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5136-DNP-CPCI

Hardware Reference

Version 1.0



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Publication Name : dnp-cpci.doc
Publication Revision: 1.0
Date Printed: 7/21/99

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--This Document Applies To --
5136-DNP-CPCI Interface Card

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1. Introduction

1.1 Purpose of this Document

This document is a hardware reference manual for the 5136-DNP-CPCI interface card.

The 5136-DNP-CPCI has its own CPU that executes downloadable application software modules. Each of these software modules has an accompanying manual that describes its operation.

1.2 5136-DNP-CPCI Overview

The 5136-DNP-CPCI is a CompactPCI interface card for communication with DeviceNet and other CAN-based networks.

The main features of the 5136-DNP-CPCI are:

- 33 MHz, 32 bit CompactPCI interface (fully compliant with PCI 2.1 Spec and CompactPCI 2.0 R2.1 spec)
- 40 MHz AM186EM microprocessor with 256K RAM
- 256K shared RAM
- Optically isolated CAN interface
- DeviceNet compatible 5-pin CAN connector
- DeviceNet compatible Network Status bicolor indicator
- Supports connection to non-powered (3 wire) CAN networks with external 12-24 VDC supply
- Compatible with CAN specification 2.0 part A
- Supports CAN data rates up to 1 Mbaud
- Supports standard DeviceNet data rates 125, 250 and 500 Kbaud

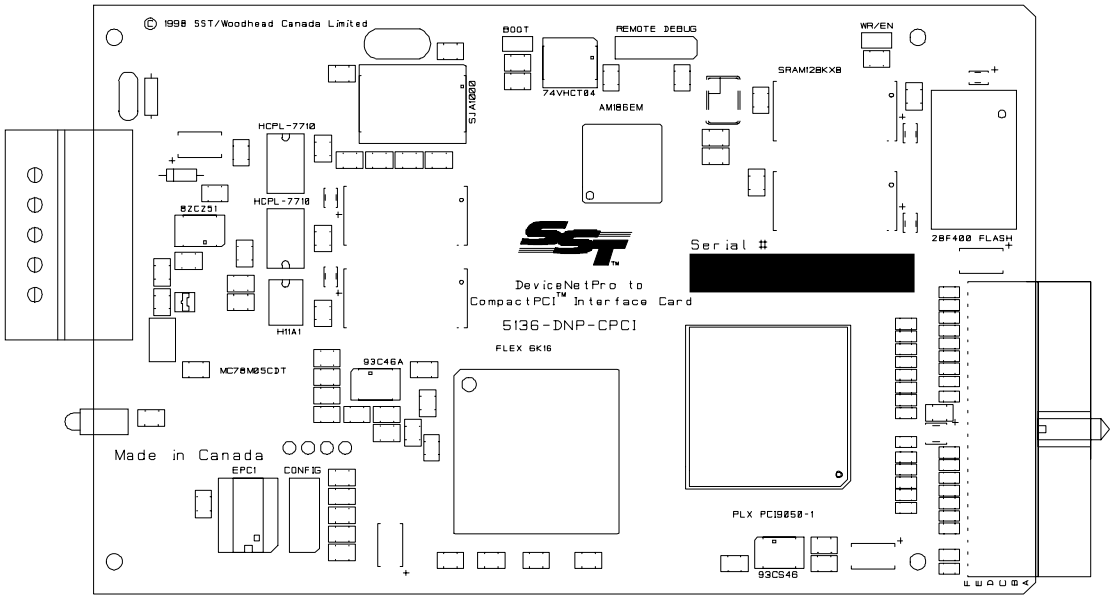
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2. Hardware Description

2.1 Overview

The 5136-DNP-CPCI is a 3U small form factor 32-bit CompactPCI interface card. The main features of the card are described in detail in the following sections.



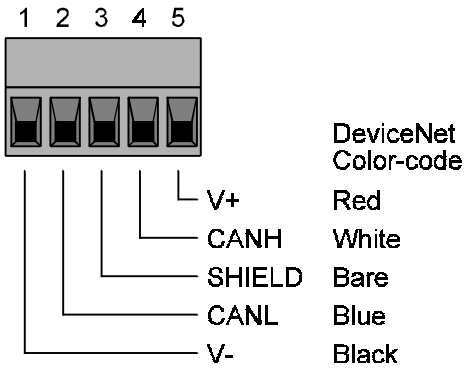
2.2 Connectors

2.2.1 CompactPCI Edge Connector

The CompactPCI connector can plug in to any 5V CompactPCI motherboard connector. The 5136-DNP-CPCI does not require that the motherboard connector supply 3.3V power. The 5136-DNP-CPCI will not plug in to 3.3V-only PCI connectors.

2.2.2 CAN Connector (CN1)

The CAN connector, a standard 5-pin removable connector, conforms to the standard DeviceNet pinout.



2.2.2.1 V+, V-

These are the DeviceNet network power supply terminals. Connect to an external 11-25 VDC power supply if the network cable does not have power supply conductors.

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2.2.2.2 CANH, CANL

These are the CAN communication bus terminals. Use only shielded twisted pair cable.

2.2.2.3 SHIELD

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

2.2.3 Test Points (TP1, TP2)

Test Point	Test Point Description
TP1	+5V
TP2	Ground

2.3 Indicators

2.3.1 Health Indicator

The Health indicator is a DeviceNet compliant bicolor LED indicating the status of the 5136-DNP-CPCI card.

Color	Status
Off	No Power
Green	Application module loaded and running
Red	Application module not loaded, an error occurred during the load, or a runtime fatal error occurred

2.3.2 Health Indicator (Health)

The Health indicator is a bicolor LED indicating the status of the 5136-DNP-CPCI interface card.

Color	Status
Off	No Power
Green	Application module loaded and running
Red	Application module not loaded, an error occurred during the load, or a runtime fatal error occurred

2.3.3 Network Status Indicator (Comm)

The Network Status indicator is a bicolor LED indicating the status of the communication channel. The meaning of this LED is determined by the currently loaded application module. Refer to the application module's reference guide for more details.

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3. Hardware Installation

3.1 Introduction

This section describes the steps necessary to configure and install the 5136-DNP-CPCI.

The 5136-DNP-CPCI is plug-and-play compatible. No DIP-switches need to be set since all required memory regions, I/O regions, and interrupts are automatically allocated by the Plug&Play BIOS.

3.2 Installing the card

To install the 5136-DNP-CPCI in your computer:

1. Turn the CompactPCI system off.
2. Wear an anti-static strap for the remaining steps.

   If an anti-static strap is not available, leave the power cord connected and try to keep in contact with the metal case of your CompactPCI system to eliminate the possibility of damaging the 5136-DNP-CPCI.
3. Locate an unused CompactPCI slot in your system.
4. Take the 5136-DNP-CPCI out of the anti-static bag, touching only the edges of the card. Do not touch the header pins or the surface of the board.
5. Slide the 5136-DNP-CPCI card into an available slot in the CompactPCI system.

3.3 Connecting to a DeviceNet Network

Connect either a DeviceNet Trunk or Drop cable to the 5-pin connector according to the color code in section 2.2.2. Make sure that all strands of wire go into the connector as bent strands may cause shorts to the adjacent terminal.

Directly connecting DeviceNet Trunk cable is not recommended due to the mechanical stress placed on the connector by the heavy trunk cable. If you must attach trunk cable, secure it so no undue stress is placed on the 5-pin connector.

3.3.1 Termination Resistor

The 5136-DNP-CPCI does not have a built-in termination resistor. If the card is at the extreme end of the network (end of trunk), connect a 120 ohm termination resistor from pin 2 to pin 4 of the 5-pin connector (providing there are not already 2 terminators present on the network). This resistor can be inserted along with the DeviceNet cable prior to tightening the screws.

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3.4 Connecting to a CAN Network

Connect the CAN cable to the 5-pin connector and tighten all screws. Make sure that all strands of wire go into the connector as bent strands may cause shorts to the adjacent terminal.

3.4.1 Termination Resistor

The 5136-DNP-CPCI does not have a built-in termination resistor. You must add termination in accordance with the requirements of the target CAN network.

3.4.2 Power

If the CAN network does not supply 11-24 VDC power, connect an external power supply to the V+ and V- pins on the connector.

3.5 Grounding

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

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4. Hardware Technical Information

4.1 Introduction

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

4.2 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						

4.2.1 Card Command Register - CCM - Base Address + 0

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

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 5136-DNP-CPCI 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 this card's memory is currently enabled. • Reading 00 indicates that this card's memory is currently disabled.

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Bit Name	Description
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.

4.2.2 Card Configuration Register - CCR - Base Address + 2

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	

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. • When this bit is 1, the card is set to boot from Flash ROM. Note: There is no Flash ROM on the 5136-DNP-CPCI. • When this bit is 0, the card is set to boot from Static RAM.
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 start it running again. If this has occurred, the card's HealthLED 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.

4.2.3 Memory Configuration Registers MCR 0 - 3 - Base Address + 3

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).							

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4.2.4 Memory Configuration Register 0 - MCR0

Bank Selection

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			

Bit Name	Description
Bank	The 5136-DNP-CPCI 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 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. See section 4.2.5.
Reserved	These bits are reserved for future expansion. Always write 00 to these bits.

4.2.5 Memory 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	

*The shaded area is reserved for future use

4.2.6 Memory Configuration Register 1 - MCR1

Memory Mode

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			

Bit Name	Description

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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 5136-DNP-CPCI 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 5136-DNP-CPCI at this time.

4.2.7 Memory Configuration Register 2 - MCR2

Memory Address Selection

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

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

4.2.8 Memory Configuration Register 3 - MCR3

Memory Address Selection

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						

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

4.2.9 Interrupt Configuration Register - ICR - Base Address + 4

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			

Bit Name	Description
IrqMode	These bits determine the hardware interrupt mode • 00 disables PCI interrupts • 11 enables PCI interrupts
Reserved	Reserved bits, always write 0.

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4.2.10 Identification Register - IDR - Base Address + 7

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 = 0x0D						
Read/Write	R/W	R	R	R/W	R/W	R/W	R	R/W
AIDR Name	IdMode	Lock	Reserved		SEL	Di	Do	CLK

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 0x0D indicates that this is a 5136-DNP-CPCI card.
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.

4.3 DeviceNet Compatibility Mode I/O Registers

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						

4.3.1 Main Board Control Register - BCR0 - Base Address + 0

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

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.

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Bit Name	Description
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 5136-DNP-CPCI 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. See the Memory Bank Selection table in section 4.2.5. Note B: It is not necessary to use Memory Banks with the 5136-DNP-CPCI as the entire 256k can be linearly accessed. Banks are supported though for backward compatibility. See section 4.2.5.
MemEn (MEN)	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 5136-DNP 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

4.3.2 Loader/Memory Configuration Register - BCR1 - Base Address + 1

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				

Bit Name	Description
Reserved	Bits 0-4 are are read/write for backward compatibility but perform no function. Bit 5 is read only, bit 6 is read/write for compatibility.
Win32K	This bit controls and indicates the Memory Bank Size • 0 indicates a 32K bank size • 1 indicates a 16K bank size

4.3.3 Loader/Memory Configuration Register - BCR2 - Base Address + 2

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			

Bit Name	Description
Reserved	These bits are Read/Write for backward compatibility, but perform no function on the 5136-DNP-CPCI.
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.

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Bit Name	Description
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.

4.3.4 Identification Register - IDR - Base Address + 7

IDR at Base Address + 7 is identical to that of ProMode. Refer to section 4.2.10.

4.4 PCI Configuration

Upon power up, the PCI Configuration is as follows.

PCI CFG Register Address	Register Function 32 24 23 16 15 8 7 0				PCI Writable
0x00	Device ID 0x9050		Vendor ID 0x10B5		N
0x04	Status 0x0000		Command 0x0000		Y
0x08	Class Code 0x028000			Revision ID Factory set	N
0x0C	BIST 0x00	Header ID 0x00	PCI Latency 0x00	CacheLineSize 0x00	Y[7:0]
0x10	PCI Base Address 0 for Memory-Mapped Config Registers 0xFFFFFF80				Y
0x14	PCI Base Address 1 for IO-Mapped Config Registers 0x00000000				Y
0x18	**PCI Base Address 2 for Local Address Space 0 Shared RAM Access Window 0xFFFC0000**				Y
0x1C	**PCI Base Address 3 for Local Address Space 1 I/O Space Access Window 0xFFFFFFF9**				Y
0x20	PCI Base Address 4 for Local Address Space 2 0x0000000				Y
0x24	PCI Base Address 5 for Local Address Space 3 0x00000000				Y
0x28	Cardbus CIS Pointer (Not supported) 0x00000000				N
0x2C	Subsystem ID 0x0010		Subsystem Vendor ID 0x133D		N

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PCI CFG Register Address	Register Function 32 24 23 16 15 8 7 0				PCI Writable
0x30	PCI Base Address for Local Expansion ROM 0x00000000				Y
0x34	Reserved 0x00000000				N
0x38	Reserved 0x00000000				N
0x3C	Max_Lat 0x00	Min_Gnt 0x00	Interrupt Pin 0x01	Interrupt Line 0x00	Y[7:0]

4.5 Application Module Header

Applications for the 5136-DNP-CPCI 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 5136-DNP-CPCI applications. This area is called the *Application Module Header*.

4.5.1 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

4.5.2 Byte Ordering

The 5136-DNP-CPCI 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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4.5.3 Application Module Header

The following table defines the layout of the *Application Module Header*. The non-shaded sections of the table are common to all application modules for the 5136-DNP-CPCI. The shaded areas are either optional or the function is determined by the application module. See the application module reference guide for details.

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. "5136-DNP-CPCI")
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[2]	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[2]	UINT2	CAN lost messages counter. Incremented when a CAN message is received before the previous one is queued.
003ch	CanOverrun[2]	UINT2	CAN receive queue overrun counter. Incremented when a CAN message is lost due to a full receive queue.
003eh	AddCode[1]	UINT2	Additional Application Error Code
0040h	Message	CHAR[60]	When ModuleType is "DN", contains the module identification string. When ModuleType is "ER", contains the kernel error string.
007ch	MajorTickInterval	UINT2	Major Tick Interval (equivalent of system timebase)
007eh	MinorTickCount	UINT2	Number of minor ticks per major tick interval
0080h	Application[1]	Undefined	Application host interface. The format of this area is defined by the application module.

[1] Format / meaning defined by the application module, see module documentation

[2] May not be supported by the application module, see module documentation

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4.6 Loading an Application Module in Compatible Mode

The following sections describe the sequence of steps to load an application module into the 5136-DNP-CPCI card. The loader application provided with the software handles this process. For register descriptions, see section 4.3.

4.6.1 Test for 5136-DNP-CPCI at I/O port address specified

1. Write zero to each of the configuration registers (BCR0, BCR1 and BCR2) in case of a re-load condition.
2. Write 0x06 to BCR0.
3. Read BCR0. It should contain 0x02.
4. Write 0x00 to BCR0.
5. Read BCR0. It should contain 0x00.
6. (Optional) Read IDR. This register should contain 0x0D.

4.6.2 Check for conflicting RAM

During these steps, disable operating system task switching, interrupts and any other processes that may be using the target memory.

1. Read a word from the target memory block 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.
5. Refer to section 4.6.10 for further instructions.
6. Repeat steps 1-3 for the entire target memory block.

4.6.3 Enable and test the 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 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.
8. Refer to section 4.6.10 for further instructions.
9. Fill the memory bank with 0.
10. Repeat steps 3-7 for all other memory banks.

4.6.4 Load the application module

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

1. Write the application module to banks 4, 5, 6 and 7.
2. The application binary file is 65535 bytes in length; 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.

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4.6.5 Configure Interrupts

1. Set IrqPending in BCR0 to clear the interrupt latch.
2. If physical interrupts are required, write the interrupt level to IrqLevel in BCR2. See section 4.3.3.
3. If a physical interrupt test is required, perform the necessary initialization to receive the test interrupt and set IrqPending in BCR0 to enable physical interrupt generation.

4.6.6 Start the application 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.

4.6.7 Check module startup results

1. If *ModuleType* in the *Application Module Header* does not contain *'DN'* or *'ER'* the application module failed to start.
2. Refer to section 4.6.10 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 *Application Module Header* provides details. Refer to section 4.6.10 for further instructions.
5. If *ModuleType* contains *'DN'*, the card processor is operating correctly.

4.6.8 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.

4.6.9 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.

4.6.10 If something goes wrong

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

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Appendix A Specifications

Environmental

Power requirements	5V ±5%, 400mA (typical)
Operating Temperature	0 ºC to 50 ºC
Storage Temperature	-25 ºC to 70 ºC
Operating Humidity	5% to 90% non-condensing

Network

Cable	Shielded twisted pair compatible with target network
External Power	11-24 VDC, 50mA
Isolation	500V
Protocol	CAN 2.0 A
Data Rate	Up to 1 Mbaud

CompactPCI Bus

Spec	PCI Spec 2.1 compliant and Compact PCI Spec 2.0 R2.1 compliant
Size	Standard 3U small form factor, 32-bit, 33MHz, 5V CompactPCI card
Addressing	(memory) 256K located anywhere in PCI memory space (I/O) 8 bytes for DNP command interface (memory) 128 bytes for PCI configuration
Interrupts	Uses PCI interrupt A

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Appendix B Card Error Messages

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.

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 application module is invalid. Each application 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 application 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 application module. Contact the vendor of the application module for assistance. See the *Software Reference Guide* for information on application security.

Error 11: Application initialization error

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

Error 12: Unknown application initialization code

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

Error 13: Application terminated

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

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

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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 application 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 application 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 application module. Make note of the circumstances that caused this error.

Error 23: Nested user timer interrupt

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

Error 26: Imperfect interrupt

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

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

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Appendix C Technical Support

Before you call for help ...

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: application module type and version, target network, circumstances that caused the problem

Getting Help

Technical support is available during regular business hours (eastern standard time) or by fax, mail, or e-mail.

Technical Support
SST, a division of Woodhead Canada Limited
50 Northland Road
Waterloo, Ontario, Canada
N2V 1N3

Phone (519) 725-5136
Fax (519) 725-1515

e-mail: techsupport@sstech.on.ca
Web site: http://www.sstech.on.ca

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Appendix D Warranty

Warranty

SST warrants all new products to be free of defects in material and workmanship when applied in the manner for which they were intended and according to SST's published information on proper installation. The Warranty period is 1 year from the date of shipment.

SST will repair or replace, at its option, all products returned to it freight prepaid, which prove upon examination to be within the Warranty definitions and time period.

The Warranty does not cover costs of installation, removal or damage to user's property or any contingent expenses or consequential damages. Maximum liability of SST is the cost of the product(s).

Product Returns

If it should be necessary to return or exchange items, please contact SST for a Return Authorization Code.

Inside Sales

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e-mail: sales@sstech.on.ca

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