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IR104-V4

User Guide



Opto-isolated Industrial I/O Relay Module

Tri-M Technologies Inc.

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Important Notes

About Tri-M Technologies Inc.

Tri-M Technologies Inc. specializes in embedded computing for rugged environments. Tri-M's innovative solutions are the premiere choice for off-highway vehicles, industrial controls, robotics, military equipment, aerospace technologies, undersea and advanced security products. We offer a wide range of DC-to-DC converters, CPU boards, hardened enclosures, I/O modules, wireless communication devices, and customized systems. With over 28 years of industry experience, Tri-M is your embedded systems specialist.

Who this Guide is For

This user guide is intended for integrators of embedded system applications. It contains detailed information on hardware and software requirements to interconnect to other embedded devices. Carefully read this user guide before you begin installation. The user should be familiar with practicing safe techniques while making supply or pin connections.

User Guide Revision History

Revision	Date	Description
A	12 Jan 2012	Rebranded

Trademarks

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Technical Support

Business hours: M–F, 8:30am to 5pm PST

Warranty

For warranty information, see "Tri-M Technologies Inc. (Limited Warranty)" on page 17.

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Important Safety Instructions

Conventions Used in this Guide

Note
This note contains important or useful information in the use or installation of the product.

CAUTION
The caution provides information to prevent potential equipment damage or shock hazard.

Electrostatic Discharge (ESD) Precautions

To avoid electrostatic discharge or transient voltage damage to the board, observe the following procedures:

- Before touching the board, discharge your body and any tools you use from electricity.
- Ensure that the board or the unit you want to install the board on is de-engergized before installing.
- Do not touch any devices or components on the board.

CAUTION: Shock Hazard
As soon as the board is connected to a working power supply, touching the board may result in electrical shock, even if the board has not been switched on yet.

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1 Introduction

Overview

Tri-M's IR104 PC/104 relay module is designed for controlling low and high current loads operating in rugged industrial environments. The IR104 features 20 opto-isolated digital inputs and 20 relay outputs, ideal for industrial control applications. The bidirectional inputs are isolated up to 3000V and can handle input voltages from 3V to 24V AC or DC. The 2×20 SPST (normally open) relays have dual 20-position detachable screw terminal blocks designed for 14 to 24 AWG wiring. The contacts are UL Certified and rated for 5A, 250VAC and 30VDC, allowing the IR104 to directly control small motors or solenoids.

In order to take full advantage of the IR104, up to 4 modules can be stacked. This maximizes IR104's functionality to configure IRQs and input change flags. Tri-M also offers custom designs, such as 12V or Solid State relays for lower current draw and less interference. For more information, please visit http://www.tri-m.com/support/proservices.html.

Key Specifications

- 20 Opto-isolated bi-directional inputs with 3000V protection
- 20 SPST Output Relays with 20,000,000 Lifetime Cycles
- Input Voltages from 3V to 24V AC or DC and Output UL ratings of 5A @30 VDC and 250VAC
- I/O Map configuration options such as Relay Output Control, Digital Input Reading, Input Change Flags, and Interrupt Control Registers
- Operating Temperature -25°C to +70°C (-13°F to +158°F) for rugged industrial environments

Options

Tri-M offers the following options:

- **Conformal Coating (Acrylic CH, Acrylic higher voltage CH1, Silicone CS, Urethane CU)**
  Ruggedized protection against the elements for temperature, fungal resistance, and humidity and chemical.
- **Lead-Tin Soldering (LD)**
  Tri-M is RoHS compliant but also offers Lead-Tin soldering for automotive, military and aerospace applications
- **Design Build (12V, SS, Non-Stackthrough)**
  The IR104 can be built with 12V or Solid State Relays, and without stackthroughs
- **Cables (Latch)**
  To secure the cables to the board, latching cables are available

For more information, please visit www.tri-m.com or call 1.800.665.5600 or +1.604.945.9565.

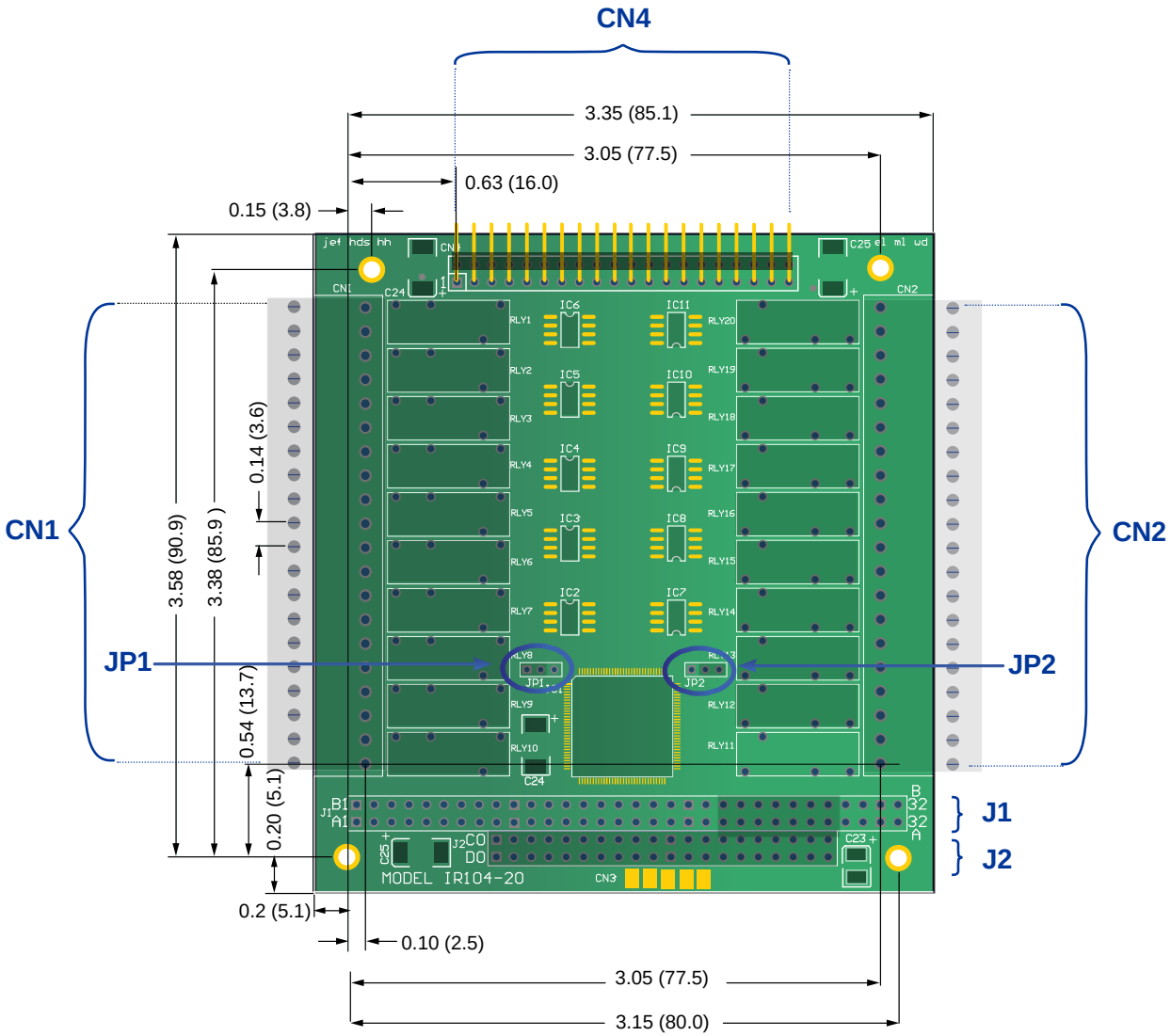
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Specifications

Electrical Specifications	
Supply Voltage	+5VDC
Supply Current	Maximum 1A, Typical 110mA (all relays off)
Supply Voltage Tolerance	±5%
Input Voltage	3V to 24V DC or AC
Input Opto-isolation	3000V
Relay Maximum Current	5A @ 30VDC and 250VAC
Relay Maximum Voltage	150VDC, 250VAC
Relay Maximum Power	150W, 1250VA
Operate Time	10ms maximum
Release Time	5ms maximum
Environmental Specifications	
Operating Temperature	-25°C to +70°C (-13°F to +158°F)
Mechanical Specifications	
Input Relays	20 Opto-isolated Inputs
Output Relays	20 SPST Output Relays
Relay Lifetime	20,000,000 min. / 70,000 min. at rated loads
Dimensions	PC/104 Compliant, 90 × 96mm (3.55 × 3.78")
Component Height	12.49mm (0.492"), slightly over the 0.435" PC/104 standard
Weight	127.12 g (4.48 oz)
MTBF	
	57,098 hours @ 30°C (86°F) Ambient Temperature
Certifications	RoHS Compliant RoHS compliant Manufactured in **ISO 9001:2008**, **ISO 14001:2004** & **ANSI/ESD S20.20** Environments

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Dimensions and Connector Locations



Dimensions in inches (mm)

Label	Page	Description	Mechanical Specifications
CN1	9	10 × Output Relays for 14–24 AWG wire	20 pin socket (Wieland 25.647.0553.0 mates with screw terminal block Wieland 25.640.0553.0)
CN2	9	10 × Output Relays for 14–24 AWG wire	20 pin socket (Wieland 25.647.0553.0 mates with screw terminal block Wieland 25.640.0553.0)
CN4	10	20 × Opto-isolated Inputs	2 × 20 position pin header
JP1	16	Jumper Block for Address Selection	3 × 1 jumper block
JP2	16	Jumper Block for Address Selection	3 × 1 jumper block
J1	11	PC/104, 8-bit ISA PC/104 Connector	2 × 32 press-fit header
J2	12	PC/104 16-bit Bus PC/104 Connector	2 × 20 press-fit header

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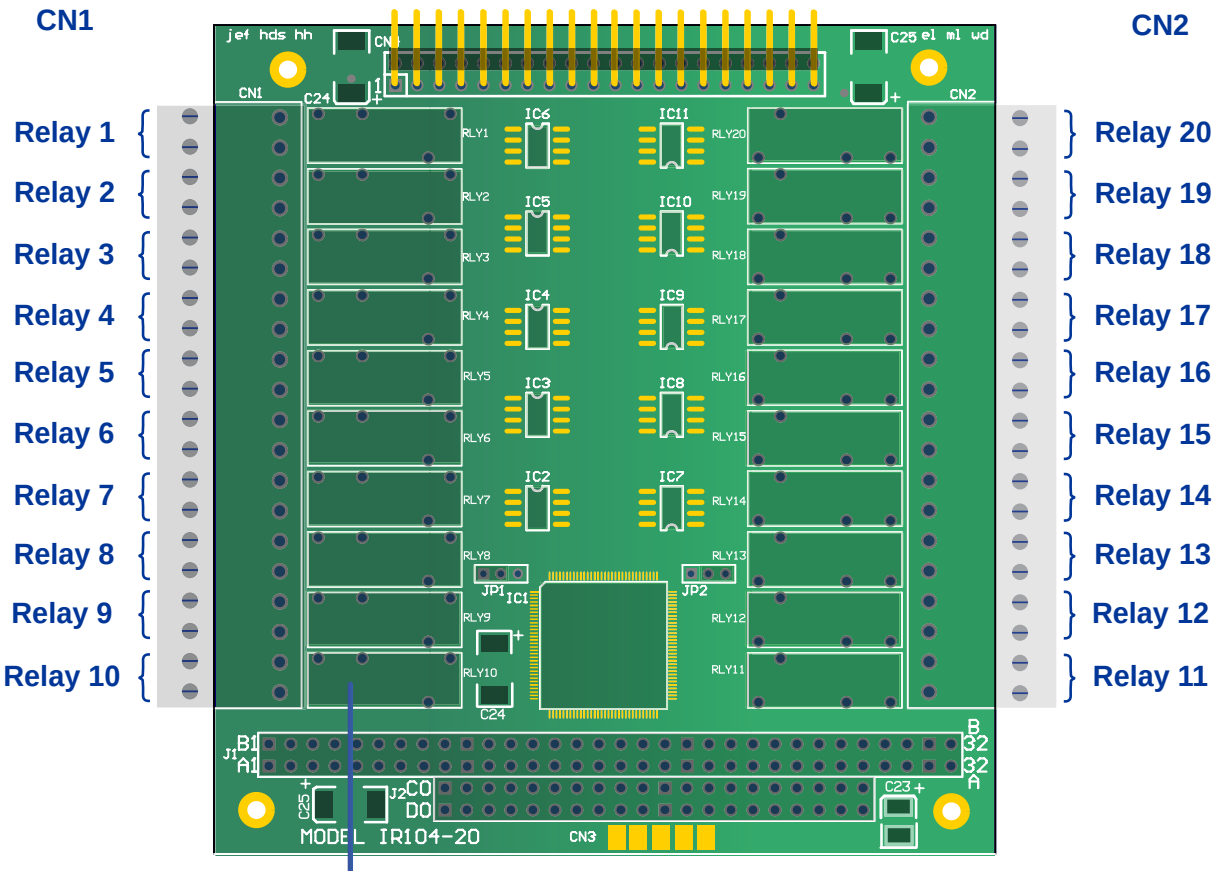
2 Connectors

Connector Overview

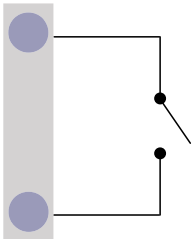
The following sections describe the pinouts and mechanical specifications for the 3 connectors (CN1, CN2, CN4) and 2 (JP1, JP2) jumper blocks.

Terminal Plugs (CN1 & CN2)

There are 20 SPST output relays with 2×20 position sockets that mate with 2×20 screw terminal block plugs intended for 14–24 AWG wires. They have a UL certified contact rating of 5A @ 30VDC and 250VAC.



Note
The terminal sockets are Wieland 25.647.0553.0, which mate with the screw terminal block plugs, Wieland 25.640.0553.0.



SPST relay contact example

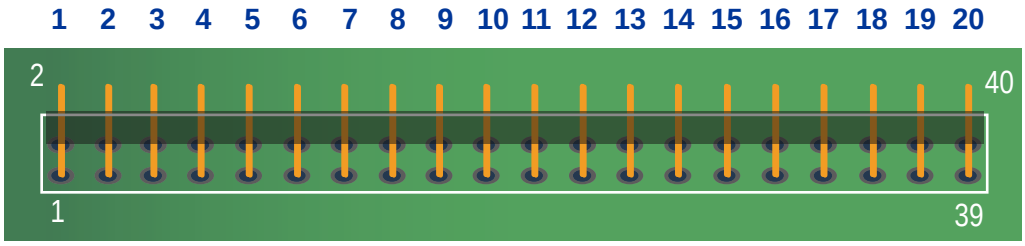
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Opto-isolated Inputs (CN4)

There are 20 bi-directional opto-isolated inputs with 3000V protection. They are accessed by a standard 2-row right-angled 40-pin header, with 0.1" pin spacing. The input voltage ranges from 3V to 24V DC or AC.

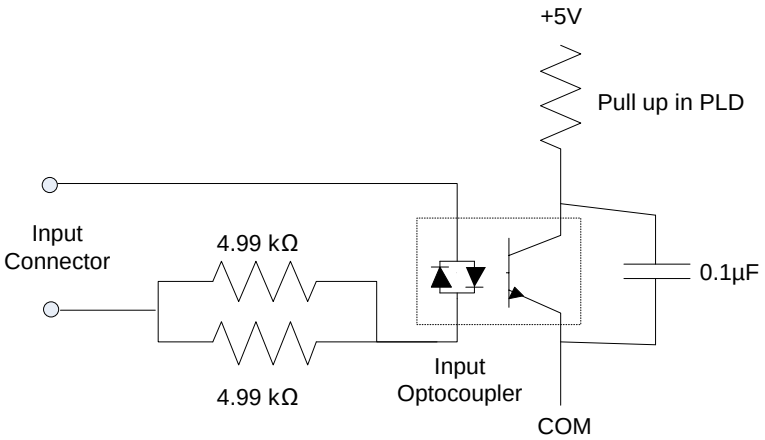
For higher input voltage requirements, please contact our Professional Services Team (see "Contact Information" on page 2) or visit http://www.tri-m.com/support/proservices.html.

CN4



PCB TOP VIEW

3V to 24V DC or AC input

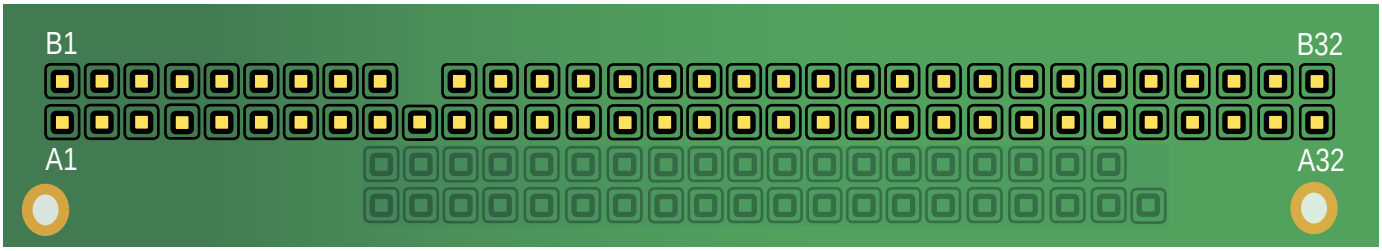


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PC/104 8-bit Bus (J1)

J1 is a PC/104 ISA 8-bit bus with non-pass through connectors. Tri-M also accommodates non-pass through and non-PC/104 compliant customizations.

J1



TOP SIDE

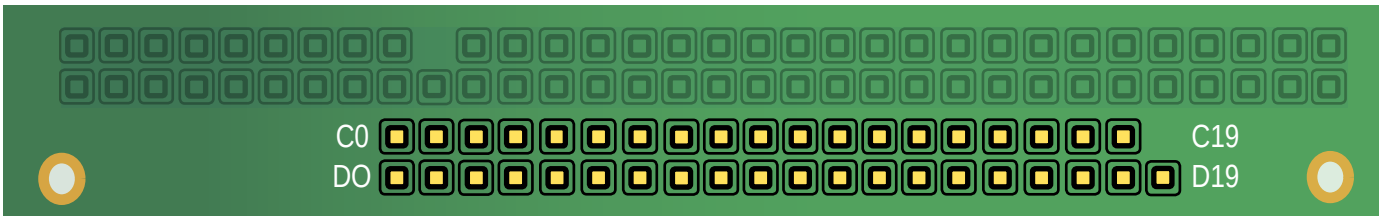
PC/104 8-bit Connector (J1)							
Pin	**Signal**	**Pin**	**Signal**	**Pin**	**Signal**	**Pin**	**Signal**
A1	/IOCHCK	B1	GND	A17	SA14	B17	/DACK1
A2	SD7	B2	RESETDRV	A18	SA13	B18	DRQ1
A3	SD6	B3	+5V	A19	SA12	B19	/REFRESH
A4	SD5	B4	IRQ9	A20	SA11	B20	SYSCLK
A5	SD4	B5	-5V	A21	SA10	B21	IRQ7
A6	SD3	B6	DRQ2	A22	SA9	B22	N/A
A7	SD2	B7	-12V	A23	SA8	B23	IRQ5
A8	SD1	B8	/0WS	A24	SA7	B24	IRQ4
A9	SD0	B9	+12V	A25	SA6	B25	IRQ3
A10	IOCHRDY	B10	GND	A26	SA5	B26	/DACK2
A11	AEN	B11	/SMEMW	A27	SA4	B27	TC
A12	SA19	B12	/SMEMR	A28	SA3	B28	BALE
A13	SA18	B13	/IOW	A29	SA2	B29	+5V
A14	SA17	B14	/IOR	A30	SA1	B30	OSC
A15	SA16	B15	DACK3	A31	SA0	B31	GND
A16	SA15	B16	DRQ3	A32	GND	B32	GND

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PC/104 16-bit Bus (J2)

J2 is a PC/104 ISA 16-bit bus with pass through connectors. Tri-M also accommodates non-pass through and non-PC/104 compliant customizations.

J2



TOP SIDE

PC/104 16-bit Connector (J2)			
Pin	**Signal**	**Pin**	**Signal**
C0	GND	D0	GND
C1	/SBHE	D1	/MEMCS16
C2	LA23	D2	/IOCS16
C3	LA22	D3	IRQ10
C4	LA21	D4	IRQ11
C5	LA20	D5	IRQ12
C6	LA19	D6	IRQ15
C7	LA18	D7	IRQ14
C8	LA17	D8	/DACK0
C9	/MEMR	D9	DRQ0
C10	/MEMW	D10	/DACK5
C11	SD8	D11	DRQ5
C12	SD9	D12	/DACK6
C13	SD10	D13	DRQ6
C14	SD11	D14	/DACK7
C15	SD12	D15	DRQ7
C16	SD13	D16	+5V
C17	SD14	D17	/MASTER
C18	SD15	D18	GND
C19	GND	D19	GND

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3 Configuration

I/O Map

There are four I/O maps:

- Relay Output Control (ROC)
- Digital Input Reading (DIR)
- Input Change Flags (ICF), see page 14
- Interrupts Control Register (ICR), see page 15

Relay Output Control (ROC)

The ROC bank energizes and de-energizes through the I/O writes. They are two grouped banks of eight and one bank of four. When an I/O read is executed, the relay output register is accessed. This allows the relay data to be read back. To energize a relay (close contact), write a logic “1” to the corresponding bit in the register bank. To de-energize a relay (open contact), write a logic “0” to the corresponding bit in the register bank.

ROC Grouping

Relay	Output	Address
ROC Bank 1	DO1 to DO8	I/O address = Base Address (0x00)
ROC Bank 2	DO9 to D16	I/O address = Base Address + 1 (0x01)
ROC Bank 3	DO17 to DO20	I/O address = Base Address + 2 (0x02)

Note
The I/O address is an offset from the base decoded address.

ROC I/O Map

Relay	SD7	SD6	SD5	SD4	SD3	SD2	SD1	SD0
ROC Bank 1	Relay 8	Relay 7	Relay 6	Relay 5	Relay 4	Relay 3	Relay 2	Relay 1
ROC Bank 2	Relay 16	Relay 15	Relay 14	Relay 13	Relay 12	Relay 11	Relay 10	Relay 9
ROC Bank 3	Not used	Not used	Not used	Not used	Relay 20	Relay 19	Relay 18	Relay 17

Digital Input Reading (DIR)

The DIR bank is accessed through I/O reads and are grouped in two banks of eight and one bank of four. A logic “0” read for an input indicates the corresponding physical input is “powered”. A logic “1” read on any input indicates the corresponding physical input is “non-powered”.

DIR Grouping

Bank	Input	Address
DIR Bank 1	DI1 to DI8	I/O address = Base Address + 4 (0×04)
DIR Bank 2	DI9 to DI16	I/O address = Base Address + 5 (0×05)
DIR Bank 3	DI17 to DI20	I/O address = Base Address + 6 (0×06)

Note
The I/O address is an offset from the base decoded address.

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DIR I/O Map

Bank	SD7	SD6	SD5	SD4	SD3	SD2	SD1	SD0
DIR Bank 1	Input 8	Input 7	Input 6	Input 5	Input 4	Input 3	Input 2	Input 1
DIR Bank 2	Input 16	Input 15	Input 14	Input 13	Input 12	Input 11	Input 10	Input 9
DIR Bank 3	Not used	Not used	Not used	Not used	Input 20	Input 19	Input 18	Input 17

Input Change Flags (ICF)

When a change is detected on one of the inputs, the corresponding bit in the ICF register is set to logic “1”. The input change flags are accessed through I/O reads and are grouped in two banks of eight and one bank of four.

ICF Grouping

Bank	Flags	Address
ICF Bank 1	F1 to F8	I/O address = Base Address + 8 (0×08)
ICF Bank 2	F9 to F16	I/O address = Base Address + 9 (0×09)
ICF Bank 3	F17 to F20	I/O address = Base Address + 10 (0×0A)

Note
The I/O address is an offset from the base decoded address.

ICF I/O Map

Bank	SD7	SD6	SD5	SD4	SD3	SD2	SD1	SD0
ICF Bank 1	Flag 8	Flag 7	Flag 6	Flag 5	Flag 4	Flag 3	Flag 2	Flag 1
ICF Bank 2	Flag 16	Flag 15	Flag 14	Flag 13	Flag 12	Flag 11	Flag 10	Flag 9
ICF Bank 3	Not used	Not used	Not used	Not used	Flag 20	Flag 19	Flag 18	Flag 17

Note
An input change flag can be cleared by reading the corresponding input bank.

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Interrupts Control Register (ICR)

The ICR I/O map has one Interrupt Enable (IE) per input and four Interrupt Output enables (IRQen4, IRQen5, IRQen6 and IRQen7). Each of the Interrupt Outputs correspond to a PC/104 interrupt line. Only one Interrupt Output should be enabled.

Interrupts are generated and issued on the PC/104 Bus when ALL of the following conditions are met:

1. A change of input state has occurred indicated by the Flag registers.
2. The input that changed has its Interrupt Enable set (logic “1”).
3. One of the Interrupt Output Enables is set (logic “1”).

ICR Grouping

Bank	Interrupts	Address
ICR Bank 1	IE1 to IE8	I/O address = Base Address + 12 (0x0C)
ICR Bank 2	IE9 to IE16	I/O address = Base Address + 13 (0x0D)
ICR Bank 3	IE17 to IE20 & IRQen4 to 7	I/O address = Base Address + 14 (0x0E)

ICR I/O Map

Bank	SD7	SD6	SD5	SD4	SD3	SD2	SD1	SD0
ICR Bank 1	IE8	IE7	IE6	IE5	IE4	IE3	IE2	IE1
ICR Bank 2	IE16	IE15	IE14	IE13	IE12	IE11	IE10	IE9
ICR Bank 3	IRQen7	IRQen6	IRQen5	IRQen4	IE20	IE19	IE18	IE17

Note

An Interrupt will stay asserted until all the Input Change Flags that have their Interrupt Enabled flags enabled are cleared. An input change flag can be cleared by reading the corresponding input bank.

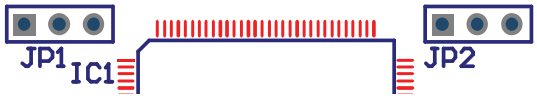
CAUTION: Equipment Damage

The IR104-V4 interrupts cannot be shared with other PC/104 boards. Attempting to share an IRQ may cause damage to the IR104-V4 and the other PC/104 board as well.

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Base Addresses

There are four decoded base addresses: 0x240, 0x260, 0x280, and 0x300. They are jumper selectable using the address select blocks JP1 and JP2.



0x240	0x260	0x280	0x300
1 JP1 *Not Installed*	1 JP1 *Not Installed*	1 JP1 *Installed*	1 JP1 *Installed*
1 JP2 *Not Installed*	1 JP2 *Installed*	1 JP2 *Not Installed*	1 JP2 *Installed*

	Base Address				
Register	**0x240**	**0x260**	**0x280**	**0x300**	**Description**
ROC Bank 1	0x240	0x260	0x280	0x300	Relays 1 to 8
ROC Bank 2	0x241	0x261	0x281	0x301	Relays 9 to 16
ROC Bank 3	0x242	0x262	0x282	0x302	Relays 17 to 20
DIR Bank 1	0x244	0x264	0x284	0x304	Inputs 1 to 8
DIR Bank 2	0x245	0x265	0x285	0x305	Inputs 9 to 16
DIR Bank 3	0x246	0x266	0x286	0x306	Inputs 17 to 20
ICF Bank 1	0x248	0x268	0x288	0x308	Change Flag Inputs 1 to 8
ICF Bank 2	0x249	0x269	0x289	0x309	Change Flag Inputs 9 to 16
ICF Bank 3	0x24A	0x26A	0x28A	0x30A	Change Flag Inputs 17 to 20
ICR Bank 1	0x24C	0x26C	0x28C	0x30C	Interrupt Enables Inputs 1 to 8
ICR Bank 2	0x24D	0x24D	0x28D	0x30D	Interrupt Enables Inputs 9 to 16
ICR Bank 3	0x24E	0x26E	0x28E	0x30E	Interrupt Enables Inputs 17 to 30 & IRQ output enables 4, 5, 6 & 7

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Warranty and Product Information

Tri-M Technologies Inc. (Limited Warranty)

Unless otherwise agreed to in writing, Tri-M Technologies Inc. (Tri-M) warrants to the original purchaser that its products will be free from defects in material and workmanship for a period of (1) one year from the date of shipment. Tri-M's obligation under this warranty is limited to replacement or repair at its option and its designated site. Any such products must be returned within the warranty period to Tri-M in Tri-M approved packaging with a Tri-M-assigned RMA (Return Material Authorization) number referenced on the shipping documents.

All warranties are void if there is evidence of misuse, tampering, or attempted repair of parts. Any returns must be accompanied by a return material authorization (RMA) number issued by Tri-M. Purchaser shall prepay transportation to Tri-M's designated site. If returned products are repaired or replaced under the terms of this warranty, Tri-M shall pay return transportation charges.

In no case will Tri-M be held liable for consequential damages arising out of its obligations under this warranty or the failure or incorrect use of any of its products. This warranty is in lieu of all warranties, either express or implied, including, without limitation, any implied warranty of merchantability or fitness for any particular purpose, and of any other obligation on the part of Tri-M.

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Appendix

Frequently Asked Questions (FAQ)

What is the mating connector for relay connectors (CN1, CN2)?

IR104's relay socket terminals (CN1, CN2) use Wieland's Part# 25.647.0553.0. The mating screw plug terminal block is Wieland Part# 25.640.0553.0.

What happens to the IR104's relays on a power-up or hardware reset?

Ensured by design on IR104-V3 (version 3) and higher versions, the relays are de-energized and the contacts open on a power-up or hardware reset.

What options are available on the IR104?

There are a variety of options available for the IR104, such as conformal coating, connectors, and custom designs. Custom builds include 12V and solid state relays. For more information about these options, please contact us. See "Contact Information" on page 2.

I have an older version of IR104, what's new in IR104-V4 (version 4)?

New features include input change flags, interrupt enables, and software IRQ selection.

Is the IR104-V4 software compatible with other IR104 version?

IR104 software support is compatible with previous versions. All new features have been set in previously unused I/O registers.

Is the IR104 RoHS Compliant?

All Tri-M's products are RoHs, and we also provide other customizable options depending on your requirements.

What is the MTBF?

The IR104 MTBF is rated at 57,098 hours at 30°C (86°F) ambient temperature.

What is IR104-V4's OS support?

The IR104 does not come with any software. I/O mapped registers are supported by any system with ISA support. An OS using x86 protected mode requires I/O driver support such as Linux ioperm or Windows® PortTalk.

How do I request an RMA or warranty issue?

To request an RMA, please fill out the online form on our website at www.tri-m.com/support .

What if I have a technical or specific question?

For technical support, please see "Contact Information" on page 2.

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