EXC-4000PCI
EXC-4000cPCI

Test and Simulation Carrier Board for PCI Systems

User's Manual

EXCALIBUR SYSTEMS

311 Meacham Ave ♦ Elmont ♦ NY 11003 ♦ tel. (516) 327-0000 ♦ fax (516) 327-4645
e:mail: excalibur@mil-1553.com website: www.mil-1553.com

Table of Contents

1 Introduction

The User's Manual supports both the *EXC-4000PCI* and the *EXC-4000cPCI* carrier boards. Unless otherwise indicated all references to the *EXC-4000PCI* also apply to the *EXC-4000cPCI*. For mechanical and electrical differences between the PCI and cPCI boards, see **Chapter 3 Mechanical and Electrical Specifications**.

1.1 Overview

The *EXC-4000PCI* is a multiprotocol PCI 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*II	Based on our 1553Px family. 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*II-1760	Same as **M4K1553P*xII*** plus MIL-STD-1760 options
M4K1553MCH	Based on our 1553MCH family. This module qualifies for airborne applications.
M4K429RT*x*	Based on our ARINC 429RxTx board. 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.
M4KDiscrete	This module supports 15 input and 5 open collector output discretes. The module supports TTL (0 to 5 volts) or avionics (0 to 32 volts) voltage levels.
M4KSerial	This module supports up to 4 independent channels of serial communications, each of which can be selected as RS485, RS422 or RS232.
M4KH009	This double size module supports a fully functional H009 channel (CCC, multi-PU,MON) and a concurrent Bus Monitor.
M4KCAN	This module supports up to 6 independent channels of CAN 2.0B protocol with standard and extended message frames and message identifiers.
M4K708	This module supports two channels of ARINC 708/453, each one selectable as either transmit or receive
M4KMMSI	Mini Munitions Store Interface module. Supports RT, BC/Concurrent-RT/ Concurrent Monitor and Bus Monitor modes. Up to 8 hub ports ERB-1553 [10 Mbps 1553 protocol using RS-485 transceivers] and 1 monitor output.

For more details about the modules and ordering information, see **Chapter 4 Ordering Information**

Excalibur will be adding modules to those listed above, increasing the *EXC-4000PCI*'s and *EXC-4000cPCI*'s 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.

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

All modules come with Windows 9*x*/NT/2000/XP drivers, including source code, a mating connector with four terminal sticks and a plastic hood.

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

EXC-4000PCI and cPCI Board Features

General Specifications

EXC-4000PCI	Half-size PCI Card
EXC-4000cPCI	Standard 3U cPCI size
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

Physical Characteristics

	PCI Board	cPCI board
Dimension	174mm – 107mm	160mm – 100mm
Weight	135g*	152g*

* without modules

Host Interface

PCI compliance:	Universal target 8/16 bit
Memory space occupied:	512 Kbytes (128K per module)
Interrupts:	INTA#
Power	Depends on configuration

IRIG B Time Code Input

Carrier wave	1KHz 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]

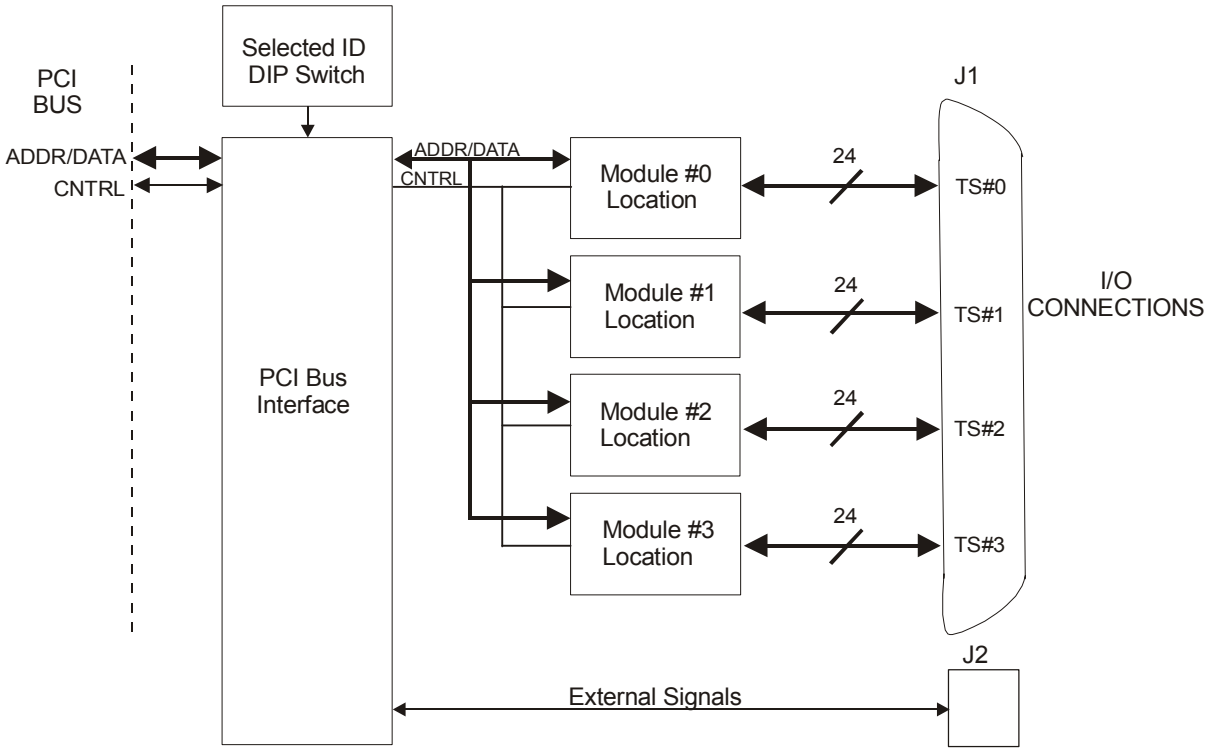

Figure 1-1 *EXC-4000PCI* Block Diagram

1.2 Installation

To operate the *EXC-4000PCI* 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 *EXC-4000PCI* board is similar to that of all PCI "Local Bus" boards. The *EXC-4000PCI* 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: Wear a suitably grounded electrostatic discharge wrist strap whenever handling the Excalibur board and use all necessary antistatic precautionary measures.

To install the *EXC-4000PCI*:

1. Make certain the computer power source is disconnected. Insert the
   - **EXC-4000PCI** board into any **PCI** compatible slot
   - **EXC-4000cPCI** board into any **cPCI** compatible slot
2. For the *EXC-4000PCI* tighten the board's PCI bracket with the slot screw, to ground the board to the computer.
3. 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.

1.2.2 Adding Excalibur Software Tools

The standard software included with the *EXC-4000PCI* card 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 for the *EXC-4000PCI* on the *Excalibur Installation CD*.

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 is 512K bytes in size and contains the memory space for the modules on the carrier board.

The second memory block is 64 bytes in size and contains the Global Registers which are explained in more detail in section **2.5 EXC-4000PCI Global Registers Map** on page 2-9.

2.2 PCI Configuration Space Header

The *EXC-4000PCI* 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.

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 = 0s)				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

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: PCI 4000 H
cPCI 4001 H

Size: 16 bits

The Device Identification register contains the *EXC-4000PCI* 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**	Always set to 1
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**	Always set to 0
01	**Memory Access Enable**	Always set to 1
00	**I/O Access Enable**	Since the *EXC-4000PCI* board does not use I/O space, the value of this register is ignored.

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**	

PCI Status Register

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 *EXC-4000PCI*.

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 *EXC-4000PCI* 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: 00 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 *EXC-4000PCI* 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 *EXC-4000PCI*.

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.

Two memory pages are required by the *EXC-4000PCI:* 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

Base Address Registers Definition

Each Base Address Register contains 32 bits:

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
00	Always 0 – indicates memory space

Base Address Register

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 *EXC-4000PCI*.

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 *EXC-4000PCI*.

2.3.16 Reserved — Address: 34–3A (H)

Power-up value: 0000000000000000 H

Size: 64 bits

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 *EXC-4000PCI*.

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 *EXC-4000PCI*.

2.4 EXC-4000PCI Module Memory Space Map

The module memory space map resides in the first memory block. Each module is allocated a space of 128KB which is mapped as shown in **Figure 2-2 Module Memory Space Map**.

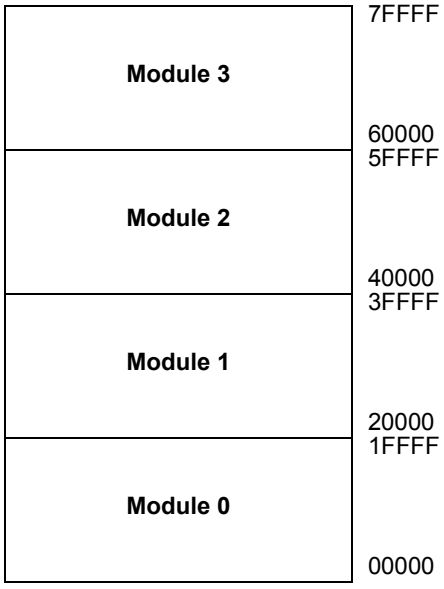

Figure 2-2 Module Memory Space Map

2.5 EXC-4000PCI Global Registers Map

The board global registers reside in the second memory block.

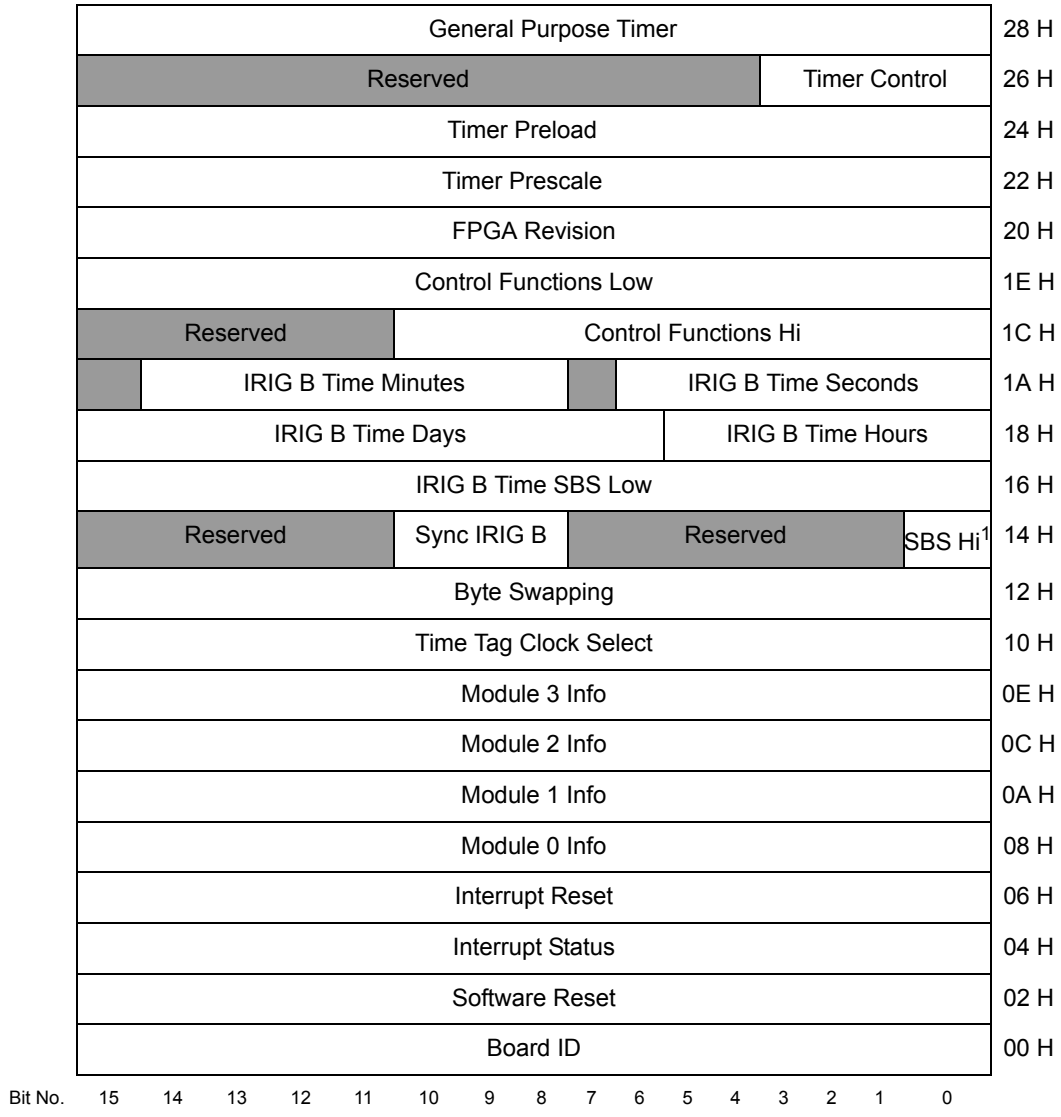

Figure 2-3 EXC-4000PCI Global and IRIG B Registers Map

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 three identification items.

Bit	Description
04-15	Hard coded to the value 400 H
00-03	Selected ID See section **3.3.1 Selected ID DIP Switch [SW1],** on page 3-4.

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 modules 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

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
04-15	Reserved – set to 0
04	1 = indicates that an interrupt was generated by the General Purpose Timer [See section **2.7 Global Timer Registers,** on page 2-16]
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

Interrupt Status Register

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

Interrupt Reset Register

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 four modules, respectively.

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 04 H = M4K429RTx module 05 H = M4K1553PxII module 06 H = M4KMMSI module 07 H = M4K708 module 09 H = M4KH009 module 0C H = M4KCAN module 0D H = M4KDiscrete module 1F H = no module installed

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 section **3.4.5 External Signals Connector J2,** on page 3-10, 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**]

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 *EXC-4000PCI*. 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]**

Byte Swapping Register

2.6 IRIG B Global Registers

The *EXC-4000PCI* is 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 section **3.4.5 External Signals Connector J2,** on page 3-10.

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 *EXC-4000PCI*.

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 2-3 EXC-4000PCI Global and IRIG B Registers Map, on page 2-9** for the location of the registers on the memory map.

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

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 2-3 EXC-4000PCI Global and IRIG B Registers Map, on page 2-9** 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

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 2-11)
		0	No effect
01	Reload mode	1	Reload mode
		0	Non-reload/One-shot mode
00	Start/Stop	1	Start
		0	Sop

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).

3 Mechanical and Electrical Specifications

Chapter 3 describes the mechanical and electrical specifications of the *EXC-4000PCI* and *EXC-4000cPCI* carrier boards.

3.1 Board Layout

3.1.1 EXC-4000PCI

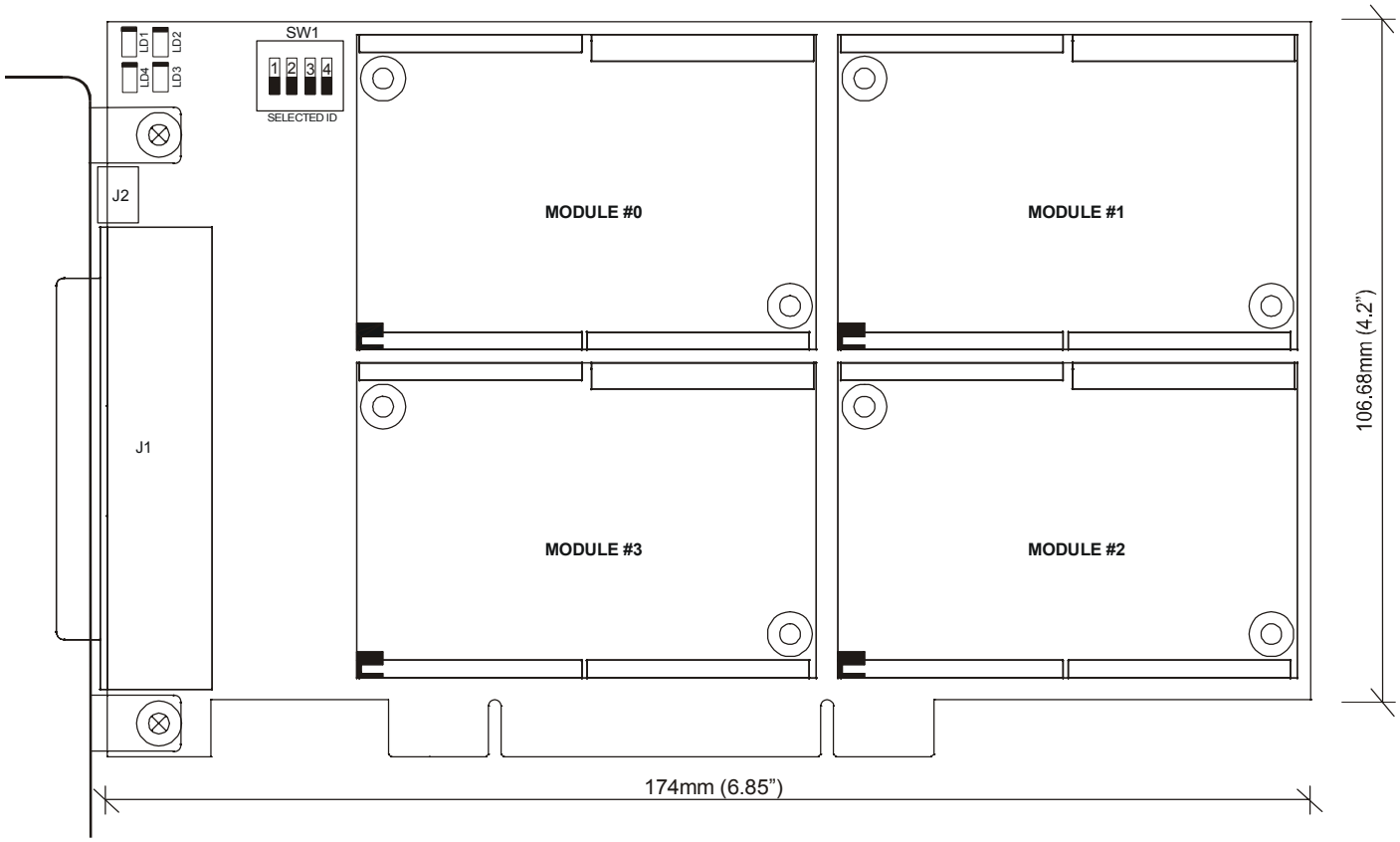

Figure 3-1 EXC-4000PCI Board Layout

3.1.2 EXC-4000cPCI

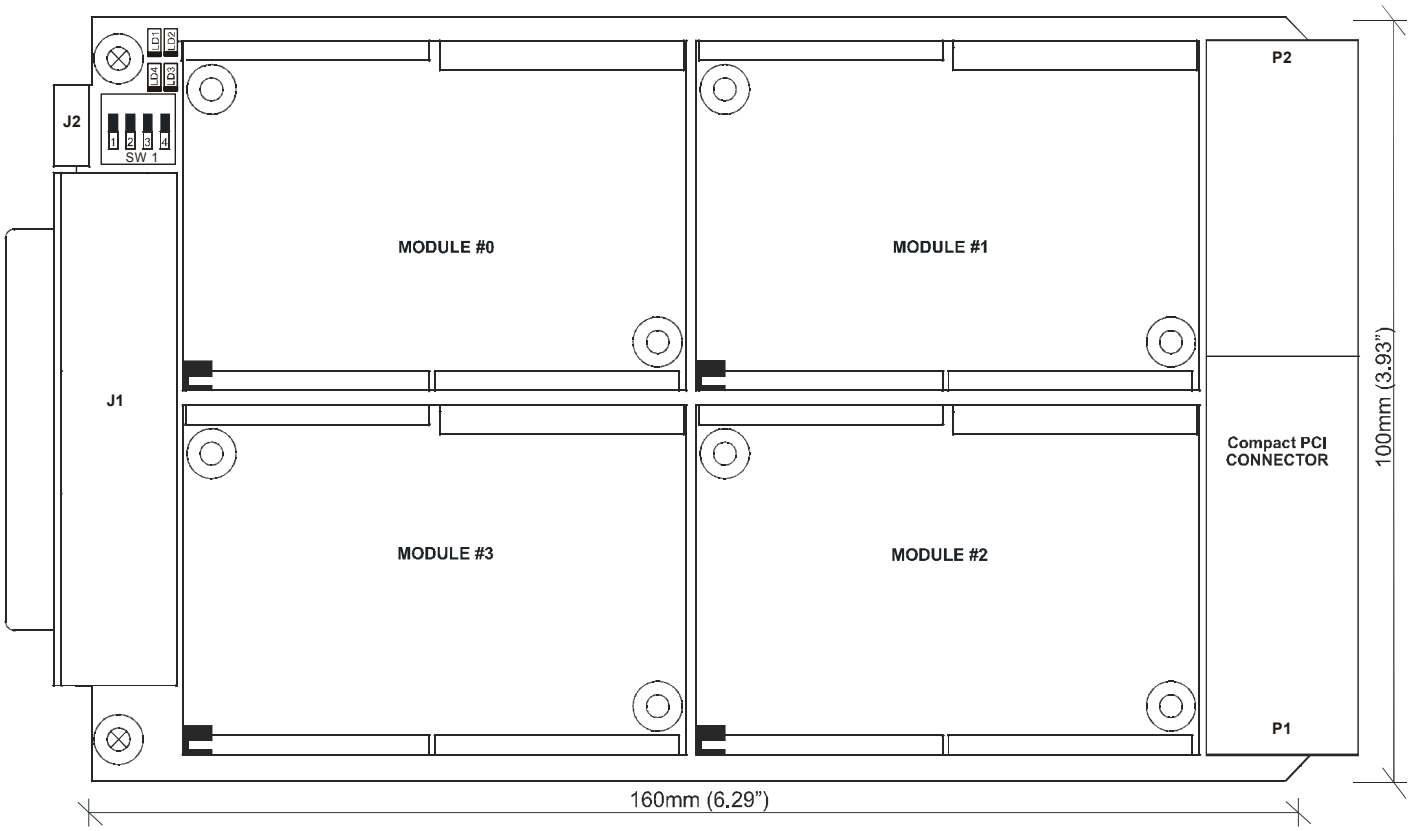

Figure 3-2 EXC-4000cPCI Board Layout

3.2 Led Indicators

The *EXC-4000PCI* contains 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

Led Indicators

3.3 DIP Switches

The *EXC-4000PCI* 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

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 3-3.

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

Note: Bits 1 and 2 are not used and should be kept closed

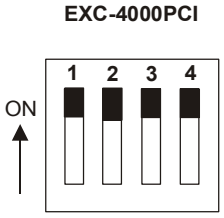

Figure 3-3 DIP Switch SW1 with all switches set to on (Select ID#0)

3.4 Connectors

The *EXC-4000PCI* and the *EXC-4000cPCI* boards contain the following connectors:

1. A **96-pin female connector** (J1) passes all the modules I/O signals. (P/N: Molex®51-26-0000).

   A Mating connector with 4 terminal sticks and a plastic hood are provided:

Molex ® 51-26-0012	Cable plug
Molex ® 51-25-1012	24-pin Terminal stick

2. For the **EXC-4000PCI,** see section **3.4.2 PCI Bus Edge Connector Pinout** on page 3-6.
   or
   For the **EXC-4000cPCI,** see section **3.4.3 cPCI Bus Mating Connector [P1]** on page 3-7 and page 3-8.
3. For the **EXC-4000cPCI only see** section **3.4.4 Rear I/O Connector for 32-bit cPCI Systems [P2] - Optional** on page 3-9 and page 3-10.
4. A 8-pin male connector (J2) provides all the external signals.

   P/N Molex ® 87333-0831

   A mating crimp housing and crimp terminals are provided:

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

   The connector pinouts and signals are described in section **3.4.5 External Signals Connector J2** on page 3-10.

3.4.1 Communications I/O Connector [J1]

This 96-pin connector is divided into four rows (or terminal sticks) of 24 pins each. Each Terminal stick is for a specific module location. All the pins in the specific Terminal Stick are defined by the individual module. See the *User's Manual* for each module.

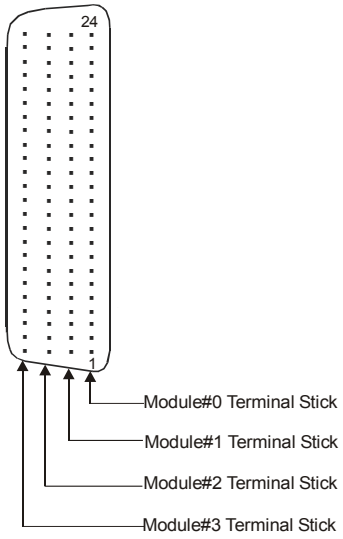

Figure 3-4 J1 Connector Layout: Front View

3.4.2 PCI Bus Edge Connector Pinout

Pin	PCI Names	Board Signal Names
B1	-12V	-12V
B2	TCK	
B3	GROUND	GND
B4	TDO	
B5	+5V	VCC
B6	+5V	VCC
B7	INTB#	
B8	INTD#	
B9	PRSNT1#	GND
B10	RESERVED	
B11	PRSNT2#	
B12 B13	CONNECTOR KEY	
B14	RESERVED	
B15	GROUND	GND
B16	CLK	CLK
B17	GROUND	GND
B18	REQ#	Arden
B19	+5V (I/O)	
B20	AD[31]	AD31
B21	AD[29]	AD29
B22	GROUND	GND
B23	AD[27]	AD27
B24	AD[25]	AD25
B25	+3.3V	+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	+3.3V
B32	AD[17]	AD17
B33	C/BE[2]#	C_BE2n
B34	GROUND	GND
B35	IRDY#	Arden
B36	+3.3V	+3.3V
B37	DEVSEL#	Devising
B38	GROUND	GND
B39	LOCK#	Locking
B40	PERR#	Preen
B41	+3.3V	+3.3V
B42	SERR#	Siren
B43	+3.3v	+3.3V
B44	C/BE[1]#	C_BE1n
B45	AD[14]	AD14
B46	GROUND	GND
B47	AD[12]	AD12
B48	AD[10]	AD10
B49	GROUND	GND
B50 B51	CONNECTOR KEY	
B52	AD[08]	AD8
B53	AD[07]	AD7
B54	+3.3V	+3.3V
B55	AD[05]	AD5
B56	AD[03]	AD3
B57	GROUND	GND
B58	AD[01]	AD1
B59	+5V (I/O)	
B60	ACK64#	
B61	+5V	VCC
B62	+5V	VCC

Pin	PCI Names	Board Signal Names
A1	TRST#	
A2	+12V	+12V
A3	TMS	
A4	TDI	
A5	+5V	VCC
A6	INTA#	INTAn
A7	INTC#	
A8	+5V	VCC
A9	RESERVED	
A10	+5V	
A11	RESERVED	
A12 A13	CONNECTOR KEY	
A14	RESERVED	
A15	RST#	RSTn
A16	+5V	
A17	GNT#	GNTn
A18	GROUND	GND
A19	RESERVED	
A20	AD[30]	AD30
A21	+3.3V	+3.3V
A22	AD[28]	AD28
A23	AD[26]	AD26
A24	GROUND	GND
A25	AD[24]	AD24
A26	IDSEL	IDSEL
A27	+3.3V	+3.3V
A28	AD[22]	AD22
A29	AD[20]	AD20
A30	GROUND	GND
A31	AD[18]	AD18
A32	AD[16]	AD16
A33	+3.3V	+3.3V
A34	FRAME#	Freeman
A35	GROUND	GND
A36	TRDY#	Trodden
A37	GROUND	GND
A38	STOP#	Stop
A39	+3.3V	+3.3V
A40	SDONE	
A41	SBO#	
A42	GROUND	GND
A43	PAR	PAR
A44	AD[15]	AD15
A45	+3.3V	+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	+3.3V
A54	AD[06]	AD6
A55	AD[04]	AD4
A56	GROUND	GND
A57	AD[02]	AD2
A58	AD[00]	AD0
A59	+5V	
A60	REQ64#	
A61	+5V	VCC
A62	+5V	VCC

Table 3-1 PCI Bus Edge Connector Pinout

3.4.3 cPCI Bus Mating Connector [P1]

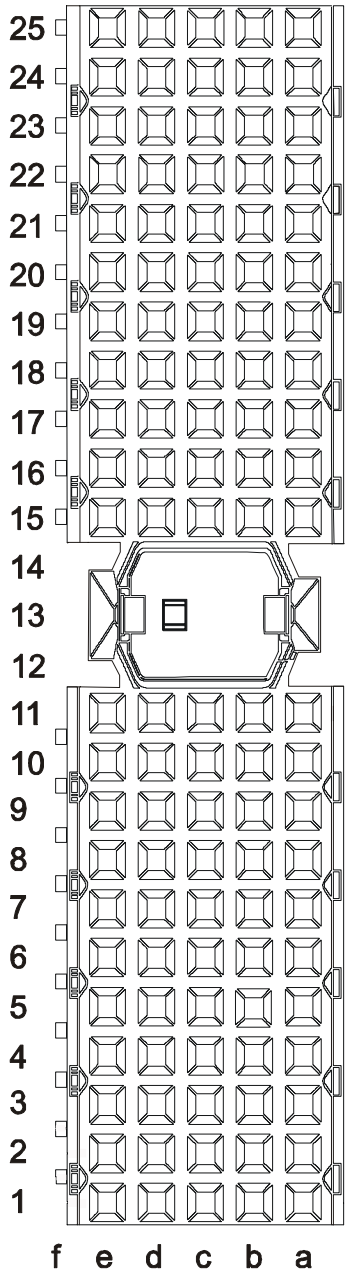

Figure 3-5 P1 Bus Mating Connector - Rear View

3.4.3.1 cPCI Bus Mating Connector Assignments [P1]

25	+5V	N/C	N/C	+3.3V	+5V	GND
24	AD[1]	+5V	N/C	AD[0]	N/C	GND
23	+3.3V	AD[4]	AD[3]	+5V	AD[2]	GND
22	AD[7]	GND	+3.3V	AD[6]	AD[5]	GND
21	+3.3V	AD[9]	AD[8]	N/C	C/BE[0]#	GND
20	AD[12]	GND	N/C	AD[11]	AD[10]	GND
19	+3.3V	AD[15]	AD[14]	GND	AD[13]	GND
18	SERR#	GND	+3.3V	PAR	C/BE[1]#	GND
17	+3.3V	N/C	N/C	GND	PERR#	GND
16	DEVSEL#	GND	N/C	STOP#	LOCK#	GND
15	+3.3V	FRAME#	IRDY#	GND	TRDY#	GND
12–14	KEY AREA					
11	AD[18]	AD[17]	AD[16]	GND	C/BE[2]#	GND
10	AD[21]	GND	+3.3V	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	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	N/C	+5V	GND
PIN	**A**	**B**	**C**	**D**	**E**	**F**

Table 3-2 cPCI Bus Mating Connector Assignments [P1]

N/C = not connected

3.4.4 Rear I/O Connector for 32-bit cPCI Systems [P2] - Optional

The I/O signals from each of the four modules can be found on the optional rear connector P2 of the *EXC-4000cPCI* board. The pinout for these signals is detailed in Figure 3-6 and Table 3-3 on page 3-10.

Warning: An *EXC-4000cPCI* with a P2 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.

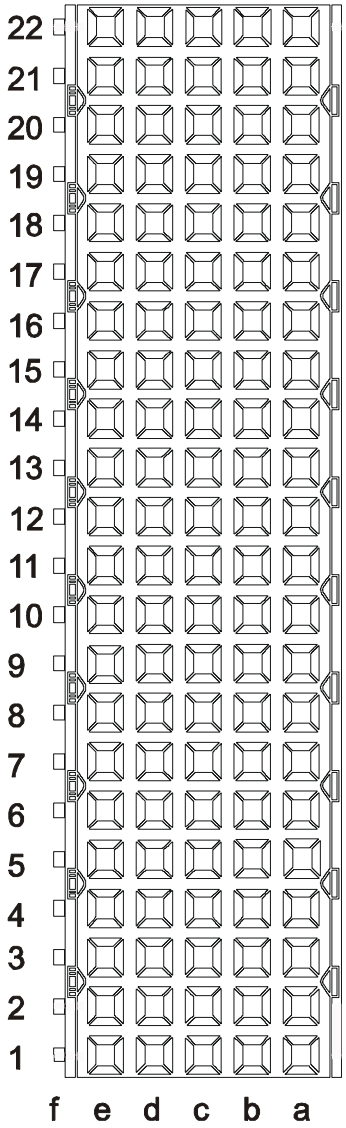

Figure 3-6 Rear I/O Connector for 32-bit cPCI Systems - Rear View

3.4.4.1 Rear I/O Connector for 32-bit cPCI Systems [P2] Pin Assignments

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

Table 3-3 Rear I/O Connector for 32-bit cPCI Systems [P2] Pin Assignments

Note: TS1-TS24: The 24 I/O signals from each module. See the specific modules *User's Manual* for descriptions of these signals.

3.4.5 External Signals Connector J2

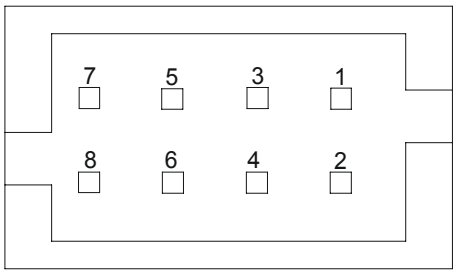

Figure 3-7 Connector J2 Pinout

Key

1	EXTTCLKI	**2**	EXTTRSTn
3	EXTTCLKO	**4**	GND
5	RESERVED	**6**	IRIG B
7	SHIELD	**8**	EXTTRSOn

Table 3-4 J2 Pin Assignments

3.4.5.1 External Signals Descriptions [Connector J2]

Signal	Description
EXTTCLKI	**External Time Tag Clock Input** (Nominal value: 1MHz). This signal supplies an external global clock for the Time Tags of all the modules. Use the 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, page 2-12.
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, page 2-12
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 each time a Global Time Tag Reset is applied. Use the signal to synchronize other boards or systems to the Time Tags that are implemented on the modules.[1] This signal is activated by either the internal Global Time Tag signal (see Software Reset Register on page 2-10) or from the External Time Tag signal (EXTTRSOn).[2]
IRIG B	**IRIG B Input** This should be a 1KHz sine wave, amplitude modulated, IRIG B signal with 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 3-5 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. **To Synchronize with External Sources**

   To synchronize a single *EXC-4000PCI* board to an external system, the external clock source and the external reset must be connected to the **EXTTCLKI** and the **EXTTRSTn** signals respectively.

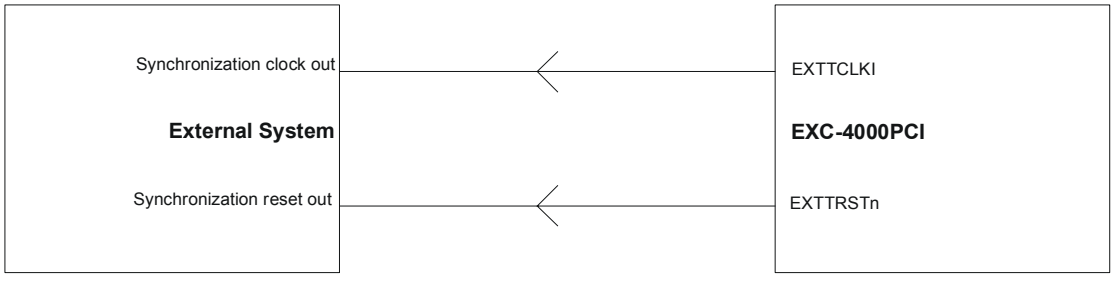

Figure 3-8 Synchronization of a single EXC-4000PCI board to an external system

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

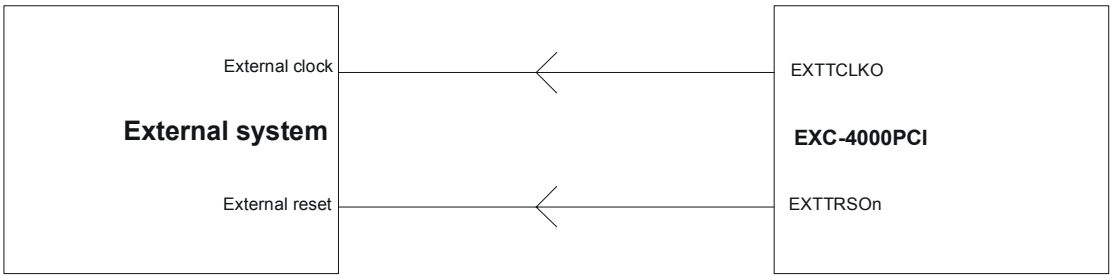

Figure 3-9 Synchronization of an external system to a single EXC-4000PCI board

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

To Synchronize Between *EXC-4000PCI* Boards

To synchronize multiple *EXC-4000PCI* boards the **EXTCLKO** and the **EXTTRSOn** signals of one board need to be connected to all the **ETTCLKI** and the **EXTTRSTn** signals respectively, of the remaining boards.

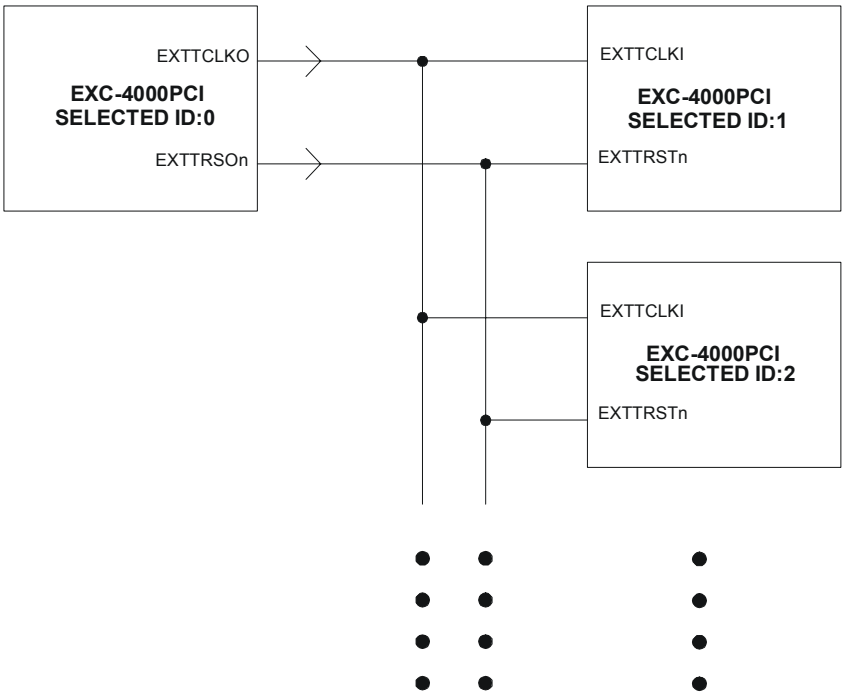

Figure 3-10 Synchronization between EXC-4000PCI Boards

3.5 Power Requirements

The *EXC-4000PCI* power requirements, without any modules installed, are:

	+3.3V	+5V	+12V	–12V
EXC-4000PCI	N/A*	150mA	15mA	15mA
EXC-4000cPCI	N/A	150mA	15mA	15mA

EXC-4000PCI and EXC-4000cPCI Power Requirements

* Rev C card also requires 30mA at 3.3V.

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 an *EXC-4000PCI* or *EXC-4000cPCI* carrier board.

Basic part #

EXC-4000PCI/*xx*	Multi-protocol interface for PCI compatible systems
EXC-4000PCI/*xx*-E	Same as above with extended temperature/ ruggedized version. All the modules come with a ruggedized, extended temperature (-40° to + 85°C) option.
EXC-4000cPCI/*xx*	Multi-protocol interface for cPCI compatible systems
EXC-4000cPCI/*xx-002*	Same as above with P2 Rear I/O connector. For 32-bit systems only
EXC-4000cPCI/*xx*-E	Same as above with extended temperature/ ruggedized version. All the modules come with a ruggedized, extended temperature (-40° to + 85°C) option.

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

Module Code	Module Part #	Description
A*x*	M4K429RT5	ARINC 429 interface module: supports up to five channels
B*x*	M4K429RT10	ARINC 429 interface module: supports up to ten channels
C*x*	M4K708	The module supports two ARINC 708/453 channels, each one selectable as either transmit or receive
D*x*	M4KH009	Double-size H009 interface module: supports CCC, multi-PU, CCC/ Concurrent PU and Bus monitor modes. Includes Concurrent Bus monitor mode
E*x*	M4K1553MCH	MIL-STD-1553 interface module: supports BC, single RT, RT/ Concurrent-BM and BM modes.
F*x*	M4K1553P*x*II	MIL-STD-1553 interface module: supports BC, multiple RTs, BC/ Concurrent-RT and BM modes. Supports an Internal Concurrent Monitor in RT and BC/RT modes
G*x*	M4K1553PM*x*	Same as M4K1553P*x*II
I*x*	M4KDiscrete	Discrete interface module: supports 15 input and 5 output discretes with TTL (0 – 5V) or Avionic (0 – 32V) levels
J*x*	M4KSerial2	Serial Interface module: supports two independent channels with RS485, RS422 or RS232 communication
K*x*	M4KSerial4	Same as above - supports four independent channels
L*x*	M4K1553P*x*II-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
M*x*	M4K1553PM*x*-1760	Same as M4K1553P*x*II-1760
O*x*	M4KCAN2	2 independent channels of CAN 2.0 B protocol with standard and extended message frames and message identifiers

Module Code	Module Part #	Description
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 module. Supports RT, BC/Concurrent-RT/ Concurrent Monitor and Bus Monitor modes. Up to 8 hub ports EBR-1553 [10 Mbps 1553 protocol using RS-485 transceivers] and 1 monitor output.

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

Note:

1. Use the Module part# if ordering separately from the *EXC-4000PCI* or *EXC-4000cPCI*.
2. The ***x*** following the module code denotes the number of modules per board.

   Example: B2 = 2 × ARINC 429 M4K429RT10 modules

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

   EXC-4000PCI/AxBxExGx

   The occupation of modules starts from the left, module location 0, to right, module location n. If an empty module location is required, insert an asterisk (*).

   Example: EXC-4000PCI/A1F2K1

   This is a EXC-4000PCI board with:
   1 M4K429RT5 module at module location 0;
   2 M4K1553P*x* modules at module location 1 and 2;
   1 M4KSerial4 module at module location 3.

   The *EXC-4000PCI*/ *EXC-4000cPCI* supports up to 4 modules.

4. 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.

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

March 2005, Rev B-3