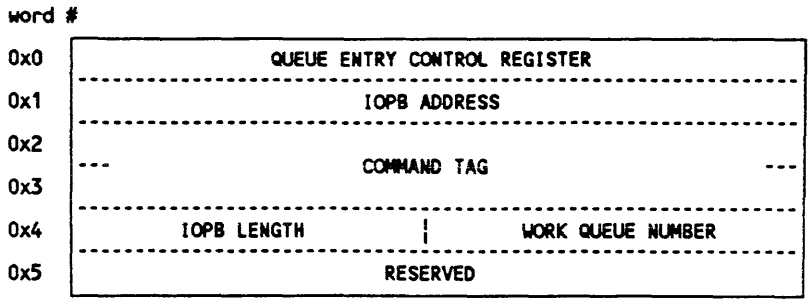
The Command Queue (CQ) consists of a user-programmed number of Command Queue entries. The entries in the Command Queue is set by the host when it initializes the controller. The Command Queue is circular, but it is up to the host to keep track of the next Command Queue entry that it can use. Because 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:



COMMAND QUEUE ENTRY FOR OFFBOARD IOPBs:

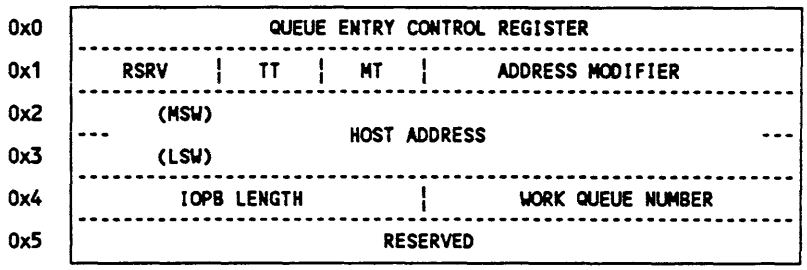


Figure 16. Command Queue Entry Format for Onboard and Offboard IOPBs

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).

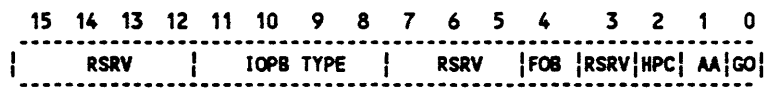


Figure 17. Queue Entry Control Register (QECR)

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 offboard Command Queue entry and its 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.

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, see page 60.

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.

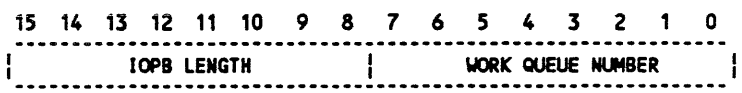


Figure 18. IOPB Length/Work Queue Number

Bits 0-7 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 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 (p. 48) for additional information.

For offboard IOPBs, the Jaguar will add the value in the IOPB Length to 12 (the number of

bytes in the CQE). This value determines how many bytes it will DMA into its memory. Therefore, the field should contain the exact number of bytes in the IOPB.

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 that space has become available in the Command Queue to accept new entries. (The latter use of the CRB only occurs after a "queue full" condition. See "Interrupt on Queue Available Register", page 28, for details.)

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. A recommended value for the Command Response Block length is 76 bytes.

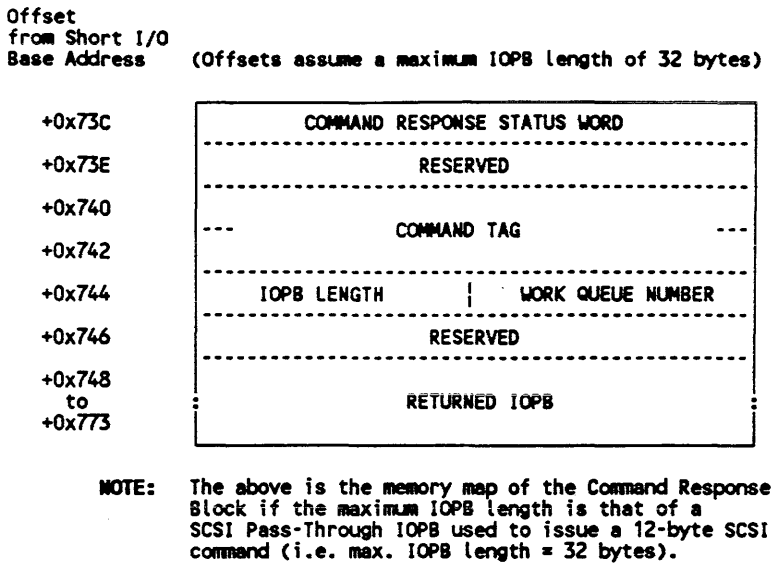


Figure 19. Command Response Block (Sample Memory Map)

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:

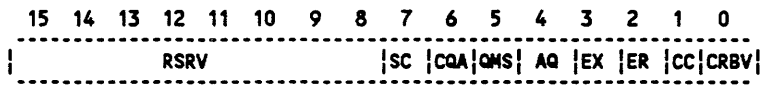


Figure 20. Command Response Status Word (CRSW)

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", p. 128, 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:

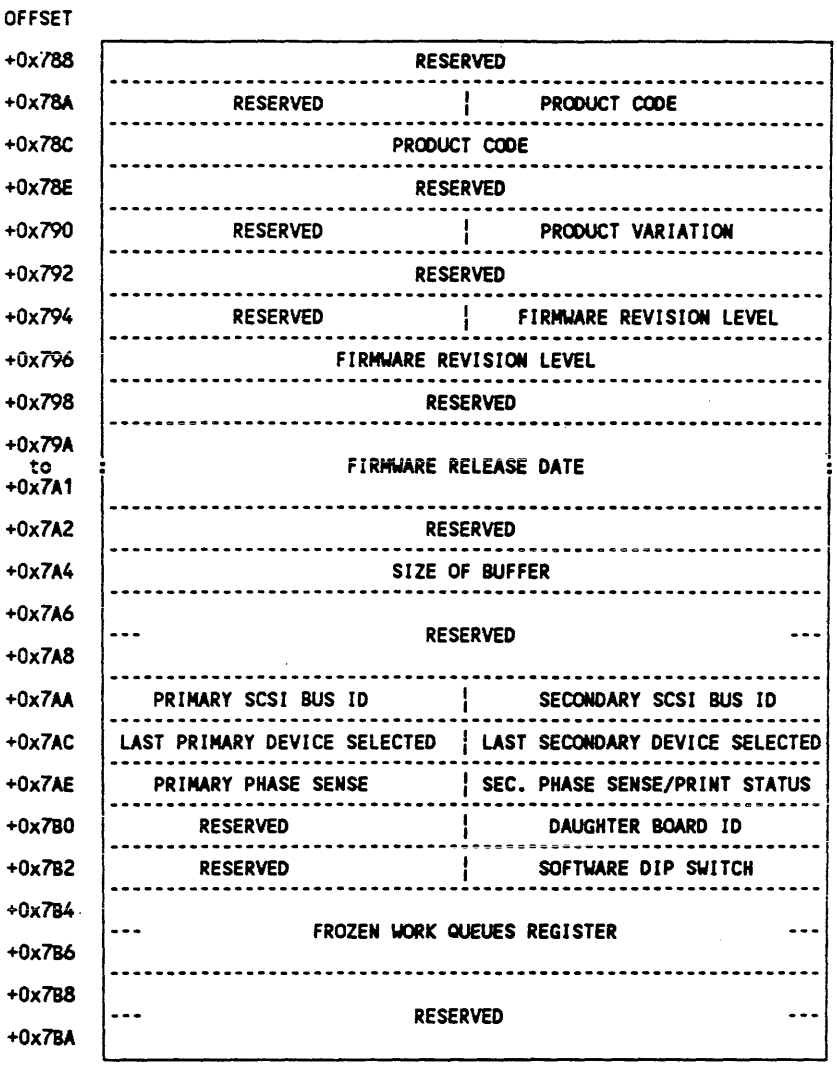


Figure 21. Configuration Status Block

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, see page 13.)

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:

D7	D6	D5	D4	D3	D2	D1	D0
REQ	ACK	ATN	SEL	BSY	MSG	C/D	I/O

Figure 22. SCSI Bus Status Byte

The above signals are active high, and each corresponds to a signal on the SCSI bus. 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:

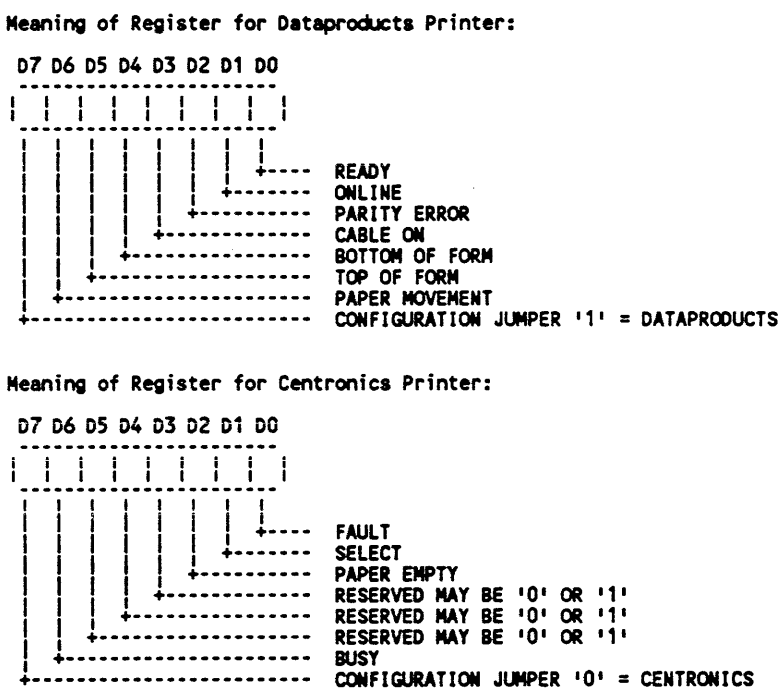


Figure 23. Printer Status Register

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 7. 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 on page 9. 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:

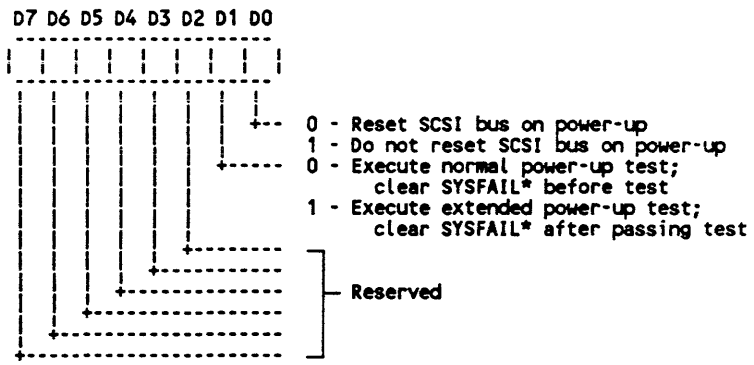
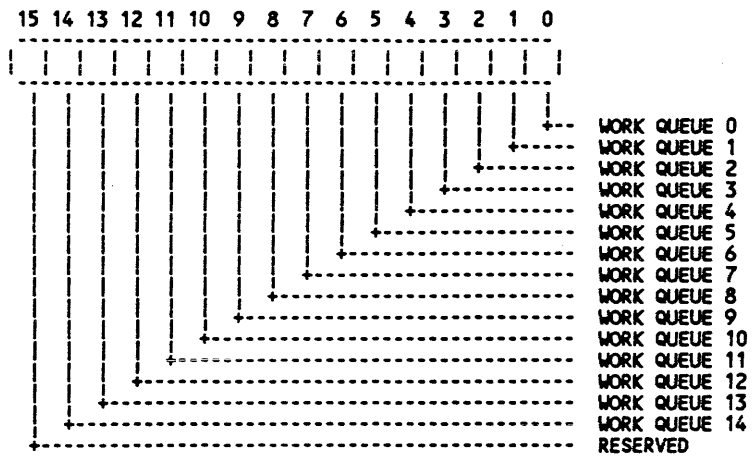


Figure 24. Software Configuration Switch Settings Reported in Configuration Status Block

Frozen Work Queues (2 bytes):

This register provides Work Queue frozen status for the Jaguar's 14 Work Queue's, 1 - 14. (Work Queue 0 cannot be frozen.) 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: Bits 16 - 31 of the Frozen Work Queues Register are reserved.

Figure 25. Frozen Work Queues Register

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. (See IOPB Format.) 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, page 36).

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.

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.

The following commands are supported by the Jaguar:

Table 8. Jaguar Command Set

SCSI IOPBs	**Command Code**
SCSI Pass-Through	(0x20)
SCSI Reset	(0x22)
Printer Port	(0x23)
Control IOPBs	
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 (p. 55) for details.

For ease of reference, each command in this chapter starts on a new page.

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 #	
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	LNK* | RSRV | TT | MT | Address Modifier
0x8	--- Buffer Address ---
0x9	(or scatter/gather list address*)
0xA	--- Maximum Transfer Length ---
0xB	(or scatter/gather element count*)
0xC	--- Reserved ---
0xD	(or scatter/gather transfer count*)
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 26. SCSI Pass-Through IOPB
for 12-byte SCSI Command

SCSI commands of other lengths are formed by appending the appropriate number of bytes at Word 10. The Jaguar examines the group code field of the operation code in the SCSI Command Descriptor Block (SCSI Byte 0) to find the length of the Command Descriptor Block. If Group 0, 1, or 5 commands are used, the lengths will be known to be 6, 10, or 12 bytes. In these cases, clear the IOPB Length field of the corresponding Command Queue entry to '0'.

If a vendor-unique SCSI command (Group 6 or 7) is used, the IOPB Length field in the corresponding Command Queue entry must contain the length of the IOPB in words. 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:

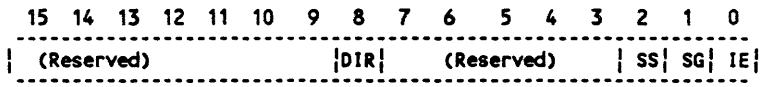


Figure 27. SCSI Pass-Through Command Options

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," p. 131.

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:

Table 9. VMEbus Transfer Direction for the SCSI Pass-Through Command

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.

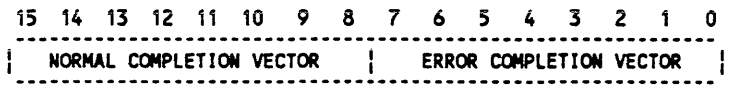


Figure 28. Normal Completion Vector/Error Completion Vector for the SCSI Pass-Through Command

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).

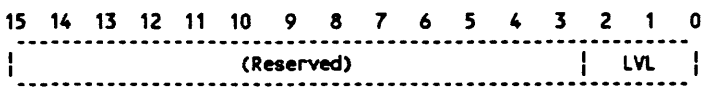


Figure 29. Interrupt Level for the SCSI Pass-Through Command

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.

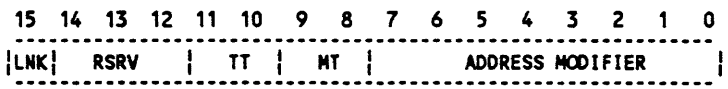


Figure 30. Address Modifier/Memory Type/Transfer Type for the SCSI Pass-Through Command

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 10. Memory Type for the 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 11. Transfer Type for the SCSI Pass-Through Command

Bit 11	Bit 10	Transfer Type
0	0	Normal mode
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," p. 133, for details.

• 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.

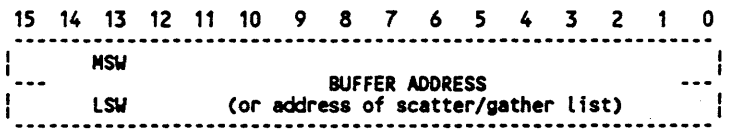


Figure 31. Buffer Address for the SCSI Pass-Through Command

• 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.

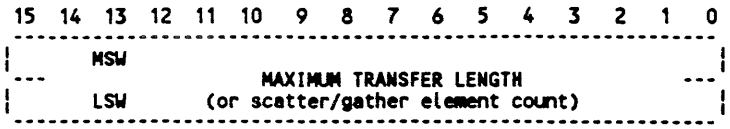


Figure 32. Maximum Transfer Length for the SCSI Pass-Through Command

- 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," p. 131, for details.

- Unit Address (2 bytes)

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

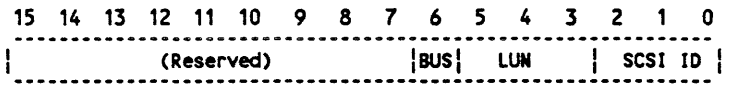


Figure 33. Unit Address for the SCSI Pass-Through Command

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.

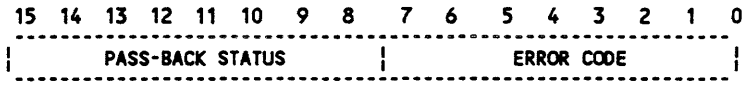


Figure 34. Return Status for the SCSI Pass-Through Command

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.

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, page 75.)

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

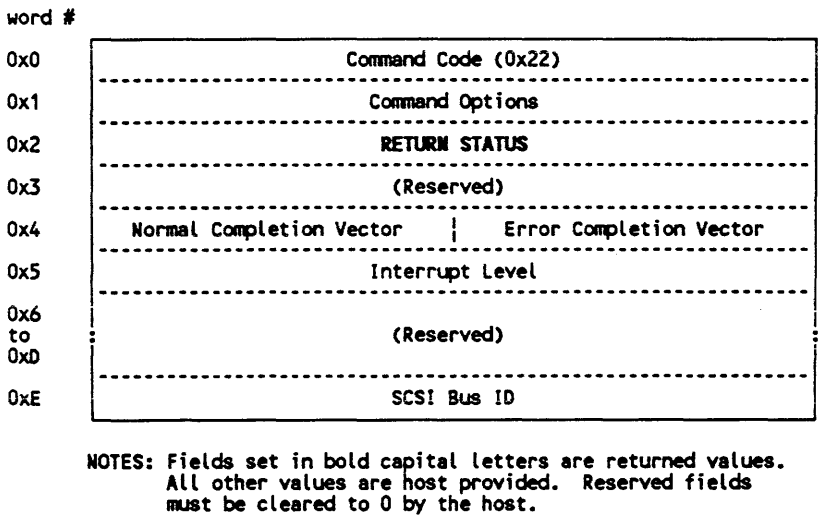


Figure 35. SCSI Reset IOPB

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:

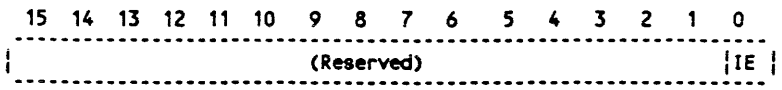


Figure 36. Command Options for the SCSI Reset Command

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.

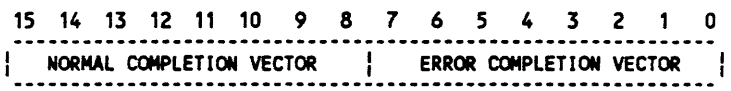


Figure 37. Normal Completion Vector/Error Completion Vector for the SCSI Reset Command

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).

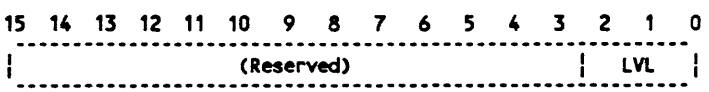


Figure 38. Interrupt Level for the SCSI Reset Command

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.

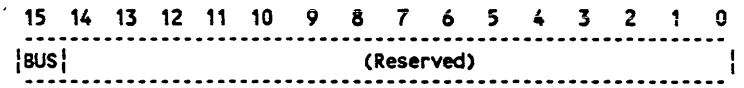


Figure 39. SCSI Bus ID for the SCSI Reset Command

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 (see p. 105).

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

The format of the Printer Port IOPB is as follows:

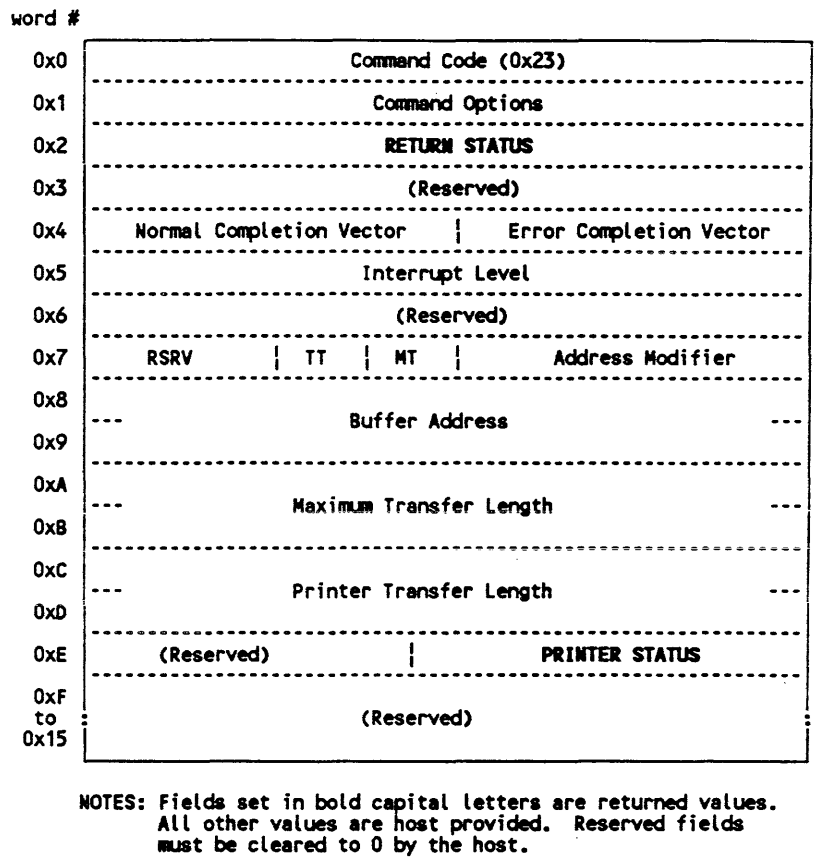


Figure 40. Printer Port IOPB

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:

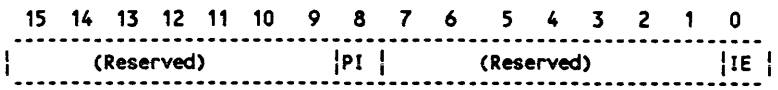


Figure 41. Command Options for the Printer Port Command

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.

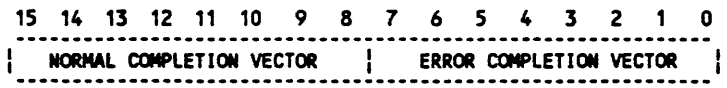


Figure 42. Normal Completion Vector/Error Completion Vector for the Printer Port Command

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).

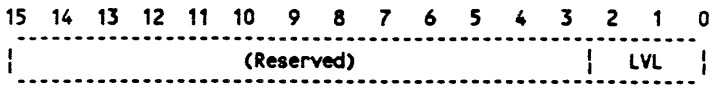


Figure 43. Interrupt Level for the Printer Port Command

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.

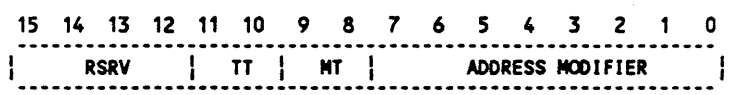


Figure 44. Address Modifier/Memory Type/Transfer Type for the Printer Port Command

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 12. Memory Type for the 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 13. Transfer Type for the 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.

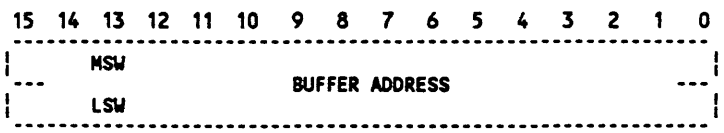


Figure 45. Buffer Address for the Printer Port Command

- **Maximum Transfer Length (4 bytes)**

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

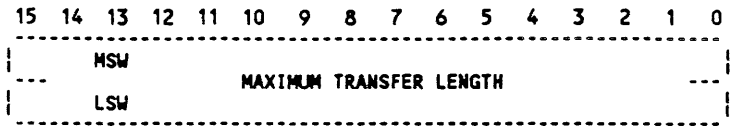


Figure 46. Maximum Transfer Length for the Printer Port Command

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.

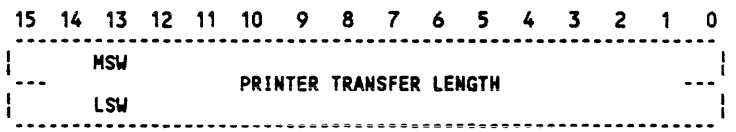


Figure 47. Printer Transfer Length for the Printer Port Command

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 (see Initialize Printer Port, p. 107). The definition of the bits in this field vary depending on the printer type, as listed below.

Table 14. Definition of Printer Status Bits

```
Dataproducts Status 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.

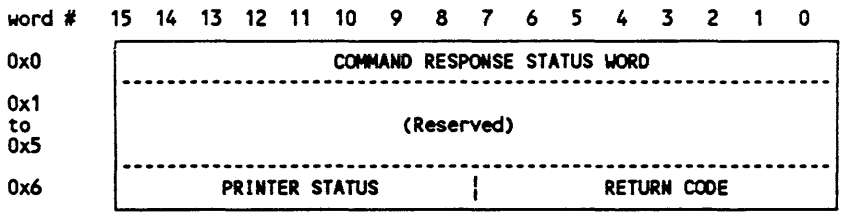


Figure 48. Returned Information for Printer Status Change Interrupt

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 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 several minutes 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.

In all cases, a test result of 0xFFFF indicates a successful test. Any other value indicates an error code.

word #	
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 49. 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.

- **Scratchpad RAM Test Result (2 bytes)**

  These bytes return the status of the Scratchpad RAM Test.

- **Buffer RAM Test Result (2 bytes)**

  These bytes return the status of the Buffer RAM Test.

- **Event RAM Test Result (2 bytes)**

  These bytes return the status of the Event RAM Test.

- **Primary SCSI Port Register Test (2 bytes)**

  These bytes return the status of the Primary SCSI Port Register Test.

- **SCSI Secondary Port Register Test (2 bytes)**

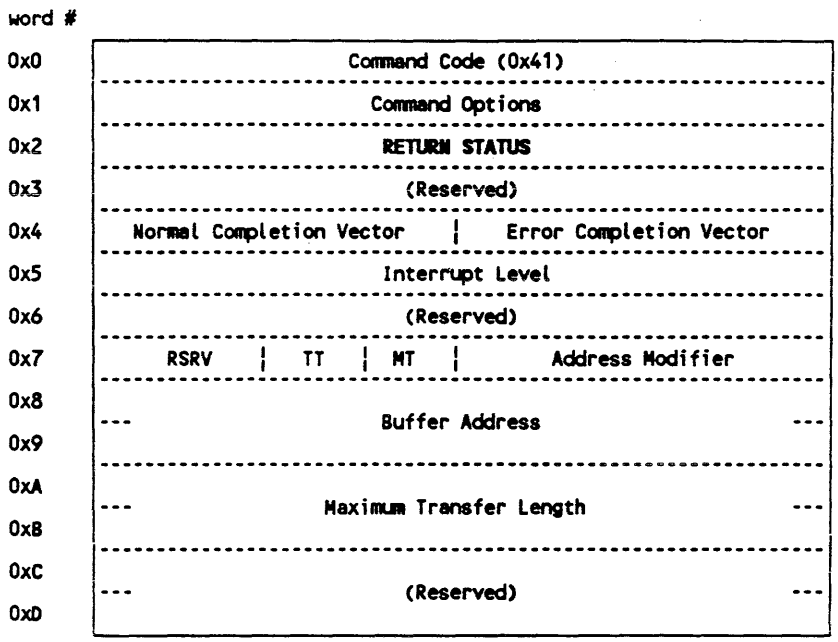
  These bytes return the status of the SCSI Secondary Port Register Test.

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:



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 50. 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:

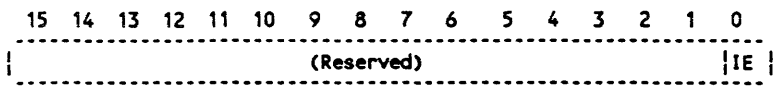


Figure 51. Command Options for the Initialize Controller Command

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.

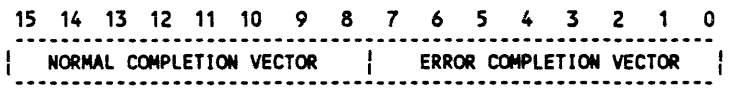


Figure 52. Normal Completion Vector/Error Completion Vector for the Initialize Controller Command

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).

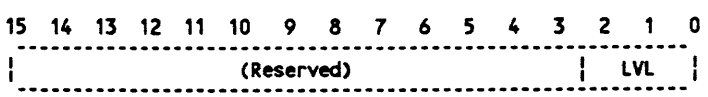


Figure 53. Interrupt Level for the Initialize Controller Command

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.

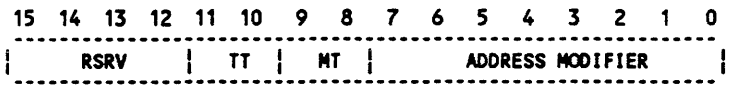


Figure 54. Address Modifier/Memory Type/Transfer Type for the Initialize Controller Command

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 15. Memory Type Field for the 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.

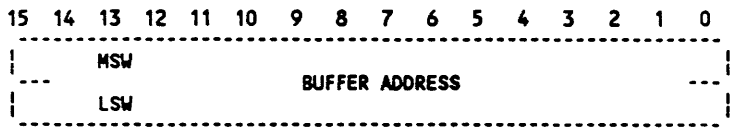


Figure 55. Buffer Address for the Controller Initialization Block

- **Maximum Transfer Length (4 bytes)**

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

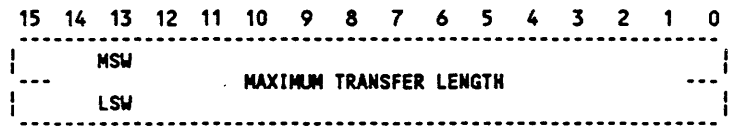


Figure 56. Maximum Transfer Length for the Initialize Controller Command

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:

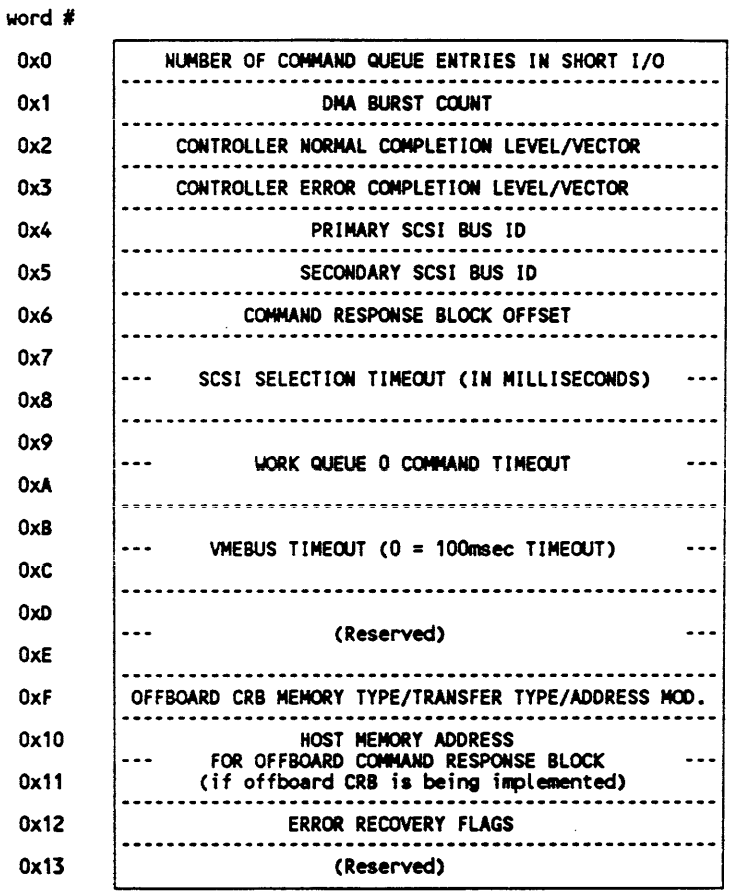


Figure 57. Controller Initialization Block

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 Command Queue entries/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.

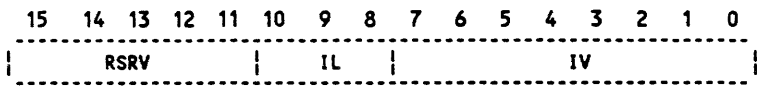


Figure 58. Controller Normal Completion Level/Vector

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, please refer to the discussion in Chapter 6 (p. 128).

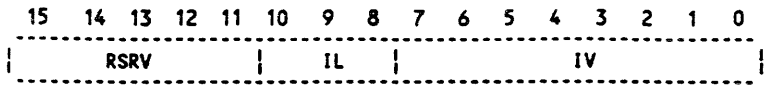


Figure 59. Controller Error Completion Level/Vector

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.

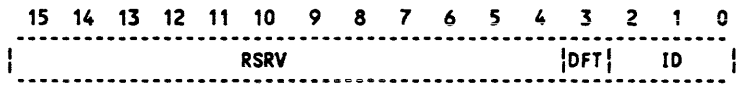


Figure 60. Primary SCSI Bus ID

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 (see page 17). 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.

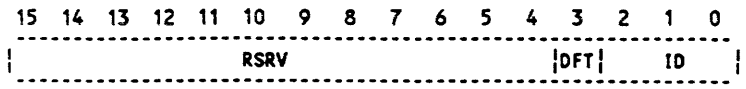


Figure 61. Secondary SCSI Bus ID

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 (refer to page 13). 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.

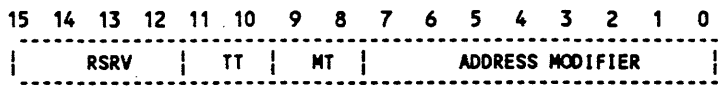


Figure 62. Memory Type/Transfer Type/Address Modifier for Offboard Command Response Block

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 16. 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 17. 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:

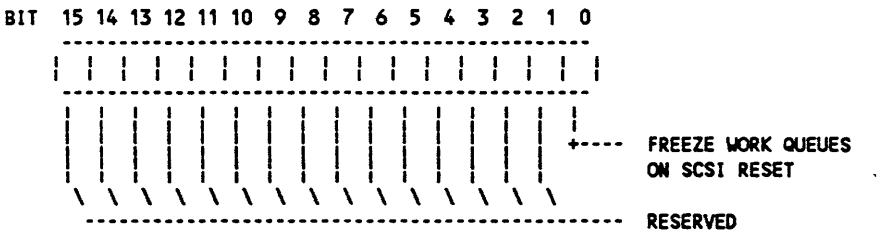


Figure 63. Error Recovery Options in Controller Initialization Block

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 #	
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 capital letters are returned values.
All other values are host provided. Reserved fields must be cleared to 0 by the host.

Figure 64. 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:

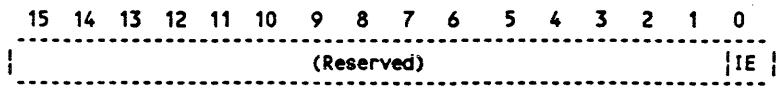


Figure 65. Command Options for the Initialize Work Queue Command

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.

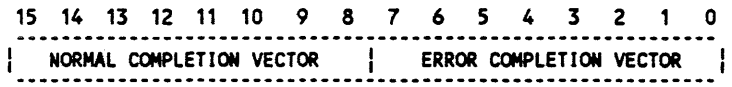


Figure 66. Normal Completion Vector/Error Completion Vector for the Initialize Work Queue Command

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).

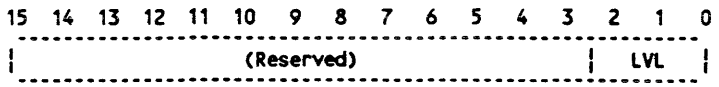


Figure 67. Interrupt Level for the Initialize Work Queue Command

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 0x0 - 0xF 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.

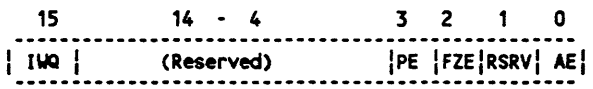


Figure 68. Initialize Work Queue Command Options

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 busy 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 #	
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	RSRV | 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 69. 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:

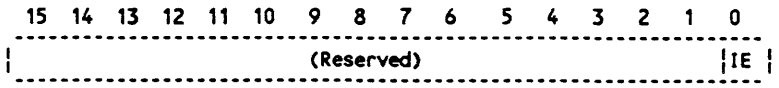


Figure 70. Command Options for the Dump Initialization Parameters Command

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.

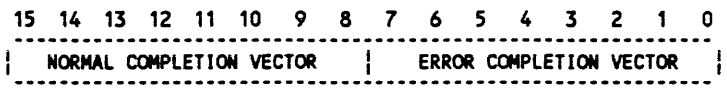


Figure 71. Normal Completion Vector/Error Completion Vector for the Dump Initialization Parameters Command

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).

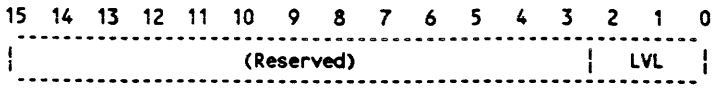


Figure 72. Interrupt Level for the Dump Initialization Parameters Command

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.

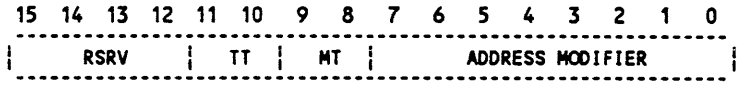


Figure 73. Memory Type/Transfer Type/Address Modifier for the Dump Initialization Parameters Command

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 18. Memory Type (MT) Field for the 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.

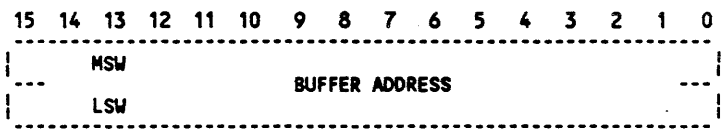


Figure 74. Buffer Address for the Dump Initialization Parameters Block

- Maximum Transfer Length (4 bytes)

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

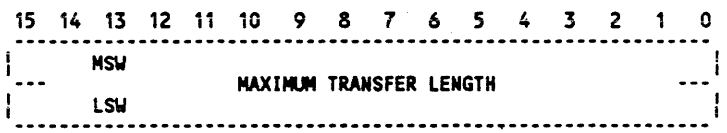


Figure 75. Maximum Transfer Length for the Dump Initialization Parameters Command

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:

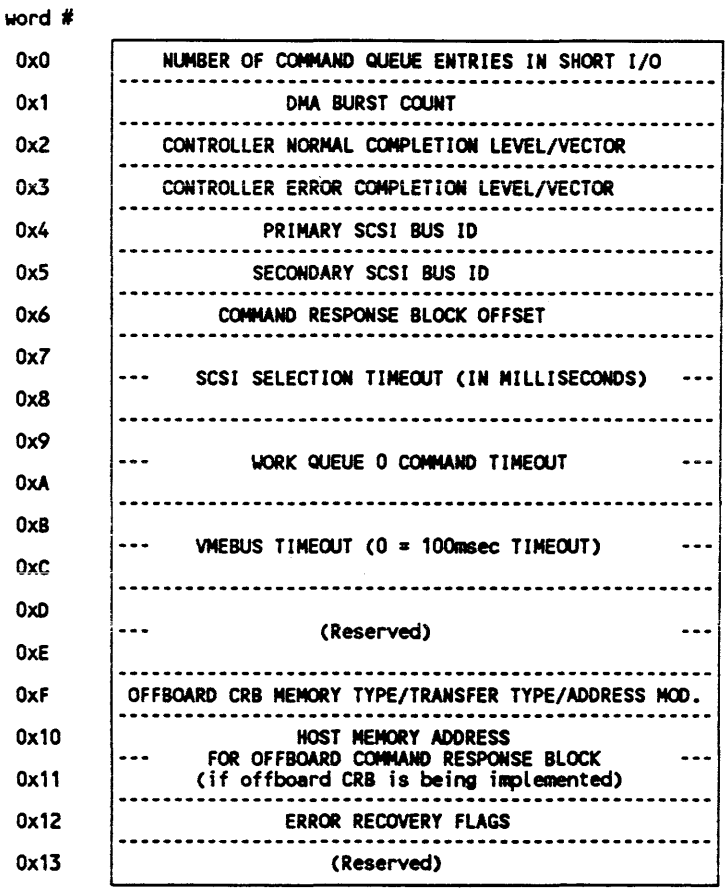


Figure 76. Dump Initialization Parameters Block

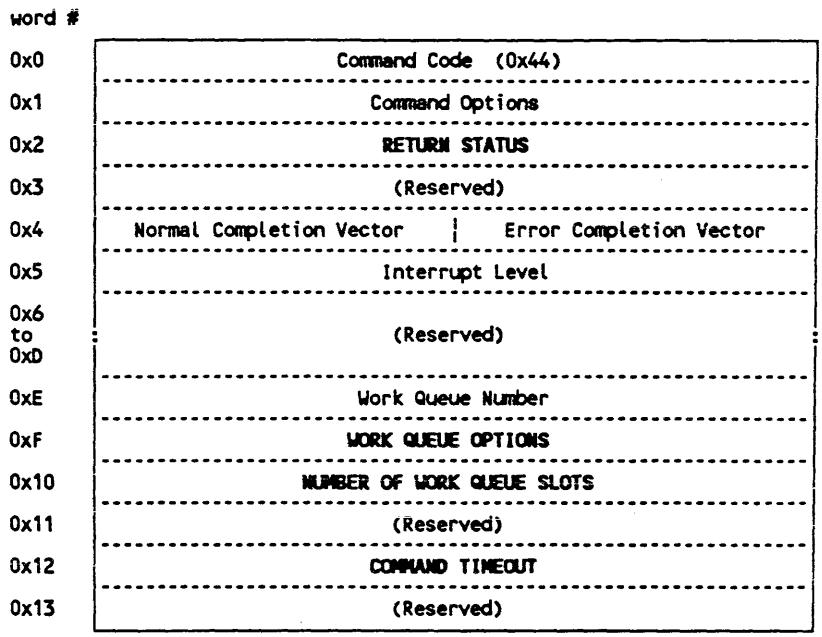
For an explanation of the fields in the Dump Initialization Parameters Block, please refer to the Controller Initialization Block (p. 70).

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:



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 77. 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:

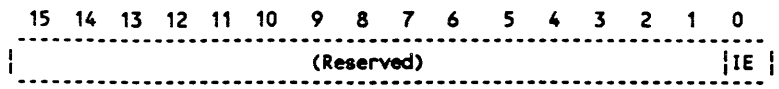


Figure 78. Command Options for the
Dump Work Queue Parameters Command

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.

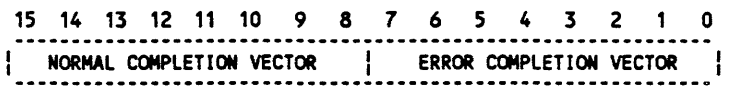


Figure 79. Normal Completion Vector/Error Completion Vector
for the Dump Work Queue Parameters Command

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).

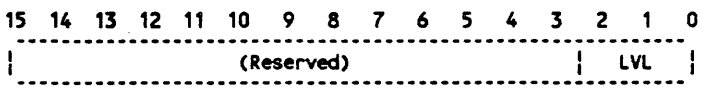


Figure 80. Interrupt Level for the
Dump Work Queue Parameters Command

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 - 0xF (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 #	
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 81. 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:

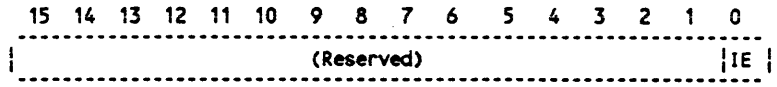


Figure 82. Command Options for the Bus Status Inquiry Command

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.

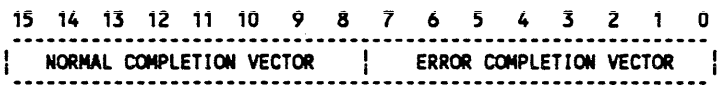


Figure 83. Normal Completion Vector/Error Completion Vector for the Bus Status Inquiry Command

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).

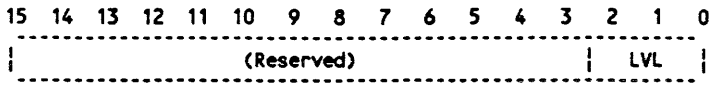


Figure 84. Interrupt Level for the
Bus Status Inquiry Command

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.

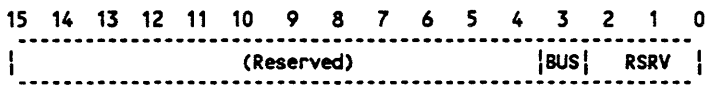


Figure 85. Bus Selection for the
Bus Status Inquiry Command

Bits 0-2 Reserved (RSRV):

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

Bit 3 Bus:

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

Bits 4-15 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**

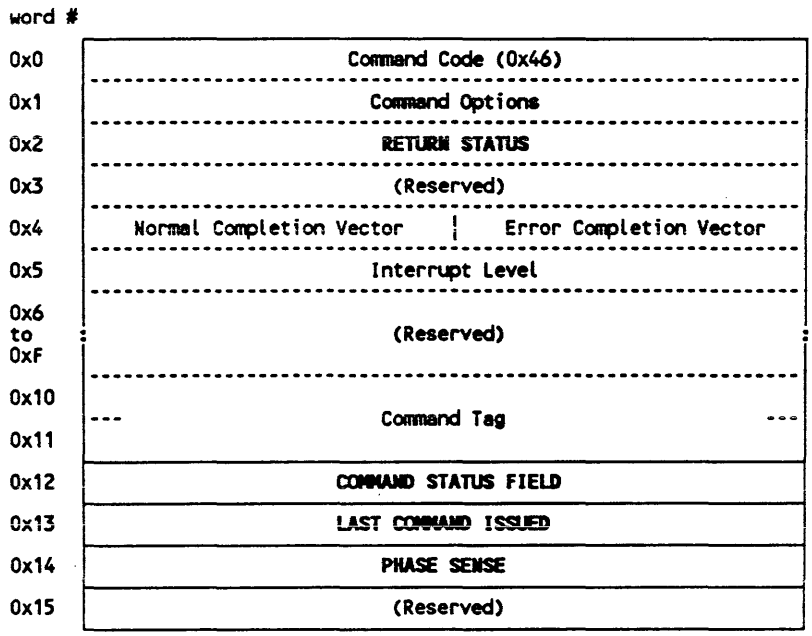
  The Busy Command Tags fields will contain any other currently "in-progress" IOPBs that may not be able to complete due to the "hung" active command. There can be up to seven busy commands per port. (words 0x8 - 0x9, 0xA - 0xB, 0xC - 0xD, 0xE - 0xF, 0x10 - 0x11, 0x12 - 0x13, 0x14 - 0x15). **NOTE:** The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



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 86. 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:

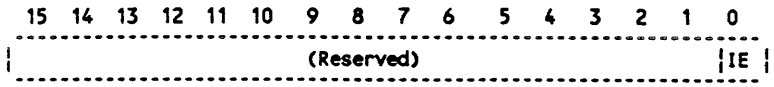


Figure 87. Command Options for the Command Status Inquiry IOPB

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.

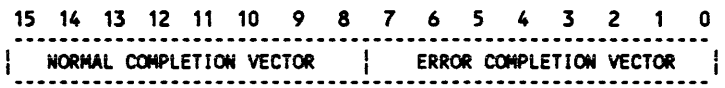


Figure 88. Normal Completion Vector/Error Completion Vector for the Command Status Inquiry IOPB

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).

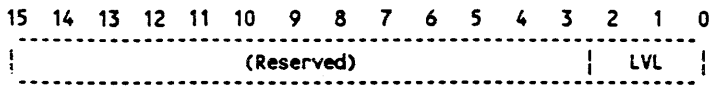


Figure 89. Interrupt Level for the Command Status Inquiry IOPB

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 (3 bytes)**

  The lower byte in word 0x12 contains the returned command status. If the command is active, two additional bytes of information are returned in words 0x13 and 0x14, as shown below:

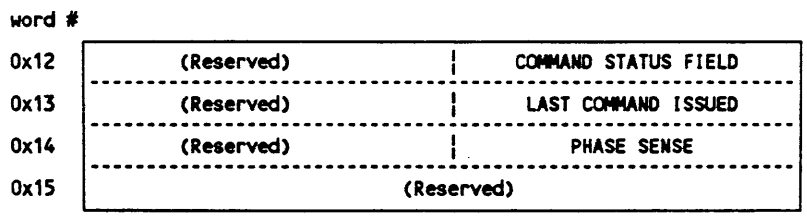


Figure 90. Returned Fields for Command Status Inquiry

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

Table 19. Returned Values for Command Status Field

Code	Explanation
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 Jaguar's 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)

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 20. Returned Values in Last Command Field

Code	Explanation
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

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

Table 21. Returned Values in Phase Sense Field

Code	Explanation
0x07	Request
0x06	Acknowledge
0x05	Attention
0x04	Select
0x03	Busy
0x02	Message
0x01	Command/Data
0x00	Input/Output

CANCEL COMMAND TAG (0x48)

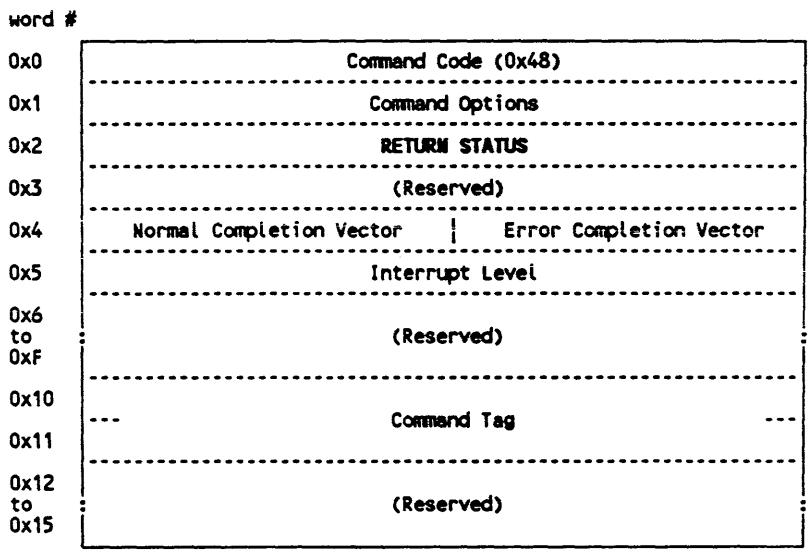
This IOPB cancels the execution of a previously issued IOPB, based on the command tag specified in words 10-11 of the Cancel Command Tag IOPB. Issuing the command causes the Jaguar to find and cancel the *first* command tag that matches the one given in the IOPB. If multiple IOPBs exist with the same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



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 91. 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:

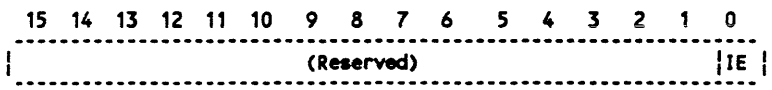


Figure 92. Command Options for the Cancel Command Tag Command

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.

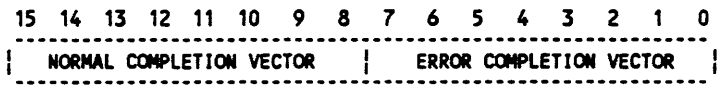


Figure 93. Normal Completion Vector/Error Completion Vector for the Cancel Command Tag Command

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).

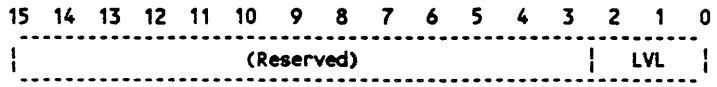


Figure 94. Interrupt Level for the Cancel Command Tag Command

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 cancelled.

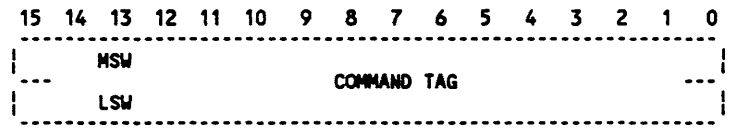


Figure 95. Command Tag Field for the Cancel Command Tag IOPB

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 "In Progress" when the Flush Work Queue command was executed.

If any of the flushed commands are "In Progress", 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 #	
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 96. 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:

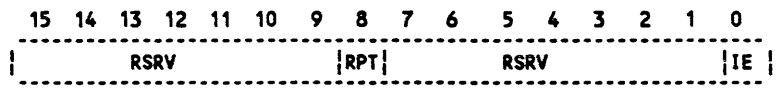


Figure 97. Command Options for the Flush Work Queue Command

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.

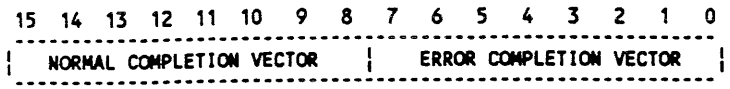


Figure 98. Normal Completion Vector/Error Completion Vector for the Flush Work Queue Command

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).

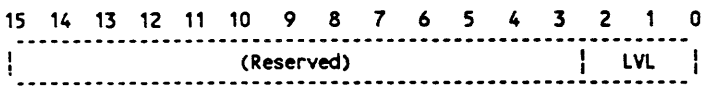


Figure 99. Interrupt Level for the Flush Work Queue Command

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)

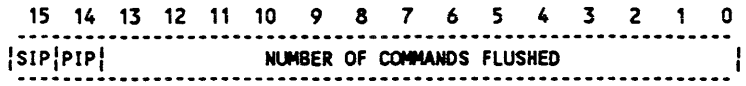


Figure 100. Number of Commands Flushed/In Progress

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).

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

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 #	
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 101. 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:

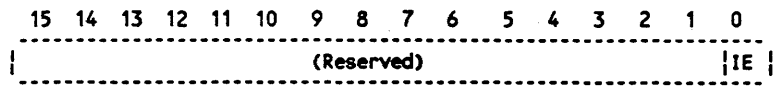


Figure 102. Command Options for the Initialize Printer Port Command

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.

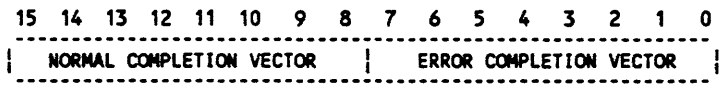


Figure 103. Normal Completion Vector/Error Completion Vector for the Initialize Printer Port Command

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).

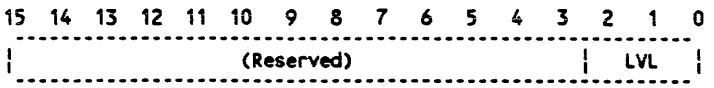


Figure 104. Interrupt Level for the Initialize Printer Port Command

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:

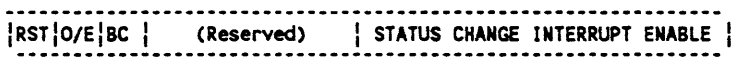


Figure 105. Printer Options Field for the Initialize Printer Port Command

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 22. 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 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.

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 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 15 to issue a Buffer Clear/Print Init instruction, the host must issue another Initialize Printer Port command with Bit 15 cleared to return to normal printer operations.

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.

The format of the IOPB is as follows:

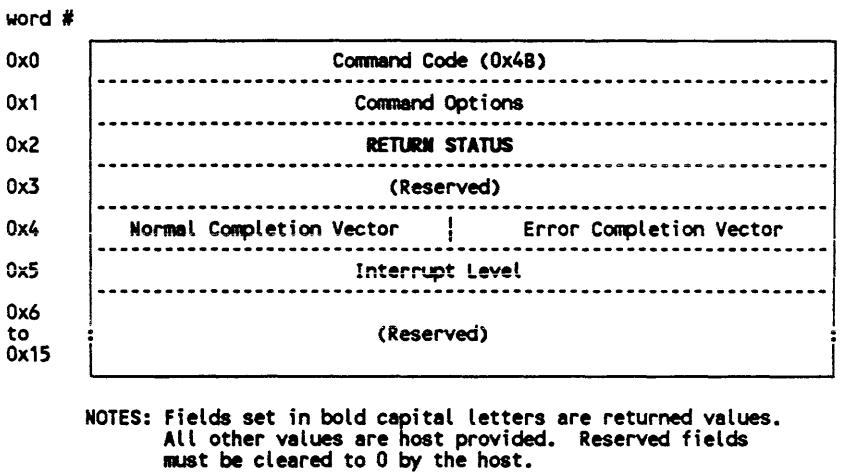


Figure 106. Restart Controller IOPB

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:

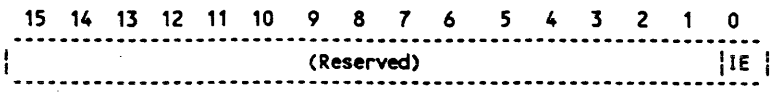


Figure 107. Command Options for the Restart Controller Command

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.

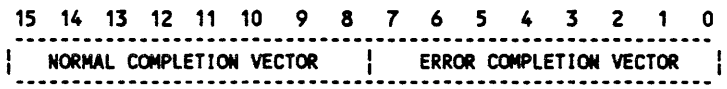


Figure 108. Normal Completion Vector/Error Completion Vector for the Restart Controller Command

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).

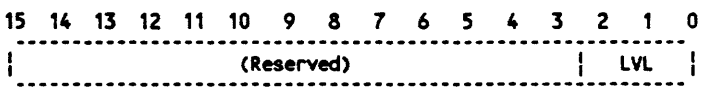


Figure 109. Interrupt Level for the Restart Controller Command

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:

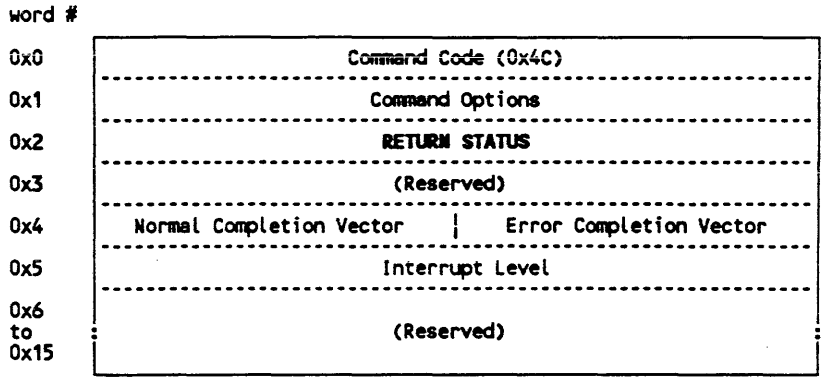
- **Return Status (2 bytes)**

  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:



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 110. 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:

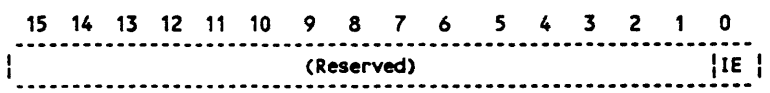


Figure 111. Command Options for the Device Reinitialize Command

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.

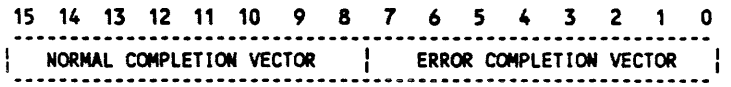


Figure 112. Normal Completion Vector/Error Completion Vector for the Device Reinitialize Command

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).

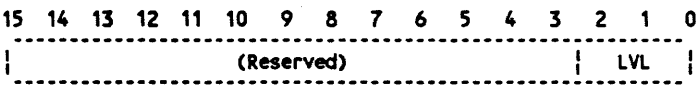


Figure 113. Interrupt Level for the Device Reinitialize Command

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 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.

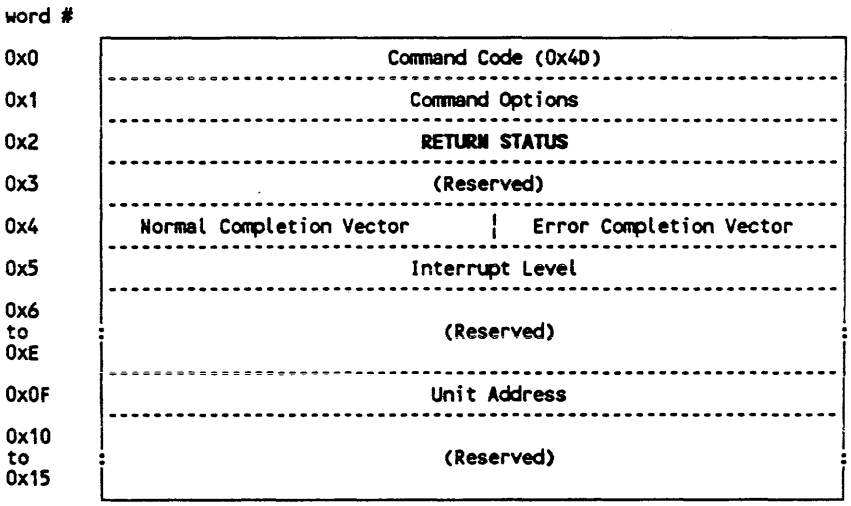
ISSUE BUS DEVICE RESET MESSAGE (0x4D)

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.

The format of the IOPB is as follows:



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 114. 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:

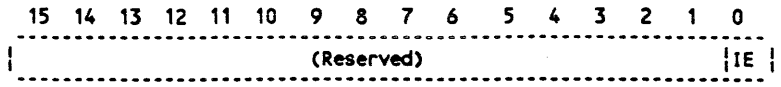


Figure 115. Command Options for the
Issue Bus Device Reset Message Command

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.

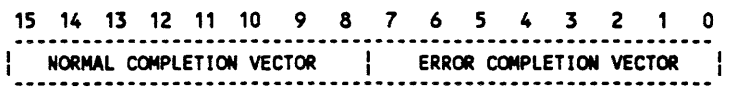


Figure 116. Normal Completion Vector/Error Completion Vector
for the Issue Bus Device Reset Message Command

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).

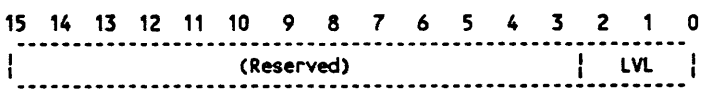


Figure 117. Interrupt Level for the
Issue Bus Device Reset Message Command

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.

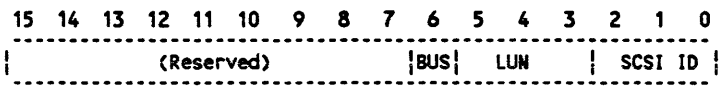


Figure 118. Unit Address for the Issue Bus Device Reset Message

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.

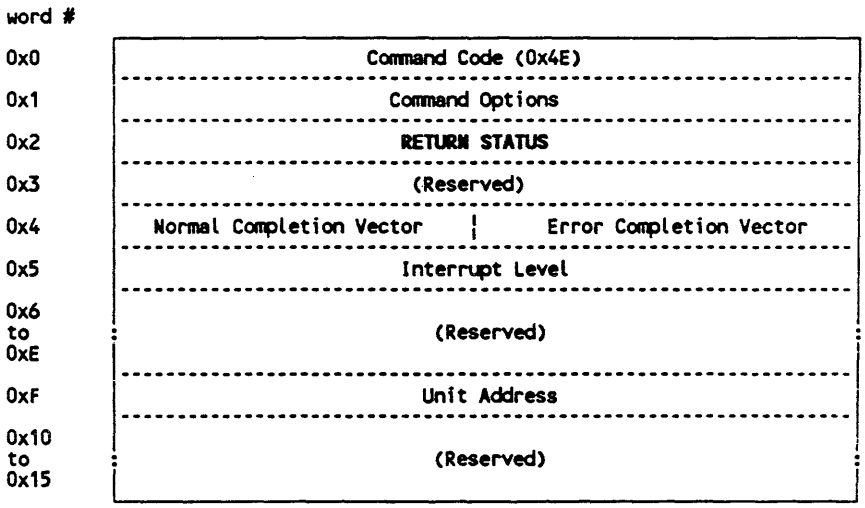
ISSUE ABORT MESSAGE (0x4E)

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:



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 119. 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:

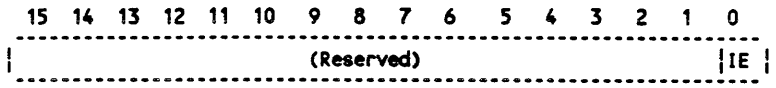


Figure 120. Command Options for the Issue Abort Message Command

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.

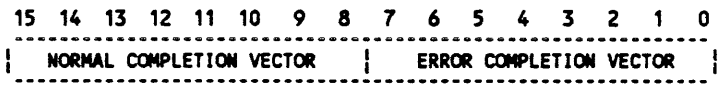


Figure 121. Normal Completion Vector/Error Completion Vector for the Issue Abort Message Command

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).

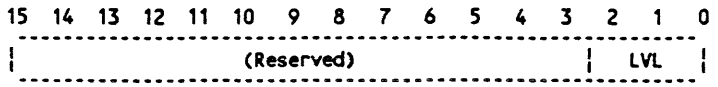


Figure 122. Interrupt Level for the
Issue Abort Message Command

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.

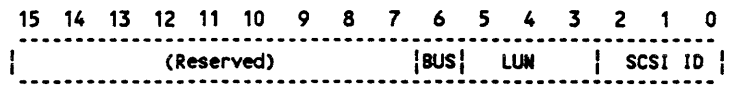


Figure 123. Unit Address for the
Issue Bus Device Reset Message IOPB

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.

6
APPLICATION NOTES

This chapter contains application notes on the following topics:

- Error recovery tools
- Scatter/gather operations
- Printer port operation
- Offboard IOPBs

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.

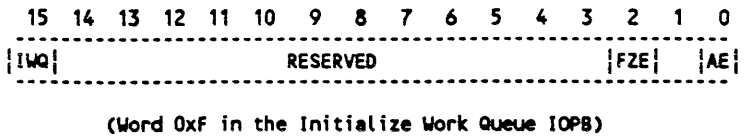


Figure 124. Freeze Work Queue Option

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:

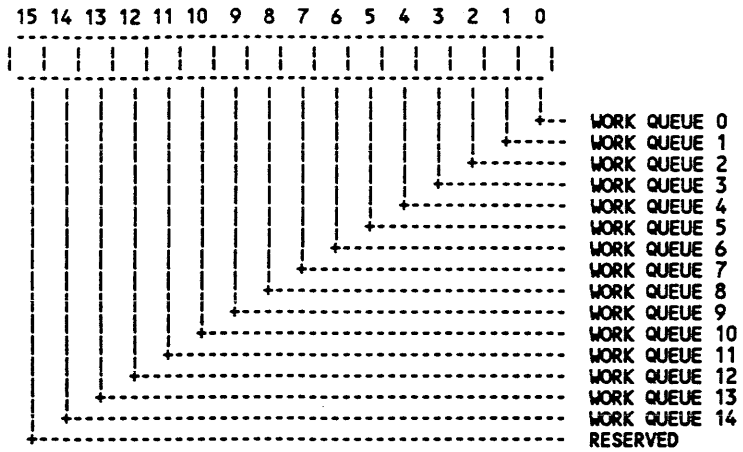


Figure 125. Frozen Work Queues Register

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 the register to acknowledge the thawing of the work queue. The Thaw Work Queue Status Register is defined as follows:

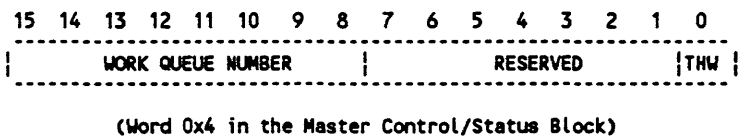


Figure 126. Thaw Work Queue Register

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. That is, a given work queue cannot be both frozen *and* aborted in the event of an error.

The register is depicted below:

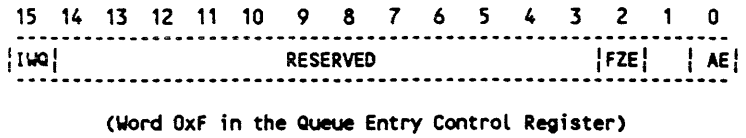


Figure 127. Abort Work Queue on Error Option

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:

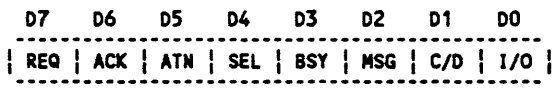


Figure 128. SCSI Bus Status Byte

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 a complete description of the signals, please refer to the SCSI specification or the Fujitsu 87030 phase sense register user's guide.

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 prevents 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 - 15 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 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 70).

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 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

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.

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 #	
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 129. 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 23. 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

IOPB Type Error (0xC0). 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. 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, Command Queue entry 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 Command Queue entry 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 Command Queue entry 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 Command Queue entry 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:

1. 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.

2. 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).

3. 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.

4. 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 in system memory to be written to non-contiguous areas ("scatter"), or moved from non-contiguous blocks of 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.

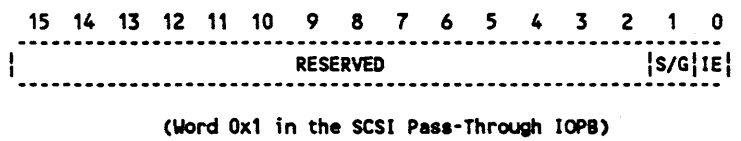


Figure 130. Command Options Word in the SCSI Pass-Through IOPB

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/Gather List Linking", below.

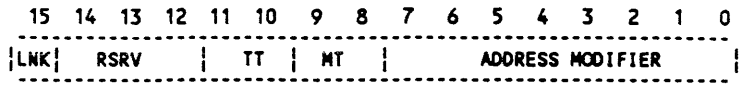


Figure 131. Memory Type/Transfer Type/Address Modifier Field for Scatter/Gather Operations

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.

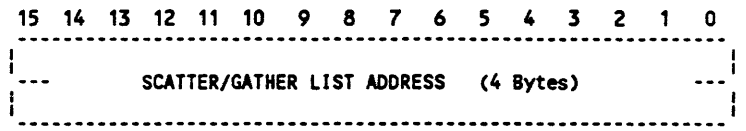


Figure 132. Scatter/Gather List Address

Words 0xA - 0xB contain the number of elements in the scatter/gather list. Valid entries in this field are 1 to 64 (decimal).

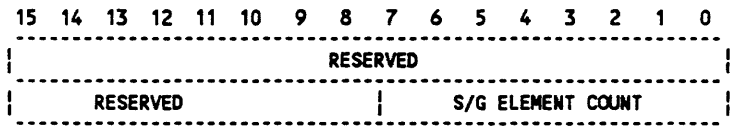


Figure 133. Scatter/Gather Element Count

Words 0xC - 0xD of the IOPB specify the sum of the individual element entry counts.

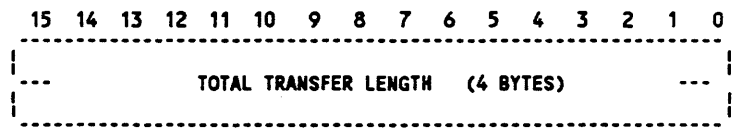


Figure 134. Total Transfer Length for Scatter/Gather Operations

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:

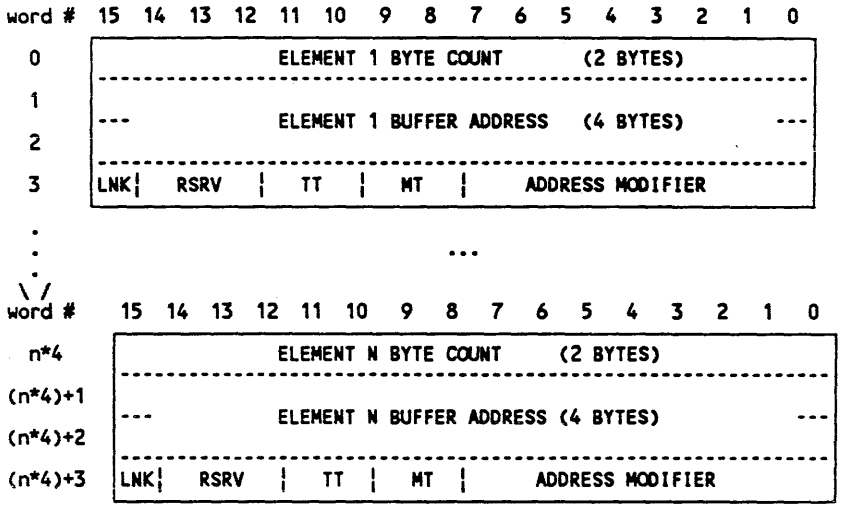


Figure 135. Scatter/Gather Element List Format

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:

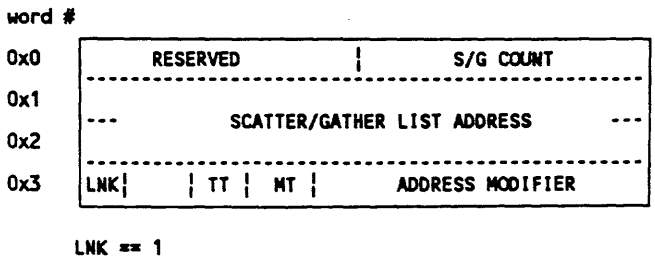


Figure 136. Link Element Structure

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.

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 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 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 Port IOPBs 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 and transferred to the host. 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.

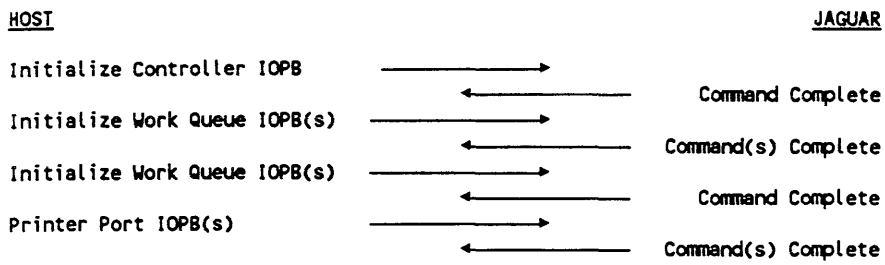


Figure 14. Example of Printer Port Operation

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:

1) 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.

2) 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.

3) 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 Bit (FOB) 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 the FOB bit 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 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:

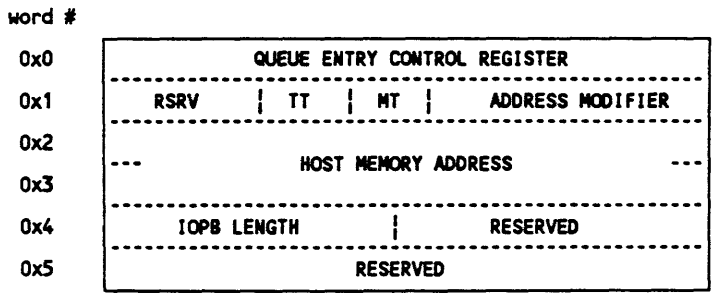


Figure 138. Format of Offboard Command Queue Entry

Note the following important restrictions when building offboard Command Queue entries/IOPBs:

1) 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).

2) 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 Command 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.

Initiating 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 (p. 35) and Controller Initialization Block (p. 70) 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.

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 SPECIFICATION

Peripheral Data Rate	Up to 4Mbytes/sec synchronous Up to 1.5Mbytes/sec asynchronous

POWER REQUIREMENTS (Single-ended drivers)

V/SCSI 4210 Jaguar	4.67 A typical @ +5V DC (+/- 5%) 6.85 A maximum @ +5V DC (+/- 5%)
V/SCSI 4210-DC Option SCSI port	0.75 A typical @ +5V DC (+/- 5%) 1.25 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 one 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 (p. 8 or 9).

DIAGNOSTIC LEDs

The Jaguar has four LEDs behind the panel that may provide useful diagnostic information. To locate the LEDs, refer to either Jaguar board layout (page 8 or 9). The placement and use of the LEDs are identical for both board layouts.

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:

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	IO+	48	IO-
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.

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.

0x0A PRIORITY ERROR:

The priority specified for the work queue is invalid.

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 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.
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 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.

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_WQO_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;
```