EXC-4000PCI[e] Family

Test and Simulation Carrier Boards for PCI Systems

EXC-4000PCIe
EXC-4000PCIe64
EXC-4000PCI

EXC-4000cPCI
EXC-4000cPCI6U

User's Manual

EXCALIBUR SYSTEMS

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1 Introduction

This user's manual is for the *EXC-4000PCI[e]* family of carrier boards. For a list of available boards, see **Chapter 4 Ordering Information**. For mechanical and electrical differences between the various boards, see **Chapter 3 Mechanical and Electrical Specifications**.

Note: The *EXC-4000PCIe and EXC-4000PCIe64* boards will not work without the power cable connected. See 1.2.1 Installing the Board on page 1-5.

1.1 Overview

The *EXC-4000PCI[e]* family boards are multiprotocol PCI and PCIe interface board for avionics test and simulation applications. Each board holds up to four independent modules[1] where each module can be any one of the following types:

M4K1553P*x*	MIL-STD-1553 interface module. This module operates as a Bus Controller, up to 32 Remote Terminals and as a Bus Monitor. Supports an Internal Concurrent Monitor in RT and BC/RT modes.
M4K1553P*x*-1760	Same as M4K1553Px plus MIL-STD-1760 options.
M4KH009	H009 interface module. This double size module supports a fully functional H009 channel (CCC, multi-PU,MON) and a concurrent Bus Monitor.
M4KMMSI	Mini Munitions Store Interface module. This module supports RT, BC/ Concurrent-RT/ Concurrent Monitor and Bus Monitor modes. Up to 8 hub ports EBR-1553 (10 Mbps MIL-STD-1553 protocol using RS-485 transceivers) and 1 monitor output.
M4K429RT*x*	ARINC 429 multi-channel interface module. This module supports either five or ten ARINC 429 channels each of which can be configured in real time as a receive or transmit channel.
M4K708	ARINC 708 interface module. This module supports up to two ARINC 708/ 453 channels for the Weather Radar Display Databus. Each channel is selectable as transmit or receive and implements a 64K-word FIFO and supports polling and/or interrupt driven operation.
M4K717[1]	ARINC 717 interface module. This module supports two ARINC 717 receive channels and two transmit channels.
M4KSerialPlus	Serial communications interface module. This module supports either two or four independent channels of serial communications, each of which can be selected as RS485, RS422 or RS232.
M4KDiscrete	Discrete I/O interface module. This module supports 20 bi-directional discretes with TTL (0 to 5 volts) or avionics (0 to 32 volts) voltage levels.
M4KCAN	CAN protocol interface module. This module supports either two, four or six independent channels of CAN 2.0B protocol with standard and extended message frames and message identifiers.
M4K825CAN[1]	ARINC 825 interface module. The module supports up to ten ARINC 825 channels.
M4KETH[2]	Ethernet interface module. The module supports 10Mhz, 100Mhz and 1Ghz full duplex UDP/IP Ethernet.

1. Only works with newer carrier boards. For more details, see the module's user's manual.
2. Only works with *EXC-4000PCIe64*, in module locations 0 and 3.

Excalibur will be adding modules to those listed above, increasing the boards' flexibility even further.

Users may choose to populate the board with different types of modules or with multiple modules of the same type. For example, populating the board with four M4K429RT10 modules will give you *forty* programmable channels.

All modules come with Windows drivers, including source code, a mating connector with four terminal sticks and a plastic hood.

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1. The only exception is the double-size *M4KH009* module which occupies two module slots.

Excalibur also produces standard adapter cables for each module which can be ordered separately.

1.1.1 Board Features

General Specifications

Supports up to 4 modules

Protocols supported:	ARINC-429/575 (5 or 10 channels per module)
	ARINC 708/453
	MIL-STD-1553 (Px and MCH compatible)
	MIL-STD-1760
	Discrete I/O
	Serial - RS485/RS422/RS232
	H009
	CAN
	MMSI
Timer:	16-bit count down timer
Resolution:	1 μs min, 65536 μs max
Output:	Interrupt, Global reset

Operating Environment

Temperature:	0° - 70°C standard temp.
	-40°– +85°C extended temp. (optional)
Humidity:	5% – 90% non-condensing

	PCI Board	PCIe[64] Board	cPCI Board	cPCI6U Board
MTBF (at 25°C, G_F, S217F):	201,400 hours	188,540 hours	197,200 hours	197,200 hours

Physical Characteristics

	PCI Board	PCIe[64] Board	cPCI Board	cPCI6U Board
Dimension:	174x106.7 mm	188x106.7 mm	160x100 mm	160x233 mm
Weight (without modules):	135g	136g	165g	280g

System Requirements

Operating system:	64-bit Windows
CPU:	Intel® Core™ i3 Processors or equivalent (recommended)
RAM:	8 GB (recommended)

Host Interface

PCI compliance:	Target 8/16 bit
PCI Express compliance:	x1 lane PCIe v1.1 with incorporated DMA data transfer

Memory space occupied when all module are installed:

PCIe64 Board	All Other Boards
256 MB	512 KB

Interrupts: INTA#

IRIG B Time Code Input

Carrier wave:	1 KHz Amplitude modulated sine wave
Rate Designation:	100 peaks per second
Modulation ratio:	3:1
Input Amplitude:	0.8 Vpp min, 3.5 Vpp max, 3 Vpp Typ
Coded Expressions supported:	BCD Time-of-Year code word, Control functions, straight binary seconds time-of-day (seconds-of-day)
Application:	Synchronization of Time Tags, display and IRIG B time

Software Support

C Drivers with source code
Mystic Windows software for 429 modules
MerlinPlus Windows software for Px modules
Merlin Windows software for MCH modules
Exalt and *ExaltPlus* [Optional - contact your Excalibur representative for details

1.1.2 Block Diagram

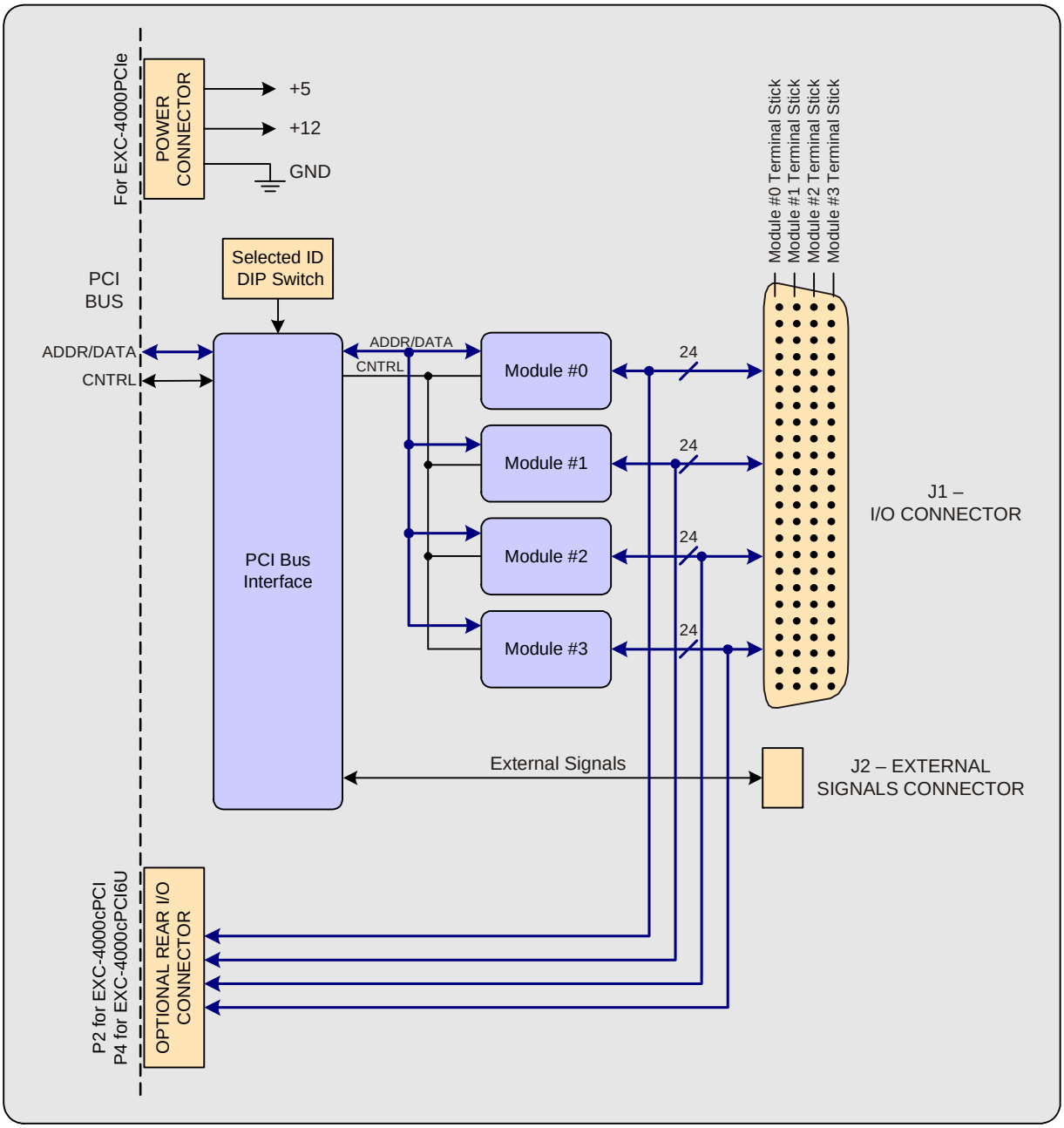

Figure 1-1 Block Diagram

1.2 Installation

To operate the board:

1. Install the board in the computer.
2. Add Excalibur Software Tools to the hard disk.

1.2.1 Installing the Board

Installation of the board is similar to that of all PCI "Local Bus" boards. The board complies with the "Plug and Play" specification of the PCI standard. As such, its absolute address is determined by the BIOS at start-up.

Warning: Make sure you are grounded for electrostatic discharge when handling the Excalibur board, and use all antistatic precautions.

To install the board:

1. Make certain the computer's power source is disconnected.
2. For PCI Express, you must connect one of the computer's power cables to the board. For more information, see **3.5.1 SATA Connector [J3] for *EXC-4000PCIe[64]* Boards (for Power Only)** on page 3-11.
3. Insert the board into a compatible slot (PCI, cPCI or PCI Express).
4. For *EXC-4000PCIe*, *EXC-4000PCIe64* and *EXC-4000PCI*, tighten the board's PCI bracket with the slot screw, to ground the board to the computer.
5. Attach the adapter cable to the board and to the communication bus. The cable may be connected to and disconnected from the board while power to the computer is turned on, but not while the board is transmitting over the bus.

   A **Found New Hardware** message appears.
6. Follow the on-screen instructions for your specific operating system and service pack.

Note: The *EXC-4000PCIe and EXC-4000PCIe64* boards will not work without the power cable connected.

1.2.2 Adding Excalibur Software Tools

The standard software included with the board is for Windows operating systems. Software compatible with other operating systems is available and can be downloaded from our website: www.mil-1553.com

For information about adding the accompanying software drivers, see the **`readme.pdf`** file on the *Excalibur Installation CD*.

1.3 Technical Support

Excalibur Systems is ready to assist you with any technical questions you may have. For technical support, visit the Technical Support page of our website (www.mil-1553.com). You can also contact us by phone. To find the location nearest you, visit to the Contact Us page of our website. Before contacting Technical Support, please see Information Required for Technical Support.

2 PCI Architecture

Chapter 2 describes the PCI architecture. The following topics are covered:

2.1 Memory Structure

The *EXC-4000PCI* requests two memory blocks:

- The first memory block (Base 0) is 512 KB in size and contains the memory space for the modules on the carrier board. For more information, see **2.9 Module Memory Space Map** on page 2-25.
- The second memory block (Base 1) is 128 bytes in size (in hardware revision 2.9 or later; 64 bytes in revision 2.8 or earlier) and contains the Global Registers. For more information, see **2.5 Board Global Registers Map** on page 2-12.

The *EXC-4000PCIe[64]* requests two memory blocks:

- The first memory block (Base 0) is 512 KB in size (256 MB for *PCIe64*) and contains the memory space for the modules on the board. For more information, see **2.9 Module Memory Space Map** on page 2-25.
- The second memory block (Base 2) is 16 KB in size and contains the Global and DMA registers. For more information, see **2.5 Board Global Registers Map** on page 2-12 and **2.8 DMA Registers for PCI Express** on page 2-21.

2.2 PCI Configuration Space Header

The board includes a PCI Configuration Space Header, as required by the PCI specification. The registers contained in this header enable software to set up the Plug and Play operation of the board, and set aside system resources.

The following figures show the PCI and PCIe Configuration Space Header:

MAX_LAT	MIN_GNT	Interrupt Pin	Interrupt Line	3C H
Reserved = 0s				38 H
Reserved = 0s			Cap. pointer	34 H
Expansion ROM Base Address (not used)				30 H
Subsystem ID		Subsystem Vendor ID		2C H
Cardbus CIS Pointer (not used)				28 H
Base Address Register #5 (not used)				24 H
Base Address Register #4 (not used)				20 H
Base Address Register #3 (not used)				1C H
Base Address Register #2 (not used)				18 H
Base Address Register #1 – Global Registers				14 H
Base Address Register #0 Module Memory Space				10 H
BIST	Header Type = 0	Latency Timer	Cache Line Size	0C H
Class Code			Rev ID	08 H
Status Register		Command Register		04 H
Device ID		Vendor ID		00 H
31 24	**23 16**	**15 08**	**07 00**	

Figure 2-1 PCI Configuration Space Header

MAX_LAT	MIN_GNT	Interrupt Pin	Interrupt Line	3C H
Reserved = 0s				38 H
Reserved = 0s			Cap. pointer	34 H
Expansion ROM Base Address (not used)				30 H
Subsystem ID		Subsystem Vendor ID		2C H
Cardbus CIS Pointer (not used)				28 H
Base Address Register #5 (not used)				24 H
Base Address Register #4 (not used)				20 H
Base Address Register #3 (not used)				1C H
Base Address Register #2 – Global and DMA Registers				18 H
Base Address Register #1 (not used)				14 H
Base Address Register #0 – Module Memory Space				10 H
BIST	Header Type = 0	Latency Timer	Cache Line Size	0C H
Class Code			Rev ID	08 H
Status Register		Command Register		04 H
Device ID		Vendor ID		00 H
31 24	**23 16**	**15 08**	**07 00**	

Figure 2-2 PCI Express Configuration Space Header

2.3 PCI Configuration Registers

2.3.1 Vendor Identification Register (VID) Address: 00–01 (H)

Power-up value 1405 H

Size: 16 bits

The Vendor Identification register contains the PCI Special Interest Group vendor identification number assigned to Excalibur Systems.

2.3.2 Device Identification Register (DID) Address: 02–03 (H)

Power-up value:
PCIe Board: E400 H
PCIe64 Board: E464 H
PCI Board: 4000 H
cPCI Board: 4001 H

Size: 16 bits

The Device Identification register contains the board's device identification number.

2.3.3 PCI Command Register (PCICMD) Address: 04–05 (H)

Power-up value: 0000 H

Size: 16 bits

The PCI Command register contains the PCI Command.

Bit	Bit Name	Description
10-15	**Reserved**	Set to 0s
09	**Fast Back-to Back Enable**	Always set to 0
08	**System Error Enable**	Always set to 0
07	**Address Stepping Support**	**For PCI Board:** Always set to 1 **For PCIe Board:** Always set to 0
06	**Parity Error Enable**	Always set to 0
05	**VGA Palette Snoop Enable**	Always set to 0
04	**Memory Write and Invalidate Enable**	Always set to 0
03	**Special Cycle Enable**	Always set to 0
02	**Bus Master Enable**	**For PCI Board:** Always set to 0 **For PCIe Board:** Always set to 1
01	**Memory Access Enable**	Always set to 1
00	**I/O Access Enable**	Since the board does not use I/O space, the value of this register is ignored.

Table 2-1 PCI Command Register

2.3.4 PCI Status Register (PCISTS) Address: 06–07 (H)

Power-up value: 0080 H

Size: 16 bits

The PCI Status register contains the PCI status information.

Bit	Bit Name	Description
15	**Detected Parity Error**	This bit is set whenever a parity error is detected. It functions independently from the state of Command Register Bit 6. This bit may be cleared by writing a 1 to this location.
14	**Signaled System Error**	Not used
13	**Received Master Abort**	Not used
12	**Received Target Abort**	Not used
11	**Signaled Target Abort**	This bit is set whenever this device aborts a cycle when addressed as a target. This bit can be reset by writing a 1 to this location.
09-10	**Device Select (DEVSEL#) Timing Status**	Set to 10 (slow timing)
08	**Data Parity Reported**	Not used
07	**Fast Back-to-Back Capable**	Set to 1
06	**Reserved**	
05	**66MHz capable**	Set to 0
04	**Capability List enable**	Set to 1
00-03	**Reserved**	

Table 2-2 PCI Status Register for PCI Boards

Bit	Bit Name	Description
15	Detected Parity Error	This bit is set whenever a parity error is detected. It functions independently from the state of Command Register Bit 6. This bit may be cleared by writing a 1 to this location.
14	Signaled System Error	Not used
13	Received Master Abort	This bit is set when the device receives a master abort to terminate a transaction. This bit can be reset by writing a 1 to this location.
12	Received Target Abort	Not used
11	Signaled Target Abort	Not used
09-10	Device Select (DEVSEL#) Timing Status	Set to 00 (fast timing)
08	Data Parity Reported	Not used
07	Fast Back-to-Back Capable	Set to 0
06	UDF Supported	Set to 0
05	66MHz capable	Set to 0
04	Capability List enable	Set to 1
03	Interrupt Status	This bit is set when an interrupt is received.
00-02	Reserved	

Table 2-3 PCI Status Register for PCIe Boards

2.3.5 Revision Identification Register (RID) Address: 08 (H)

Power-up value: 01 H

Size: 8 bits

The Revision Identification register contains the revision identification number of the board.

2.3.6 Class Code Register (CLCD) Address: 09–-0B (H)

Power-up value: FF0000 H

Size: 24 bits

The Class code Register value indicates that the board does not fit into any of the defined class codes.

2.3.7 Cache Line Register Size Register (CALN) — Address: 0C (H)

Power-up value: **PCI Board:** 00 H
PCIe Board: 10 H

Size: 8 bits

Not used

2.3.8 Latency Timer Register (LAT) — Address: 0D (H)

Power-up value: 00 H

Size: 8 bits

Not used

2.3.9 Header Type Register (HDR) — Address: 0E (H)

Power-up value: 00 H

Size: 8 bits

The board is a single function PCI device.

2.3.10 Built-In Self-Test Register (BIST) — Address: 0F (H)

Power-up value: 00 H

Size: 8 bits

The Built-In Self-Test register is not implemented in the board.

2.3.11 Base Address Registers (BADR)

Address: 10, 14, 18, 1C, 20, 24 (H)

Power-up value: 00000000 H for each

Size: 32 bits

The Base Address Registers are used by the system BIOS to determine the number, size and base addresses of memory pages required by the board, within host address space.

For PCI Board: Two memory pages are required by the board: one for the module memory space and one for the Global Registers.

Register	Offset	Size	Function
Base Address 0	10 H	512 K Byte	Module memory space
Base Address 1	14 H	64 Byte	Global registers

Table 2-4 Base Address Registers Definition for PCI Board

For PCIe Board: Three memory pages are required by the board: one for the module memory space, one for the Global Registers and one for the DMA registers.

Register	Offset	Size	Function
Base Address 0	10 H	512 KB 256 MB for PCIe64	Module memory space
Base Address 2	18 H	16 KB	Global and DMA registers

Table 2-5 Base Address Registers Definition for PCIe Board

Note: Each Base Address Register contains 32 bits. Since the PCI Express board uses 64-bit address space, each memory page covers two base addresses (0 – 1, 2 – 3, 4 – 5).

The following tables describe the bits of the Base Address Register.

Bit	Description
04-31	Address of memory region (with lower 4 bits removed)
03	Always 0 – memory is not prefetchable
01-02	Always 0 – memory may be mapped anywhere within the 32 bit memory space
00	Always 0 – indicates memory space

Table 2-6 Base Address Register for PCI Board

Bit	Description
04-31	Address of memory region (with lower 4 bits removed)
03	Always 1 – memory is prefetchable
01-02	Always 2 – memory may be mapped anywhere within the 64 bit memory space
00	Always 0 – indicates memory space

Table 2-7 Base Address Register for PCIe Board

2.3.12 Cardbus CIS Pointer

Address: 28 (H)

Power-up value: 00000000 H

Size: 32 bits

The Cardbus Pointer is not implemented on the board.

2.3.13 Subsystem ID

Address: 2C (H)

Power-up value: 0000 H

Size: 16 bits

2.3.14 Subvendor ID

Address: 2E (H)

Power-up value: 0000 H

Size: 16 bits

2.3.15 Expansion ROM Base Address Register (XROM)

Address: 30 (H)

Power-up value: 00000000 H

Size: 32 bits

The Expansion ROM Space is not implemented on the board.

2.3.16 PCI Capabilities Pointer

Address: 34 (H)

Power-up value: 50 H

Size: 8 bits

The PCI Capabilities Pointer (Cap. Pointer) indicates the location of the PCI Capabilities Identification (ID) Register. The Capabilities ID Register stores a pointer to a structure within the configuration space. With a known Capabilities ID value, the associated structure can be found during the scanning process.

2.3.17 Interrupt Line Register (INTLN) Address: 3C (H)

Power-up value: 00 H

Size: 8 bits

The Interrupt Line register indicates the interrupt routing for the PCI Controller. The value of this register is system-architecture specific. For *x*86-based PCs, the values in this register correspond with the established interrupt numbers associated with the dual 8259 controllers used in those machines; the values of 1 to F (H) correspond with the IRQ numbers 1 through 15, and the values from 10(H) to FE (H) are reserved. The value of 255 signifies either "unknown" or "no connection" for the system interrupt.

2.3.18 Interrupt Pin Register (INTPIN) Address: 3D (H)

Power-up value: 01 H

Size: 8 bits

Set to INTA#

2.3.19 Minimum Grant Register (MINGNT) Address: 3E (H)

Power-up value: 00 H

Size: 8 bits

The Minimum Grant register is not implemented on the board.

2.3.20 Maximum Latency Register (MAXLAT) Address: 3F (H)

Power-up value: 00 H

Size: 8 bits

The Maximum Latency register is not implemented on the board.

2.4 Board Global and DMA Registers Memory Space Map

The Global and DMA Registers are mapped as follows.

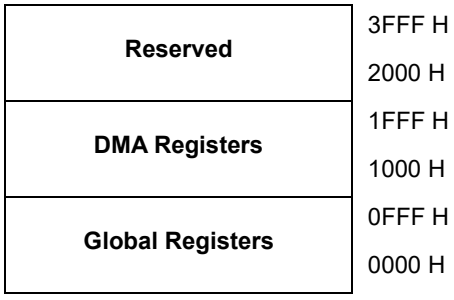

Figure 2-3 Global and DMA Registers Memory Space Map

2.5 Board Global Registers Map

The board global registers reside in the second memory block.

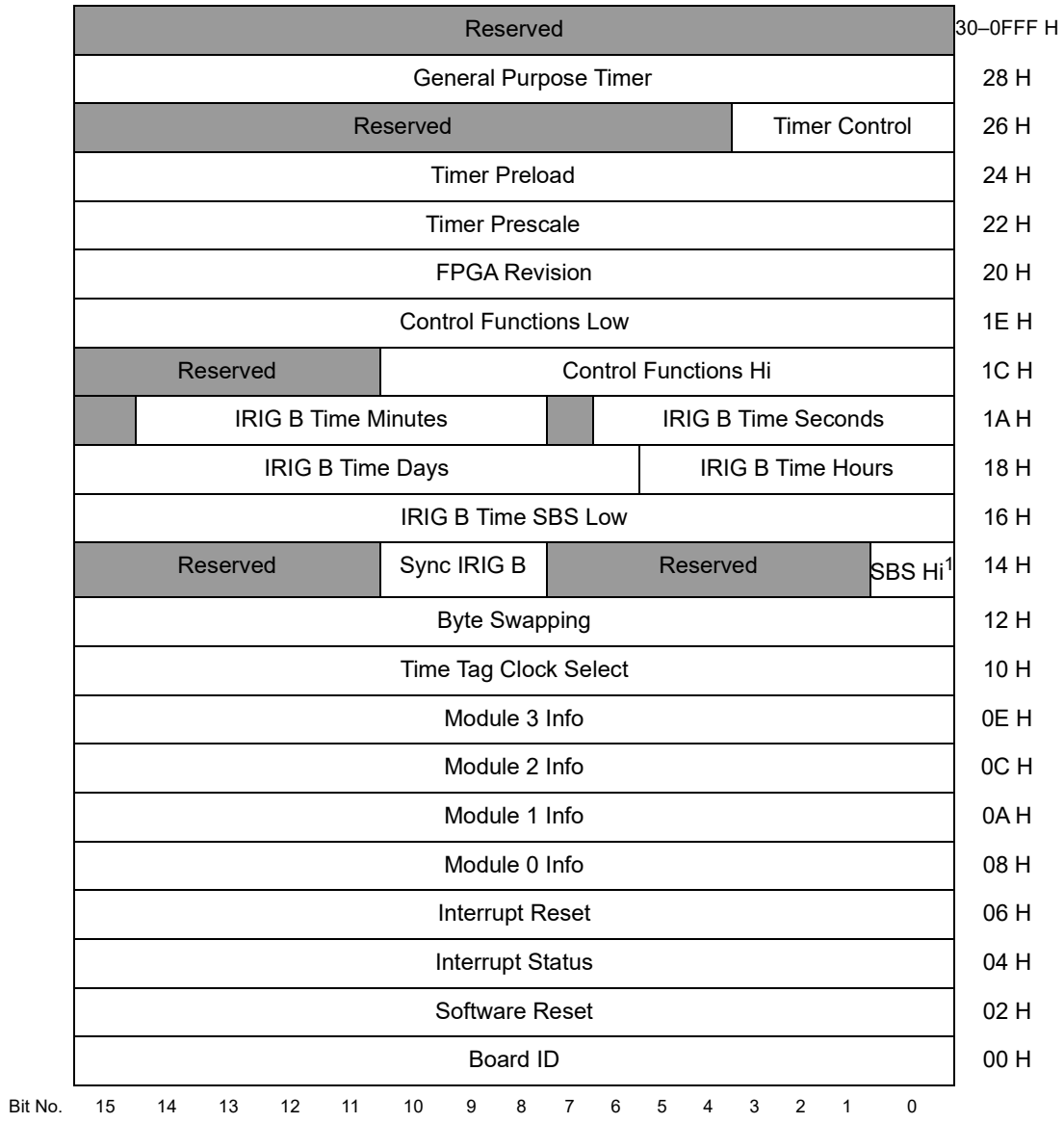

Figure 2-4 *EXC-4000PCI[e]* and *EXC-4000PCIe64* Global and IRIG B Registers Map

1. IRIG B Time SBS Hi Register

2.5.1 Board Identification Register

Address: 00 (H)
Length 16 bits

Read only The Board Identification register comprises the following identification items.

Bit	Description
04-15	**For PCI Board:** Hard coded to the value 400 H **For PCIe Board:** Hard coded to the value 4E0 H
00-03	Selected ID See **3.3.1 Selected ID DIP Switch [SW1]** on page 3-5.

Table 2-8 Board Identification Register

2.5.2 Software Reset Register

Address: 02 (H)
Length 16 bits

Read/Write The Software Reset register performs reset operations of the modules. Individual modules may be reset.

Bit 04, the Global Time Tag reset bit, resets all the module's Time Tag counters.

Bit	Description	
05-15	Reserved – set to 0	
04	Global time tag reset	1 = reset all time tag counters 0 = no effect
03	Module 3 reset	1 = reset module 0 = no effect
02	Module 2 reset	1 = reset module 0 = no effect
01	Module 1 reset	1 = reset module 0 = no effect
00	Module 0 reset	1 = reset module 0 = no effect

Table 2-9 Software Reset Register

2.5.3 Interrupt Status Register

Address: 04 (H)
Length 16 bits

Read only The Interrupt Status register indicates which modules are currently interrupting or if the General Purpose Timer has produced an interrupt.

Bit	Description
05-15	Reserved – set to 0
04	1 = indicates that an interrupt was generated by the General Purpose Timer [See **2.7 Global Timer Registers** on page 2-19]
03	1 = indicates that module 3 is interrupting
02	1 = indicates that module 2 is interrupting
01	1 = indicates that module 1 is interrupting
00	1 = indicates that module 0 is interrupting

Table 2-10 Interrupt Status Register

Note: See also **2.8.7 DMA Interrupt Status Register** on page 2-24.

2.5.4 Interrupt Reset Register

Address: 06 (H)
Length 16 bits

Write only The Interrupt Reset register resets the interrupting modules by writing to the relevant bits of the register.

Bit	Description
05-15	Reserved – set to 0
04	1 = Resets General Purpose Timer interrupt 0 = No effect
03	1 = Resets module 3 interrupt 0 = No effect
02	1 = Resets module 2 interrupt 0 = No effect
01	1 = Resets module 1 interrupt 0 = No effect
00	1 = Resets module 0 interrupt 0 = No effect

Table 2-11 Interrupt Reset Register

Note: See also **2.8.7 DMA Interrupt Status Register** on page 2-24.

2.5.5 Module Info Registers

Address: 08, 0A, 0C, 0E (H)
Length 16 bits each

Read only The Module Info Registers provide identification information for each of the modules.

Bit	Description	
12-15	Module ID	00 H = Module 0 Info register 01 H = Module 1 Info register 02 H = Module 2 Info register 03 H = Module 3 Info register
05-11	Reserved – set to 0	
00-04	Module type	02 H = *M4KSerial* 03 H = *M4K1553MCH* module (not for PCI Express carrier boards) 04 H = *M4K429RTx* module 05 H = *M4K1553Px[-1760]* module 06 H = *M4KMMSI* module 07 H = *M4K708* module 08 H = *M4K825CAN* module 09 H = *M4KH009* module 12 H = *M4KSerialPlus* module 17 H = *M4K717* module 0C H = *M4KCAN* module 0D H = *M4KDiscrete* module 1F H = no module installed

Table 2-12 Module Info Registers

2.5.6 Time Tag Clock Select Register

Address: 10 (H)
Length 16 bits

Read/Write The Time Tag Clock Select Register is used to set either an internal (1 MHz) or external source for the board's Global Time Tag Clock. See **3.5.8 External Signals Connector [J2]** on page 3-38, for details of the External Time Tag Clock.

Bit	Description	
01-15	Reserved – set to 0	
00	Time Tag Clock Select	1 = External Source 0 = Internal Source [**Default**]

Table 2-13 Time Tag Clock Select Register

2.5.7 Byte Swapping

Address: 12 (H)
Length 16 bits

Read/Write The Byte Swapping Register may be used to swap the high byte with the low byte of the module memory space and the global registers on the board. This may be useful on some host computers that byte-swap their memory.

Bit	Description	
00-15	A1A1	Enable byte swapping
	Any other value	Disable byte swapping **(Default)**

Table 2-14 Byte Swapping Register

2.5.8 FPGA Revision Register

Address: 20 (H)
Length 16 bits

Read only The FPGA Revision register contains the FPGA revision of the board.

2.6 IRIG B Global Registers

The *EXC-4000PCI[e]* and *EXC-4000PCIe64* are able to receive and decode standard serial IRIG B time code format signals (1 KHz carrier wave, sine wave - amplitude modulated, 100 peaks per second) via its External Signal Connector J2. See **3.5.8 External Signals Connector [J2]** on page 3-38.

The IRIG B signal, which contains 3 types of words within each Time Code Frame, can be used to synchronize the Time Tags of the modules on the board.

- 1st Word — Time-of-year in binary coded decimal (BCD) notation in hours, minutes and seconds.
- 2nd Word — Set of bits reserved for decoding various control, identification and other special purpose functions.
- 3rd Word — Seconds-of-day weighted in straight binary seconds (SBS) notation

These three words can be stored and displayed in the IRIG B global registers 14 - 1E (H).

See **Figure 2-4 EXC-4000PCI[e] and EXC-4000PCIe64 Global and IRIG B Registers Map** on page 2-12 for the location of the registers on the memory map.

Note: The synchronization of IRIG B time can take up to two seconds. IRIG B functions are meant to be used on an occasional basis, not on a constant basis.

2.6.1 Sync IRIG B Register

Address: 14 (H)
Bits 08 – 10

Read/Write The 3-bit Sync IRIG B register controls the synchronization of a module's Time Tags relative to the IRIG B input signal and the display of the IRIG B time within the IRIG B time registers.

Bit		Description
10	1	Set by board to indicate that the current IRIG B time has been stored in the IRIG B registers
	0	No IRIG B time has been stored in the IRIG B registers. This bit must be reset by the user after the board has written a '1'.
09	1	Stores and displays the IRIG B time and control functions into the 6 IRIG B registers (14-1E [H]) corresponding to the previous valid IRIG B message. If bit 08 is set, then the IRIG B time will be stored at the same time that the Time tags are reset. To calculate the realtime to which the Time tags are synchronized the user will need to **add** '1' to the value of the IRIG B time stored into these registers.
	0	The previous valid IRIG B message should not be stored in the IRIG B registers. This bit will be automatically reset by the board after the storage of the IRIG B time.
08	1	Resets and synchronizes Time Tags of all the modules to the next rising edge of the on-time Reference Point **Pr** of the IRIG B signal. Also sets Bit 09 to a value of '1' in order to store and display the IRIG B time and control functions into the 6 IRIG B registers.
	0	No reset/synchronization of Time tags relative to the **Pr** of the IRIG B signal. This bit will be automatically reset by board after reset of time tags

Table 2-15 Sync IRIGB Register

Note: All bits are read and write.

2.6.2 IRIG B Time SBS High Register

Address: 14 (H)
Bit 0

Read only The IRIG B Time SBS High register contains the MSB of the 17 bit straight binary representation of the seconds-of-day code word within the IRIG B message.

2.6.3 IRIG B Time SBS Low Register

Address: 16 (H)
Bits 15 – 0

Read only The IRIG B Time SBS Low register contains the lower 16 bits of the 17 bit straight binary representation of the seconds-of-day code word within the IRIG B message.

2.6.4 IRIG B Time Days Register

Address: 18 (H)
Bits 15 – 6

Read only The IRIG B Time Days register contains the days value of the BCD time-of-year subword within the IRIG B coded message.

2.6.5 IRIG B Time Hours Register

Address: 18 (H)
Bits 5 – 0

Read only The IRIG B Time Hours register contains the hours value of the BCD time-of-year subword within the IRIG B coded message.

2.6.6 IRIG B Time Minutes Register

Address: 1A (H)
Bits 14 – 8

Read only The IRIG B Time Minutes register contains the minutes value of the BCD time-of-year subword within the IRIG B coded message.

2.6.7 IRIG B Time Seconds Register

Address: 1A (H)
Bits 6 – 0

Read only The IRIG B Time Seconds register contains the seconds value of the BCD time-of-year subword within the IRIG B coded message.

2.6.8 Control Functions Registers

Hi Register **Address:** 1C (H) / Bits 10 – 0
Low Register **Address:** 1E (H) / Bits 15 – 0

Read only The IRIG B time code formats reserve 27 bits known as Control Functions. The Control Functions are for user-defined encoding of various control, identification or other special purpose functions. No standard coding system exists. The control bits may be programmed in any predetermined coding system.

2.6.9 FPGA Revision Register

Address: 20 (H)
Bits 15 – 0

Read only The FPGA Revision register contains the FPGA revision of the board.

2.7 Global Timer Registers

See **Figure 2-4 EXC-4000PCI[e] and EXC-4000PCIe64 Global and IRIG B Registers Map** on page 2-12 for location of the registers on the memory map.

2.7.1 Timer Prescale Register

Address: 22 (H)
Bits 15 – 0

Read/Write The Timer Prescale Register defines the resolution of the General Purpose Timer. It is based on the Global Time Tag Clock (nominally 1 MHz) and thus will give the General Purpose Timer resolution as follows:

Timer Prescale Register Value (DEC)	General Purpose Time Resolution (μsec)
0 or 1	1 (default)
2	2
3	3
•	•
•	•
•	•
10	10
•	•
•	•
•	•
65535	65535

Table 2-16 Timer Prescale/General Purpose Timer Resolution

Note: The Timer Prescale register can only be changed when the timer has been stopped.

2.7.2 Timer Preload Register

Address: 24 (H)
Bits 15 – 0

Read/Write The value stored in the Timer Preload Register sets the starting count value for the General Purpose Timer from which it will start to count down. The Timer Preload Register can only be changed while the timer is stopped and has a maximum count value of 65535.

Note: The General Purpose Timer will not start counting if a value of zero is stored into the Timer Preload Register.

Default value: 00 00

2.7.3 Timer Control Register

Address: 26 (H)
Bits 3 – 0

Read/Write The Timer Control Register is used to control the General Purpose Timer register. The value stored in bits 01 to 03 take effect when the General Purpose timer reaches a value of zero. Bit 00 is used to start and stop the General Purpose

Timer. The values of bits 01 – 03 can only be changed when the General Purpose Timer register is stopped.

Default value: 00 00

Bit	Description		
04-15	Reserved - set to 0		
03	Global reset on count completed	1	Causes global reset of all installed modules
		0	No effect
02	Interrupt on count completed	1	Output an interrupt (see **2.5.3 Interrupt Status Register** on page 2-14)
		0	No effect
01	Reload mode	1	Reload mode
		0	Non-reload/One-shot mode
00	Start/Stop	1	Start
		0	Stop

Table 2-17 Timer Control Register

2.7.4 General Purpose Timer Register

Address: 28 (H)
Bits 15 – 0

Read Only

The General Purpose Timer Register stores the current count value of the General Purpose Timer. The General Purpose Timer is controlled by the Timer Control Register. When the General Purpose Timer is started it will count down to zero, at which point either an interrupt can be generated and or all installed modules can be reset.

If the General Purpose Timer is in reload mode then the current value in Timer Preload Register will be stored into the General Purpose Timer and the timer will start to count down from this value.

If the General Purpose Timer is in non-reload / one shot mode, when it reaches zero it will stop and a value of zero will be displayed in the General Purpose Timer Register. In this case bit 00 (Start/Stop bit) of the Timer Control Register will automatically be set to zero in this case. If the General purpose Timer Register is then started it will start to count from the current Timer Preload Register value automatically (without the need to do a write to the Timer Preload Register).

At any point in time, the General Purpose Timer can be stopped at the current count value. When a start is then issued, the General purpose Timer will start to count down from this current count value. If the user wishes to stop the counter and start from the original preload value or from a new preload value, this value will need to be rewritten into the Timer Preload register prior to the restarting of the General Purpose Timer register.

Note: The maximum clock period of the General Purpose Timer is 4295 seconds (1 hour, 11min & 35 Seconds).

2.8 DMA Registers for PCI Express

Direct Memory Access (DMA) enables the board to access a module's memory space for reading and writing independently of the computer's CPU. This results in faster data transfer to and from the board, with much less CPU overhead than when not using DMA.

There are two DMA channels:

- **DMA0** – DMA channel 0 is used for DMA writes
- **DMA1** – DMA channel 1 is used for DMA reads

Reserved		1046 – 1FFF (H)
Repeat Code Register		1042 H
Base Address for DMA0 and DMA1 Transfers		1040 H
Reserved		1038 H
Reserved (Bits 2 – 31)	DMA Interrupt Status (Bits 0 – 1)	1034 H
Reserved		1030 H
Reserved		1028 H
Reserved		1024 H
Reserved		1020 H
DMA1 Control		101C H
DMA1 Data Transfer Size		1018 H
DMA1 Address of Contiguous Host Memory – High 32 bits		1014 H
DMA1 Address of Contiguous Host Memory – Low 32 bits		1010 H
DMA0 Control		100C H
DMA0 Data Transfer Size		1008 H
DMA0 Address of Contiguous Host Memory – High 32 bits		1004 H
DMA0 Address of Contiguous Host Memory – Low 32 bits		1000 H

2.8.1 DMA0 Address of Contiguous Host Memory (Low and High)

Address: **1000 (H) (Low)**
1004 (H) (High)
Length **64 bits**

The start address of the Contiguous Host Memory must be written to this register by the user. The address stored in this register is automatically incremented during the process of the DMA transfer. The current value in this register is the address following (the address of) the last requested data. Upon successful completion of a transfer, this register contains the following value: Start Address + Write Transfer Size, where Start Address is the start address of the Contiguous Host Memory.

2.8.2 DMA0 Data Transfer Size

Address: 1008 (H)
Length 32 bits

This register contains the total amount of data (in bytes) to be written during a DMA write transfer. The total transfer size must be written to this register by the user. The transfer size value stored in this register is automatically decremented during the process of the DMA transfer. The current value stored indicates the remaining amount of data that needs to be transferred. Upon successful completion of a DMA write transfer, the value of this register should be 0.

2.8.3 DMA0 Control Register

Address: 100C (H)
Length 32 bits

This register contains information about, and controls, the DMA write data transfer.

Bit	Description	
12-13	Reserved – set to 0	
08-11	DMA channel state	These bits describe the state of the DMA write channel. 0000 = (idle state) Last transfer ended successfully 0001 = (idle state) Last transfer was stopped by a module 0010 = (idle state) Last transfer ended because of CPL timeout 0011 = (idle state) Last transfer ended because of CPL UR error 0100 = (idle state) Last transfer ended because of CPL CA error 0101 – 0111 = (idle state) Reserved 1000 = (busy state) The DMA channel is busy processing 1001 = (busy state) Requesting transfer. The DMA channel is in the process of requesting data from the host computer 1010 = (busy state) The DMA channel is waiting for completion of a read data transfer in response to a DMA read request 1011 = (busy state) Waiting for board to provide/accept data. The DMA channel is waiting for completion of a data transfer to or from the internal module memory. 1100 – 1111 = (busy state) Reserved
04-07	Reserved – set to 0	
03	Abort DMA transfer	1 = Abort transfer 0 = no effect
02	Start DMA transfer	1 = Start DMA transfer 0 = no effect
00-01	Reserved – set to 0	

Table 2-18 DMA0 Control Register

2.8.4 DMA1 Address of Contiguous Host Memory

Address: 1010 (H) (Low)
1014 (H) (High)
Length 64 bits

The start address of the Contiguous Host Memory must be written to this register by the user. The address stored in this register is automatically incremented during the process of the DMA transfer. The current value in this register is the address following (the address of) the last requested data.

Upon successful completion of a transfer, this register contains the following value: Start Address + Read Transfer Size, where Start Address is the start address of the Contiguous Host Memory.

2.8.5 DMA1 Data Transfer Size

Address: 1018 (H)
Length 32 bits

This register contains the total amount of data (in bytes) to be read during a DMA read transfer. The total transfer size must be written to this register by the user. The transfer size value stored in this register is automatically decremented during the process of the DMA transfer. The current value stored indicates the remaining amount of data that needs to be transferred. Upon successful completion of a DMA read transfer, the value of this register should be 0.

2.8.6 DMA1 Control Register

Address: 101C (H)
Length 32 bits

This register contains information about, and controls, the DMA read data transfer.

Bit	Description	
12-13	Reserved – set to 0	
08-11	DMA channel state	These bits describe the state of the DMA read channel. 0000 = (idle state) Last transfer ended successfully 0001 = (idle state) Last transfer was stopped by a module 0010 = (idle state) Last transfer ended because of CPL timeout 0011 = (idle state) Last transfer ended because of CPL UR error 0100 = (idle state) Last transfer ended because of CPL CA error 0101 – 0111 = (idle state) Reserved 1000 = (busy state) The DMA channel is busy processing 1001 = (busy state) Requesting transfer. The DMA channel is in the process of requesting data from the host computer 1010 = (busy state) The DMA channel is waiting for completion of a read data transfer in response to a DMA read request 1011 = (busy state) Waiting for board to provide/accept data. The DMA channel is waiting for completion of a data transfer to or from the internal module memory. 1100 – 1111 = (busy state) Reserved
04-07	Reserved – set to 0	
03	Abort DMA transfer	1 = Abort transfer 0 = no effect
02	Start DMA transfer	1 = Start DMA transfer 0 = no effect
00-01	Reserved – set to 0	

Table 2-19 DMA1 Control Register

2.8.7 DMA Interrupt Status Register

Address: 1034 (H)
Length 2 bits

Bit 0 of this register is set upon completion of a DMA transfer on DMA0 (DMA write). Bit 1 is set upon completion of a DMA transfer on DMA1 (DMA read). To clear either bit, write a 1 to the corresponding location.

Note: The two bits of the DMA Interrupt Status Register work together with the five bits of the Global Interrupt Status Register. When any of these seven bits are set, an interrupt is generated. To locate the source of an interrupt to the host, both of these registers need to be read.

In order to reset an interrupt, you must reset the appropriate bits of **both** the DMA Interrupt Status Register **and** the Global Interrupt Reset Register. See **2.5.3 Interrupt Status Register** on page 2-14.

2.8.8 Base Address for DMA0 and DMA1 Transfers

Address: 1040 (H)
Length 32 bits

This register contains the start address of the current DMA transfer (read or write transfer). The base must be written to this register by the user.

2.8.9 Repeat Code Register

Address: 1042 (H)
Length 32 bits

This register determines the type of DMA reads and writes done by the board. When bits 00–03 are set to 0, the board performs standard DMA reads and writes. When bits 00–03 set to 1, 2, 4 or 8, the board performs FIFO reads/writes of either 1, 2, 4 or 8, bytes.

Bit	Description	
04-13	Reserved – set to 0	
00-03	Repeat Code	0000 = Start DMA transfer 0001 = 1-byte FIFO reads/writes 0010 = 2-byte FIFO reads/writes 0100 = 4-byte FIFO reads/writes 1000 = 8-byte FIFO reads/writes

Table 2-20 Repeat Code Register

2.9 Module Memory Space Map

The module memory space map resides in the first memory block. Each module is allocated a space of 128 KB (128 MB for *PCIe64*) which is mapped as shown in **Figure 2-5 Module Memory Space Map for All Boards Except for PCIe64**. (See **Chapter 4 Ordering Information** for information on the available modules for this carrier board.)

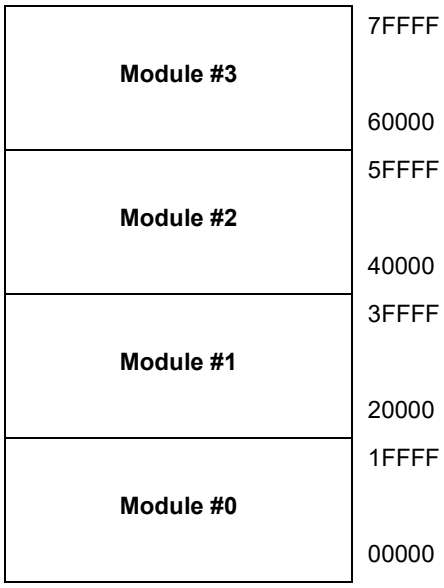

Figure 2-5 Module Memory Space Map for All Boards Except for *PCIe64*

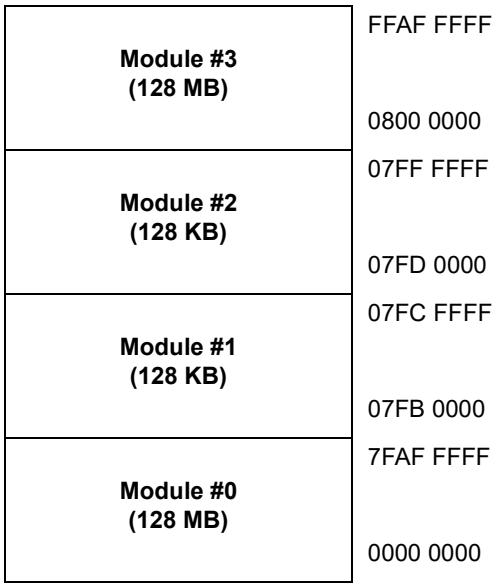

Figure 2-6 Module Memory Space Map for *PCIe64*

3 Mechanical and Electrical Specifications

Chapter 3 describes the mechanical and electrical specifications of the *EXC-4000PCI[e]* family of carrier boards.

3.1 Board Layout

3.1.1 *EXC-4000PCI*

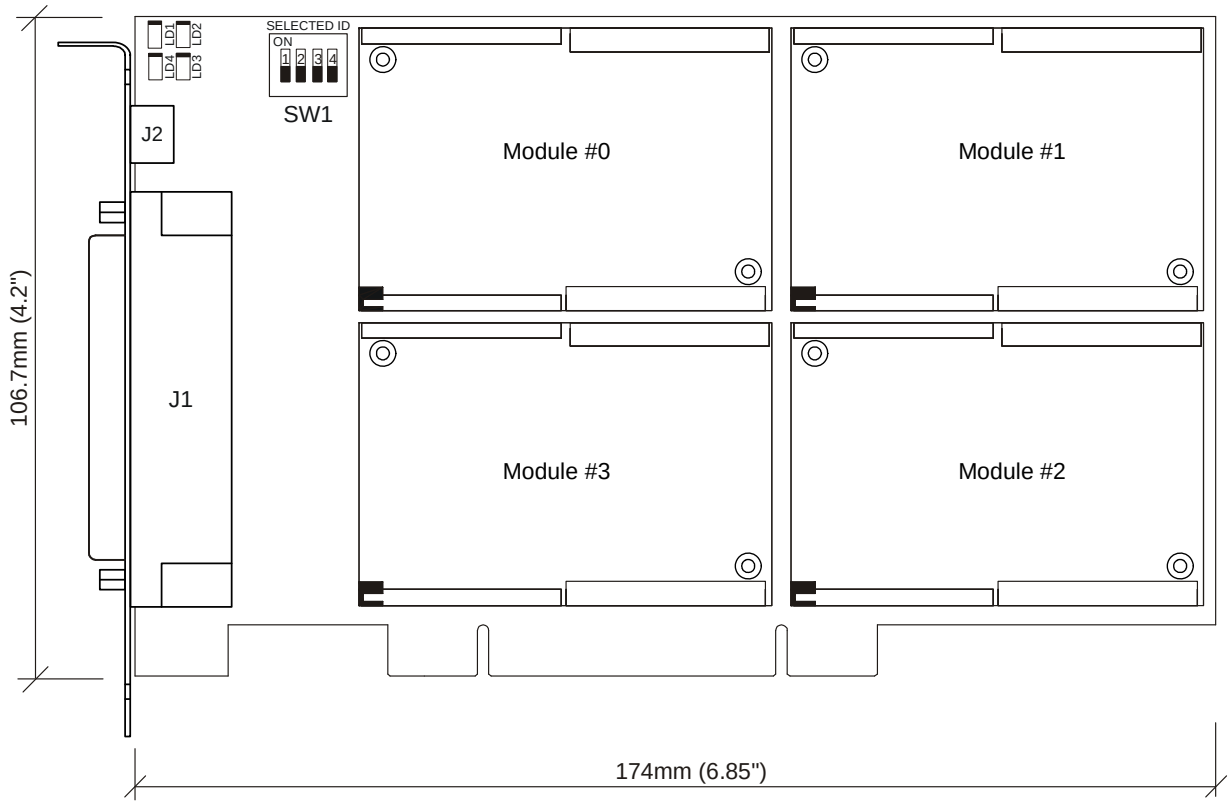

Figure 3-1 *EXC-4000PCI* Board Layout

3.1.2 *EXC-4000PCIe* and *EXC-4000PCIe64*

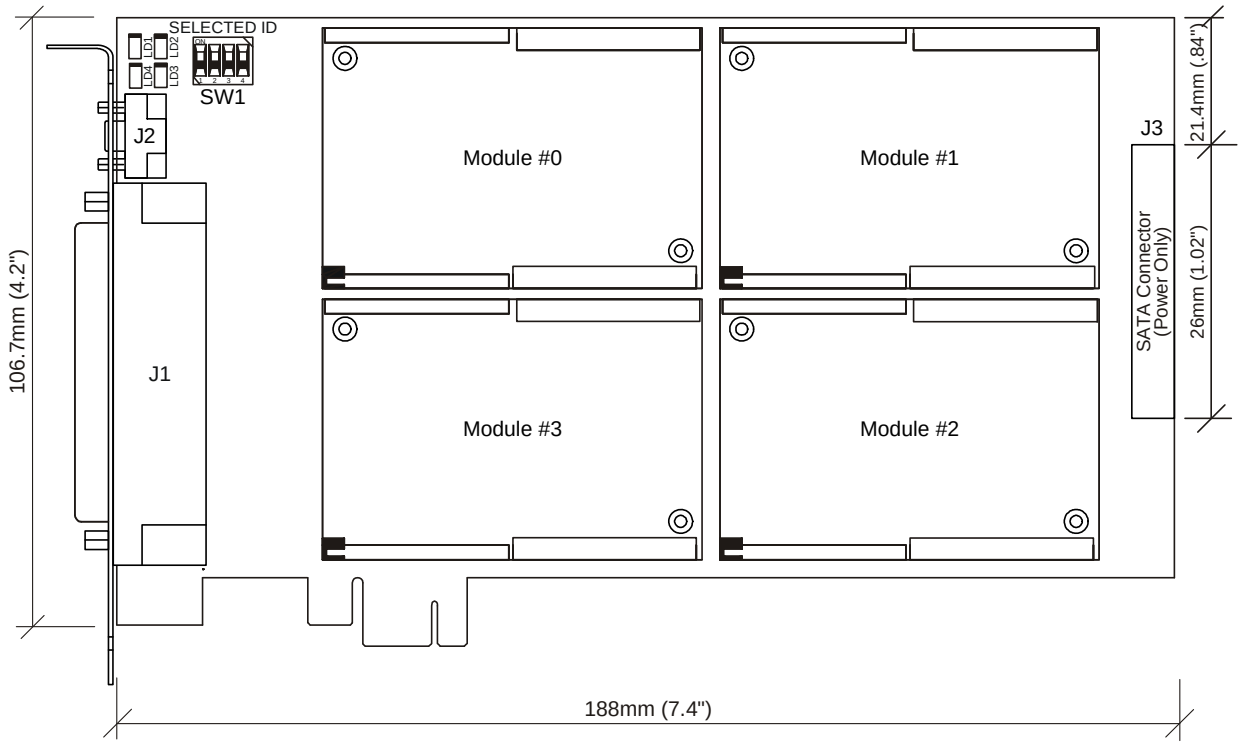

Figure 3-2 *EXC-4000PCIe[64]* Board Layout

3.1.3 *EXC-4000cPCI* (including *-002* and *-006*)

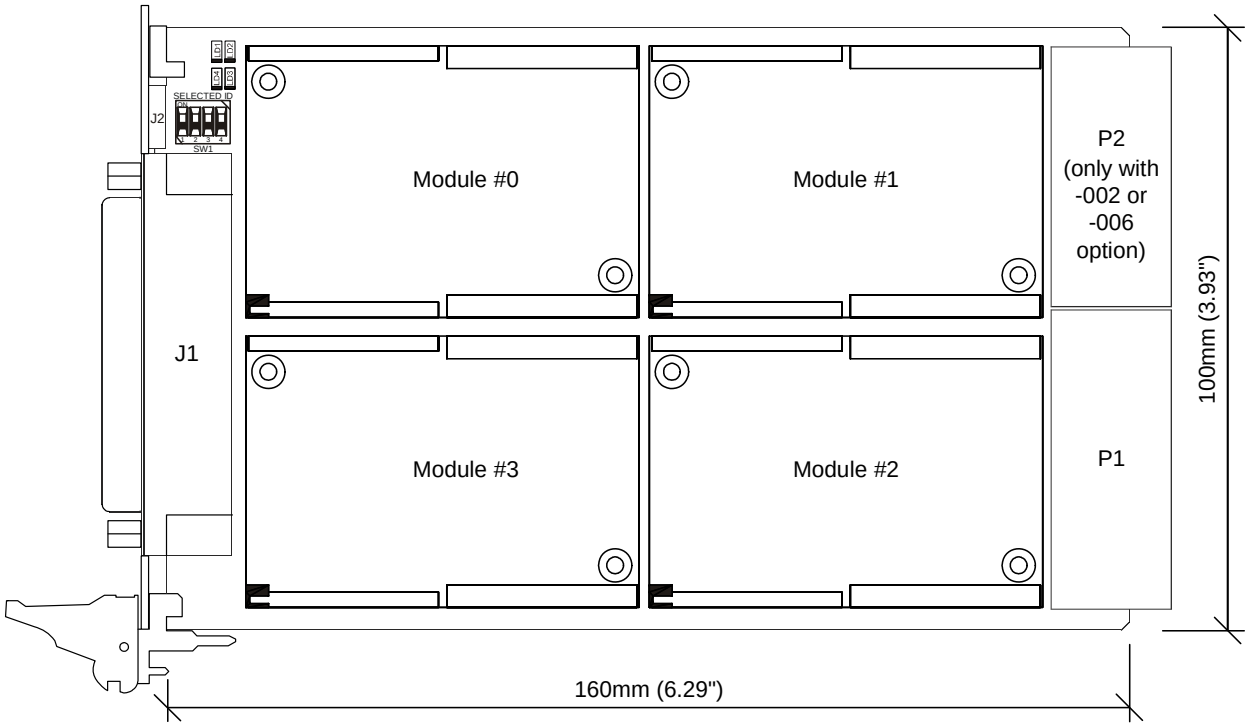

Figure 3-3 *EXC-4000cPCI* Board Layout

3.1.4 *EXC-4000cPCI6U*

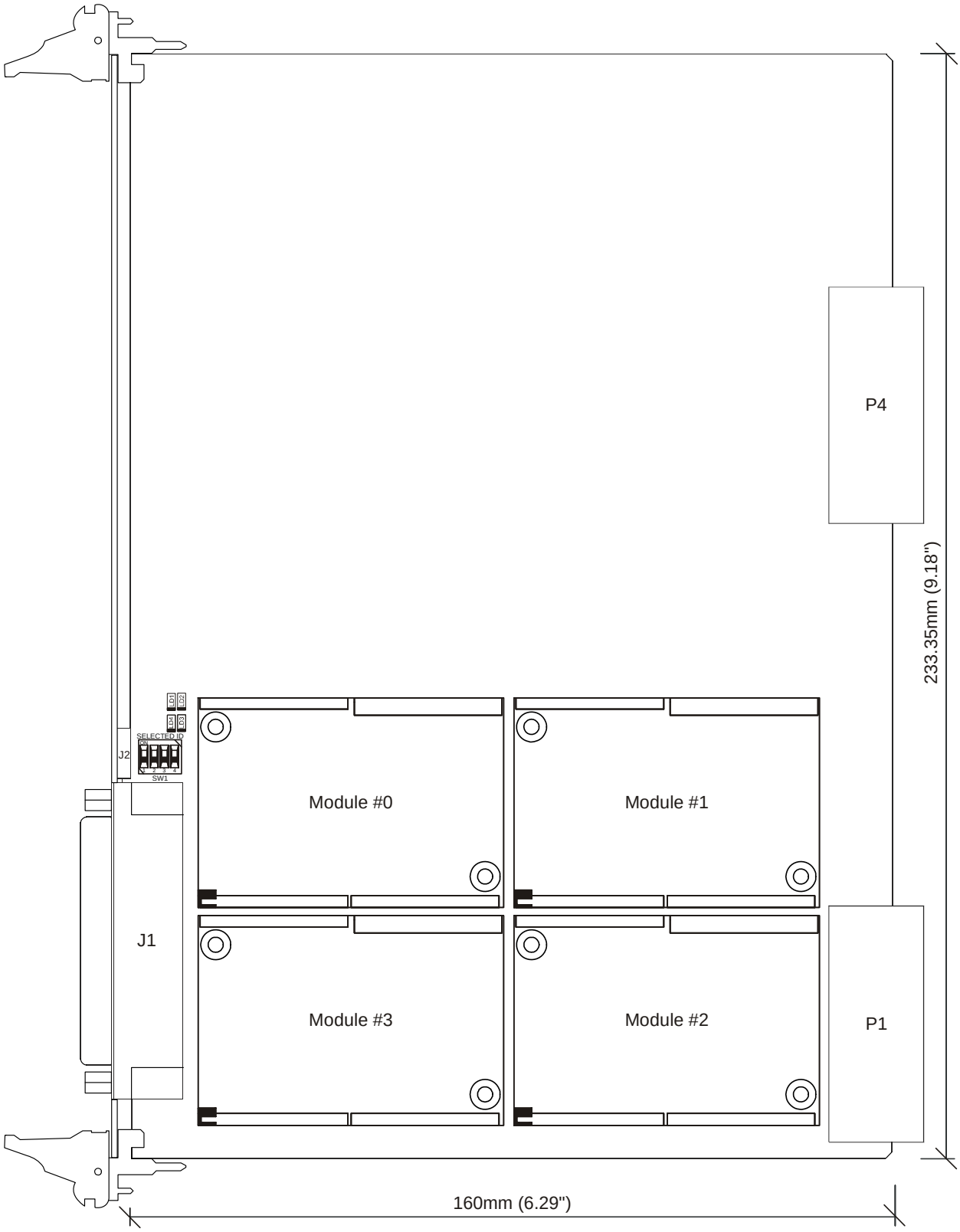

Figure 3-4 *EXC-4000cPCI6U* Board Layout

3.2 Led Indicators

The *EXC-4000PCI[e]* and *EXC-4000PCIe64* contain four LEDs.

LED	Name	Indication
LD1	RDY0	Module 0 Ready
LD2	RDY1	Module 1 Ready
LD3	RDY2	Module 2 Ready
LD4	RDY3	Module 3 Ready

Table 3-1 Led Indicators

3.3 DIP Switches

The *EXC-4000PCI[e]* contains one DIP switch (SW1).

3.3.1 Selected ID DIP Switch [SW1]

This four contact DIP switch provides the board's 'Select ID'. It represents a four bit number of which position #1 is the most significant bit. When a specific bit of the switch is:

- **Off** a value of "1" will be set for that bit
- **On** a value of "0" will be set for that bit

Multiple Board Applications

To provide a unique 'Selected ID', to identify a board by the application software in a multiple board application, the DIP switch should be set differently for each board. For example:

Board	ID#1	ID#3
Bit 1	On	On
Bit 2	On	On
Bit 3	On	Off
Bit 4	Off	Off

Table 3-2 Dip Switch settings for unique 'Selected ID'

For multiple board applications, each board's device number may be set by using the Excalibur configuration utility program provided with the drivers, and by setting the 'unique ID' to match that set on the DIP switch shown in Figure 3-5.

Select ID	Bit 1	Bit 2	Bit 3	Bit 4
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1

Table 3-3 Selected ID Bits

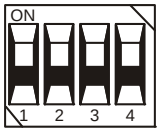

Figure 3-5 DIP Switch SW1 with All Switches Set to ON (Select ID#0)

3.4 Connectors Per Board

3.4.1 *EXC-4000PCIe* and *EXC-4000PCIe64* Connectors

The *EXC-4000PCIe and EXC-4000PCIe64* contain the following connectors:

1. A 96-pin female connector [J1] passes all the modules I/O signals:

   P/N: Molex® 51-26-0000

   The connector pinouts and signals are described in section **3.5.2 Front I/O Connector [J1] for all Boards** on page 3-12.

   The J1 connector mates with:

P/N: Molex® 51-26-0012	Cable plug
P/N: Molex® 51-25-1012	Four 24-pin terminal sticks
P/N: Adamtec DD50-HD-PN-SS	Hood

   These are provided when an adapter cable is not ordered with the board.

2. A PCI Express Bus Edge Connector. The connector pinouts and signals are described in section **3.5.5 Bus Edge Connector for PCIe** on page 3-35.

3. A 9-pin micro-D male connector [J2] provides all the external signals:

   P/N: Molex® 83611-9006

   The connector pinouts and signals are described in section **3.5.8 External Signals Connector [J2]** on page 3-38.

   The J2 connector mates with:

P/N: Molex® 83421-9014	Crimp housing
P/N: Molex® 83000-0083	Crimp pins

   These are provided when an adapter cable with an External Signals connector is not ordered with the board.

4. A standard 4-pin male power connector [J3] provides the required additional power for the board.

   P/N: Molex® 0015244455

   The connector pinouts and signals are described in section **3.5.1 SATA Connector [J3] for EXC-4000PCIe[64] Boards (for Power Only)** on page 3-11.

   A standard 4-pin female 5.08 mm (0.200") power connector found in most computers should be used as the mating connector. This is one of the standard power connectors attached to the computer's power supply via power cables. An example of this mating connector is:

   P/N: Molex® 0015244048

3.4.2 *EXC-4000PCI* Connectors

The *EXC-4000PCI* contains the following connectors:

1. A 96-pin female connector [J1] passes all the modules I/O signals:

   P/N: Molex® 51-26-0000

   The connector pinouts and signals are described in section **3.5.2 Front I/O Connector [J1] for all Boards** on page 3-12.

   The J1 connector mates with:

P/N: Molex® 51-26-0012	Cable plug
P/N: Molex® 51-25-1012	Four 24-pin terminal sticks
P/N: Adamtec DD50-HD-PN-SS	Hood

   These are provided when an adapter cable is not ordered with the board.

2. A PCI Bus Edge Connector. The connector pinouts and signals are described in section **3.5.6 Bus Edge Connector for PCI** on page 3-36.

3. An 8-pin male connector [J2] provides all the external signals:

   P/N: Molex® 87833-0831

   The J2 connector mates with:

P/N: Molex® 51110–0860	Crimp housing
P/N: Molex® 50394–8100	Crimp terminals

   These are provided when an adapter cable with an External Signals connector is not ordered with the board.

3.4.3 *EXC-4000cPCI* Connectors

The *EXC-4000cPCI* contains the following connectors:

1. A 96-pin female connector [J1] passes all the modules I/O signals:

   P/N: Molex® 51-26-0000

   The connector pinouts and signals are described in section **3.5.2 Front I/O Connector [J1] for all Boards** on page 3-12.

   The J1 connector mates with:

P/N: Molex® 51-26-0012	Cable plug
P/N: Molex® 51-25-1012	Four 24-pin terminal sticks
P/N: Adamtec DD50-HD-PN-SS	Hood

   These are provided when an adapter cable is not ordered with the board.

2. A Compact PCI Bus mating connector [P1]. The connector pinouts and signals are described in section **3.5.7 Bus Connector [P1] for cPCI and cPCI6U** on page 3-37 and page 3-8.

3. An 8-pin male connector [J2] provides all the external signals[1]:

   P/N: FCI® 98417-661-08LF

   The connector pinouts and signals are described in section **3.5.8 External Signals Connector [J2]** on page 3-38.

   The J2 connector mates with[1]:

P/N: FCI® 10073599-008LF	Crimp housing
P/N: FCI® 77138-101LF	Crimp terminals

   These are provided when an adapter cable with an External Signals connector is not ordered with the board.

   The connector pinouts and signals are described in section **3.5.8 External Signals Connector [J2]** on page 3-38.

1. These part numbers are for PCB Rev. D and later. For older connectors, contact our sales department.

3.4.4 *EXC-4000cPCI-002* and *EXC-4000cPCI-006* Connectors

The *EXC-4000cPCI-002* and the *EXC-4000cPCI-006* contain the following connectors:

1. A 96-pin female connector [J1] passes all the modules I/O signals:

   P/N: Molex® 51-26-0000

   The connector pinouts and signals are described in section **3.5.2 Front I/O Connector [J1] for all Boards** on page 3-12.

   The J1 connector mates with:

P/N: Molex® 51-26-0012	Cable plug
P/N: Molex® 51-25-1012	Four 24-pin terminal sticks
P/N: Adamtec DD50-HD-PN-SS	Hood

   These are provided when an adapter cable is not ordered with the board.

2. A Compact PCI Bus mating connector [P1]. The connector pinouts and signals are described in section **3.5.7 Bus Connector [P1] for cPCI and cPCI6U** on page 3-37.

3. A rear I/O Connector for Compact PCI Systems [P2]. The connector pinouts and signals are described in section **3.5.2.11 Pinouts for M4KETH Module** on page 3-32.

4. An 8-pin male connector [J2] provides all the external signals[1]:

   P/N: FCI® 98417-661-08LF

   The connector pinouts and signals are described in section **3.5.8 External Signals Connector [J2]** on page 3-38.

   The J2 connector mates with[1]:

P/N: FCI® 10073599-008LF	Crimp housing
P/N: FCI® 77138-101LF	Crimp terminals

   These are provided when an adapter cable with an External Signals connector is not ordered with the board.

1. These part numbers are for PCB Rev. D and later. For older connectors, contact our sales department.

3.4.5 *EXC-4000cPCI6U* Connectors

The *EXC-4000cPCI6U* contains the following connectors:

1. A 96-pin female connector [J1] passes all the modules I/O signals:

   P/N: Molex® 51-26-0000

   The connector pinouts and signals are described in section **3.5.2 Front I/O Connector [J1] for all Boards** on page 3-12.

   The J1 connector mates with:

P/N: Molex® 51-26-0012	Cable plug
P/N: Molex® 51-25-1012	Four 24-pin terminal sticks
P/N: Adamtec DD50-HD-PN-SS	Hood

   These are provided when an adapter cable is not ordered with the board.

2. A Compact PCI Bus mating connector [P1]. The connector pinouts and signals are described in section **3.5.7 Bus Connector [P1] for cPCI and cPCI6U** on page 3-37.

3. A rear I/O Connector for Compact PCI Systems [P4]. The connector pinouts and signals are described in section **3.5.4 Rear I/O Connector [P4] for EXC-4000cPCI6U** on page 3-34.

4. An 8-pin male connector [J2] provides all the external signals:

   P/N: Molex® 87833-0831

   The connector pinouts and signals are described in section **3.5.8 External Signals Connector [J2]** on page 3-38.

   The J2 connector mates with:

P/N: Molex® 51110–0860	Crimp housing
P/N: Molex® 50394–8100	Crimp terminals

   These are provided when an adapter cable with an External Signals connector is not ordered with the board.

3.5 Connector Pinouts

3.5.1 SATA Connector [J3] for *EXC-4000PCIe[64]* Boards (for Power Only)

The power section of this connector mates with the standard PC SATA power supply cable. The signal pins are not connected on the board. See **1.2.1 Installing the Board** on page 1-5.

Note: The *EXC-4000PCIe* and *EXC-4000PCIe64* board will not work without the power cable connected.

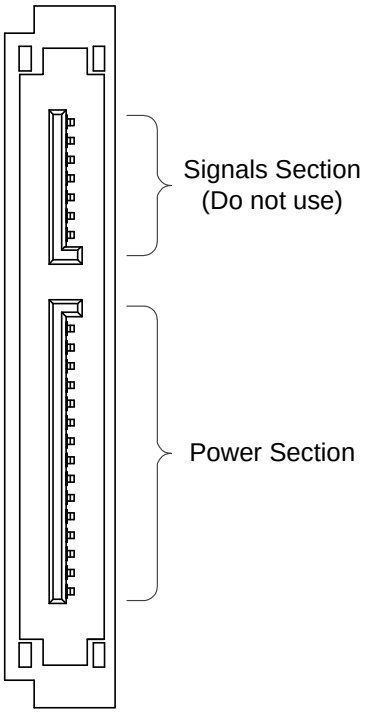

Figure 3-6 15+7-Pin Male SATA Connector – Front View

Pin	Signal
S1	N/C[1]
S2	N/C
S3	N/C
S4	N/C
S5	N/C
S6	N/C
S7	N/C
P1	N/C
P2	N/C
P3	N/C
P4	GND
P5	GND
P6	GND
P7	+5V
P8	+5V
P9	+5V
P10	N/C
P11	N/C
P12	N/C
P13	+12V
P14	+12V
P15	+12V

Table 3-4 15+7-Pin Male SATA Connector Pinouts

1. N/C = Not connected.

3.5.2 Front I/O Connector [J1] for all Boards

The I/O signals of all modules on the carrier board are connected to the carrier board's 96-pin female connector [J1] (Molex® LFH75 51-26-0000, see Figure 3-7). This 96-pin connector is divided into four rows of 24 pins each.

The J1 connector mates with a 96-pin male connector (Molex® LFH75 51-26-0012) comprised of four terminal sticks of 24 pins each (Figure 3-8). Each row of the J1 connector mates with one terminal stick and carries the signals of one of the board's modules (except for the H009 module, which occupies two rows of the J1 connector).

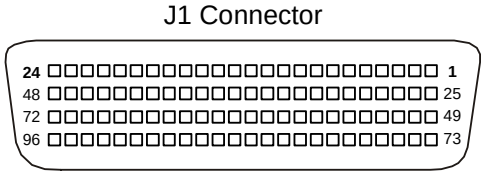

Figure 3-7 96-Pin Female I/O Connector [J1] – Front View

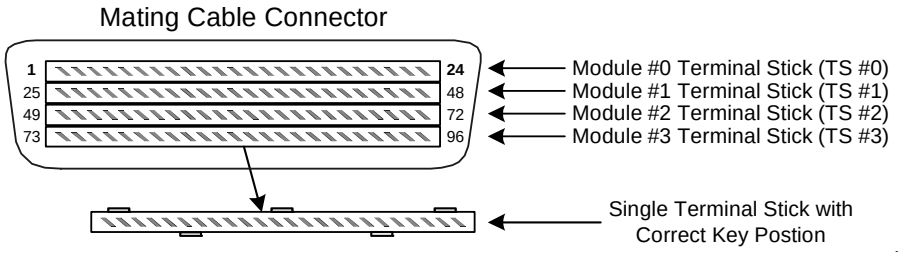

Figure 3-8 96-Pin Male I/O Mating Cable Connector – Front View

Note: For mating connector part numbers, see **3.4.1 EXC-4000PCIe and EXC-4000PCIe64 Connectors** on page 3-6.

The pinouts of the J1 connector vary depending on the modules installed on the board. Each row of the J1 connector carries the signals of one of the board's modules, and mates with one terminal stick in the adapter cable.

The following tables list the pinouts of each row of the J1 connector, based on the pin numbers of the corresponding terminal stick (in the mating adapter cable connector).

3.5.2.1 Pinouts for *M4K1553Px* Module

The following table lists the pinouts for the module's terminal stick and corresponding adapter cable.

24-Pin Terminal Stick Pin #	Adapter Cable Connector (Twinax)	Signal Name	Signal Description
1	BODY ASSEMBLY	SHIELD	Provided for 1553 cables shield connection. This signal is connected to the case of the computer.
2	INNER SHEATH	BUSALO	1553 Bus A low connection.
3	CENTER PIN	BUSAHI	1553 Bus A high connection.
4 – 9		Reserved	Do not use this pin.
10	INNER SHEATH	BUSBLO	1553 Bus B low connection.
11	CENTER PIN	BUSBHI	1553 Bus B high connection.
12	BODY ASSEMBLY	SHIELD	Provided for 1553 cables shield connection. This signal is connected to the case of the computer.
013		RTA0	Single function module (*PxS*) RT address bit position 0 input[1].
14		RTA1	Single function module (*PxS*) RT address bit position 1 input[1].
15		RTA2	Single function module (*PxS*) RT address bit position 2 input[1].
16		RTA3	Single function module (*PxS*) RT address bit position 3 input[1].
17		RTA4	Single function module (*PxS*) RT address bit position 4 input[1].
18		RTPTY	Single function module (*PxS*) RT address parity bit input[1].
19		RTLOCKn	Single function module (*PxS*) RT address lock input[1]. 0 = RT number locked (RT address is set to the value represented by pins 13 – 18) 1 = RT number unlocked (RT address can be changed by writing to the RT Number Register)
20		GND	Provided for single function module (*PxS*) RT address pins that need to be set to '0.'
21 – 22		Reserved	Do not use this pin.
23		EXSTARTn	External Start LVTTL input. Provides an option to start the module externally by applying a negative pulse with respect to the GND pin, with a minimum width of 100 nsec. Before applying the pulse, the module should be fully set up in the required mode, except the Start register bit 00, which should be left at 0. To stop the selected operation, follow the normal procedure described under the Start register.
24		GND	Provides ground reference for the digital signal connections.

Table 3-5 *M4K1553Px* Module Terminal Stick and Adapter Cable Pinouts

1. Single function module (*PxS*) only;
   Pin shorted to ground = logic 0
   Pin open = logic 1
   See the RT Number Register in the *M4K1553Px Module User's Manual*.

M4K1553Px Module Adapter Cable

A standard adapter cable can be purchased from Excalibur that converts the Molex® terminal stick to two female twinax connectors (Trompeter CJ70 or equivalent) for Bus A and Bus B. The cable is 0.5 meter in length.

The twinax connectors mate, for example, with Trompeter PL75 male twinax connectors. These connectors are not supplied by Excalibur.

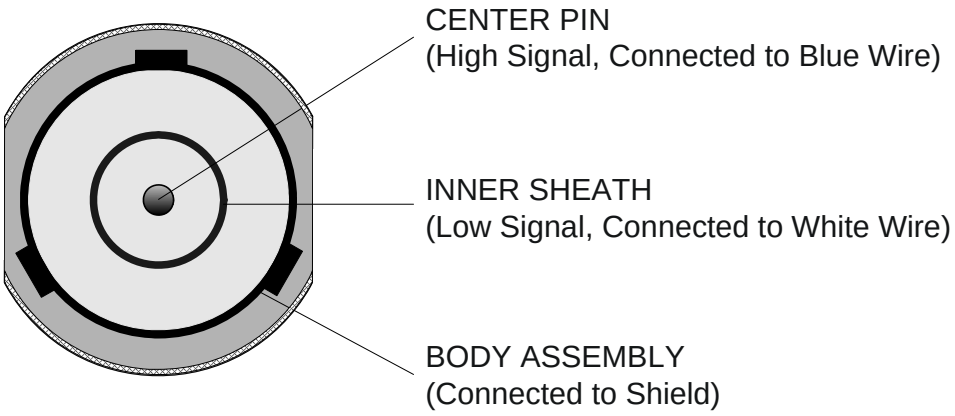

Figure 3-9 *M4K1553Px* Module Twinax Connector – Front View

3.5.2.2 Pinouts for *M4KH009* Module

The following table lists the pinouts for the module's terminal stick and corresponding adapter cable.

24-Pin Terminal Stick Pin #	Adapter Cable Connector (Twinax)	Signal Name	Signal Description
1	BODY ASSEMBLY	SHIELD	Provided for H009 cables shield connection. This signal is connected to the case of the computer
2	INNER SHEATH	DBUSAL	Bus A Data low connection
3	CENTER PIN	DBUSAHI	Bus A Data high connection
4	INNER SHEATH	DBUSBL	Bus B Data low connectionv
5	CENTER PIN	DBUSBHI	Bus B Data high connection
6	INNER SHEATH	CBUSAL	Bus A Clock low connection
7	CENTER PIN	CBUSAHI	Bus A Clock high connection
8	INNER SHEATH	CBUSBL	Bus B Clock low connection
9	CENTER PIN	CBUSBHI	Bus B Clock high connection
10 – 11		GND	Provides ground reference for digital signal connections
12	BODY ASSEMBLY	SHIELD	Provided for H009 cables shield connection. This signal is connected to the case of the computer
13 – 21		N/C	Not connected
22		Reserved	Do not use this pin.
23 – 24		GND	Provides ground reference for digital signal connections

Table 3-6 *M4KH009* Module Terminal Stick and Adapter Cable Pinouts

***M4KH009* Module Adapter Cable**

A standard adapter cable can be purchased from Excalibur that converts the Molex® terminal stick to two female twinax connectors (Trompeter CJ70 or equivalent) for Bus A Data and Clock and Bus B Data and Clock. The cable is 0.5 meter in length.

The twinax connectors mate, for example, with Trompeter PL75 male twinax connectors. These connectors are not supplied by Excalibur.

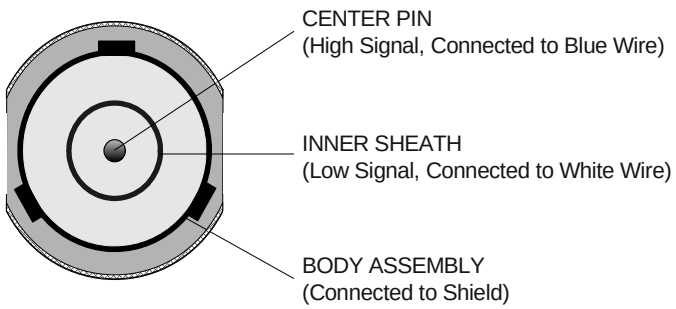

Figure 3-10 *M4KH009* Module Twinax Connector – Front View

3.5.2.3 Pinouts for *M4KMMSI* Module

The following table lists the pinouts for the module's terminal stick and corresponding adapter cable.

24-Pin Terminal Stick Pin #	Adapter Cable Connector Pin # (HDB 26-pin Female)	Signal Name	Signal Description
1	1	SHIELD	Provided for the cable's shield connection. This signal is connected to the computer's case through the carrier board's bracket or panel.
2	2	CH0L	Port 0 low connection
3	3	CH0H	Port 0 high connection
4	4	CH1L	Port 1 low connection
5	5	CH1H	Port 1 high connection
6	6	CH2L	Port 2 low connection
7	7	CH2H	Port 2 high connection
8	8	CH3L	Port 3 low connection
9	9	CH3H	Port 3 high connection
10	10	CH4L	Port 4 low connection
11	11	CH4H	Port 4 high connection
12	12	SHIELD	Provided for the cable's shield connection. This signal is connected to the computer's case through the carrier board's bracket or panel.
13	13	CH5L	Port 5 low connection
14	14	CH5H	Port 5 high connection
15	15	CH6L	Port 6 low connection
16	16	CH6H	Port 6 high connection
17	17	CH7L	Port 7 low connection
18	18	CH7H	Port 7 high connection
19	19	CH8L	Composite BM Output low connection
20	20	CH8H	Composite BM Output high connection
21	21	N/C	Not connected
22	22	N/C	Not connected
	23 – 26	N/C	Not connected
23		EXSTRTn	External Start TTL input. Provides an option to start the module externally by applying a negative pulse of 100 nsec/min. with respect to the GND pin. Before applying the pulse, the module should be fully set up in the required mode, except the Start register bit 00, which should be left at 0. To stop the selected operation, follow the normal procedure described under the Start register.
24		GND	Provides ground reference for the EXSTRTn signal

Table 3-7 *M4KMMSI* Module Terminal Stick and Adapter Cable Pinouts

M4KMMSI Module Adapter Cable

A standard adapter cable can be purchased from Excalibur that converts the Molex® terminal stick to a standard 26-pin high density D-type female connector with jack screws (see figure below). The cable is 0.5 meter in length and a mating connector (with hood) is included in the cable package.

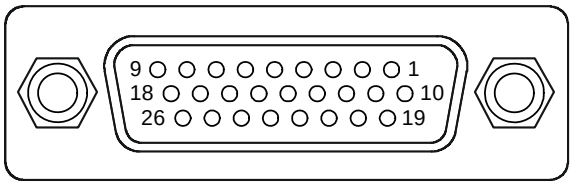

Figure 3-11 *M4KMMSI* Module Adapter Cable Connector – HDB 26-Pin Female – Front View

3.5.2.4 Pinouts for *M4K429RTx* Module

The following table lists the pinouts for the module's terminal stick and corresponding adapter cable.

24-Pin Terminal Stick Pin #	Adapter Cable Connector Pin # (HDB 26-pin Female)	Signal Name	Signal Description
1	1	SHIELD	Provided for the cable's shield connection. This signal is connected to the computer's case through the carrier board's bracket or panel.
2	2	CH0L	ARINC 429 Channel 0 low connection
3	3	CH0H	ARINC 429 Channel 0 high connection
4	4	CH1L	ARINC 429 Channel 1 low connection
5	5	CH1H	ARINC 429 Channel 1 high connection
6	6	CH2L	ARINC 429 Channel 2 low connection
7	7	CH2H	ARINC 429 Channel 2 high connection
8	8	CH3L	ARINC 429 Channel 3 low connection
9	9	CH3H	ARINC 429 Channel 3 high connection
10	10	CH4L	ARINC 429 Channel 4 low connection
11	11	CH4H	ARINC 429 Channel 4 high connection
12	12	SHIELD	Provided for the cable's shield connection. This signal is connected to the computer's case through the carrier board's bracket or panel.
13	13	CH5L	ARINC 429 Channel 5 low connection
14	14	CH5H	ARINC 429 Channel 5 high connection
15	15	CH6L	ARINC 429 Channel 6 low connection
16	16	CH6H	ARINC 429 Channel 6 high connection
17	17	CH7L	ARINC 429 Channel 7 low connection
18	18	CH7H	ARINC 429 Channel 7 high connection
19	19	CH8L	ARINC 429 Channel 8 low connection
20	20	CH8H	ARINC 429 Channel 8 high connection
21	21	CH9L	ARINC 429 Channel 9 low connection
22	22	CH9H	ARINC 429 Channel 9 high connection
23	23	OUTRIGn	This low active output provides trigger pulses of approximately 400 nsec. width and is activated under software control upon the same conditions as interrupts. See Interrupt/Trigger Mask Registers. This output is an open-collector with 330-ohm pull-up resistor.
24	24	GND	Provides ground reference for the OUTRIGn output.
	25 – 26	N/C	Not connected

Table 3-8 *M4K429RTx* Module Terminal Stick and Adapter Cable Pinouts

M4K429RTx Module Adapter Cable

A standard adapter cable can be purchased from Excalibur that converts the Molex® terminal stick to a standard 26-pin high density D-type female connector with jack screws (see figure below). The cable is 0.5 meter in length and a mating connector (with hood) is included in the cable package.

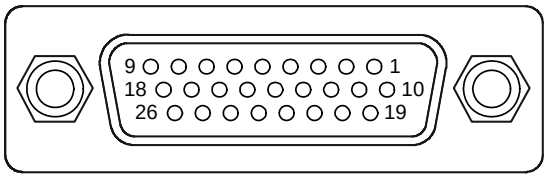

Figure 3-12 *M4K429RTx* Module Adapter Cable Connector – HDB 26-Pin Female – Front View

3.5.2.5 Pinouts for *M4K708* Module

The following table lists the pinouts for the module's terminal stick and corresponding adapter cable.

24-Pin Terminal Stick Pin #	Adapter Cable Connector (Twinax)	Signal Name	Signal Description
1	BODY ASSEMBLY	SHIELD	Provided for the cable's shield connection. This signal is connected to the computer's case through the carrier board's bracket or panel.
2	INNER SHEATH	BUS0L	Channel 0 low connection
3	CENTER PIN	BUS0H	Channel 0 high connection
4 – 9		N/C	Not connected
10	INNER SHEATH	BUS1L	Channel 1 low connection
11	CENTER PIN	BUS1H	Channel 1 high connection
12	BODY ASSEMBLY	SHIELD	Provided for the cable's shield connection. This signal is connected to the computer's case through the carrier board's bracket or panel.
13 – 18		N/C	Not connected
19 – 22		Reserved	Do not use this pin.
23		OUTRIGn	Output trigger low active output. Provides trigger pulses of approximately 500 nsec. width and is activated upon the same conditions as interrupts. See Channel Output Trigger Mask Register in the *M4K708 Module User's Manual*. This output is an open-collector type pulled up with a 330-Ohm resistor to 5V.
24		GND	Provides ground reference for the OUTRIGn output.

Table 3-9 *M4K708* Module Terminal Stick and Adapter Cable Pinouts

M4K708 Module Adapter Cable

A standard adapter cable can be purchased from Excalibur that converts the Molex® terminal stick to two female twinax connectors (Trompeter CJ70 or equivalent) for Channel 0 and Channel 1. The cable is 0.5 meter in length.

The twinax connectors mate, for example, with Trompeter PL75 male twinax connectors. These connectors are not supplied by Excalibur.

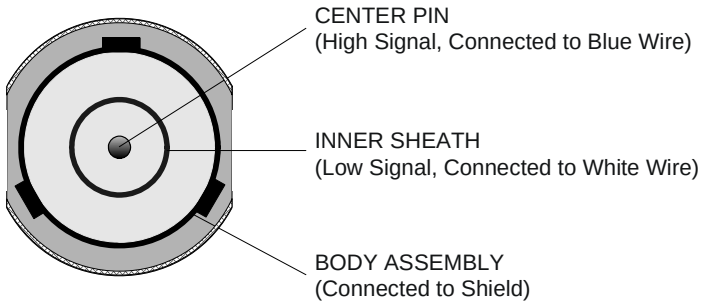

Figure 3-13 *M4K708* Module Twinax Connector – Front View

3.5.2.6 Pinouts for *M4K717* Module

The following table lists the pinouts for the module's terminal stick and corresponding adapter cable.

24-Pin Terminal Stick Pin #	Adapter Cable Connector Pin # (DB 15-pin Female)	Signal Name	Signal Description
1	1	SHIELD	Provided for the cable's shield connection. This signal is connected to the computer's case through the carrier board's bracket or panel.
2	2	CH0TxL	Channel 0 Tx low connection
3	3	CH0TxH	Channel 0 Tx high connection
4	4	CH0RxL	Channel 0 Rx low connection
5	5	CH0RxH	Channel 0 Rx high connection
6		N/C	Not connected
7		N/C	Not connected
8		N/C	Not connected
9		N/C	Not connected
10		N/C	Not connected
11		N/C	Not connected
12	9	SHIELD	Provided for the cable's shield connection. This signal is connected to the computer's case through the carrier board's bracket or panel.
13	10	CH1TxL	Channel 1 Tx low connection
14	11	CH1TxH	Channel 1 Tx high connection
15	12	CH1RxL	Channel 1 Rx low connection
16	13	CH1RxH	Channel 1 Rx high connection
17		N/C	Not connected
18		N/C	Not connected
19		N/C	Not connected
20		N/C	Not connected
21		N/C	Not connected
22		N/C	Not connected
23	7	OUTRIGn	Trigger Output. This low active LVTTL open-collector output with a 330-Ohm pull-up resister provides trigger pulses of approximately 110 nsec. width and is activated under software control upon the same conditions as interrupts. See **Trigger Mask Register**.
24	8	GND	Provides ground reference for the OUTRIGn output.
	6, 14, 15	N/C	Not connected

Table 3-10 *M4K717* Module Terminal Stick and Adapter Cable Pinouts

M4K717 Module Adapter Cable

A standard adapter cable can be purchased from Excalibur that converts the Molex® terminal stick to a standard 15-pin D-type female connector with jack screws (see figure below). The cable is 0.5 meter in length and a mating connector (with hood) is included in the cable package. See **Ordering Information**.

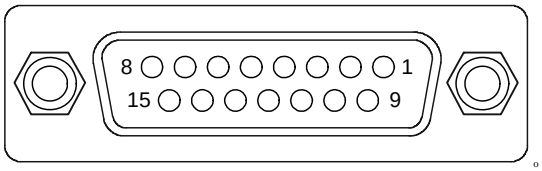

Figure 3-14 *M4K717* Module Adapter Cable Connector – DB 15-Pin Female – Front View

3.5.2.7 Pinouts for *M4KSerial[Plus]* Module

The following table lists the pinouts for the module's terminal stick and corresponding adapter cable.

24-Pin Terminal Stick Pin #	Adapter Cable Con. Pin # (DB 25-pin Male)	Signal Name	Signal Description		
			RS-232	RS-485	RS-422
1	1	Reserved	Do not use this pin.		
2	14	485/422T_0	N/C	Channel 0 high connection	Channel 0 Transmit high connection
3	2	232T/485n/422Tn_0	Channel 0 Transmit connection	Channel 0 low connection	Channel 0 Transmit low connection
4	15	232R/422R_0	Channel 0 Receive connection	N/C	Channel 0 Receive high connection
5	3	422Rn_0	N/C	N/C	Channel 0 Receive low connection
6	9	GND	Provides ground reference	N/C	N/C
7	4	Reserved	Do not use this pin.		
8	17	485/422T_1	N/C	Channel 1 high connection	Channel 1 Transmit high connection
9	5	232T/485n/422Tn_1	Channel 1 Transmit connection	Channel 1 low connection	Channel 1 Transmit low connection
10	18	232R/422R_1	Channel 1 Receive connection	N/C	Channel 1 Receive high connection
11	6	422Rn_1	N/C	N/C	Channel 1 Receive low connection
12	19	SHIELD	Provided for the cable's shield connection. This signal is connected to the computer's case through the carrier board's bracket or panel.		
13	7	485/422T_2	N/C	Channel 2 high connection	Channel 2 Transmit high connection
14	20	232T/485n/422Tn_2	Channel 2 Transmit connection	Channel 2 low connection	Channel 2 Transmit low connection
15	8	232R/422R_2	Channel 2 Receive connection	N/C	Channel 2 Receive high connection
16	21	422Rn_2	N/C	N/C	Channel 2 Receive low connection
17	16	GND	Provides ground reference	N/C	N/C
18	22	Reserved	Do not use this pin.		
19	10	485/422T_3	N/C	Channel 3 high connection	Channel 3 Transmit high connection
20	23	232T/485n/422Tn_3	Channel 3 Transmit connection	Channel 3 low connection	Channel 3 Transmit low connection
21	11	232R/422R_3	Channel 3 Receive connection	N/C	Channel 3 Receive high connection
22	24	422Rn_3	N/C	N/C	Channel 3 Receive low connection
23	12	Reserved	Do not use this pin.		
24	25	SHIELD	Provided for the cable's shield connection. This signal is connected to the computer's case through the carrier board's bracket or panel.		
	13	N/C	Not connected	Not connected	Not connected

Table 3-11 *M4KSerial[Plus]* Module Terminal Stick and Adapter Cable Pinouts

M4KSerial[Plus] Module Adapter Cable

A standard adapter cable can be purchased from Excalibur that converts the Molex® terminal stick to a standard 25-pin D-type male connector with jack screws (see figure below). The cable is 0.5 meter in length and a mating connector (with hood) is included in the cable package.

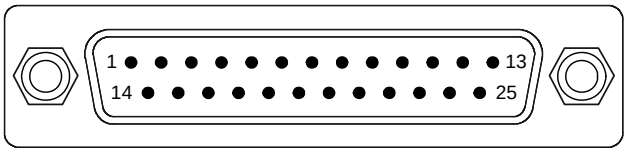

Figure 3-15 *M4KSerial[Plus]* Module Adapter Cable Connector – DB 25-Pin Male – Front View

3.5.2.8 Pinouts for *M4KDiscrete* Module

The following table lists the pinouts for the module's terminal stick and corresponding adapter cable.

24-Pin Terminal Stick Pin #	Adapter Cable Connector Pin # (DB 25-pin Female)	Signal Name	Signal Description
1	1	IO0	Discrete 0
2	14	IO1	Discrete 1
3	2	IO2	Discrete 2
4	15	IO3	Discrete 3
5	3	IO4	Discrete 4
6	16	IO5	Discrete 5
7	4	IO6	Discrete 6
8	17	GND	Provides ground reference for input and output channels
9	5	IO7	Discrete 7
10	18	IO8	Discrete 8
11	6	EXT_TRIG	TTL Active low External trigger (pulse width approx. 150 nS)
12	19	SHIELD	Provides the input and output channels with shield connections. This signal is connected to the case of the computer.
13	7	IO9	Discrete 9
14	20	IO10	Discrete 10
15	8	IO11	Discrete 11
16	21	IO12	Discrete 12
17	9	IO13	Discrete 13
18	22	IO14	Discrete 14
19	10	IO15	Discrete 15
20	23	IO16	Discrete 16
21	11	GND	Provides ground reference for input and output channels
22	24	IO17	Discrete 17
23	12	IO18	Discrete 18
24	25	IO19	Discrete 19
	13	N/C	Not connected

Table 3-12 *M4KDiscrete* Module Terminal Stick and Adapter Cable Pinouts

M4KDiscrete Module Adapter Cable

A standard adapter cable can be purchased from Excalibur that converts the Molex® terminal stick to a standard 25-pin D-type female connector with jack screws (see figure below). The cable is 0.5 meter in length and a mating connector (with hood) is included in the cable package.

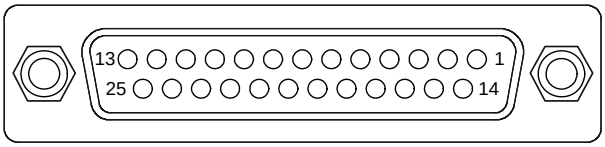

Figure 3-16 *M4KDiscrete* Module Adapter Cable Connector – DB 25-Pin Female – Front View

3.5.2.9 Pinouts for *M4K825CAN* Module

The following table lists the pinouts for the module's terminal stick and corresponding adapter cable.

24-Pin Terminal Stick Pin #	Adapter Cable Connector Pin # (HDB 26-pin Male)	Signal Name	Signal Description
1	1	SHIELD	Provided for the cable's shield connection. This signal is connected to the computer's case through the carrier board's bracket or panel.
2	2	CH0L	Channel 0 low connection
3	3	CH0H	Channel 0 high connection
4	4	CH1L	Channel 1 low connection
5	5	CH1H	Channel 1 high connection
6	6	CH2L	Channel 2 low connection
7	7	CH2H	Channel 2 high connection
8	8	CH3L	Channel 3 low connection
9	9	CH3H	Channel 3 high connection
10	10	CH4L	Channel 4 low connection
11	11	CH4H	Channel 4 high connection
12	12	SHIELD	Provided for the cable's shield connection. This signal is connected to the computer's case through the carrier board's bracket or panel.
13	13	CH5L	Channel 5 low connection
14	14	CH5H	Channel 5 high connection
15	15	CH6L	Channel 6 low connection
16	16	CH6H	Channel 6 high connection
17	17	CH7L	Channel 7 low connection
18	18	CH7H	Channel 7 high connection
19	19	CH8L	Channel 8 low connection
20	20	CH8H	Channel 8 high connection
21	21	CH9L	Channel 9 low connection
22	22	CH9H	Channel 9 high connection
23	23	OUTRIGn	Trigger Output. This low active LVTTL open-collector output with a 330-Ohm pull-up resister provides trigger pulses of approximately 110 nsec. width and is activated under software control upon the same conditions as interrupts. See **Trigger Mask Register**.
24	24	GND	Provides ground reference
	25 – 26	N/C	Not connected

Table 3-13 *M4K825CAN* Module Terminal Stick and Adapter Cable Pinouts

M4K825CAN Module Adapter Cable

A standard adapter cable can be purchased from Excalibur that converts the Molex® terminal stick to a standard 26-pin high density D-type male connector with jack screws (see figure below). The cable is 0.5 meter in length and a mating connector (with hood) is included in the cable package. See **Ordering Information**.

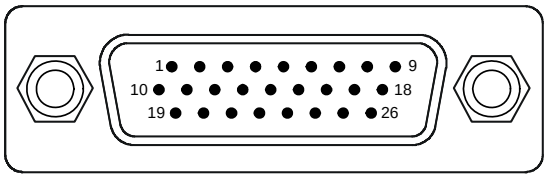

Figure 3-17 *M4K825CAN* Module Adapter Cable Connector – HDB 26-Pin Male – Front View

3.5.2.10 Pinouts for *M4KCAN* Module

The following table lists the pinouts for the module's terminal stick and corresponding adapter cable.

24-Pin Terminal Stick Pin #	Adapter Cable Connector Pin # (HDB 26-pin Male)	Signal Name	Signal Description
1	1	SHIELD	Provided for CAN cables shield connection. This signal is connected to the case of the computer
2	2	CAN0H	Channel 0 high connection
3	3	CAN0L	Channel 0 low connection
4	4	CAN1H	Channel 1 high connection
5	5	CAN1L	Channel 1 low connection
6	6	SHIELD	Provided for CAN cables shield connection. This signal is connected to the case of the computer
7	7	SHIELD	Provided for CAN cables shield connection. This signal is connected to the case of the computer
8	8	CAN2H	Channel 2 high connection
9	9	CAN2L	Channel 2 low connection
10	10	CAN3H	Channel 3 high connection
11	11	CAN3L	Channel 3 low connection
12	12	SHIELD	Provided for CAN cables shield connection. This signal is connected to the case of the computer
13	13	SHIELD	Provided for CAN cables shield connection. This signal is connected to the case of the computer
	14	N/C	Not connected
14	15	CAN4H	Channel 4 high connection
15	16	CAN4L	Channel 4 low connection
16	17	CAN5H	Channel 5 high connection
17	18	CAN5L	Channel 5 low connection
18	19	SHIELD	Provided for CAN cables shield connection. This signal is connected to the case of the computer
19	20	Reserved	Do not use this pin.
20	21	Reserved	Do not use this pin.
21	22	GND	Provides ground reference
22	23	N/C	Not connected
23	24	N/C	Not connected
24	25	N/C	Not connected

Table 3-14 *M4KCAN* Module Terminal Stick and Adapter Cable Pinouts

M4KCAN Module Adapter Cable

A standard adapter cable can be purchased from Excalibur that converts the Molex® terminal stick to a standard 26-pin high density D-type male connector with jack screws (see figure below). The cable is 0.5 meter in length and a mating connector (with hood) is included in the cable package.

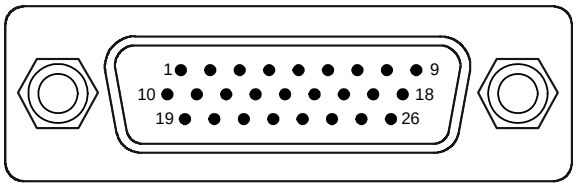

Figure 3-18 *M4KCAN* Module Adapter Cable Connector – HDB 26-Pin Male – Front View

3.5.2.11 Pinouts for *M4KETH* Module

The following table lists the pinouts for the module's terminal stick and corresponding adapter cable.

24-Pin Terminal Stick Pin #	Adapter Cable Connector Pin # (RJ45 Male)	Signal Name		Signal Description
		10/100baseT	**1000baseT**	
1	Outer casing of connector	SHIELD	SHIELD	Provided for the cable's shield connection. This signal is connected to the computer's case through the carrier board's bracket or panel.
2	1	TX_p	BI_DA_p	Transmit data high / bidirectional A high
3	2	TX_n	BI_DA_n	Transmit data low / bidirectional A low
4	3	RX_p	BI_DB_p	Receive data high / bidirectional B high
5	6	RX_n	BI_DB_n	Receive data low / bidirectional B low
6	4	N/C	BI_DC_p	Not connected / bidirectional C high
7	5	N/C	BI_DC_n	Not connected / bidirectional C low
8	7	N/C	BI_DD_p	Not connected / bidirectional D high
9	8	N/C	BI_DD_n	Not connected / bidirectional D low
10		N/C	N/C	Not connected
11		N/C	N/C	Not connected
12		N/C	N/C	Not connected
13		Reserved	Reserved	Do not use this pin
14		Reserved	Reserved	Do not use this pin
15		Reserved	Reserved	Do not use this pin
16		Reserved	Reserved	Do not use this pin
17		N/C	N/C	Not connected
18		N/C	N/C	Not connected
19		N/C	N/C	Not connected
20		N/C	N/C	Not connected
21		TRIGINn	TRIGINn	Trigger Input (optional)
22		TRIGOUTn	TRIGOUTn	Trigger Output (optional)
23		GND	GND	Ground
24		SHIELD	SHIELD	Provided for the cable's shield connection. This signal is connected to the computer's case through the carrier board's bracket or panel.

Table 3-15 *M4KETH* Module Terminal Stick and Adapter Cable Pinouts

M4KETH Module Adapter Cable

A standard adapter cable can be purchased from Excalibur that converts the Molex® terminal stick to a standard RJ45 male connector (see figure below). A female to female adapter comes together with the cable. The cable is 0.5 meter in length. See **Ordering Information**.

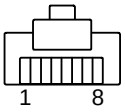

Figure 3-19 *M4KETH* Module Adapter Cable Connector – RJ45 Male – Front View

3.5.3 Rear I/O Connector [P2] for EXC-4000cPCI-002 and EXC-4000cPCI-006

For the *EXC-4000cPCI-002* and *EXC-4000cPCI-006* boards, the I/O signals from each of the four modules can be found on the optional rear connector [P2]. The pinout for these signals is detailed in Figure 3-20 and Table 3-16 on page 3-33.

Warning: **Boards with this connector should only be used with 32-bit systems. If the board is used with a 64-bit system, it will cause damage to the system.**

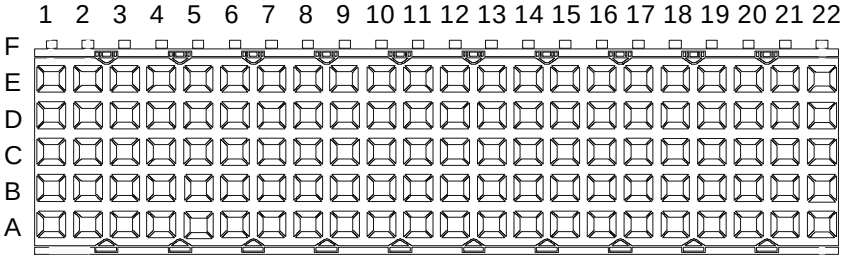

Figure 3-20 Rear I/O Connector for 32-Bit cPCI Systems – Front View

		A	B	C	D	E	F
Module 3	22	TS19[1]	TS20	TS24	TS21	TS22	GND
	21	TS15	TS16	TS23	TS17	TS18	GND
	20	TS8	TS9	TS12	TS13	TS14	GND
	19	TS4	TS5	N/C[2]	TS6	TS7	GND
	18	TS2	TS3	TS1	TS10	TS11	GND
Module 2	17	TS19	TS20	TS24	TS21	TS22	GND
	16	TS15	TS16	TS23	TS17	TS18	GND
	15	TS8	TS9	TS12	TS13	TS14	GND
	14	TS4	TS5	N/C	TS6	TS7	GND
	13	TS2	TS3	TS1	TS10	TS11	GND
	12	N/C	N/C	N/C	N/C	N/C	GND
Module 1	11	TS19	TS20	TS24	TS21	TS22	GND
	10	TS15	TS16	TS23	TS17	TS18	GND
	9	TS8	TS9	TS12	TS13	TS14	GND
	8	TS4	TS5	N/C	TS6	TS7	GND
	7	TS2	TS3	TS1	TS10	TS11	GND
	6	N/C	N/C	N/C	N/C	N/C	GND
Module 0	5	TS19	TS20	TS24	TS21	TS22	GND
	4	TS15	TS16	TS23	TS17	TS18	GND
	3	TS8	TS9	TS12	TS13	TS14	GND
	2	TS4	TS5	N/C	TS6	TS7	GND
	1	TS2	TS3	TS1	TS10	TS11	GND

Table 3-16 Rear I/O Connector for 32-Bit cPCI Systems Pinouts [P2]

1. TS1–TS24: The 24 I/O signals from each module. For the signals of each module, see **3.5.2 Front I/O Connector [J1] for all Boards** on page 3-12.
2. N/C = Not connected.

3.5.4 Rear I/O Connector [P4] for *EXC-4000cPCI6U*

On the *EXC-4000cPCI6U* board, the I/O signals from each of the four modules can be found on the rear P4 connector. The *EXC-4000cPCI6U* uses the P4 connector instead of the optional P2 connector used on the 3U board. The pinouts for this connector are detailed in Figure 3-21 and Table 3-17 on page 3-34.

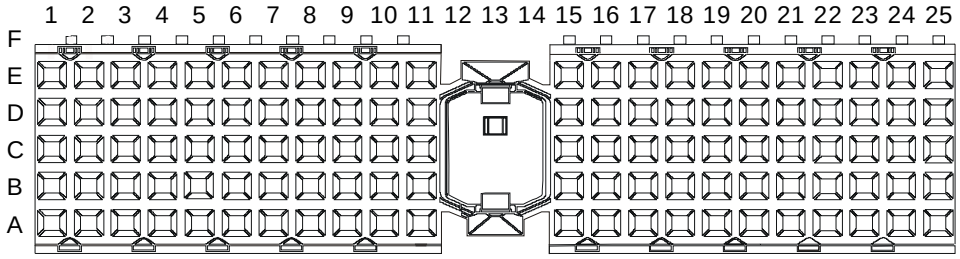

Figure 3-21 Rear I/O Connector for cPCI6U Systems – Front View

		A	B	C	D	E	F
Module 3	**25**	TS19	TS20	TS24	TS21	TS22	GND
	24	TS15	TS16	TS23	TS17	TS18	GND
	23	TS8	TS9	TS12	TS13	TS14	GND
	22	TS4	TS5	N/C[1]	TS6	TS7	GND
	21	TS2	TS3	TS1	TS10	TS11	GND
	20	N/C	N/C	N/C	N/C	N/C	GND
Module 2	**19**	TS19	TS20	TS24	TS21	TS22	GND
	18	TS15	TS16	TS23	TS17	TS18	GND
	17	TS8	TS9	TS12	TS13	TS14	GND
	16	TS4	TS5	N/C	TS6	TS7	GND
	15	TS2	TS3	TS1	TS10	TS11	GND
	12 – 14	CONNECTOR KEY					
Module 1	**11**	TS19	TS20	TS24	TS21	TS22	GND
	10	TS15	TS16	TS23	TS17	TS18	GND
	9	TS8	TS9	TS12	TS13	TS14	GND
	8	TS4	TS5	N/C	TS6	TS7	GND
	7	TS2	TS3	TS1	TS10	TS11	GND
	6	N/C	N/C	N/C	N/C	N/C	GND
Module 0	**5**	TS19	TS20	TS24	TS21	TS22	GND
	4	TS15	TS16	TS23	TS17	TS18	GND
	3	TS8	TS9	TS12	TS13	TS14	GND
	2	TS4	TS5	N/C	TS6	TS7	GND
	1	TS2	TS3	TS1	TS10	TS11	GND

Table 3-17 Rear I/O Connector for cPCI6U Systems Pinouts [P4]

1. N/C = Not connected.

3.5.5 Bus Edge Connector for PCIe

	Side B Connector		Side A Connector	
Pin	**Signal Name**	**Description**	**Signal Name**	**Description**
1	+12V	+12 volt power	PRSNT#1	Hot plug presence detect
2	+12V	+12 volt power	+12V	+12 volt power
3	RSVD	Reserved	+12V	+12 volt power
4	GND	Ground	GND	Ground
5	SMCLK	SMBus clock	JTAG2	TCK
6	SMDAT	SMBus data	JTAG3	TDI
7	GND	Ground	JTAG4	TDO
8	+3.3V	+3.3 volt power	JTAG5	TMS
9	JTAG1	+TRST#	+3.3V	+3.3 volt power
10	3.3Vaux	3.3 volt auxiliary power	+3.3V	+3.3 volt power
11	WAKE#	Link reactivation	PWRGD	Power good
CONNECTOR KEY				
12	RSVD	Reserved	GND	Ground
13	GND	Ground	REFCLK+	Reference clock, differential pair
14	HSOp	Transmitter lane, differential pair	REFCLK-	
15	HSOn		GND	Ground
16	GND	Ground	HSIp	Receiver lane, differential pair
17	PRSNT#2	Hot plug detect	HSIn	
18	GND	Ground	GND	Ground

Table 3-18 PCI Express Bus Edge Connector Pinouts

3.5.6 Bus Edge Connector for PCI

The *EXC-4000PCI* board is a 32-bit universal add-in type.

Side B Connector		
Pin	**Signal**	**Signal Name**
B1	-12V	-12V
B2	N/C[1]	N/C
B3	GROUND	GND
B4	N/C	N/C
B5	+5V	+5V
B6	+5V	+5V
B7	N/C	N/C
B8	N/C	N/C
B9	PRSNT1#[2]	PRSNT1n
B10	N/C	N/C
B11	PRSNT2#[2]	PRSNT2n
B12–B13	CONNECTOR KEY	
B14	N/C	N/C
B15	GROUND	GND
B16	CLK	CLK
B17	GROUND	GND
B18	N/C	N/C
B19	N/C	N/C
B20	AD[31]	AD31
B21	AD[29]	AD29
B22	GROUND	GND
B23	AD[27]	AD27
B24	AD[25]	AD25
B25	+3.3V[3]	+3.3V
B26	C/BE[3]#	C/BE3n
B27	AD[23]	AD23
B28	GROUND	GND
B29	AD[21]	AD21
B30	AD[19]	AD19
B31	+3.3V[3]	+3.3V
B32	AD[17]	AD17
B33	C/BE[2]#	C/BE2n
B34	GROUND	GND
B35	IRDY#	IRDYn
B36	+3.3V[3]	+3.3V
B37	DEVSEL#	DEVSELn
B38	GROUND	GND
B39	LOCK#	LOCKn
B40	PERR#	PERRn
B41	+3.3V[3]	+3.3V
B42	SERR#	SERRn
B43	+3.3V[3]	+3.3V
B44	C/BE[1]#	C/BE1n
B45	AD[14]	AD14
B46	GROUND	GND
B47	AD[12]	AD12
B48	AD[10]	AD10
B49	M66EN[4]	M66EN
B50–B51	CONNECTOR KEY	
B52	AD[08]	AD8
B53	AD[07]	AD7
B54	+3.3V[3]	+3.3V
B55	AD[05]	AD5
B56	AD[03]	AD3
B57	GROUND	GND
B58	AD[01]	AD1
B59	N/C	N/C
B60	N/C	N/C
B61	+5V	+5V
B62	+5V	+5V

Side A Connector		
Pin	**Signal**	**Signal Name**
A1	N/C	N/C
A2	+12V	+12V
A3	N/C	N/C
A4	N/C	N/C
A5	+5V	+5V
A6	INTA#	INTAn
A7	N/C	N/C
A8	+5V	+5V
A9	N/C	N/C
A10	N/C	N/C
A11	N/C	N/C
A12–A13	CONNECTOR KEY	
A14	N/C	N/C
A15	RST#	RSTn
A16	N/C	N/C
A17	GNT#	GNTn
A18	GROUND	GND
A19	N/C	N/C
A20	AD[30]	AD30
A21	+3.3V[3]	+3.3V
A22	AD[28]	AD28
A23	AD[26]	AD26
A24	GROUND	GND
A25	AD[24]	AD24
A26	IDSEL	IDSEL
A27	+3.3V[3]	+3.3V
A28	AD[22]	AD22
A29	AD[20]	AD20
A30	GROUND	GND
A31	AD[18]	AD18
A32	AD[16]	AD16
A33	+3.3V[3]	+3.3V
A34	FRAME#	FRAMEn
A35	GROUND	GND
A36	TRDY#	TRDYn
A37	GROUND	GND
A38	STOP#	STOPn
A39	+3.3V[3]	+3.3V
A40	N/C	N/C
A41	N/C	N/C
A42	GROUND	GND
A43	PAR	PAR
A44	AD[15]	AD15
A45	+3.3V[3]	+3.3V
A46	AD[13]	AD13
A47	AD[11]	AD11
A48	GROUND	GND
A49	AD[09]	AD9
A50–A51	CONNECTOR KEY	
A52	C/BE[0]#	C/BE0n
A53	+3.3V[3]	+3.3V
A54	AD[06]	AD6
A55	AD[04]	AD4
A56	GROUND	GND
A57	AD[02]	AD2
A58	AD[00]	AD0
A59	N/C	N/C
A60	N/C	N/C
A61	+5V	+5V
A62	+5V	+5V

Table 3-19 PCI Bus Edge Connector Pinouts

1. N/C = Not connected.
2. The PRSNT1# and PRSNT2# pins are configured for 25W maximum.
3. The +3.3V power pins are not currently in use.
4. M66EN is configured for 33MHz PCI clock.

3.5.7 Bus Connector [P1] for cPCI and cPCI6U

The *EXC-4000cPCI*, *EXC-4000cPCI-002*, *EXC-4000cPCI-006* and *EXC-4000cPCI6U* boards are the 32-bit universal add-in type.

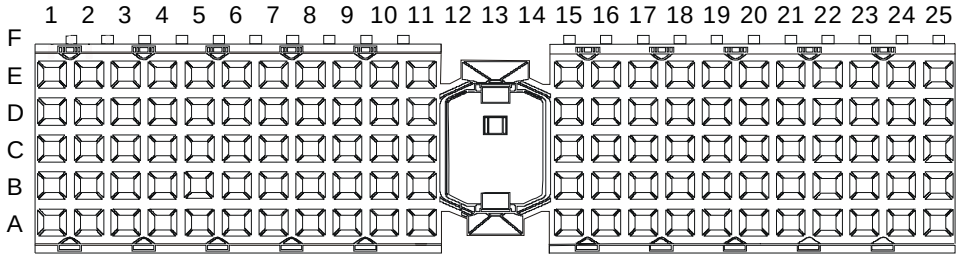

Figure 3-22 P1 Bus Connector – Front View

PIN	A	B	C	D	E	F
25	+5V	N/C[1]	N/C	+3.3V[2]	+5V	GND
24	AD[1]	+5V	N/C	AD[0]	N/C	GND
23	+3.3V[2]	AD[4]	AD[3]	+5V	AD[2]	GND
22	AD[7]	GND	+3.3V[2]	AD[6]	AD[5]	GND
21	+3.3V[2]	AD[9]	AD[8]	M66EN[3]	C/BE[0]#	GND
20	AD[12]	GND	N/C	AD[11]	AD[10]	GND
19	+3.3V[2]	AD[15]	AD[14]	GND	AD[13]	GND
18	SERR#	GND	+3.3V[2]	PAR	C/BE[1]#	GND
17	+3.3V[2]	N/C	N/C	GND	PERR#	GND
16	DEVSEL#	GND	N/C	STOP#	LOCK#	GND
15	+3.3V[2]	FRAME#	IRDY#	GND	TRDY#	GND
12–14	CONNECTOR KEY					
11	AD[18]	AD[17]	AD[16]	GND	C/BE[2]#	GND
10	AD[21]	GND	+3.3V[2]	AD[20]	AD[19]	GND
9	C/BE[3]#	IDSEL	AD[23]	GND	AD[22]	GND
8	AD[26]	GND	N/C	AD[25]	AD[24]	GND
7	AD[30]	AD[29]	AD[28]	GND	AD[27]	GND
6	N/C	GND	+3.3V[2]	CLK	AD[31]	GND
5	N/C	N/C	RST#	GND	N/C	GND
4	N/C	GND	N/C	N/C	N/C	GND
3	INTA#	N/C	N/C	+5V	N/C	GND
2	N/C	+5V	N/C	N/C	N/C	GND
1	+5V	–12V	N/C	+12V	+5V	GND

Table 3-20 cPCI Bus Connector Pinouts [P1]

1. N/C = Not connected.
2. The +3.3V power pins are not currently in use.
3. M66EN is configured for 33MHz PCI clock.

3.5.8 External Signals Connector [J2]

PCIe boards have a 9-pin micro-D External Signals Connector. All other boards have an 8-pin 2mm External Signals Connector.

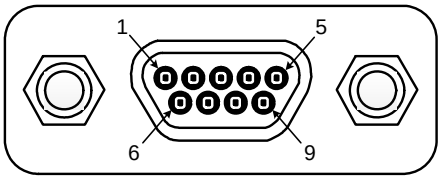

Figure 3-23 9-Pin Male Connector [J2] – Front View

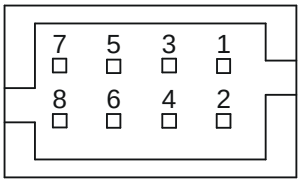

Figure 3-24 8-Pin Male Connector [J2] – Front View

Pin	Signal
1	EXTTCLKI
2	EXTTRSTn
3	EXTTCLKO
4	GND
5	RESERVED
6	IRIG B
7	SHIELD
8	EXTTRSOn
9	RESERVED (9-pin connector only)

For information about the mating connector, see **3.4 Connectors Per Board** on page 3-6.

Signal	Description
EXTTCLKI	External Time Tag Clock Input. This signal supplies an external global clock for the Time Tags of all the modules. Use this signal to synchronize the Time Tags that are implemented on the modules[1] to other boards or systems.[2] See **Time Tag Clock Select Register** on page 2-15. This signal is a standard TTL input (Vih_min = 2.0V) with a nominal 1 MHz clock of 50% duty cycle (+/-10%) in reference to the ground pin. Our internal Time Tag clock source has a 50 ppm stability.
EXTTCLKO	Global Time Tag Clock TTL Output (1 MHz). This signal is the Global Clock that is supplied to all the modules for their Time Tags. Use the signal to synchronize other boards or systems to the Time Tags that are implemented on the modules.[1] The source of this clock is either the External Time Tag Clock EXTTCLKI[2] or the Internal Time Tag Clock. See **Time Tag Clock Select Register** on page 2-15.
EXTTRSTn	External Time Tag reset TTL Input. Use this low active pulsed signal (minimum 100 nsec.wide) to simultaneously reset the Time Tags of all the modules from an external source. Use the signal to synchronize these Time Tags to other boards or systems.[2]
EXTTRSOn	Global Time Tag Reset TTL Output. This low active signal is activated by either the internal Global Time Tag signal (see Software Reset Register on page 2-13) or from the External Time Tag signal (EXTTRSOn).[2] Use the signal to synchronize other boards or systems to the Time Tags that are implemented on the modules.[1]
IRIG B	IRIG B120 Input. The signal should have the following specifications: B = 100 pulses per second (PPS), 10 msec count 1 = Sine wave carrier, amplitude modulated 2 = 1 kHz carrier wave (1 msec resolution) 0 = Binary Coded Decimal (BCD), Control Functions (CF) depending on the user application, Straight Binary Second (SBS) of day (0 – 86400) The IRIG B signal should have a 3:1 modulation ratio at 3V typical.
GND	Provides ground reference for the digital signal connections.
SHIELD	Provided for a cables shield connection. This signal is connected to the case of the computer through the boards brackets or panel.

Table 3-21 External Signals Description [Connector J2]

1. See the manual for each module for a description of how the Time Tag clock is implemented, if used, for that module.
2. See **3.5.8.1 Synchronizing with an External Source** on page 3-40 and **3.5.8.2 Synchronizing Between Boards** on page 3-41.

3.5.8.1 Synchronizing with an External Source

To synchronize a single board to an external system, the external clock source and the external reset must be connected to the EXTTCLKI and the EXTTRSTn signals respectively.

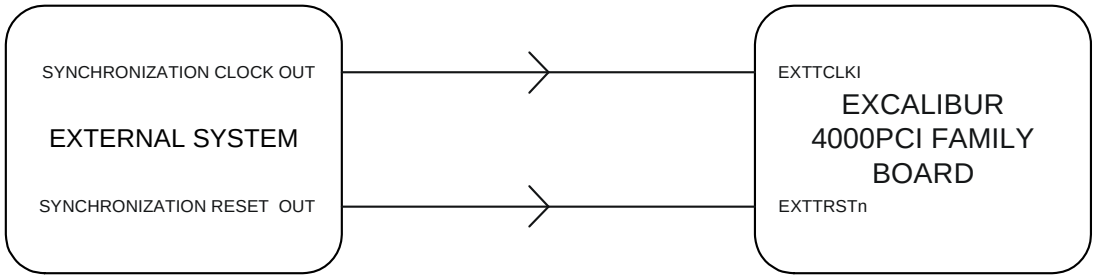

Figure 3-25 Synchronization of a Single Board to an External System

To synchronize an external system to a single *EXC-4000PCI[e]* board, the EXTTCLKO and the EXTTRSOn signals need to be connected to the external clock source and the external reset respectively.

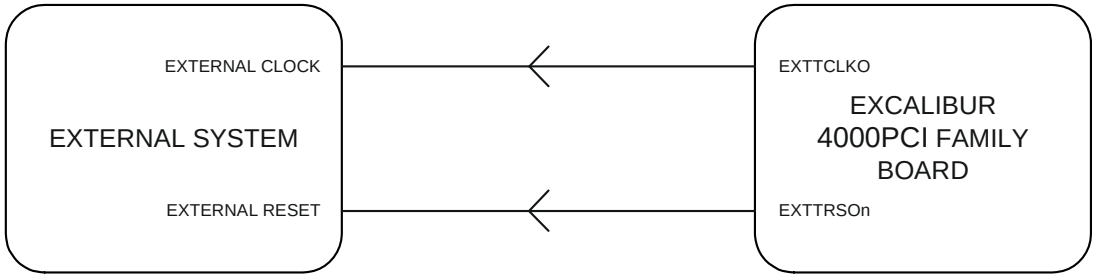

Figure 3-26 Synchronization of an External System to a Single Board

Warning: The synchronization clock and reset signals may be connected to multiple targets to achieve system wide synchronization.

3.5.8.2 Synchronizing Between Boards

To synchronize multiple boards the EXTTCLKO and the EXTTRSOn signals of one board need to be connected to all the EXTTCLKI and the EXTTRSTn signals respectively, of the remaining boards.

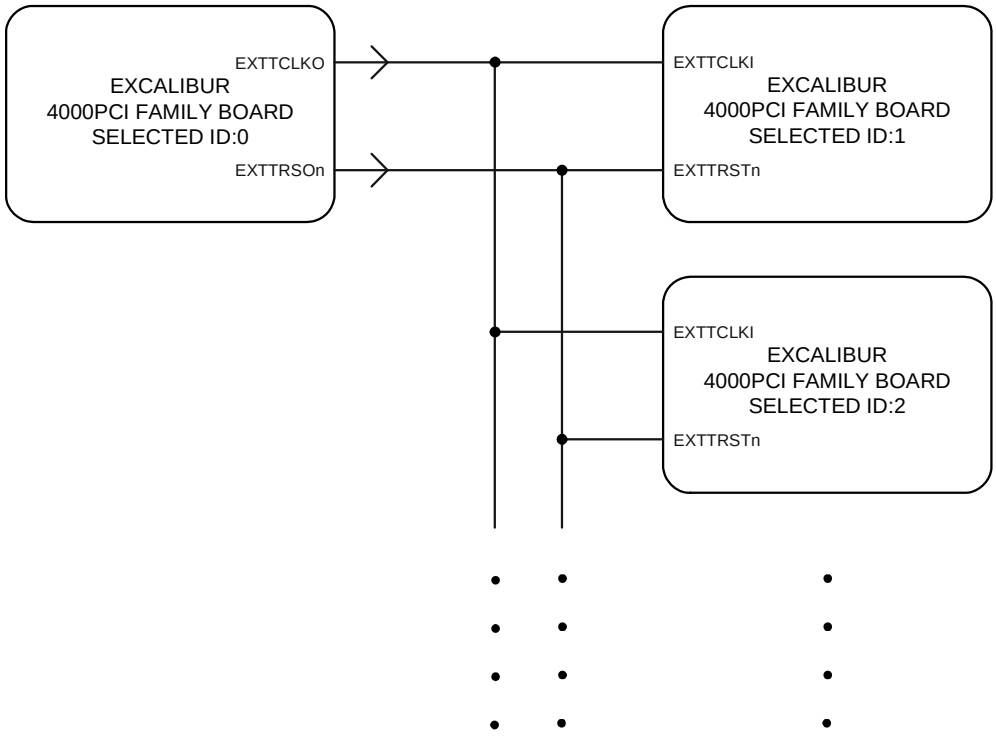

Figure 3-27 Synchronization Between Boards

3.6 Power Requirements

The PCI, PCI Express and cPCI standby power requirements, without any modules installed, are:

	+3.3V	+5V
EXC-4000PCI	N/A	150mA
EXC-4000cPCI* and *EXC-4000cPCI6U	N/A	110mA
EXC-4000PCIe[64]	480mA	N/A

When using an *EXC-4000[c]PCI* board, the power for the board and its modules is drawn from PCI bus connector.

When using an *EXC-4000PCIe[64]* board, the power for the board is drawn from the PCI Express bus edge connector and the power for its modules is drawn from the power connector [J3]. See **3.5.1 SATA Connector [J3] for EXC-4000PCIe[64] Boards (for Power Only)** on page 3-11.

The final power requirements will depend on how many and which modules are installed. To calculate the exact board power requirements, see the specific module's *User's Manual*.

4 Ordering Information

Chapter 4 explains which options to indicate when ordering.

Basic Part #	Option	Description
EXC-4000PCIe/*xx*		Multiprotocol carrier board for PCI Express (PCIe) compatible systems. **Note:** The *M4KETH* module only works with EXC-4000PCIe64, in module locations 0 and 3.
EXC-4000PCIe64/*xx*		Multiprotocol carrier board for PCI Express (PCIe) compatible systems, for 64-bit Windows
EXC-4000PCI/*xx*		Multiprotocol carrier board for PCI compatible systems
EXC-4000cPCI/*xx*		Multiprotocol carrier board for compact PCI (cPCI) compatible systems
EXC-4000cPCI/*xx-002*		Multiprotocol 3U compact PCI carrier board with rear I/O connector [P2]. **Note: For 32-bit systems only.**
EXC-4000cPCI/*xx-006*		Multiprotocol 3U compact PCI carrier board with 6U panel and rear I/O connector [P2]. **Note: For 32-bit systems only.**
EXC-4000cPCI6U/*xx*		Multiprotocol carrier board for 6U cPCI compatible systems with rear I/O connector [P4]
	-E	Extended temperature/ruggedized version. All the modules come with a ruggedized, extended temperature option (-40° to + 85°C).
	-001	With conformal coating

Table 4-1 Ordering Information

"***xx***" specifies the modules ordered with the carrier board. At present the following module options are available:

Module Code (for Ordering with Carrier Board)	Module Part # (for Ordering Separately)	Description
A*x*	**M4K429RT5**	ARINC 429 interface module: supports up to five channels.
AA*x*	**M4K429RT5**	ARINC 429 interface module for 32-bit carrier boards: supports up to five channels.
B*x*	**M4K429RT10**	ARINC 429 interface module: supports up to ten channels.
BB*x*	**M4K429RT10**	ARINC 429 interface module for 32-bit carrier boards: supports up to ten channels.
C*x*	**M4K708**	The module supports two ARINC 708/453 channels, each one selectable as either transmit or receive.

Table 4-2 M4K Module Codes and Part Numbers

Module Code (for Ordering with Carrier Board)	Module Part # (for Ordering Separately)	Description
D*x*	**M4KH009**	Double-sized H009 interface module (occupies two module locations): supports CCC, multi-PU, CCC/Concurrent PU and Bus monitor modes. Includes Concurrent Bus monitor mode.
F*x* (or G*x*)	**M4K1553Px**	MIL-STD-1553 interface module: supports BC, multiple RTs, BC/Concurrent-RT and Bus Monitor modes. Supports an Internal Concurrent Monitor in RT and BC/RT modes.
H*x*	**M4K1553PxS-1760**	Single-function MIL-STD-1760 interface module: supports single RT, BC, and Bus Monitor modes with an Internal Concurrent Monitor in RT and BC modes. Without error injection.
I*x*	**M4KDiscrete**	Discrete interface module: supports 20 bi-directional discretes with TTL (0 – 5V) or Avionic (0 – 32V) levels.
JJ*x*	**M4KSerialPlus2**	Serial interface module – supports two independent channels with RS485, RS422 or RS232 communication.
KK*x*	**M4KSerialPlus4**	Same as above with four independent channels.
L*x* (or M*x*)	**M4K1553Px-1760**	MIL-STD-1553 interface module: supports BC, multiple RTs, BC/Concurrent-RT and BM modes with MIL-STD-1760 option. Supports an Internal Concurrent Monitor in RT and BC/RT modes.
N*x*	**M4K717**	ARINC 717 interface module – supports two ARINC 717 receive channels and two transmit channels.
O*x*	**M4KCAN2**	2 independent channels of CAN 2.0 B protocol with standard and extended message frames and message identifiers.
P*x*	**M4KCAN4**	Same as above with 4 independent channels.
Q*x*	**M4KCAN6**	Same as above with 6 independent channels.
R*x*	**M4KMMSI**	Mini Munitions Store Interface (MMSI) module. Supports RT, BC/Concurrent-RT/ Concurrent Monitor and Bus Monitor modes. Up to 8 hub ports EBR-1553 (10 Mbps MIL-STD-1553 protocol using RS-485 transceivers) and 1 composite monitor output.
SA*x*	**M4K825CAN2**	ARINC 825 interface module – supports two ARINC 825 channels.
SB*x*	**M4K825CAN4**	ARINC 825 interface module – supports four ARINC 825 channels.
SC*x*	**M4K825CAN6**	ARINC 825 interface module – supports six ARINC 825 channels.
SD*x*	**M4K825CAN10**	ARINC 825 interface module – supports 10 ARINC 825 channels.
T*x*	**M4K1553PxS**	Single-function MIL-STD-1553 interface module: supports single RT, BC, and Bus Monitor modes with an Internal Concurrent Monitor in RT and BC modes. Without error injection.

Table 4-2 M4K Module Codes and Part Numbers (Continued)

Module Code (for Ordering with Carrier Board)	Module Part # (for Ordering Separately)	Description
U*x*	**M4KETH**	Ethernet interface module. The module supports 10Mhz, 100Mhz and 1Ghz full duplex UDP/IP Ethernet. This module only works with *EXC-4000PCIe64*, in module locations 0 and 3.
V*x*	**M4K1553PxM**	Monitor-only MIL-STD-1553 interface module.
Options	Add **-E** at the end of the part number for an extended temperature/ruggedized version of any module. The ruggedized version has an extended temperature range of -40º to +85º C.	
	Add **-001** at the end of the part number for conformal coating.	

Table 4-2 M4K Module Codes and Part Numbers (Continued)

More modules are in design. Check our website for the latest modules: www.mil-1553.com.

Note:

- Use the **Module Part #** if ordering separately from the carrier board.
- Use the **Module Codes** when ordering modules with the carrier board.
- The ***x*** in the **Module Code** denotes the number of consecutive modules of the same type on the board.

  Example: B2 = 2 consecutive *M4K429RT10* modules

- When ordering a board with a number of different protocol modules, the module codes must be in the following form:

  Example: EXC-4000PCI/A1B1E1G1

  The first module code in the part number is Module 0, the second is Module 1, and so on.

- If one or more empty module locations are required in between other modules, insert an asterisk (*) followed by the number of empty locations, for example, *2.

  Example 1: EXC-4000PCI/A1*2F1

  This is an *EXC-4000PCI* board with:

  1 *M4K429RT5* module at module location 0
  Empty slots at module locations 1 and 2
  1 *M4K1553Px* module at module location 3

  Example 2: EXC-4000PCIe/K2

  This is an *EXC-4000PCIe* board with:

  2 *M4KSerial4* modules at module locations 0 and 1

- The accompanying cable assembly may be order using the same module codes as used in specifying the modules on the board but with the prefix: **X4K-**

  Example: **X4K-A1F2K1** – this is the matching cable for the *EXC-4000PCI/A1F2K1* board in the example above.

- External Loopback test connectors are available for most configurations. Contact Excalibur's technical support for information about these connectors.

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