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SST-DNP-PCI-4

Hardware Reference Guide

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This document applies to the 4-channel SST-DNP-PCI interface card.

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Preface

Preface Sections:

- Purpose of this Guide
- Conventions

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Purpose of this Guide

This guide contains technical and product-related information on the 4-channel SST-DNP-PCI interface card. This card allows applications running on a host computer to communicate with DeviceNet and other CAN-based networks.

Each channel in the card has its own CPU that executes downloadable firmware modules. For more details, refer to the relevant firmware documentation.

Conventions

This guide uses stylistic conventions, special terms, and special notation to help enhance your understanding.

Style

The following stylistic conventions are used throughout this guide:

Bold	indicates field names, button names, tab names, and options or selections
Italics	indicates keywords (indexed) or instances of new terms and/or specialized words that need emphasis
CAPS	indicates a specific key selection, such as ENTER, TAB, CTRL, ALT, DELETE
`Code Font`	indicates command line entries or text that you'd type into a field
Underlining	indicates a hyperlink
">" delimiter	indicates how to navigate through a hierarchy of menu selections/options
xxxxH	indicates a hexadecimal representation of an address or offset, where 'xxxx' is the relevant value

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Terminology

The following special terms are used throughout this guide:

card	the SST-DNP-PCI-4 interface card
firmware module	the embedded software module running on the card
host	the computer system in which the card is installed
.ss2	an encrypted firmware module for the DNP family of cards
.bin	an unencrypted firmware module
Pro Mode	Register layout used by special applications
Compatible Mode	Default startup register layout for the DNP family of cards

Special Notation

The following special notations are used throughout this guide:



Warning

Warning messages alert the reader to situations where personal injury may result. Warnings are accompanied by the symbol shown, and precede the topic to which they refer.



Caution

Caution messages alert the reader to situations where equipment damage may result. Cautions are accompanied by the symbol shown, and precede the topic to which they refer.



Note

A note provides additional information, emphasizes a point, or gives a tip for easier operation. Notes are accompanied by the symbol shown, and follow the text to which they refer.

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1
Card Overview

Chapter Sections:

- Warnings and Cautions
- Card Features
- Hardware Description

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1.1 Warnings and Cautions

The card is an electrical component and must be treated with the following precautions:



Warning

Only qualified electrical personnel familiar with the construction/ operation of this equipment and the hazards involved should install, adjust, operate, and/or service this equipment. Read and understand this guide in its entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or, in extreme cases, loss of life.



Warning

You must provide an external, hand-wired emergency stop circuit outside the programmable controller circuitry. This circuit must disable the system in case of improper operation. Uncontrolled machine motion may result if this procedure is not followed. Failure to observe this precaution could result in bodily injury.



Caution

The card contains static-sensitive components. Careless handling may severely damage the card. Do not touch any of the connectors or pins on the card. When not in use, the card should be stored in an anti-static bag. Failure to observe this precaution could result in damage to or destruction of the equipment.

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1.2 Card Features

The SST-DNP-PCI-4 offers the following features:

- 33 MHz, 32-bit PCI interface (fully compliant with PCI 2.2)
- 40 MHz AM186ER microprocessor with 256K of shared RAM on each channel
- Optically isolated CAN interface on each channel
- DeviceNet-compatible Network Status bicolor indicator for each channel
- Supports connection to non-powered (3-wire) CAN networks with external 11-25 VDC supply
- Compatible with CAN specification 2.0 part A and 2.0 part B
- Supports CAN data rates of up to 1 Mbaud
- Supports standard DeviceNet data rates of 125, 250 and 500 Kbaud



Note

Applications running on one channel do not affect the performance of other channels and do not share memory or processor resources with other channels.

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1.3 PCI Compatibility

The following table outlines the requirements of different PCI revisions and the PCI requirements of the SST-DNP-PCI-4.

Table 1: PCI Compatibility Table

PCI Revision	Supply Voltage Provided by Motherboard		PCI I/O signaling voltage level of Motherboard	
	3.3V	5V	3.3V	5V
2.1	[1]Optional	Required	Not supported	Supported
2.2	Required	Required	Supported	Supported
2.3	Required	Required	Supported	Not supported
SST Product				
SST-DNP-PCI-4	Required	Required	[2]Supported	[2]Supported

[1]Note

The SST-DNP-PCI-4 requires both 3.3V and 5V to be supplied by the host. Because 3.3V supply voltage is optional in PCI revision 2.1, the card may not function in some PCI 2.1-compliant systems.

[2] The SST-DNP-PCI-4 will auto-detect the host PCI I/O signaling level and adjust its signaling level accordingly, allowing it to function in PCI systems that support either 5V or 3.3V I/O signaling levels.

The SST-DNP-PCI-4's compatibility can be summarized as follows:

- Will operate in PCI 2.2- and 2.3-compliant systems
- Will also operate in PCI 2.1-compliant systems that have implemented the optional 3.3V supply voltage

Note

This card will function in a PCI-X slot.

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1.4 Hardware Description

The main features of the SST-DNP-PCI-4 are described in more detail in the following sections.

Figure 1: Card Components

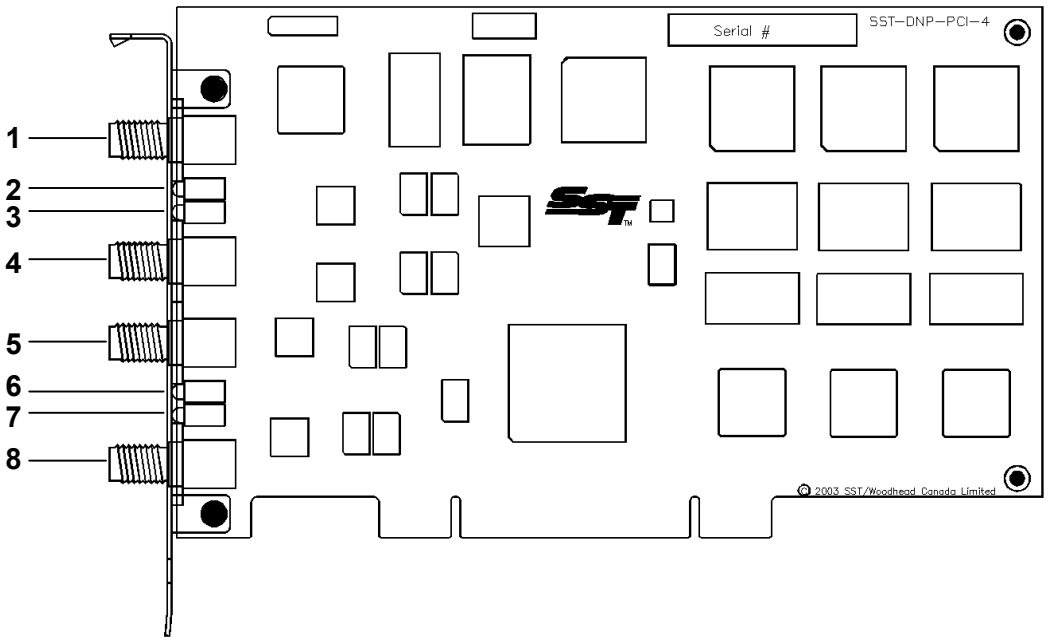


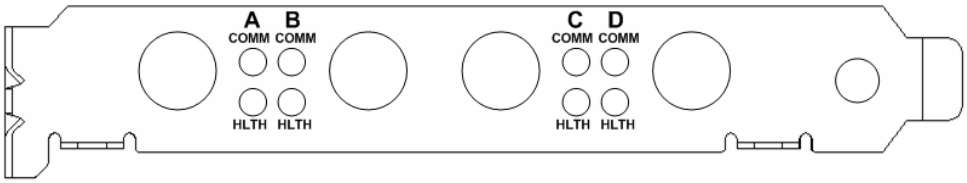
Table 2: Component Names

Feature	Description
1	Channel A DeviceNet Nano Connector
2	Channel A LEDs
3	Channel B LEDS
4	Channel B DeviceNet Nano Connector
5	Channel C DeviceNet Nano Connector
6	Channel C LEDs
7	Channel D LEDs
8	Channel D DeviceNet Nano Connector

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1.4.1 LEDs

Figure 2: Mounting Bracket – Front View



There are two bi-color LEDs on the card per channel, visible through the mounting bracket. The LED closest to the card's printed circuit board is the HLTH LED; the LED furthest from the card's printed circuit board is the COMM LED.

1.4.1.1 Health Indicator LED

The Health LED indicates the status of each channel on the card. The following table lists the three HLTH LED states and describes what each state means.

Table 3: HLTH LED Behavior

LED State	Meaning
Off	No Power
Green	Firmware module loaded and running
Red	Firmware module not loaded, an error occurred during the load, or a runtime fatal error occurred

1.4.1.2 Comm Indicator LED

The COMM LED indicates the communications status of each channel on the card.
The following table lists the four COMM LED states and describes what each state means.

Table 4: COMM LED Behavior

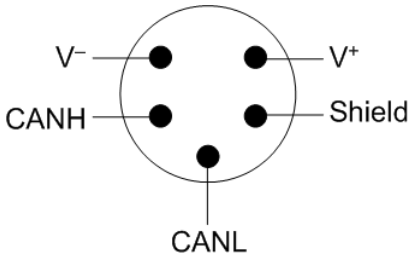
LED State	Meaning
Off	Card is not online
Solid green	Card is online and scanning an active network
Flashing green	Card is online but not scanning
Red	Bus Off or Duplicate MACID Check Failure.

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1.4.1.3 Network Connector

The PCI network connector is an M8 (Nano) connector.

Figure 3: Network Connector (Male)



1.4.1.4 V+, V-

These are the DeviceNet network power supply terminals. Connect to an external 11-25 VDC (24 VDC recommended) power supply if the network cable does not have power supply conductors. Refer to the DeviceNet Specification for power supply ratings and further information.

1.4.1.5 CANH, CANL

These are the CAN communication bus terminals. Use only shielded, twisted-pair cable. Refer to the DeviceNet Specification for more information on cable specifications.

1.4.1.6 SHIELD

Connect the network cable shield to this terminal. The shield is snubbed to the PC chassis ground, and should be connected directly to earth ground at only one point in the network.

Note

For instructions on connecting to a CAN or DeviceNet network, refer to Section 2.4, Connecting to a Network.

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2
Hardware Installation

Chapter Sections:

- System Requirements
- Handling Precautions
- Installing the Card
- Connecting to a Network

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2.1 System Requirements

To install and operate the card, the following system requirements must be met:

- An available PCI 2.2 or 2.3 slot. The card will also operate in some PCI 2.1-compliant systems. Refer to Section 1.3, PCI Compatibility, for details.
- At least one available physical interrupt

2.2 Handling Precautions

The SST-DNP-PCI-4 contains components that are sensitive to electrostatic discharge (ESD). Do not touch the card without following these precautions:



Caution

- Always follow correct ESD procedures before handling the card. We strongly recommend the use of a grounding wrist strap.
- Never touch any of the card's connectors or pins. Handle the card by its edges or bracket.
- When the card isn't in your computer, always store it in its protective ESD bag.

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2.3 Installing the Card

This section describes the steps necessary to configure and install the card in your computer.

The SST-DNP-PCI-4 is Plug & Play compatible. No DIP switches need to be set, as all required memory regions, I/O regions, and interrupts are automatically allocated by the Plug & Play BIOS.

To install the card in your computer:

1. Ensure that all power to your computer is off.
2. Adequately ground yourself, as explained in Section 2.2, Handling Precautions.
3. Unplug the power cord, modem (if applicable), and any network cables.
4. Remove the computer cover.
5. Locate a compatible PCI slot in your system (refer to Section 1.3, PCI Compatibility, for more details).
6. Take the card out of its shipping container, being careful not to touch any of the connectors or pins.
7. Slide the card into the slot and screw it down.
8. Replace the computer cover and power up your computer.

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2.4 Connecting to a Network

This section is divided into two parts: connecting to a DeviceNet network, and connecting to a CAN network.



Note

When connecting to a network, the recommended cable is Brad Harrison® Micro-Change/Nano Change 485032D12M012, 15 or 30.

2.4.1 Connecting to a DeviceNet Network

DeviceNet network connections for the SST-DNP-PCI-4 are provided through the DeviceNet M8 (Nano) Connector.

2.4.1.1 Termination Resistor

The SST-DNP-PCI-4 card does not have a built-in termination resistor. If the card is at the extreme end of the network (end of trunk), connect a 12-ohm termination resistor. This resistor can be inserted along with the DeviceNet cable. Refer to the DeviceNet Specification for more detailed information on termination requirements.

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2.4.2 Connecting to a CAN Network

Network connections are made through the DeviceNet M8 (Nano) Connector. For more information on the M8, refer to Section 1.4.1.6, Shield.

2.4.2.1 Termination Resistor

The SST-DNP-PCI-4 does not have a built-in termination resistor. You must add termination in accordance with the requirements of the target CAN network.

2.4.2.2 Power

If the CAN network does not supply power, connect an external 12-24 VDC power supply to the V+ and V- pins on the connector.

2.4.2.3 Grounding

The network shield should be connected directly to earth ground at only one point in the network.



Note

All wiring should be done in accordance with the target CAN Network. The above details are generic and intended only as basic guidelines.

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3
Hardware Register Details

Chapter Sections:

- Introduction
- SST-DNP-PCI-4 Card Configuration Registers

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3.1 Introduction

This section provides technical hardware information. The following information is intended for programmers familiar with hardware-level PC programming.

3.2 PCI Card Configuration Registers

This section provides hardware register details for the SST-DNP-PCI-4 card.



Note

Refer to the PCI specification and your particular OS documentation for the function of all other PCI configuration space registers and their typical uses.



Note

Typically, the PCI configuration space registers do not need to be written to by the host system driver. A Plug & Play BIOS and/or host operating system will ensure there are no resource conflicts in the system.

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Table 5: SST-DNP-PCI-4 Configuration Space

In this table, information relevant to the SST-DNP-PCI-4 card is bolded.

PCI CFG Register Address	Register Function 32 24 23 16 15 8 7 0				PCI Writable
0000H	**Device ID** **SST-DNP-PCI-4 = 0x0034**		**Vendor ID** **0x133D**		N
0004H	Status 0x0000		Command 0x0000		Y
0008H	Class Code 0x0280000			Revision ID Factory set	N
000CH	BIST 0x00	Header ID 0x00	PCI Latency 0x00	CacheLineSize 0x00	Y[7:0]
0010H	PCI Base Address 0 for Memory-Mapped Config Registers				Y
0014H	PCI Base Address 1 for I/O-Mapped Config Registers				Y
0018H	**PCI Base Address 2 for Local Address Space 0** **Shared RAM Access Window for all channels**				**Y**
001CH	**PCI Base Address 3 for Local Address Space 1** **I/O Space Access Window for all channels**				**Y**
0020H	PCI Base Address 4 for Local Address Space 2				Y
0024H	PCI Base Address 5 for Local Address Space 3				Y
0028H	Cardbus CIS Pointer (Not supported)				N
002CH	**Subsystem Device ID** **0x9030**		**Subsystem Vendor ID** **0x10B5**		**N**
0030H	PCI Base Address for Local Expansion ROM 0x00000000				Y
0034H	Reserved 0x00000000				N
0038H	Reserved 0x00000000				N
003CH	Max_Lat 0x00	Min_Gnt 0x00	Interrupt Pin 0x01	Interrupt Line 0x00	Y[7:0]

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3.3 DeviceNet Compatible Mode I/O Registers

Compatible Mode is the default (power-up) value for the card. The base address for this layout is PCI Base Address 3. Refer to Table 5, SST-DNP-PCI-4 Configuration Space, for more details).

Table 6: DeviceNet Compatible Mode Register Interface

Offset	Register	7	6	5	4	3	2	1	0
0	BCR0	MemEn	Bank			IntEn	IrqPending	Reserved	CardInt
1	BCR1	Win16K	Reserved	Reserved	Reserved				
2	BCR2	CardRun	WDInh	HealthGrn	Mode	Reserved			
7	AIDR	IdMode	Lock	Reserved		SEL	Di	Do	CLK
7	SIDR	IdMode	CardId						

The following subsections describe these registers in more detail.

3.3.1 Main Board Control Register - BCR0

This register is located at offset 0. Refer to Table 6, DeviceNet Compatible Mode Register Interface, for more details.

Table 7: BCR0 Register Layout

Bit	7	6	5	4	3	2	1	0
Read/Write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Reset	0	0			0	0	0	0
Name	MemEn	Bank			IntEn	IrqPending	Reserved	CardInt

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Table 8: BCR0 Bit Descriptions

Bit Name	Description
CardInt **(CINT)**	This bit is used to send interrupts to the card processor. Writing 1 generates an interrupt to the card. Writing 0 has no effect. Reading 1 indicates interrupt in progress. Reading 0 indicates interrupt complete.
Reserved	This bit is read/write for backward compatibility. This bit has no effect.
IrqPending **(IRQ)**	This bit indicates that an interrupt from the card is still pending. Writing 1 acknowledges the interrupt (and clears this condition). Writing 0 has no effect. Reading 1 indicates interrupt in progress. Reading 0 indicates interrupt complete.
IntEn **(IRQE)**	Writing 1 enables PCI interrupts. Writing 0 disables PCI interrupts (the IrqPending flag still functions as described).
Bank	The SST-DNP-PCI-4 card has 256k of memory accessible to the host. These bits select which bank of memory the host can access. In 16K mode the bank number may be 0 through 7. In 32K mode the bank number may be 0 through 7. Note A: This means that in 16K mode, only one half of the card's memory is accessible. Refer to Table 21, Pro and Compatible Mode Bank Selection. Note B: It is not necessary to use Memory Banks with the SST-DNP-PCI-4 card, as the entire 256k can be linearly accessed. Banks are supported, though, for backward compatibility. Refer to Table 21, Pro and Compatible Mode Bank Selection.
MemEn **(MEM)**	These bits indicate and control whether or not the card's shared memory will respond to host memory accesses. This may be used to multiplex several SST-DNP-PCI-4 cards at the same base address by enabling the memory on one card at a time. Writing 0 Disables card memory. Writing 1 Enables card memory.

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3.3.2 Loader/Memory Configuration Register - BCR1

This register is located at offset 1. Refer to Table 6, DeviceNet Compatible Mode Register Interface, for more details.

Table 9: BCR1 Register Layout

Bit	7	6	5	4	3	2	1	0
Read/Write	R/W	R/W	R	R/W	R/W	R/W	R/W	R/W
Reset	0	0	0	0	0	0	0	0
Name	Win16K	Reserved	Reserved	Reserved				

Table 10: BCR1 Bit Descriptions

Bit Name	Description
Reserved	Bits 0-4 are read/write for backward compatibility but perform no function. Bit 5 is read only; bit 6 is read/write for compatibility.
Win16K	This bit controls and indicates the Memory Bank Size. 0 indicates a 32K bank size. 1 indicates a 16K bank size.

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3.3.3 Loader/Memory Configuration Register - BCR2

This register is located at offset 2. Refer to Table 6, DeviceNet Compatible Mode Register Interface, for more details.

Table 11: BCR2 Register Layout

Bit	7	6	5	4	3	2	1	0
Read/Write	R/W	R/W	R	R/W	R/W	R/W	R/W	R/W
Reset	0	0	0	0	0			
Name	CardRun	WDInh	HealthGrn	Mode	Reserved			

Table 12: BCR2 Bit Descriptions

Bit Name	Description
Reserved	These bits are read/write for backward compatibility, but perform no function on the SST-DNP-PCI-4 card.
Mode	This bit controls and indicates the current mode of operation. When this bit is 1, the Pro Mode register set is selected. When this bit is 0, the Compatibility Mode register set is selected.
HealthGrn (HLTH)	This bit controls and indicates the state of the card's Health LED. When this bit is 1, and the watchdog has not timed out, the LED is green. When this bit is 0, the LED is red. When the watchdog has timed out, the LED is red.
WDInh (WDI)	This bit controls and indicates whether or not the card's watchdog is enabled. When this bit is 0, the watchdog is enabled. When this bit is 1, the watchdog is inhibited.
CardRun (RUN)	This bit controls and indicates whether or not the card's processor is running. When this bit is 0, the processor is halted. When this bit is 1, the processor is running, unless the watchdog has timed out. This bit must remain low for at least 50 μs to guarantee proper reset.

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3.3.4 Identification Register - IDR

This register is located at offset 7. Refer to Section 3.4.5 for details.

3.4 DeviceNet Pro Mode Register Interface

Pro Mode is the register layout used by special applications. The base address for this layout is PCI Base Address 3. Refer to Table 5, SST-DNP-PCI-4 Configuration Space, for more details.

Table 13: DeviceNet Pro Mode Register Interface

Offset	Register	7	6	5	4	3	2	1	0
0	CCM	Reserved				MemEn		IrqPending	CardInt
1	SP1	Reserved							
2	CCR	CardRun	WDT	FlashEn	Mode	Reserved		MCRSel	
3	MCR0	Reserved				Bank			
3	MCR1	AddrMode		Win32K		Reserved			
3	MCR2	Reserved							
3	MCR3	A19	Reserved						
4	ICR	Reserved		IrqMode		Reserved			
5	SP2	Reserved							
6	SP3	Reserved							
7	AIDR	IdMode	Lock	Reserved		SEL	Di	Do	CLK
7	SIDR	IdMode	CardId						

The following subsections describe these registers in more detail.

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3.4.1 Card Command Register – CCM

This register is located at offset 0. Refer to Table 13, DeviceNet Pro Mode Register Interface, for more details.

Table 14: CCM Register Layout

Bit	7	6	5	4	3	2	1	0
Read/Write	R	R	R	R	R/W	R/W	R/W	R/W
Reset	0				0		0	0
Name	Reserved				MemEn		IrqPending	CardInt

Table 15: CCM Bit Descriptions

Bit Name	Description
Card Int (CINT)	This bit is used to send interrupts to the card processor. Writing 1 generates an interrupt to the card. Writing 0 has no effect. Reading 1 indicates interrupt in progress. Reading 0 indicates interrupt complete.
IrqPending	This bit indicates that an interrupt from the card is still pending. Writing 1 acknowledges the interrupt (and clears this condition). Writing 0 has no effect. Reading 1 indicates interrupt in progress. Reading 0 indicates interrupt complete.
MemEn	These bits indicate and control whether or not the card's shared memory will respond to host memory accesses. This may be used to multiplex several SST-DNP-PCI-4 cards at the same base address by enabling the memory on one card at a time. Writing 01 disables card memory. Writing 10 enables card memory. Writing 11 or 00 has no effect. Reading 11 indicates that the card's memory is currently enabled. Reading 00 indicates that the card's memory is currently disabled.
Reserved	These bits are reserved for future use. Writing 0000 has no effect. These bits may read 1 or 0. Applications should mask off and ignore these bits.

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3.4.2 Card Configuration Register – CCR

This register is located at offset 2. Refer to Table 13, DeviceNet Pro Mode Register Interface, for more details.

Table 16: CCR Register Layout

Bit	7	6	5	4	3	2	1	0
Read/Write	R/W	R	R/W	R/W	R	R	R/W	R/W
Reset	0	0	0	0	0		0	
Name	CardRun	WDT	FlashEn	Mode	Reserved		MCRSel	

Table 17: CCR Bit Descriptions

Bit Name	Description
MCRSel	These bits select which Memory Configuration Register is mapped into I/O space as the MCR at Base Address + 3. 00 Selects MCR0. 01 Selects MCR1. 10 Selects MCR2. 11 Selects MCR3.
Reserved	These bits are reserved for future expansion. Always write 00 to these bits.
Mode	This bit controls and indicates the current mode of operation. When this bit is 1, the Pro Mode register set is selected. When this bit is 0, the Compatibility Mode register set is selected.
FlashEn	This bit controls and indicates whether or not the card will boot from the on-board Flash memory. This bit is provided for compatibility reasons.
WDT	This bit indicates the state of the watchdog timer. When this bit is 1, the watchdog has timed out, and the card is NOT running. You must stop and re-start the card to get it running again. If this has occurred, the card's Health LED will be RED. When this bit is 0, the watchdog has not timed out.
CardRun	This bit controls and indicates whether or not the card's processor is running. It also affects the card's Health LED. When this bit is 0, the processor is halted, and the LED is RED. When this bit is 1, the processor is running normally, and the LED is GREEN. When this bit is 1, and watchdog has timed out, processor is halted, and the LED is RED. This bit must remain low for at least 50 µs to guarantee proper reset.

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Note

FlashEn has no effect on the SST-DNP-PCI-4 family of interface cards, as they have no flash memory capabilities.

3.4.3 Memory Configuration Registers MCR 0 – 3

This register is located at offset 3. Refer to Table 13, DeviceNet Pro Mode Register Interface, for more details.

Table 18: Memory Configuration Registers

Bit	7	6	5	4	3	2	1	0
Name	The four MCR registers are mapped into Base Address + 3, according the MCRSel bits in the Card Configuration Register (CCR).							

3.4.3.1 Memory Configuration Register 0 - MCR0

Table 19: MCR0 Register Layout

Bit	7	6	5	4	3	2	1	0
Read/Write	R	R	R	R	R/W	R/W	R/W	R/W
Reset	0				0			
Name	Reserved				Bank			

Table 20: MCR0 Bit Descriptions

Bit Name	Description
Bank	The SST-DNP-PCI-4 card has 256k of memory per channel accessible to the host. These bits select which bank of memory the host can access. In 16k mode, the bank number may be 0 through 15 (or 0x0 - 0xF). In 32k mode, the bank number may be 0 through 7. The primary host interface window is located in bank 0. Note that by setting the Bank to 0 and the Bank Size to 16K, all banks can be linearly accessed in the 256K window, Bank 0 being mapped to the lowest 16K through to Bank 15, mapped to the highest 16K. Refer to Table 21, Pro and Compatible Mode Bank Selection, for more details.
Reserved	These bits are reserved for future expansion. Always write 00 to these bits.

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Memory Bank Selection

The following table describes the bit configurations of the "Bank" field in Table 20, MCR0 Bit Descriptions.

Table 21: Pro and Compatible Mode Bank Selection

Pro Mode	Pro Mode	Compatible Mode	Compatible Mode	Comment
16k Bank Size	32k Bank Size	16k Bank Size	32k Bank Size	
0	0	3	0	Host Interface
1	0	2	0	
2	1	1	1	
3	1	0	1	
4	2	N/A	2	
5	2	N/A	2	
6	3	N/A	3	
7	3	N/A	3	
8	4	N/A	4	
9	4	N/A	4	
10	5	N/A	5	
11	5	N/A	5	
12	6	4	6	Module Load Region
13	6	5	6	
14	7	6	7	
15	7	7	7	



Note

Refer to the PCI specification and your particular OS documentation for details on all other PCI configuration space registers and their typical uses.

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3.4.3.2 Memory Configuration Register 1 - MCR1

Table 22: MCR1 Register Layout

Bit	7	6	5	4	3	2	1	0
Read/Write	R	R	R	R/W	R	R	R	R
Reset	0	0	0	1	0			
Name	AddrMode		Win32K		Reserved			

Table 23: MCR1 Bit Descriptions

Bit Name	Description
Reserved	These bits are reserved for 32-bit address selection.
Win32K	These bits control and indicate the Memory Bank Size. 00 indicates a 16k Bank Size. 01 indicates a 32k Bank Size. Other sizes are not supported by the SST-DNP-PCI-4 card at this time.
AddrMode	These bits indicate the memory mode used by this card. 00 indicates 20-bit addressing. Other modes are not supported by the SST-DNP-PCI-4 card at this time.

3.4.3.3 Memory Configuration Register 2 - MCR2

Table 24: MCR2 Register Layout

Bit	7	6	5	4	3	2	1	0
Read/Write	R	R	R	R	R	R	R	R
Reset	0							
Name	Reserved							

Table 25: MCR2 Bit Descriptions

Bit Name	Description
Reserved	These bits are reserved for 32-bit and 24-bit address selection.

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3.4.3.4 Memory Configuration Register 3 - MCR3

Table 26: MCR3 Register Layout

Bit	7	6	5	4	3	2	1	0
Read/Write	R	R/W	R/W	R/W	R/W	R/W	R	R
Reset	1	0	0	0	0	0	0	0
Name	A19	Reserved						

Table 27: MCR3 Bit Descriptions

Bit Name	Description
Reserved	These bits are reserved. Always write 0 to these locations.
A19	A19 must always be set to 1.

3.4.4 Interrupt Configuration Register – ICR

This register is located at offset 4. Refer to Table 13, DeviceNet Pro Mode Register Interface, for more details.

Table 28: ICR Register Layout

Bit	7	6	5	4	3	2	1	0
Read/Write	R	R	R/W		R/W			
Reset	0	0	0		0			
Name	Reserved		IrqMode		Reserved			

Table 29: ICR Bit Descriptions

Bit Name	Description
IrqMode	These bits determine the hardware interrupt mode. 00 disables PCI interrupts. 11 enables PCI interrupts. 01 is undefined. 10 is undefined.
Reserved	Reserved bits. Always write 0.

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3.4.5 Identification Register – IDR

This register is located at offset 7. Refer to Table 13, DeviceNet Pro Mode Register Interface, for more details.

Table 30: IDR Register Layout

Bit	7	6	5	4	3	2	1	0
Reset	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**
Read/Write	R/W	R	R	R	R	R	R	R
SIDR Name	IdMode	CardID SST-DNP-PCI-4 = 0x0018						
Read/Write	R/W	R	R	R/W	R/W	R/W	R	R/W
AIDR Name	IdMode	Lock	Reserved		SEL	Di	Do	CLK

Table 31: IDR Bit Descriptions

Bit Name	Description
IdMode	This bit selects the functionality of the remaining bits in the ID Register. 1 selects Advanced ID Register (AIDR). 0 selects Simple ID Register (SIDR).
CardId	This is a 7-bit unique card identifier. A value of 0x0018 indicates that this is an SST-DNP-PCI-4
CLK	This bit controls the data clock to the card's EEPROM.
Do	This bit provides output data from the card's EEPROM.
Di	This bit is the input data to the card's EEPROM.
Sel	This bit controls the select pin on the card's EEPROM. The Lock bit must be set before the Sel bit may be enabled.
Reserved	These bits are reserved for future use. Always write 0.
Lock	This bit is a semaphore between the card processor and the host. It determines who has control of the EEPROM. Writing 1 indicates that the host would like control. Writing 0 indicates that the host no longer needs control. Reading 1 means that the host may have control. Reading 0 means that the host may NOT have control.

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4
Memory Interface

Chapter Sections:

- Application Module Header

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4.1 Application Module Header

Firmware modules for the SST-DNP-PCI-4 card are based on an event-driven kernel. This kernel provides an abstract hardware interface, startup self-diagnostics and common services, such as timers and event management.

The kernel reserves the first 128 bytes of the host interface block for loader interface and run-time status information common to all SST-DNP-PCI-4 firmware modules. This area is called the Application Module Header.

4.1.1 Data Type Descriptions

The following table describes the data types of the Application Module Header.

Table 32: Data Type Descriptions

Data Type	Description
CHAR	8-bit ASCII character, 1 byte
UINT1	unsigned integer, 1 byte
SINT1	signed integer, 1 byte
UINT2	unsigned integer, 2 bytes
SINT2	signed integer, 2 bytes
UINT4	unsigned integer, 4 bytes

4.1.2 Byte Ordering

The SST-DNP-PCI-4 interface card uses Intel-style byte ordering for multi-byte entities LSB-low address and MSB-high address. If your host system uses Motorola byte ordering (MSB-low address and LSB-high address) you must compensate for byte ordering in software.

The following macro will compensate for byte ordering in a 16-bit data entity:

```
#define SWAP_WORD (WordData) ((WordData<<8) | (WordData>>8))
```


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4.1.3 Application Module Header Layout

The following table defines the layout of the Application Module Header. The non-shaded sections of the table are common to all firmware modules for the SST-DNP-PCI-4 card. The shaded areas are either optional or the function is determined by the firmware module. Refer to the SST DeviceNet Scanner Module 3.x Firmware/DLL Reference Guide for details.

Table 33: Application Module Header Layout

Offset	Name	Data Type	Description
0000H	ModuleType	CHAR[2]	"DN" (0444eh) = card OK "ER" (04552h) = fatal error
0002H	WinSize	UINT2	Set by loader to indicate host interface window size. 0 = 16K, 1 = 32K, 2 = 64K, 3=128K
0004H	CardId	UINT2	For host application use.
0006H	Kernel Id	UINT2	Kernel identification. 0x01 = CAN 2.0A kernel 0x02 = CAN 2.0B kernel
0008H	Kernel Rev	UINT2	Kernel revision.
000aH	ModuleId	UINT2	Module Id.
000cH	ModuleRev	UINT2	Module revision.
000eH	NetSerial	UINT4	DeviceNet serial number.
0012H	CardType	CHAR[16]	Card type (i.e. "SST-DNP-PCI-4").
0022H	CardSerial	CHAR[8]	Card serial number.
002aH	IrqControl[1]	UINT2	Card interrupt control.
002cH	IrqStatusA[1]	UINT1	Card interrupt status.
002dH	IrqStatusB[1]	UINT1	
002eH	MainCode[1]	UINT2	Main Application Error Code.
0030H	CanStatus	UINT2	CAN status word.
0032H	CanTx	UINT2	CAN transmit counter. Incremented when messages are submitted to the CAN controller.
0034H	CanAck	UINT2	CAN ack error counter. Incremented when a transmit message is aborted due to lack of acknowledgment from other stations. When CanAck is incremented, CanTx is decremented to compensate for messages not actually transmitted.
0036H	CanRx	UINT2	CAN receive counter. Incremented when messages are received. Messages that fail the receive filter still increment CanRx.
0038H	CanError	UINT2	CAN communication error counter. Incremented when a CAN frame error is detected.
003aH	CanLost	UINT2	CAN lost messages counter. Incremented when a CAN message is received before the previous one is queued.
003cH	CanOverrun	UINT2	CAN receive queue overrun counter. Incremented when a CAN message is lost due to a full receive queue.

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003eH	AddCode[1]	UINT2	Additional Application Error Code.
0040H	Message	CHAR[64]	When ModuleType is "DN", contains the module identification string. When ModuleType is "ER", contains the kernel error string.
0080H	Application[1]	Undefined	Application host interface. The format of this area is defined by the firmware module.

[1] Format / meaning defined by the firmware module. See module documentation.

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A

Error Messages

Appendix Sections:

- Introduction
- IDR Messages
- Card Error Messages

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A.1 Introduction

The following errors may be reported during the card's startup self-test. Error messages are posted in the message area (0040H) of the host interface and can be displayed using the status applications provided with the card. Refer to Section 4.1.3, Application Module Header Layout, for more kernel error information (Module Type, MainCode and AddCode).

A.2 IDR Messages

If the IDR register reads anything other than 0018H, the card hasn't been found. If you continue to experience difficulties, contact technical support (refer to Section D.3, Technical Support, for details).

A.3 Card Error Messages

Fatal failures during startup are accompanied by one of the following 8-bit fault codes, flashed on the HLTH LED.

These errors may be reported by the card either during its startup self-test or if a run-time fatal error is encountered. An error message reported by the card is placed in the message area (0040H) of the host interface and can be displayed using the status applications provided with the interface card.

Error 1: RAM data test failed

An error occurred during testing of the RAM data bus. The card should be returned for repair.

Error 2: RAM address test failed

An error occurred during testing of the RAM address bus. The card should be returned for repair.

Error 3: RAM A16 address test failed

An error occurred during testing of the RAM A16 signal. The card should be returned for repair.

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Error 4: RAM A17 address test failed

An error occurred during testing of the RAM A17 signal. The card should be returned for repair.

Error 5: Module checksum is invalid

The firmware module is invalid. Each firmware module has a checksum to verify file integrity. Since the checksum is validated by the loader, the most likely cause of this error is an undetected memory failure.

If this error occurs with more than one firmware module, the card should be returned for repair.

Error 6: CAN reset flag failed to clear

An error occurred testing the CAN controller. The card should be returned for repair.

Error 7: CAN data test failed

An error occurred testing the CAN controller data bus. The card should be returned for repair.

Error 8: CAN address test failed

An error occurred testing the CAN controller address bus. The card should be returned for repair.

Error 9: Invalid NVRAM data

The non-volatile memory on the card contains invalid information. The card should be returned for repair.

Error 10: Execution permission denied

This card has not been configured to execute the firmware module. Contact the vendor of the firmware module for assistance. See the Software Reference Guide for information on application security.

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Error 11: Application initialization error

An error occurred while initializing the firmware module. Report this condition to the vendor of the firmware module.

Error 12: Unknown application initialization code

An error occurred while initializing the firmware module. Report this condition to the vendor of the firmware module.

Error 13: Application terminated

The firmware module terminated (abnormal condition). Run the status utility provided and record the results. Report this condition to the vendor of the firmware module.

Be sure to record the Main and Additional error codes, as these will identify the exact source of the error.

Error 14: Application fatal error

A fatal runtime error occurred. Run the status utility provided and record the results. Report this condition to the vendor of the firmware module.

Be sure to record the Main and Additional error codes, as these will identify the exact source of the error.

Errors 15 - 21: XXX interrupt

An unexpected interrupt was detected. This error should be reported to the vendor of the firmware module. Make note of the circumstances that caused this error.

Error 22: Event queue overflow

This error should be reported to the vendor of the firmware module. Make note of the circumstances that caused this error.

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Error 23: Nested user timer interrupt

This error should be reported to the vendor of the firmware module. Make note of the circumstances that caused this error.

Error 24: Invalid CAN interrupt

This error should be reported to the vendor of the firmware module. Make note of the circumstances that caused this error.

Error 25: Nested system timer interrupt

This error should be reported to the vendor of the firmware module. Make note of the circumstances that caused this error.

Error 26: Imperfect interrupt

This error should be reported to the vendor of the firmware module. Make note of the circumstances that caused this error.

This error is caused by an incorrectly generated interrupt from the host to the card.

Error 27: Stack Overflow

This error should be reported to the vendor of the firmware module. Make note of the circumstances that led up to and followed this error.

Error 99: Unexpected condition encountered

A fatal runtime error occurred. Run the status utility provided and record the results. Report this condition to the vendor of the firmware module.

Be sure to record the MainCode and AddCode, as these will identify the exact source of the error. Refer to Section 4.1.3, Application Module Header Layout, for more details.

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B

Technical Specifications

Appendix Sections

- Technical Specifications

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B.1 Technical Specifications for the Card

The following tables list the environmental, network and PCI bus specifications for the SST-DNP-PCI-4.

Table 34: Environmental Specifications

Ambient Conditions	Storage temp:	-25°C to 70°C
	Operating temp:	0°C to 50°C
	Operating Humidity:	5% to 90% non-condensing
Typical Current Draw		+5V +/- 5%, 250 mA (typical) +3.3V +/- 5%, 450 mA (typical)
PCI Compliance		PCI Spec 2.2 compliant. Refer to Section 1.3, PCI Compatibility, for more information.

Table 35: Network Specifications

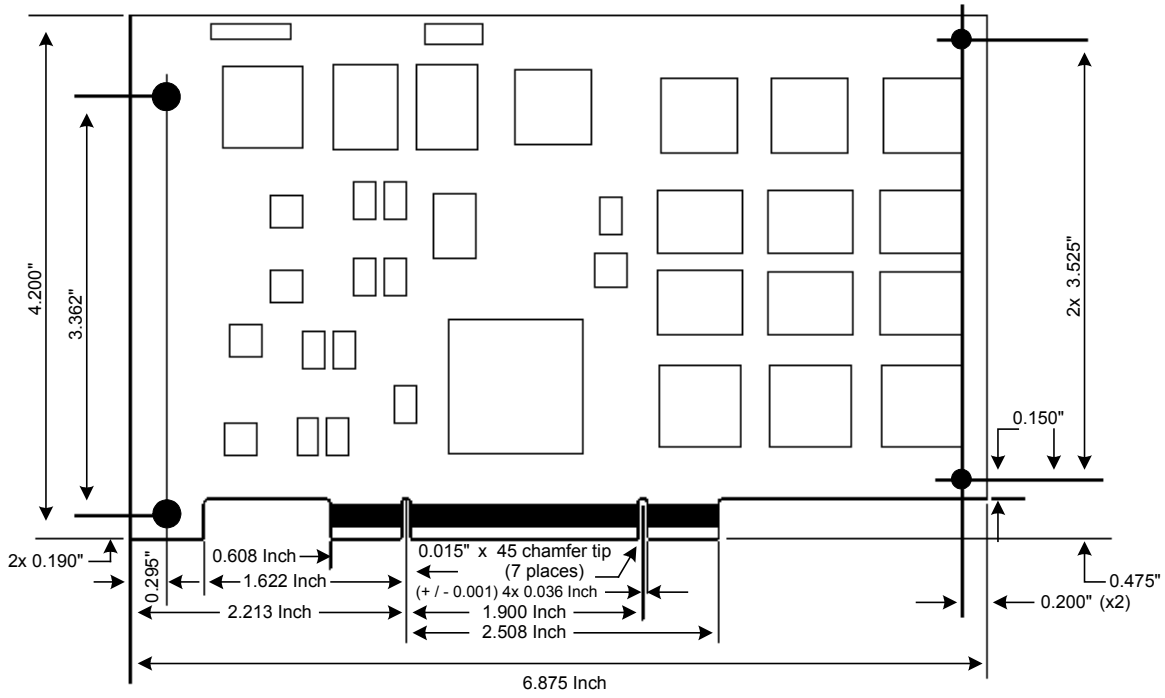
Isolation	500V
External Power	11-25 VDC, 50mA (per channel typical)
Protocol	CAN 2.0A or CAN 2.0B
Data Rate	125K, 250K and 500K baud (DeviceNet), up to 1Mbaud for CAN

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Table 36: PCI Bus Specifications

Size	Standard half-length, 32-bit, 33MHz, universal PCI card
Resources	(memory) a single 1M location located anywhere in PCI address space (I/O) a single 32-byte range for DNP command interface (memory) 128 bytes for PCI configuration

Figure 4: Card Dimensions



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C
Loading a Firmware Module

Appendix Sections:

- Loading a Firmware Module



Note

This appendix describes how to load the card manually, or how to write your own loader. If you are using a Windows loader provided by Woodhead, the following instructions are not required.

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C.1 Loading a Firmware Module

Firmware modules for the card are supplied as .ss2 or .bin files. These files are part of the 32-bit install and are found on the software CD-ROM or on the website at http://www.mysst.com/.

If you are developing a driver for the card or producing a stand-alone embedded application, the following section describes the basic sequence of steps to manually load a firmware module onto the SST-DNP-PCI-4 card.



Note

These instructions assume a 16K memory window is used and that the card is operating with Compatible Mode registers.



Note

For register descriptions, refer to Chapter 3, Hardware Register Details.

C.1.1 Test for Card at I/O Port Address Specified

1. Write 0x00 to the BCR2 configuration register.
2. Write 0x00 to BCR1.
3. Write 0x06 to BCR0.
4. Read BCR0; it should contain 0x02. If it doesn't, there is a card error. Either the card hasn't been found, or it's faulty.
5. Write 0x00 to BCR0.
6. Read BCR0. It should contain 0x00. If it doesn't, there is a card error. Either the card hasn't been found, or it's faulty.
7. (Optional) Read IDR. This register should contain the appropriate CardID (refer to Section 3.4.5, Identification Register - IDR).

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C.1.2 Check for Conflicting RAM

1. Read a word from the target address and save it.
2. Write 0xAA55 to the target address.
3. Read the target address. It should not contain 0xAA55.
4. If the result is 0xAA55, restore the saved contents of the target address and abort the load procedure. Refer to Section C.1.10, If Something Goes Wrong, for further instructions.
5. Repeat steps 1-3 for the entire target address block.

C.1.3 Enable and Test Card RAM

1. Write MemBase in BCR1 to set the card RAM base address.
2. Set MemEn in BCR0 to enable card memory.
3. Select the memory bank as required by writing to Bank in BCR0.
4. Fill the memory bank with a test pattern.
5. We recommend storing the byte offset as a 16-bit value in each word of memory (for example, write 0x0000 to the first word, 0x0002 to the next word and so on).
6. Read and verify the test pattern written in step 4.
7. If the memory test fails, abort the load procedure. Refer to section C.1.10, If Something Goes Wrong, for further instructions.
8. Fill the memory bank with 0.
9. Repeat steps 3-7 for all other memory banks.

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C.1.4 Load the Firmware Module

Select the memory bank as required in the following steps by writing to Bank in BCR0.

1. Write the firmware module to banks 4, 5, 6 and 7.
2. The application binary file is 65535 bytes long; the last byte of bank 7 is unused.
3. Calculate the sum of all of the bytes in banks 4, 5, 6 and 7, except the last byte of bank 7 (unused). The least significant byte of the result should be zero.

C.1.5 Enabling Physical Interrupts

Set IntEn in BCR0 to enable physical interrupt generation. A physical interrupt will be generated after the firmware has been loaded and the CPU has been reset.

C.1.6 Start the Firmware Module

1. Set WDInh in BCR2 to disable the watchdog timer.
2. The card self-diagnostic will fail if the watchdog is enabled during startup.
3. Toggle (clear, set) CardRun in BCR2 twice to start the card processor.
4. Start a timeout timer (typically 1-2 seconds).
5. Wait until ModuleType in the Application Module Header is set to either ‘DN’ or ‘ER’, or the timeout timer expires.

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C.1.7 Check Module Startup Results

1. If ModuleType in the Application Module Header does not contain ‘DN’ or ‘ER’, the firmware module failed to start.
2. Refer to Section C.1.10, If Something Goes Wrong, for further instructions.
3. If ModuleType contains ‘ER’, the card diagnostic has detected an error.
4. The error string in the Message area of the Firmware module Header provides details. Refer to Section C.1.10, If Something Goes Wrong, for further instructions.
5. If ModuleType contains ‘DN’ the card processor is operating correctly.

C.1.8 Test Interrupt Generation

The module startup process generates a test interrupt.

1. Read BCR0 and verify that IrqPending is set.
2. If an interrupt handler was installed, verify that the test interrupt was received.
3. Set IrqPending in BCR0 to clear the interrupt latch.

C.1.9 Successful Completion

1. Clear WDInhibit in BCR2 to enable the watchdog timer.
2. Set HealthGrn in BCR2 to change the Health LED from red to green.
3. If interrupts are required, set IrqPending in BCR0 to enable physical interrupt generation.

C.1.10 If Something Goes Wrong

1. Write 0x00 to each of the configuration registers (BCR0, BCR1 and BCR2).
2. Report the main code and additional code error message to the user.

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D
Warranty and Support

Appendix Sections:

- Warranty
- Reference Documents
- Technical Support

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D.1 Warranty

For warranty information pertaining to the card, refer to http://www.mysst.com/warranty.asp.

D.2 Reference Documents

DeviceNet Specification, Volume 1, Release 2.0, Errata 5
ODVA Publication, March 2002

PCI Local Bus Specification 2.2

PCI Special Interest Group, December 1998

PCI9030 Datasheet v.1.4
PLX Technology Publication, May 2002

D.3 Technical Support

Please ensure that you have the following information readily available before calling for technical support:

- Card type and serial number
- Computer's make, model and hardware configuration (other cards installed)
- Operating system type and version
- Details of the problem you are experiencing: firmware module type and version, target network and circumstances that may have caused the problem

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D.3.1 Getting Help

For technical support, please contact the office closest to your time zone, or visit our website at http://www.mysst.com/. Documentation and software updates are also available on the website.



Note

If you are using the card with a third-party application, refer to the documentation for that package for information on configuring the software for the card.

North America

Canada:
Tel: 519-725-5136
Fax: 519-725-1515
Email: techsupport@mySST.com

Europe

France:
Tel: 33-2-32-96-04-20
Fax: 33-2-32-96-04-21
Email: supportfr@applicom-int.com

Germany:
Tel: 49-711-782374-0
Fax: 49-711-782374-11
Email: infode@applicom-int-com

Italy:
Tel: 30-9-10-59-30-77
Fax: 39-10-59-56-925
Email: imainfo@imaweb.it

United Kingdom:
Tel: 44-1495-35-04-36
Fax: 44-1495-35-08-77
Email: contact@wdhd.co.uk

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