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5136-DN-VME

Hardware Reference

Version 1.41

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--This Document Applies To --
5136-DN-VME VME Interface Card

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1 Introduction

1.1 Purpose of this Document

This document is a hardware reference manual for the 5136-DN-VME interface card.

The 5136-DN-VME 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-DN-VME Overview

The 5136-DN-VME is a VME interface card for communication with DeviceNet and other CAN-based networks.

The main features of the 5136-DN-VME are:

- 16 MHz V40 microprocessor with 128K RAM
- Software selectable memory address (standard address space)
- Switch selectable control register address (short address space)
- Switch selectable interrupt level 0 through 7
- 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 parts A and B
- Supports CAN data rates up to 1 Mbaud
- Supports standard DeviceNet data rates 125, 250 and 500 Kbaud

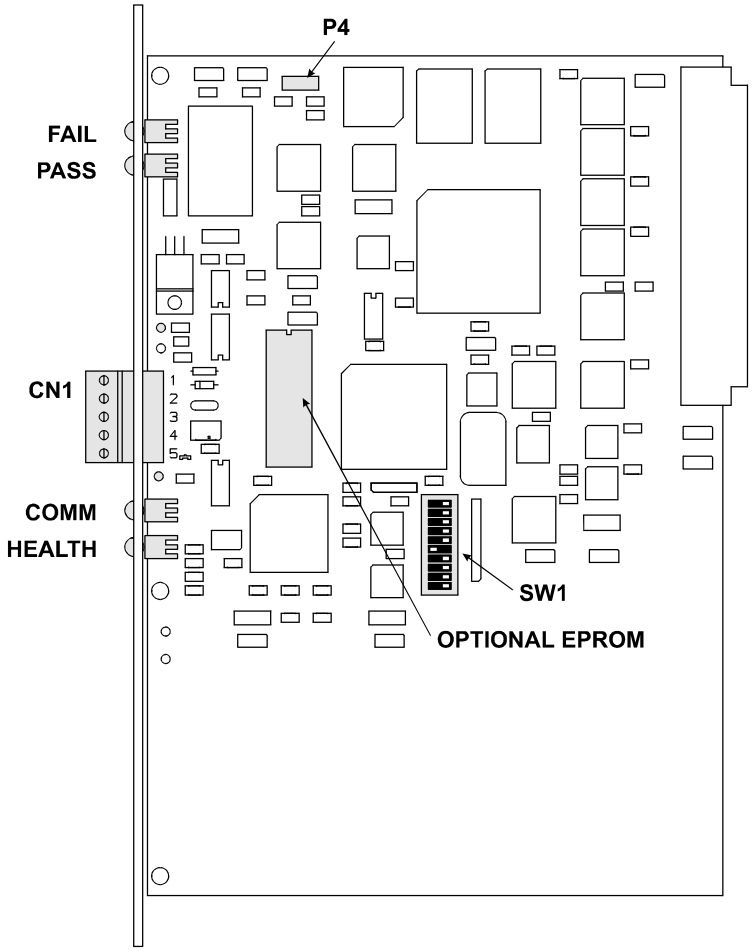
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2 Hardware Description

2.1 Overview

The 5136-DN-VME is a 6U VME interface card. The main features illustrated in the figure below are described in detail in the following sections.

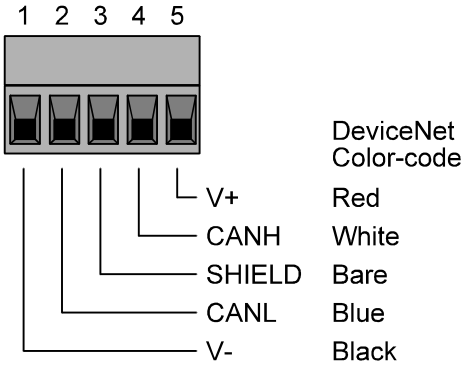


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2.2 CN1 - CAN Connector

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



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.

CANH, CANL

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

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.

2.3 Pass / Fail Indicators

These indicators reflect the status of the VMEbus SYSFAIL output from the card. The SYSFAIL signal is controlled by the VMEbus master via the Configuration / Status register (see section 4.1.1).

2.4 Health Indicator

The Health indicator is a bicolor LED indicating the status of the 5136-DN 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

2.5 Network Status Indicator

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.

2.6 SW1 - Dip Switch

The 10 position dip-switch is used to set several hardware related options:

- Base address for config registers (short address space)
- Interrupt level 1-7 or disabled
- Access restriction (supervisory only or supervisory and non-privileged)

The settings for these options are described in section 3.2.

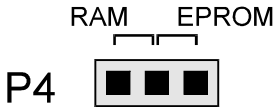
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2.7 Optional EPROM

The EPROM is an optional component that may be installed if the 5136-DN-VME is to be used in a VME system that is unsuitable for downloading the application module such as a VME-based programmable controller.

When an EPROM containing the application module is installed, the host system is required to perform much less to start the card.



EPROM-based operation is selected by jumper P4. When P4 is in the RAM position, the EPROM is disabled and the application module must be loaded by the host system. When P4 is in the EPROM position, the host may not load the application module and the EPROM must be installed.

2.7.1 Creating EPROMS

EPROMS containing the application modules are available from SST.

The EPROM is a 27C512 120 nS or faster and contains the same binary image that is loaded onto the card.

Note

The binary images are 65535 bytes long. The last byte is unused.

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3 Hardware Installation

3.1 Introduction

This section describes the steps necessary to configure and install the 5136-DN-VME in a PC compatible system.

3.2 Setting the switches

SW1 determines the base address of the card in short address space, the memory access modifier and interrupt level for the 5136-DN-VME. The host system sets the remaining options during initialization.

3.2.1 Control Register Address

The 5136-DN-VME has three control registers in short address space that are used to configure the 5136-DN-VME and to perform some run-time control.

The control registers are 8-bits wide and are located at odd addresses in an 8 byte block starting at the base address selected by the switches. The 8 byte block must be located on 1 kbyte boundaries.

Positions 1 through 6 of SW1 select the upper 6 address-bits. When a switch is ON the corresponding address-bit is 0. The following table lists switch settings for all valid base addresses.

Short Address	SW1 Setting					
	1	2	3	4	5	6
0X0000	ON	ON	ON	ON	ON	ON
0X0400 default	**ON**	**ON**	**ON**	**ON**	**ON**	**OFF**
0X0800	ON	ON	ON	ON	OFF	ON
0x0C00	ON	ON	ON	ON	OFF	OFF
0X1000	ON	ON	ON	OFF	ON	ON
0X1400	ON	ON	ON	OFF	ON	OFF
0X1800	ON	ON	ON	OFF	OFF	ON
0X1C00	ON	ON	ON	OFF	OFF	OFF
0X2000	ON	ON	OFF	ON	ON	ON
0X2400	ON	ON	OFF	ON	ON	OFF
0X2800	ON	ON	OFF	ON	OFF	ON
0X2C00	ON	ON	OFF	ON	OFF	OFF
0X3000	ON	ON	OFF	OFF	ON	ON
0X3400	ON	ON	OFF	OFF	ON	OFF
0X3800	ON	ON	OFF	OFF	OFF	ON
0X3C00	ON	ON	OFF	OFF	OFF	OFF
0X4000	ON	OFF	ON	ON	ON	ON
0X4400	ON	OFF	ON	ON	ON	OFF
0X4800	ON	OFF	ON	ON	OFF	ON
0X4C00	ON	OFF	ON	ON	OFF	OFF
0X5000	ON	OFF	ON	OFF	ON	ON
0X5400	ON	OFF	ON	OFF	ON	OFF
0X5800	ON	OFF	ON	OFF	OFF	ON
0X5C00	ON	OFF	ON	OFF	OFF	OFF
0X6000	ON	OFF	OFF	ON	ON	ON
0X6400	ON	OFF	OFF	ON	ON	OFF
0X6800	ON	OFF	OFF	ON	OFF	ON
0X6C00	ON	OFF	OFF	ON	OFF	OFF
0X7000	ON	OFF	OFF	OFF	ON	ON
0X7400	ON	OFF	OFF	OFF	ON	OFF
0X7800	ON	OFF	OFF	OFF	OFF	ON
0X7C00	ON	OFF	OFF	OFF	OFF	OFF
0X8000	OFF	ON	ON	ON	ON	ON

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Short Address	SW1 Setting					
	1	2	3	4	5	6
0X8400	OFF	ON	ON	ON	ON	OFF
0X8800	OFF	ON	ON	ON	OFF	ON
0X8C00	OFF	ON	ON	ON	OFF	OFF
0X9000	OFF	ON	ON	OFF	ON	ON
0X9400	OFF	ON	ON	OFF	ON	OFF
0X9800	OFF	ON	ON	OFF	OFF	ON
0X9C00	OFF	ON	ON	OFF	OFF	OFF
0XA000	OFF	ON	OFF	ON	ON	ON
0XA400	OFF	ON	OFF	ON	ON	OFF
0XA800	OFF	ON	OFF	ON	OFF	ON
0XAC00	OFF	ON	OFF	ON	OFF	OFF
0XB000	OFF	ON	OFF	OFF	ON	ON
0XB400	OFF	ON	OFF	OFF	ON	OFF
0XB800	OFF	ON	OFF	OFF	OFF	ON
0XBC00	OFF	ON	OFF	OFF	OFF	OFF
0XC000	OFF	OFF	ON	ON	ON	ON
0XC400	OFF	OFF	ON	ON	ON	OFF
0XC800	OFF	OFF	ON	ON	OFF	ON
0XCC00	OFF	OFF	ON	ON	OFF	OFF
0XD000	OFF	OFF	ON	OFF	ON	ON
0XD400	OFF	OFF	ON	OFF	ON	OFF
0XD800	OFF	OFF	ON	OFF	OFF	ON
0XDC00	OFF	OFF	ON	OFF	OFF	OFF
0XE000	OFF	OFF	OFF	ON	ON	ON
0XE400	OFF	OFF	OFF	ON	ON	OFF
0XE800	OFF	OFF	OFF	ON	OFF	ON
0XEC00	OFF	OFF	OFF	ON	OFF	OFF
0XF000	OFF	OFF	OFF	OFF	ON	ON
0XF400	OFF	OFF	OFF	OFF	ON	OFF
0XF800	OFF	OFF	OFF	OFF	OFF	ON
0XFC00	OFF	OFF	OFF	OFF	OFF	OFF

3.2.2 Access Privileges

The 5136-DN-VME supports a subset of the VME address modifier codes. SW1 position 7 controls whether supervisory only or supervisory and non-privileged access may take place. The following table lists the supported address modifiers and data size options.

Address Modifier	Description	Support
0x29	Short non-privileged data access	D08(O) supported if SW1-7 is on.
0x2d	Short supervisory data access	D08(O) supported.
0x39	Standard non-privileged data access	D08(EO) and D16 supported if SW1-7 is on.
0x3d	Short supervisory data access	D08(EO) and D16 supported.

SW1 position 7 must be on to enable non-privileged accesses.

Note

Accesses using any other combination of address modifier and data size options will cause a VMEbus error.

3.2.3 Interrupt Level

The 5136-DN-VME can generate and acknowledge interrupts on any one of VMEbus interrupt lines 1 through 7 (or none). The interrupt level is selected by SW1 positions 8 through 10. The following table lists all possible interrupt settings.

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SW1			VME Interrupt Level
8	9	10	
ON	ON	ON	None. Interrupts may be detected by polling the Configuration / Status register.
OFF	ON	ON	1
ON	OFF	ON	2
OFF	OFF	ON	3
ON	ON	OFF	4
OFF	ON	OFF	5
ON	OFF	OFF	6
OFF	OFF	OFF	7

The card interrupt is a ROAK (release on acknowledge) type. The VMEbus interrupt request is removed when the card responds to an interrupt acknowledge. However, the host interrupt flag in the Configuration / Status register must be manually cleared by the host application to enable further interrupts. See section 4.1.1 for details.

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. 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-DN 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. This resistor can be inserted along with the DeviceNet cable prior to tightening the screws.

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-DN 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 Software Installation

4.1 Configuration Registers

The 5136-DN-VME hardware is configured and controlled via 3 read/write I/O registers. The dip switches select the base I/O address for these registers.

I/O Address	Register
Short Base + 1	Configuration / Status Register
Short Base + 3	Interrupt Register
Short Base + 5	Memory Control Register

4.1.1 Configuration / Status Register

The Configuration / Status register is located at the short base address +1 and contains the hardware interface items that may be manipulated at runtime.

7	6	5	4	3	2	1	0
RUN	SYS	WDI	HLTH	IRQE	IRQ	POLL	CINT

CINT - Card interrupt, rising edge

A rising edge on this-bit interrupts the card processor. This-bit is rising edge triggered but must remain high until the card processes the interrupt. The recommended method of interrupting the card is to leave this signal high and strobe it low to interrupt the card.

***NOTE**: If this signal is not high when the card processes the interrupt an "Imperfect Interrupt" fatal error occurs (see Appendix B).*

POLL - Card poll, active high

This signal is unused.

IRQ - Interrupt flag, active high

This-bit has different functions for read and write.

When read, this-bit indicates the state of the interrupt latch. High indicates the card has generated an interrupt. A hardware interrupt is generated only if the switches are set to a valid interrupt level (see section 3.2.3).

Writing a 1 to this register clears the interrupt latch. This must be done during the hardware interrupt service routine to enable further interrupts.

IRQE - Interrupt enable, active high

Writing a 1 enables the interrupt latch. Writing a 0 clears and disables the interrupt latch. This-bit may be used to temporarily disable interrupts regardless of the interrupt switch settings.

HLTH - Health LED, active high

This-bit controls the Health LED. If it is 1, the Health LED is green. If it is 0, the Health LED is red.

The Health LED will light red if the watchdog timer has timed out, regardless of the state of the HLTH-bit in the Configuration / Status Register.

WDI - Watchdog timer inhibit, active high

This-bit controls the watchdog timer. The watchdog timer is used to trap an improperly executing application module. When the watchdog timer is enabled, the application module must reset the timer every 65 ms to prevent watchdog timeout.

If the watchdog timer times out, the card processor is reset and the Health LED lights red, regardless of the state of the HLTH bit in the Configuration / Status register.

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SYS - SYSFAIL signal enable - active high

This-bit controls the VMEbus SYSFAIL signal. If this-bit is 1, SYSFAIL is asserted and the FAIL LED is illuminated. If this-bit is 0, the SYSFAIL signal is inactive and the PASS LED is illuminated. This signal is controlled by the VME system.

RUN - Card processor enable, active high

If this-bit is 0, the card processor is reset. In this state the VME host may still access the card memory. On the rising edge of this-bit, the card processor is released from reset and begins executing (code must be downloaded or in EPROM prior to releasing reset).

4.1.2 Interrupt Register

The Interrupt Register is located at the short base address + 3. It contains the interrupt ID read by the VME host interrupt service routine during the interrupt acknowledge cycle.

This 8-bit value is output on the odd half of the data bus (D00-D07) when the appropriate interrupt acknowledge bus cycle is detected.

Note

The 8-bit interrupt ID is returned regardless of the transfer size used during the interrupt acknowledge cycle. If the VME host uses a transfer wider than 1 byte, the remaining-bits not driven by the card are 1 (due to the bus termination). The VME host must be aware of this condition and handle it correctly.

Caution

The Interrupt register contains 0 after reset. A valid interrupt ID must be written before enabling interrupts.

4.1.3 Memory Control Register

The Memory Control Register is located at the short base address +5. It controls the standard address space occupied by the 128K RAM on the card. The shaded row indicates the register contents after reset.

7	6	5	4	3	2	1	0
A23	A22	A21	A20	A19	A18	A17	MEN

MEN - Memory enable, active high

MEN enables access to the 128K RAM on the card. If it is 1, the VME host may access the card. If it is 0, all standard accesses are ignored.

A23-A17 - Standard Base Address

These-bits determine the standard base address of the 128K RAM on the card.

If a memory access cycle with a valid access modifier is detected and A23 through A17 match the contents of this register and MEN is set, the RAM is accessed.

4.2 Application Memory Map

The 5136-DN-VME card has 128K of shared RAM that may be accessed by the host application. The layout of this memory is illustrated in the following table.

Address		Description
Hex	Decimal	
00000H 0BFFFH	0 48K-1	Card Data Segment. Do not access at runtime
0C000H 0FFFFH	**48K 64K-1**	**Host Interface Block (runtime host interface)**
10000H 1FFFFH	64K 128K-1	Card Code Segment Do not access at runtime

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4.3 Application Module Header

Applications for the 5136-DN-VME 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-DN-VME applications. This area is called the *Application Module Header*.

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

Byte Ordering

The 5136-DN-VME 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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4.3.2 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-DN. 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	UINT2	DeviceNet serial number.
0012h	CardType	CHAR[16]	Card type. (i.e. " 5136-DN-VME")
0022h	CardSerial	CHAR[8]	Card Serial number.
002ah	IrqControl[1]	UINT2	Card interrupt control. See section 0.
002ch	IrqStatusA[1]	UINT1	Card interrupt status.
002dh	IrqStatusB[1]	UINT1	See section 0.
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 message 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[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 application module.

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

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

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4.3.3 IRQ Control / Status

The IRQ control and status areas implement up to 8 logical interrupts using only 1 physical interrupt signal.

IRQ Control Word (002Ah)

The IRQ Control Word contains 8-bits which enable the generation of a physical interrupt for each of up to 8 logical interrupt sources. This word is written by the host not by the scanner.

	Bit							
Offset	7	6	5	4	3	2	1	0
002Ah	Application Specific IRQ Control-bits							
002Bh	Reserved							

IRQ Status Byte A/B (002Ch / 002Dh)

The IRQ Status Bytes each contain 8-bits which indicate up to 8 logical interrupts. The IRQ Status Bytes indicate logical interrupts even if the physical interrupt has been disabled via the IRQ Control Word.

The scanner and the host application both write these bytes. You must follow the protocol described in this section to avoid missed interrupts.

	Bit							
Offset	7	6	5	4	3	2	1	0
002Ch	Application Specific IRQ Status-bits							
002Dh	Application Specific IRQ Status-bits							

IRQ Status Access Protocol

The card writes IrqStatusB first, followed by IrqStatusA. The host application must:

1. Read IrqStatusA and store the result in a temporary variable ‘A’.
2. Clear relevant-bits in IrqStatusA.
3. Read IrqStatusB and store the result in a temporary variable ‘B’.
4. Clear relevant-bits in IrqStatusB.
5. Logically OR the results in the temporary variables ‘A’ and ‘B’ to determine IRQ status flags. If a-bit is set, the corresponding logical interrupt has occurred.

If the scanner updates IrqStatusA or IrqStatusB at the same time as the host attempts to clear the byte, the host clear operation will fail. False logical interrupt indications can occur. The host application must be prepared to deal with false logical interrupt indications.

4.3.4 CAN Status Word

The CAN status word contains-bit flags that indicate the current status of the CAN interface and low-level interrupt handlers.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
A4	A3	A2	A1	Res.		BP	ER	ML	RO	TO	TA	A	BO	BW	OL

A1, A2, A3, A4 - Application Status-bits

These status-bits are application specific. Refer to the application module documentation for implementation details.

BP - Bus Power Detect

The BP-bit indicates the presence or absence of network power. The BP-bit is clear if the physical bus interface in not powered.

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ER - CAN Bus Error

ER is set each time a CAN communication error is detected. The host application may optionally clear ER to detect the next occurrence.

An excessive number of errors indicates a faulty physical media component (cable, connector etc.) or excessive noise from external sources (check cable routing and shield connection).

ML - Message Lost

ML is set when a message is received from the bus while the previous message is still in the receive buffer. The host application may optionally clear ML to detect the next occurrence.

ML indicates a lower layer application error (in the kernel interrupt handler). Report this condition to SST Technical Support.

RO - Receive Buffer Overrun

RO is set when messages are received from the bus faster than the application can process them. The host application may optionally clear RO to detect the next occurrence.

RO indicates an upper layer application error (in the application module). Report this condition to SST Technical Support.

TO - Transmit Timeout

TO is set when a pending transmission is incomplete within 25-50 ms. The host application may optionally clear TO to detect the next occurrence.

TO indicates excessive message traffic at a higher priority than the aborted message.

TA - Transmit Ack Error

TA is set when a pending transmission is not acknowledged within 25-50 ms. The host application may optionally clear TA to detect the next occurrence.

TA indicates that no other nodes are present (or on-line) on the network

A - Network activity detected

A is set when any message is transmitted or received. The host application may optionally clear A to detect the next occurrence.

BO - Bus off

BO is set when an excessive number of communication errors are detected and the CAN chip automatically goes off-line. BO is cleared when the CAN interface is re-initialized.

BO indicates a serious communication fault such as incorrect baud rate or physical layer error (short, open, etc.).

BW - Bus warning

BW is set when an abnormal number of communication errors are detected and the CAN chip stops transmitting error frames. BW is cleared when the error count returns to normal levels or the CAN interface is re-initialized.

BW indicates a potentially serious communication fault such as out-of-tolerance baud rate or physical layer error (electrical noise, signal attenuation, intermittent connections etc.).

OL - Online

OL indicates that the CAN interface has been initialized and is ready to communicate.

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4.4 Loading an Application Module

The following sections described the sequence of steps to load an application module into the 5136-DN-VME card. The sample loader application provided with the software handles this process.

4.4.1 Test for 5136-DN-VME present

1. Write 0x20 (powerup default) to the Configuration / Status Register.
2. Check for a VMEbus error.
3. Read the Configuration / Status Register. It should contain 0x20.
4. Check for a VMEbus error.
5. Write 0x00 to the Memory Control Register.
6. Read the Memory Control Register. It should contain 0x00.
7. Repeat steps 5 and 6 with the data 0xFE instead of 0x00
8. Write 0x00 to the Interrupt Register.
9. Read the Interrupt Register. It should contain 0x00.
10. Repeat steps 8 and 9 with the data 0xFF instead of 0x00
11. If a VMEbus error occurrs on any of these accesses or a register does not read back correctly, assume the card is not present and abort the load process.

4.4.2 Check for conflicting Memory

1. Read the first word from the target memory block.
2. Verify that a VMEbus error occurred for the access in step 1.
3. Repeat steps 1and2 for the entire target memory block.
4. If any of the memory accesses in steps 1-3 succeed (no VMEbus error), assume that the target memory address is occupied and abort the load process.

4.4.3 Enable and test the card RAM

1. Write the target memory address to the Memory Control Register A23-A17.
2. Set MEM in the Memory Control Register to enable card memory.
3. Fill the card memory with a test pattern.

   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 etc.).
4. Read and verify the test pattern written in step 3.
5. If the memory test fails, abort the load procedure.

   Refer to section 4.4.10 for further instructions.
6. Fill the card memory with 0.

4.4.4 Load the application module

Skip this step if the optional EPROM is used.

1. Write the application module binary image to the second 64K block of card memory.

   The application binary file is 65535 bytes in length; the last byte of card memory is unused.

   Byte accesses should be used when writing the binary image to avoid byte ordering problems. If word accesses must be used, care should be taken to ensure that byte ordering problems do not occur.
2. Calculate the sum of all of the bytes written (remember the last byte of card memory is unused). The least significant byte of the result should be zero.

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4.4.5 Configure Interrupts

1. Set IRQ in the Configuration / Status Register to clear the interrupt latch.
2. If a physical interrupt test is required, perform the necessary initialization to receive the test interrupt and set IRQE in Configuration / Status Register.

4.4.6 Start the application module

1. Set WDI in the Configuration / Status Register to disable the watchdog timer.

   The card self-diagnostic will fail if the watchdog is enabled during startup.
2. Toggle (clear, set) RUN in Configuration / Status Register twice to start the card processor.
3. Start a timeout timer (typically 1-2 seconds).
4. Wait until *ModuleType* in the *Application Module Header* is set to either *'DN'* or *'ER'*, or the timeout timer expires.

4.4.7 Check module startup results

1. If *ModuleType* in the *Application Module Header* does not contain *'DN'* or *'ER'* the application module failed to start.

   Refer to section 4.4.10 for further instructions.
2. If *ModuleType* contains *'ER'*, the card diagnostic has detected an error.

   The error string in the *Message* area of the *Application Module Header* provides details. Refer to section 4.4.10 for further instructions.
3. If *ModuleType* contains *'DN'* the card processor is operating correctly.

4.4.8 Test Interrupt Generation

The module startup process generates a test interrupt.

1. Read the Configuration / Status Register and verify that IRQ is set.
2. If an interrupt handler was installed, verify that the test interrupt was received.
3. Set IRQ in Configuration / Status Register to clear the interrupt latch.

4.4.9 Successful completion

1. Clear WDI in Configuration / Status Register to enable the watchdog timer.
2. Set HLTH in Configuration / Status Register to change the Health LED from red to green.
3. If interrupts are required, set IRQE in Configuration / Status Register to enable physical interrupt generation.

4.4.10 If something goes wrong

1. Write 0x20 to the Configuration / Status Register.
2. Write 0x00 to the Memory Control Register.
3. Write 0x00 to the Interrupt Register.
4. Report the nature of the error to the user.

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Appendix A Specifications

Environmental

Power requirements	5V ±5%, 750mA
Operating Temperature	0 ºC to 50 ºC
Storage Temperature	-40 ºC to 85 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/B
Data Rate	Up to 1 Mbaud

VME Bus

Size	IEEE 1014, 6U height, P1 compatible
Capabilities	(memory) SD16, SADO24 (registers) SD08(O), SADO16
Addressing	(standard) 128 kbytes on any even 128 kbyte boundary (short) 8 bytes on any 1 kbyte oundary
Interrupts	Switch selectable level 1-7 or disabled, software set 8-bit status/ID, release on acknowledge (ROAK)

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

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

Error 27: Stack Overflow

This error should be reported to the vendor of the PC 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 Drive
Waterloo, Ontario, Canada
N2V 1N3

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

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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 ten years 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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