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ISOLATED DIGITAL INPUT / RELAY OUTPUT BOARD

MODEL 104-IIRO-16
104-IIRO-16E
104-RO-16

USER MANUAL

File: M104-IIRO-16.B2e

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TABLE OF CONTENTS

Chapter 1: Functional Description 5
- **INPUTS** 5
- **INTERRUPTS** 5
- **OUTPUTS** 5

SPECIFICATION 6
- **ISOLATED INPUTS** 6
- **RELAY OUTPUTS** 6
- **ENVIRONMENTAL** 6
  - **Figure 1-1:** Block Diagram 7

Chapter 2: Installation 8
- **CD Installation** 8
- **Installing the Hardware** 9
  - **Figure 2-1:** PC/104 Key Information 9

Chapter 3: Option Selection 10
- **FILTER RESPONSE SWITCH** 10
  - **Table 3-1:** Filter Response Jumpers 10
- **INTERRUPTS** 10
  - **Figure 3-1**: Option Selection Map 10

Chapter 4: Address Selection 11
  - **Table 4-1:** Address Selection for Computers 11
  - **Table 4-2:** Address Selection Jumper Reference 12

Chapter 5: Programming 13
  - **Table 5-1:** Register Address Map 13
- **RELAY OUTPUTS** 13
- **ISOLATED DIGITAL INPUTS** 14

Chapter 6: Software 16

Chapter 7: Connector Pin Assignments 17
  - **Table 7-1:** Relay Connector Pin Assignments (P1) 17
  - **Table 7-2:** Isolated Inputs Connector Pin Assignments (P2) 18

Chapter 1: Functional Description

This board provides isolated digital inputs with Change of State Detection and electromechanical relay output interface for 104 compatible computers. The board provides sixteen optically-isolated inputs for AC or DC control signals and sixteen electromechanical relay outputs. The board occupies eight consecutive addresses in I/O space. Read and write operations are done on an 8-bit-byte oriented basis. Two versions of the board are available. The basic model includes Change Of State (COS) detection on inputs (flags an interrupt), and model E doesn't have COS detection and doesn't use interrupts. Model 104-RO-16 is relay outputs only.

INPUTS

The isolated inputs can be driven by either AC or DC signals and are not polarity sensitive. Input signals are rectified by photocoupler diodes. A 1.8K-ohm resistor in series dissipates unused power. Standard 12/24 AC control transformer outputs can be accepted as well as DC voltages. The input voltage range is 3 to 31 volts (rms). External resistors connected in series may be used to extend the input voltage range, however this will raise the input threshold range. Consult with factory for available modified input ranges.

Each input circuit contains a switchable slow/fast filter that has a 4.7 millisecond time constant. (Without filtering, the response is 10 uSec.) The filter must be selected for AC inputs in order to eliminate the on/off response to AC. The filter is also valuable for use with slow DC input signals in a noisy environment. The filter may be switched out for DC inputs in order to obtain faster response. Filters are individually selected by jumpers. The filters are switched into the circuit when the jumpers are installed in position FLT0 to FLT15.

INTERRUPTS

When enabled by a software read to base address +2 (and when a jumper is installed to select one of the interrupt levels IRQ2-7, IRQ10-12, and IRQ14-15), the board asserts an interrupt whenever any of the inputs changes state from high to low, or low to high. This is called Change-of-State (COS) detection. Once an interrupt has been generated and serviced, it must be cleared. A software write to base address+1 will clear an interrupt. Before enabling the COS detection, clear any prior interrupt by writing to base address + 1. This interrupt capability may be disabled by a software write to base address +2, and later re-enabled. (Basic model only)

OUTPUTS

The electromechanical relay outputs are comprised of sixteen FORM C SPDT outputs. The relays are all de-energized at power-on. Data to the relays is latched by a write to the base address + 0 and to base address + 4.

SPECIFICATION

ISOLATED INPUTS

Number of inputs:	Sixteen
Type:	Non-polarized, optically isolated from each other and from the computer. (CMOS compatible)
Voltage Range:	3 to 31 DC or AC Rms (40 to 10000 Hz)
Isolation:	500V*****(see note) channel-to-ground or channel-to channel
Input Resistance:	1.8K ohms in series with opto coupler
Response Time:	4.7 mSec w/filter, 10 uSec w/o filter (typical)
Interrupts:	Software controlled with jumper IRQ selection (model IIRO-16 only)

RELAY OUTPUTS

Number of outputs:	Sixteen SPDT form C
Contact Rating:	1A max at 24VDC, 60VDC max, 0.5A at 125VAC max
Contact Type:	Single crossbar, Ag with Au clad, (Bifurcated contacts optional)
Contact Resistance:	Initial 100 milliohms maximum
Contact Life: mech'l:	5 million operations minimum
Operating Time:	5 milliseconds maximum
Release Time:	5 milliseconds maximum

INTERRUPTS: Interrupts are generated when isolated inputs change state if enabled by software. (model IIRO-16 only)

POWER REQUIRED: +5VDC @ 0.50 A (all relays ON)

ENVIRONMENTAL

Operating Temp:	-30^{o} to $+70^{o}$C (Non-icing)
Weight:	Approx. 4.5 oz.

*****Notes on Isolation: Opto-Isolators and connectors are rated for at least 500V, but isolation voltage breakdowns will vary and is affected by factors like cabling, spacing of pins, spacing between traces on the PCB, humidity, dust and other environmental factors. This is a safety issue so a careful approach is required. For CE certification, isolation was specified at 40V AC and 60V DC. The design intention was to eliminate the influence of common mode. Use proper wiring techniques to minimize voltage between channels and to ground. For example, when working with AC voltages do not connect the hot side of the line to an input. Tolerance of higher isolation voltage can be obtained on request by applying a conformal coating to the board.

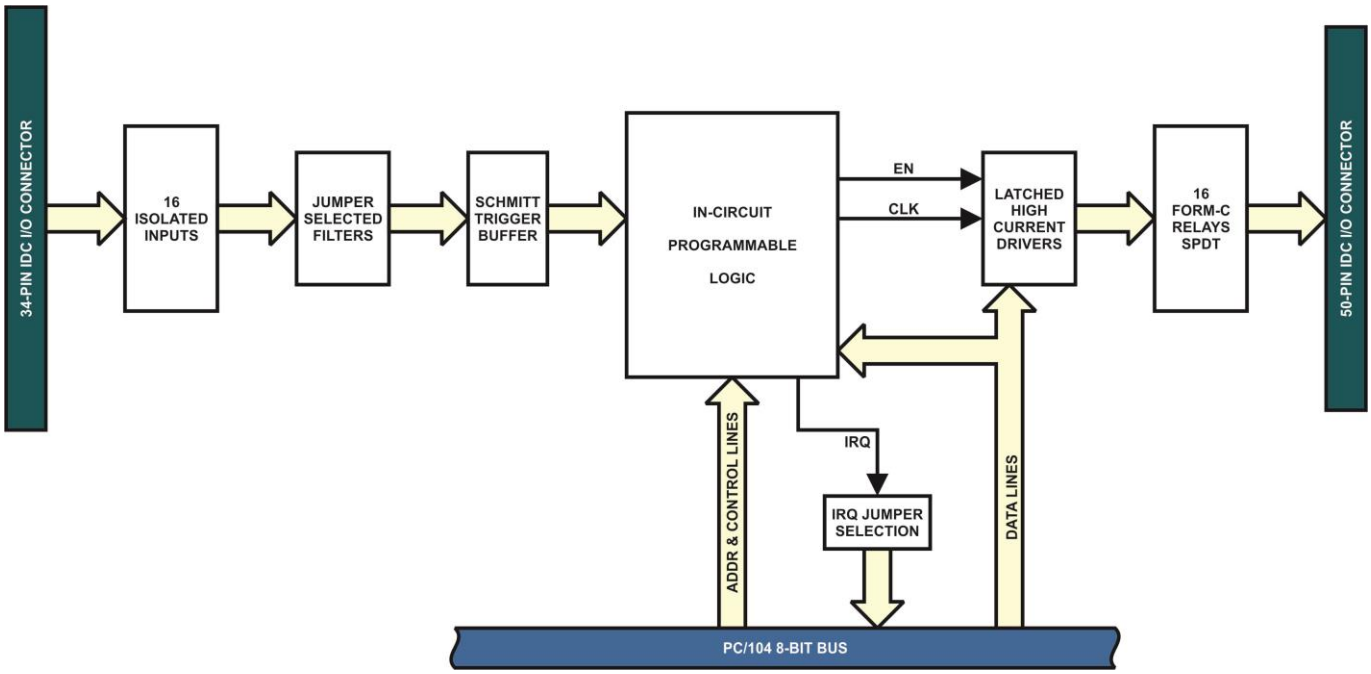


Figure 1-1: Block Diagram

Chapter 2: Installation

A printed Quick-Start Guide (QSG) is packed with the board for your convenience. If you've already performed the steps from the QSG, you may find this chapter to be redundant and may skip forward to begin developing your application.

The software provided with this PC/104 Board is on CD and must be installed onto your hard disk prior to use. To do this, perform the following steps as appropriate for your operating system. Substitute the appropriate drive letter for your CD-ROM where you see d: in the examples below.

CD Installation

The following instructions assume the CD-ROM drive is drive "D". Please substitute the appropriate drive letter for your system as necessary.

DOS

1. Place the CD into your CD-ROM drive.
2. Type D : Enter to change the active drive to the CD-ROM drive.
3. Type I N S T A L L Enter to run the install program.
4. Follow the on-screen prompts to install the software for this board.

WINDOWS

1. Place the CD into your CD-ROM drive.
2. The system should automatically run the install program. If the install program does not run promptly, click START | RUN and type D : I N S T A L L, click OK or press Enter.
3. Follow the on-screen prompts to install the software for this board.

LINUX

1. Please refer to linux.htm on the CD-ROM for information on installing under linux.

Installing the Hardware

Before installing the board, carefully read Chapter 3 and Chapter 4 of this manual and configure the board according to your requirements. The SETUP Program can be used to assist in configuring jumpers on the board. Be especially careful with Address Selection. If the addresses of two installed functions overlap, you will experience unpredictable computer behavior. To help avoid this problem, refer to the FINDBASE.EXE program installed from the CD. The setup program does not set the options on the board, these must be set by jumpers.

To Install the Board

1. Install jumpers for selected options and base address according to your application requirements, as mentioned above.
2. Remove power from the PC/104 stack.
3. Assemble standoff hardware for stacking and securing the boards.
4. Carefully plug the board onto the PC/104 connector on the CPU or onto the stack, ensuring proper alignment of the pins before completely seating the connectors together.
5. Install I/O cables onto the board's I/O connectors and proceed to secure the stack together or repeat steps 3-5 until all boards are installed using the selected mounting hardware.
6. Check that all connections in your PC/104 stack are correct and secure then power up the system.
7. Run one of the provided sample programs appropriate for your operating system that was installed from the CD to test and validate your installation.

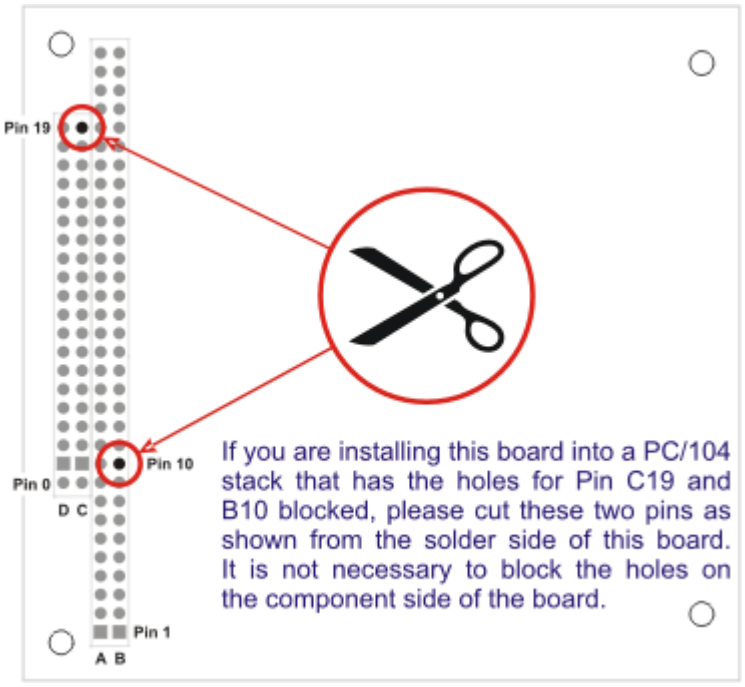


Figure 2-1: PC/104 Key Information

Chapter 3: Option Selection

FILTER RESPONSE SWITCH

Jumpers are used to select input filtering on a channel-by-channel basis. When jumper FLT0 is installed, additional filtering is introduced for input bit 0, FLT1 for bit 1, etc.

JUMPER SELECTION	Bit Filtered
FLT-0	IN0
-1	IN1
-2	IN2
-3	IN3
-4	IN4
-5	IN5
-6	IN6
-7	IN7

JUMPER SELECTION	Bit Filtered
FLT-8	IN8
-9	IN9
-10	IN10
-11	IN11
-12	IN12
-13	IN13
-14	IN14
-15	IN15

Table 3-1: Filter Response Jumpers

This additional filtering provides a slower response for DC signals as described previously and must be used when AC inputs are applied.

INTERRUPTS

Select the desired interrupt level by installing a jumper at one of the locations marked IRQxx. An interrupt is asserted by the board when an Isolated Digital Input bit changes state, if enabled in software as previously described.

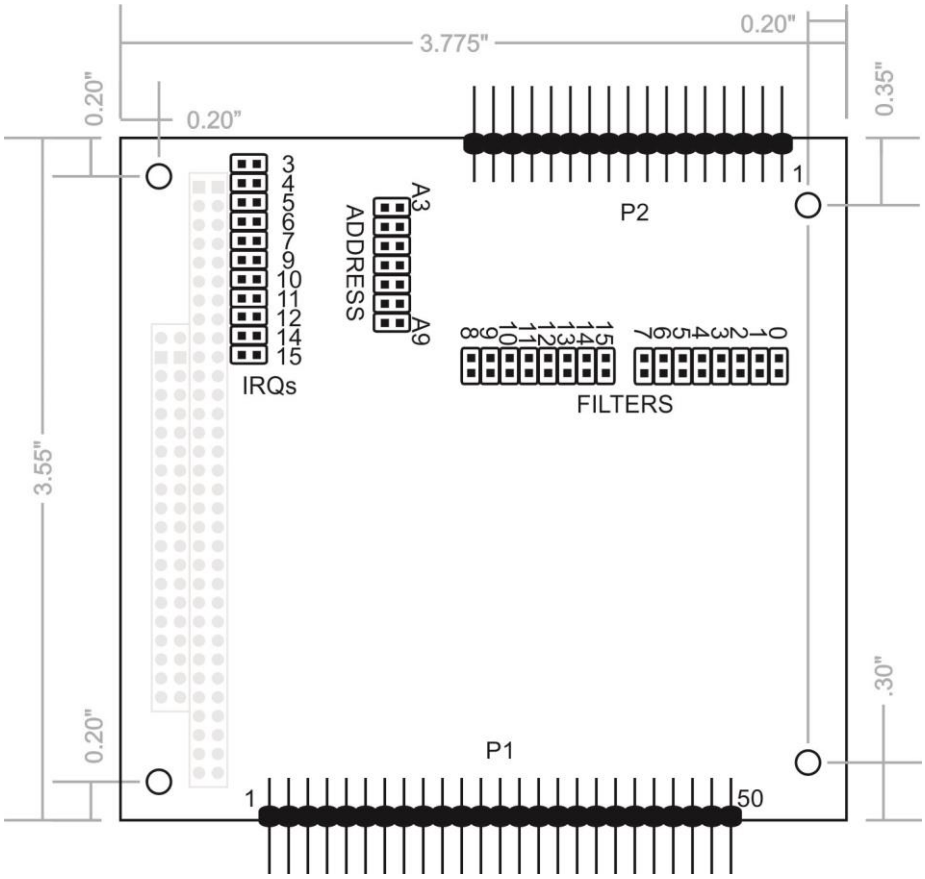


Figure 3-1: Option Selection Map

Chapter 4: Address Selection

The board occupies eight consecutive addresses in I/O space (although only six addresses are used). The base or starting address can be selected anywhere within the I/O address range 100-3FF provided that it does not cause an overlap with other functions. If the addresses of two installed functions overlap, you will experience unpredictable computer behavior. The FINDBASE program will assist you in selecting a base address that will avoid this conflict.

Table 4-1: Address Selection for Computers

HEX RANGE	USAGE
000-00F	8237 DMA Controller 1
020-021	8259 Interrupt
040-043	8253 Timer
060-06F	8042 Keyboard Controller
070-07F	CMOS RAM, NMI Mask Reg, RT Clock
080-09F	DMA Page Register
0A0-0BF	8259 Slave Interrupt Controller
0C0-0DF	8237 DMA Controller 2
0F0-0F1	Math Coprocessor
0F8-0FF	Math Coprocessor
170-177	Fixed Disk Controller 2
1F0-1F8	Fixed Disk Controller 1
200-207	Game Port
238-23B	Bus Mouse
23C-23F	Alt. Bus Mouse
278-27F	Parallel Printer
2B0-2BF	EGA
2C0-2CF	EGA
2D0-2DF	EGA
2E0-2E7	GPIB (AT)
2E8-2EF	Serial Port
2F8-2FF	Serial Port
300-30F	reserved
310-31F	reserved
320-32F	Hard Disk (XT)
370-377	Floppy Controller 2
378-37F	Parallel Printer
380-38F	SDLC
3A0-3AF	SDLC
3B0-3BB	MDA
3BC-3BF	Parallel Printer
3C0-3CF	VGA EGA
3D0-3DF	CGA
3E8-3EF	Serial Port
3F0-3F7	Floppy Controller 1
3F8-3FF	Serial Port

The board's base address is set up by JUMPERS. Those jumpers control address bits A3 through A9. (Lines A2, A1 and A0 are used on the board to control individual registers. How these three lines are used is described in the Programming section of this manual.)

To determine how to set these JUMPERS for a desired hex-code address, refer to the SETUP program provided with the board. If you prefer to determine proper jumper settings yourself, first convert the hex-code address to binary form. Then, for each "0", install corresponding jumpers and for each "1", remove the corresponding jumper.

The following example illustrates jumper selection corresponding to hex 300 (or binary 11 0000 0xxx). The "xxx" represents address lines A2, A1, and A0 used on the board to select individual registers as described in the Programming section of this manual.

Table 4-2: Address Selection Jumper Reference

Base Address in Hex Code	3		0				0
Conversion Factors	2	1	8	4	2	1	8
Binary Representation	1	1	0	0	0	0	0
Jumper Legend	A9	A8	A7	A6	A5	A4	A3
Addr. Line Controlled	A9	A8	A7	A6	A5	A4	A3
Jumper Selection	OFF	OFF	ON	ON	ON	ON	ON

Carefully review the address selection reference table on the preceding page before selecting the board address. If the addresses of two installed functions overlap, you will experience unpredictable computer behavior.

Chapter 5: Programming

The board occupies eight consecutive addresses in PC I/O space. The base, or starting address is selected during installation and will fall on an eight-byte boundary. The read and write functions as follows (model E doesn't use Base +2):

Table 5-1: Register Address Map

I/O Address	Read	Write
Base + 0	Relay Outputs 0 - 7	Relay Outputs 0 - 7
Base + 1	Isolated Inputs 0 - 7	Clear Interrupt
Base + 2	Enable IRQ	Disable IRQ
Base + 3	N/A	N/A
Base + 4	Relay Outputs 8 - 15	Relay Outputs 8 - 15
Base + 5	Isolated Inputs 8 - 15	N/A
Base +6	N/A	N/A
Base +7	Interrupt Status	N/A

RELAY OUTPUTS

At power-up, all relays are initialized in the de-energized state. The relay outputs are controlled by writing to the Base Address for relays 0 - 7 and Base + 4 for relays 8 -15. Data is written to all eight relays as a single byte. Each bit within the byte controls a specific relay. A "0" energizes the corresponding relay and a "1" turns it off.

The status of the relay outputs are read from Base +0 and Base +4.

Write / Read Base +0

Bit Position	D7	D6	D5	D4	D3	D2	D1	D0
Relay Controlled	OUT7	OUT6	OUT5	OUT4	OUT3	OUT2	OUT1	OUT0

Write / Read Base +4

Bit Position	D7	D6	D5	D4	D3	D2	D1	D0
Relay Controlled	OUT7	OUT6	OUT5	OUT4	OUT3	OUT2	OUT1	OUT0

For example, if bit D5 is turned on by writing hex DF to the base address, then the relay that controls OUT5 is energized closing the associated normally-open contacts. All other relays would be de-energized and their normally-closed contacts would be closed.

ISOLATED DIGITAL INPUTS

Isolated digital input states are read as a single byte from the port at Base Address +1 for inputs 0 - 7 or Base Address + 5 for inputs 8 -15. Each of the eight bits within the byte corresponds to a particular digital input. A "0" signifies that the input is energized, (on/high) and a "1" signifies that the input is de-energized (off/low).

Read at Base +1

Bit Position	D7	D6	D5	D4	D3	D2	D1	D0
Iso Digital Input	IN7	IN6	IN5	IN4	IN3	IN2	IN1	IN0

Read at Base +5

Bit Position	D7	D6	D5	D4	D3	D2	D1	D0
Iso Digital Input	IN15	IN14	IN13	IN12	IN11	IN10	IN9	IN8

The board response to inputs is rated at 10 uSec. Sometimes it is necessary to slow down that response to accommodate AC inputs or in noisy environments. Hardware installation of JUMPERS to implement filtering are provided.

The board supports interrupts on change of state of isolated digital inputs. Thus, it is **NOT** necessary to continuously poll inputs (by reading at base address +1 and 5) to detect any state change. To enable this interrupt capability, read at base address +2. To disable interrupts, write at base address +2 or remove the JUMPER that selects interrupt levels (IRQ2 - IRQ7, IRQ10 - IRQ12, IRQ14 and IRQ15).

The status of the interrupt is determined by a read to Base Address +7. Bit D0 high indicats if there was a change in IIN0 through IIN7. Bit D1 High indicates if there was a change in IIN8 through IIN15. Bit D7 determines if the IRQ is enabled or disabled.

Read at Base +7

Bit Position	D7	D6	D5	D4	D3	D2	D1	D0
	IRQ Enable (1) / Disable (0)	N/A	N/A	N/A	N/A	N/A	8-15 Changed State (1 = Changed, 0 = No Change)	0-7 Changed State (1 = Changed, 0 = No Change)

PROGRAMMING EXAMPLES

No function driver software is provided with this product because programming is very simple and can be accomplished most efficiently using direct I/O instructions in the language that you are using. The following examples are in C but are readily translated into other languages:

Example: Turn on OUT0 and OUT7-turn all other bits off

```
Base=0x300;                    //Base I/O address
outportb(Base, 0x7E);
```

Example: Read the isolated digital inputs

```
Y=inportb(Base+1);             //isolated digital input register, bits 0-7
```

-Refer to ACCES32 and WIN32IRQ software directories for Windows driver and utilities.

Chapter 6: Software

Utility software provided on CD with the board includes the base address locator, an illustrated setup program and a sample program. The sample program sequentially turns on and off each relay (walking bit). After each relay is turned on, the opto-isolated inputs are read, and the data is displayed.

The sample programs are in forms suitable for use with, QuickBASIC, C, and Pascal. The programs as follows:

FINDBASE: Program locates active and available port addresses.

SETUP: Board Setup Program

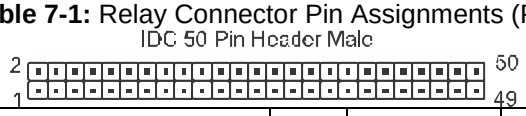
CSAMPLES: SAMPLE1This sample program will sequentially turn on all bits of the relay input and sequentially turns them off (walking bit). Each time it sets a new bit, both the relay output and the isolated input are read and the data displayed. This demonstrates how to read and write to a port.

PSAMPLES: SAMPLE1Same sample in Pascal.

Chapter 7: Connector Pin Assignments

Relay outputs are connected to the board via a 50-pin HEADER type connector named P1. The mating connector is an IDC type with 0.1 inch centers or equivalent. The wiring may be directly from the signal sources or may be on ribbon cable from screw terminal accessory boards. Pin assignments follow.

Table 7-1: Relay Connector Pin Assignments (P1)



PIN	NAME	FUNCTION	PIN	NAME	FUNCTION
1	OUT15-NO	Bit 7 Relay, Normally-Open Contact	2	OUT15-C	Bit 7 Relay Common
3	OUT15-NC	Bit 7 Relay, Normally-Closed Contact	4	OUT14-NO	Bit 6 Relay, Normally-Open Contact
5	OUT14-C	Bit 6 Relay Common	6	OUT14-NC	Bit 6 Relay, Normally-Closed Contact
7	OUT13-NO	Bit 5 Relay, Normally-Open Contact	8	OUT13-C	Bit 5 Relay Common
9	OUT13-NC	Bit 5 Relay, Normally-Closed Contact	10	OUT12-NO	Bit 4 Relay, Normally-Open Contact
11	OUT12-C	Bit 4 Relay Common	12	OUT12-NC	Bit 4 Relay, Normally-Closed Contact
13	OUT11-NO	Bit 3 Relay, Normally-Open Contact	14	OUT11-C	Bit 3 Relay Common
15	OUT11-NC	Bit 3 Relay, Normally-Closed Contact	16	OUT10-NO	Bit 2 Relay, Normally-Open Contact
17	OUT10-C	Bit 2 Relay, Common	18	OUT10-NC	Bit 2 Relay, Normally-Closed Contact
19	OUT9-NO	Bit 1 Relay, Normally-Open Contact	20	OUT9-C	Bit 1 Relay Common
21	OUT9-NC	Bit 1 Relay, Normally-Closed Contact	22	OUT8-NO	Bit 0 Relay, Normally-Open Contact
23	OUT8-C	Bit 0 Relay Common	24	OUT8-NC	Bit 0 Relay, Normally-Closed Contact
25			26		
27	OUT7-NC	Bit 7 Relay, Normally-Closed Contact	28	OUT7-C	Bit 7 Relay Common
29	OUT7-NO	Bit 7 Relay, Normally-Open Contact	30	OUT6-NC	Bit 6 Relay, Normally-Closed Contact
31	OUT6-C	Bit 6 Relay Common	32	OUT6-NO	Bit 6 Relay, Normally-Open Contact
33	OUT5-NC	Bit 5 Relay, Normally-Closed Contact	34	OUT5-C	Bit 5 Relay Common
35	OUT5-NO	Bit 5 Relay, Normally-Open Contact	36	OUT4-NC	Bit 4 Relay, Normally-Closed Contact
37	OUT4-C	Bit 4 Relay Common	38	OUT4-NO	Bit 4 Relay, Normally-Open Contact
39	OUT3-NC	Bit 3 Relay, Normally-Closed Contact	40	OUT3-C	Bit 3 Relay Common
41	OUT3-NO	Bit 3 Relay, Normally-Open Contact	42	OUT2-NC	Bit 2 Relay, Normally-Closed Contact
43	OUT2-C	Bit 2 Relay, Common	44	OUT2-NO	Bit 2 Relay, Normally-Open Contact
45	OUT1-NC	Bit 1 Relay, Normally-Closed Contact	46	OUT1-C	Bit 1 Relay Common
47	OUT1-NO	Bit 1 Relay, Normally-Open Contact	48	OUT0-NC	Bit 0 Relay, Normally-Closed Contact
49	OUT0-C	Bit 0 Relay Common	50	OUT0-NO	Bit 0 Relay, Normally-Open Contact

Isolated Inputs are connected to the board via a 34-pin HEADER type connector named P2. The mating connector is an IDC type with 0.1 inch centers or equivalent.

Table 7-2: Isolated Inputs Connector Pin Assignments (P2)



PIN	NAME	FUNCTION	PIN	NAME	FUNCTION
1	IIN7 A	Isolated Input 7 A	2	IIN7 B	Isolated Input 7 B
3	IIN6 A	Isolated Input 6 A	4	IIN6 B	Isolated Input 6 B
5	IIN5 A	Isolated Input 5 A	6	IIN5 B	Isolated Input 5 B
7	IIN4 A	Isolated Input 4 A	8	IIN4 B	Isolated Input 4 B
9	IIN3 A	Isolated Input 3 A	10	IIN3 B	Isolated Input 3 B
11	IIN2 A	Isolated Input 2 A	12	IIN2 B	Isolated Input 2 B
13	IIN1 A	Isolated Input 1 A	14	IIN1 B	Isolated Input 1 B
15	IIN0 A	Isolated Input 0 A	16	IIN0 B	Isolated Input 0 B
17			18		
19	IIN15 A	Isolated Input 15 A	20	IIN15 B	Isolated Input 15 B
21	IIN14 A	Isolated Input 14 A	22	IIN14 B	Isolated Input 14 B
23	IIN13 A	Isolated Input 13 A	24	IIN13 B	Isolated Input 13 B
25	IIN12 A	Isolated Input 12 A	26	IIN12 B	Isolated Input 12 B
27	IIN11 A	Isolated Input 11 A	28	IIN11 B	Isolated Input 11 B
29	IIN10 A	Isolated Input 10 A	30	IIN10 B	Isolated Input 10 B
31	IIN9 A	Isolated Input 9 A	32	IIN9 B	Isolated Input 9 B
33	IIN8 A	Isolated Input 8 A	34	IIN8 B	Isolated Input 8 B

Customer Comments

If you experience any problems with this manual or just want to give us some feedback, please email us at: ***manuals@accesio.com***. Please detail any errors you find and include your mailing address so that we can send you any manual updates.

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