ISOLATED DIGITAL INPUT & RELAY OUTPUT BOARDS FOR M.2 AND MINI PCI EXPRESS CARD HARDWARE MANUAL

MODELS M.2-IIRO-8, M.2-IIRO-4, M.2-RO-8, MPCIE-IIRO-8, MPCIE-RO-8, AND MPCIE-IIRO-4



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https://accesio.com/M.2-IIRO-8
https://accesio.com/mPCIe-IIRO-8
MADE IN THE USA

Chapter 1: Quick Start

It is recommended that you install the software package before installing the card in your computer. You can install the software[1] using either a stand-alone installer downloaded from the website or an optional Software Master CD.

Run the installer you downloaded (or autorun.exe on the Software Master CD) and follow the prompts to install the software for your device.

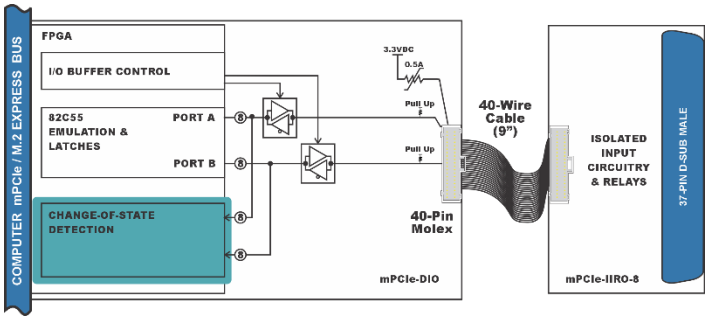
Please note: during the installation you may be prompted regarding the installation of non-WHQL-certified drivers; please carefully confirm the digitally signed source of the drivers and accept the installation.

Once the software has been installed, shut down your system and carefully install the mPCIe card.

Re-start your system. Once the computer finishes booting your new device should already be installed and ready for use; you can confirm this by launching Device Manager and looking under the "Data Acquisition" section. If, for any reason, the mPCIe displays a warning icon, right-click and select "Update Driver".

[1] In Linux or OSX please refer to github.com/accesio/apci.

Chapter 2: Introduction



M.2 and PCI Express Mini Card are low-profile, small-footprint busses standard originally intended for adding peripherals to notebook computers. They have become the de-facto standards for high-performance, small form-factor devices in many applications.

These devices consist of an M.2 or mPCIe interface board that connects to a Mobile-ITX-sized, panel-mountable, DB-37M Isolation Module via an included 9" cable.

FEATURES

- 8 or 4 optically-isolated non-polarized inputs
- 8 or 4 electromechanical 1A relay outputs
- Change-of-State (CoS) detection IRQ generation
- 9" cable (228mm), standard
- Panel-mountable DB-37M Isolation Module

These cards are well suited to complex environments, mitigating otherwise challenging ground-loops, high-common-mode, and transient voltage spikes common in electrically-noisy industrial or factory locations. The broad voltage compatibility and high current outputs allows use in a wide range of applications.

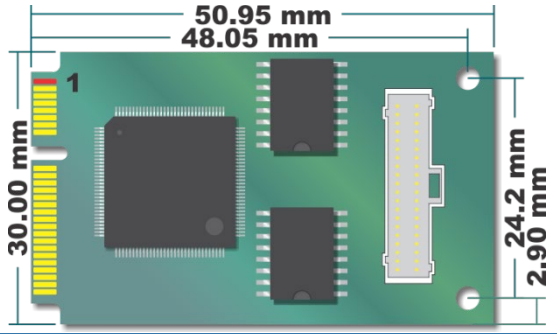
The non-polarized inputs support both AC and DC, and configuration jumpers allow 4.7ms input filters to be enabled per-channel, as desired – required for AC use. The Isolated Inputs support voltages from 3 to 31 VDC/VAC RMS [40Hz to 10000Hz], as well as standard 12/24 AC control transformer signals.

Outputs are 5 Form C ("Single-pole, double-throw", or SPDT) and 3 Form A (SPST) electromechanical relays capable of 1A continuous-current load.

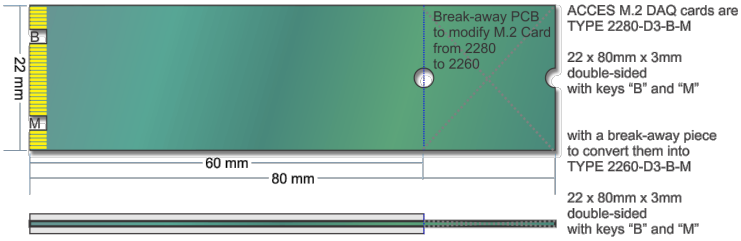
Form C (SPDT) means each relay has 3 pins: Common (C), Normally-Open (NO), and Normally-Closed (NC). While power is disconnected or the relay is commanded "off" (de-energized) the relay connects the C pin to the NC pin, and the NO pin is disconnected (no-connect). When the relay is commanded "on" (energized) C is instead connected to NO, and NC is disconnected.

Switching a relay from the ON to OFF or from OFF to ON is a mechanical operation, and is therefore relatively slow. Additionally, "mechanical contact bounce" occurs, and must be accounted for in your usage scenario. 5ms switching time is a reasonable real-world estimate that accounts for both of these factors.

Chapter 3: Hardware



This manual applies to the following models:	
M.2- or mPCIe-IIRO-8	8 Isolated Input, 8 Relay Output mPCIe Card
M.2- or mPCIe-IIRO-4	4 Isolated Input, 4 Relay Output mPCIe Card



The M.2 models are M.2 B- & M-key cards in the 2280 size (22 × 80 mm) with a break-away for 2260 (22 × 60 mm). The mPCIe models are full-length "F1" mPCIe devices (30 × 50.95 mm). Each includes a required 9" (229mm) 40-conductor cable connected to a panel-mountable DB-37M Isolation Module. The Isolation Module is 2.835" × 2.362" with 4× 0.125" mounting holes for broad installation compatibility. All units are RoHS compliant.

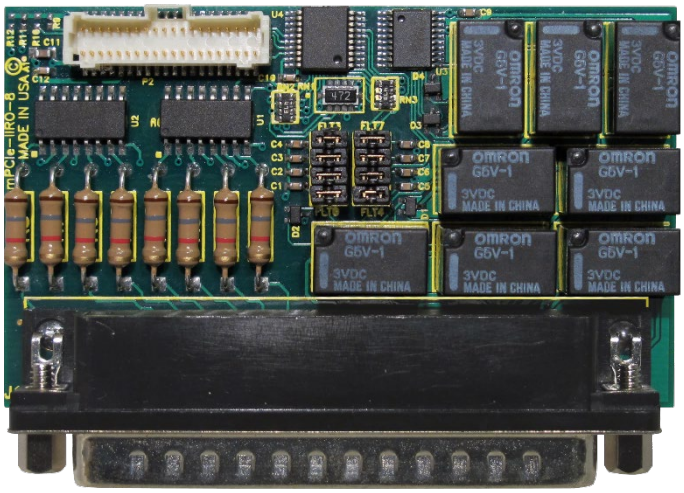
INCLUDED IN YOUR PACKAGE

Panel-mountable DB-37M Isolation Module
9" 40-pin cable (228mm)
M.2 or mPCIe Digital I/O card

Available accessories include:	
ADAP37, STB-37	37-pin Screw Terminal Accessory
mPCIe-HDW-KIT2	Mounting hardware for 2mm
mPCIe-HDW-KIT2.5	Mounting hardware for 2.5mm
M.2-HDW-KIT2	Mounting hardware for 2mm

Contact the factory for information regarding additional accessories, options, and specials that may be available to best fit your specific application requirements, such as extended temperature, conformal coating, and alternate cable lengths to name a few.

Chapter 4: Configuration Settings



The Isolation Module includes jumpers to enable input filters with a 4.7ms time-constant, optimized for dealing with AC signals, but useful for a wide variety of transient-mitigation tasks.

There is one filter option selection jumper per input channel; simply move the provided jumper plug to the ON position to enable filtering for the respective channel. The first column of four jumpers as shown in the above photograph applies to input channels 0 through 3; the second column to channels 4 through 7.

Chapter 5: PC Interface

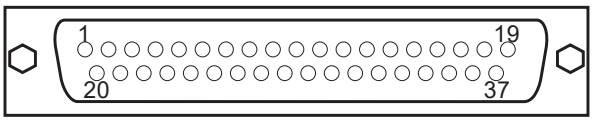
This product interfaces with a PC using either a PCI Express M.2 or PCI Express Mini Card (mPCIe) connection; a small-form-factor, high-performance, rugged peripheral interconnect technology first introduced for use in laptops and other portable computers.

The small size and powerful PCI Express performance, combined with perfect software compatibility with PCIe peripheral designs, has led to their recent adoption as go-to standards for embedded Data Acquisition and Control, and many other applications.

Although M.2 is a broadly adopted industry standard, the actual connection to the computer shares a specification with mSATA: both mSATA and M.2 use the same edge-connector. In fact, well-designed PCs can automatically detect and configure their onboard connectors to work with either M.2 or mSATA devices – and, according to the standards for M.2 and mSATA they are *supposed* to do so! However, some PC manufacturers ship computers that *only* support mSATA devices. Please confirm in your PC documentation that your edge-connector is *actually* PCI Express M.2 Card compliant before installing this, or any, M.2 card.

M.2 and mPCIe define mounting holes for securing the otherwise loose end of the card, so it is impossible for these cards to wiggle or flap themselves loose devices. Eliminating this concern for M.2 and mPCIe cards is a major reason these standards have seen rapid adoption by the Data Acquisition and Control industry.

Chapter 6: I/O Interface



Signal Definitions	
Signal	**Meanings**
IN A #	Non-Polarized Isolated Input "A" Side
IN B #	Non-Polarized Isolated Input "B" Side
C #	Relay Common pin
NO #	Relay Normally Open pin
NC #	Relay Normally Closed pin

The DB-37M pinout is identical to the ACCES PCI-IIRO-8 and PCIe-IIRO-8 pinout.

Custom hardware interfaces can be produced to fit your specific application requirement.

DB-37M Male Pinout			
		1	IN A 7
20	IN B 7	**2**	IN A 6
21	IN B 6	**3**	IN A 5
22	IN B 5	**4**	IN A 4
23	IN B 4	**5**	IN A 3
24	IN B 3	**6**	IN A 2
25	IN B 2	**7**	IN A 1
26	IN B 1	**8**	IN A 0
27	IN B 0	**9**	C 7
28	NO 7	**10**	C 6
29	NO 6	**11**	C 5
30	NO 5	**12**	NC 4
31	C 4	**13**	NO 4
32	NC 3	**14**	C 3
33	NO 3	**15**	NC 2
34	C 2	**16**	NO 2
35	NC 1	**17**	C 1
36	NO 1	**18**	NC 0
37	C 0	**19**	NO 0

Chapter 7: Software Interface

The simplest way to program for the device is using legacy-compatibility mode: the device boots into this mode, and you can control it exactly like you would a PCIe-IIRO-8, or a PCI-IIRO-8 – or even a 104-IIRO-8! In this mode the unit provides I/O-mapped registers: 1 Relay Output register, 1 Isolated Input register, and IRQ control registers.

I/O Registers at BAR [2]		
Register offset (decimal)	**Write Operation**	**Read Operation**
Relays [+ 0]	Relay 0-7 output	Relay 0-7 read-back
Isolated Inputs [+ 1]	*unused*	Bits 0-7 input
IRQ Control [+40]	En- / Dis-able IRQ	
IRQ Clear/Status [+41]	Clear IRQ	IRQ Status

In the following bit-level register descriptions the column labeled "Dir" indicates read or write operation, with the following notation:

R: Read function, and W: Write function. RW indicates both.
r: read, and w: write, but less-commonly useful than R or W

+ 0	Dir	D7	D6	D5	D4	D3	D2	D1	D0
Relay #	rW	7	6	5	4	3	2	1	0

Writing one byte to +0 will control all 8 relays. Setting a bit to 1 energizes the corresponding relay, while clearing a bit to 0 turns the relay off. Reading a byte will provide the currently commanded relay state (read-back).

+ 1	Dir	D7	D6	D5	D4	D3	D2	D1	D0
Input #	R	7	6	5	4	3	2	1	0

Reading from +1 returns 8 bits. Each set bit indicates current was detected at the corresponding isolated input.

+ 40	Dir	D7	D6	D5	D4	D3	D2	D1	D0
IRQ En	rW	IRQ ENABLE							

Writing "FF" will enable IRQs on the 8 Isolated Input bits, as well as any TTL bits configured as input. Write 00 to disable.

+ 41	Dir	D7	D6	D5	D4	D3	D2	D1	D0
IRQ Clr	W	Write 0xFF to clear pending IRQs							
IRQ Stat	R								INT

Write "1" to each IRQ status bit to clear the pending IRQ. Bits D1 through D7 are reserved, for best results write "1" to all bits (0xFF).

Reading will give the current IRQ latch state. Bit D0 "1" means "an IRQ was generated".

In addition to the I/O registers at BAR[2], BAR[0] contains two additional registers.

One register for compatibility with the PCIe product line: Register +0x69 contains a read-only status bit [d7] which indicates the card is generating an IRQ when set [1], and is not generating an IRQ when clear [0].

And, one register for flexibility: 0xFC contains a read-only 32-bit value that indicates which Isolation Module is attached to the base M.2 or mPCIe board. This register is used by our Windows driver to install a child-device which your code will interface with. In other operating systems it may be necessary to query this register in your application code. The following values are defined as of this writing:

0x00000000: No Isolation Module detected (DIO-24 mode)
0x00000001: IDIO-8 Module detected
0x00000002: IIRO-8 Module detected
0x00000003: IDIO-4 Module detected
0x00000004: IIRO-4 Module detected
0x00000005: II-16 Module detected
0x00000006: RO-8 Module detected

All of these registers can be operated from any operating system using any programming language, using either no driver at all (kernel mode, Linux ioperm(3), DOS, etc.) or using one of the ACCES provided drivers (AIOWDM [for Windows], APCI [for Linux & OSX]), or using any 3rd party APIs such as provided with Real-Time OSes.

In Windows[1], please consult the various samples (C#, Delphi, VC6, VB6, and more) to explore how to program the device. The Software Reference Manual.pdf provides reference material covering all AIOWDM driver APIs, and tips for simplifying tasks such as Plug-and-Play card detection. Please note that the Software Reference Manual.pdf will include numerous functions that don't apply to this device. A quick reference of the most-applicable functions is provided, below:

AIOWDM API Quick Reference	
Function name	Function Purpose
RelInPortB()	Read 8-bits of data
RelOutPortB()	Write 8-bits of data
GetNumCards()	Determine how many cards AIOWDM has detected in the system

There are quite a few additional functions provided by AIOWDM.dll; please consult the Software Reference manual (.pdf), and/or the sample programs, for more information.

Under certain circumstances the following information might prove useful:

PCI Express Mini Card / M.2 Plug-and-Play Data	
Vendor / Device ID	Card Type
0x494F / 0x0100	M.2 and mPCIe DIO Base
0x494F / 0x0102	M.2 and mPCIe-IIRO-8
0x494F / 0x0104	M.2 and mPCIe-IIRO-4
0x494F / 0x0106	M.2 and mPCIe-RO-8

Available Downloads

The latest information can always be found on the product page on the website. Here are some useful links:

Links to useful downloads	
Main site	https://accesio.com
Product's page	https://accesio.com/mPCIe-IIRO-8
	https://accesio.com/M.2-IIRO-8
This manual	accesio.com/MANUALS/M.2-_mPCIe-IIRO-8.pdf
Windows Software	accesio.com/files/packages/M.2-_mPCIe-IIRO
Install Package	Install.exe

[1] *In Linux or OSX please refer to the documentation at* github.com/accesio/APCI.

Chapter 8: Specifications

PC Interface

PCI Express Mini Card	Type F1 "Full Length" V1.2
M.2 PCI Express	2280/2260 B+M-key

Note: Device's connector violates component height restrictions

Isolated Inputs

Number	8 (or 4)
Type	Non-polarized, optically isolated from each other and from the computer (CMOS compatible)
Voltage	3 to 31 DC or AC RMS (40 to 10000Hz)
Isolation	500V channel-to-ground and channel-to-channel
Resistance	1.8KΩ in series with opto-coupler
Filter Response	
Rise-time	4.7 ms
Fall-time	4.7 ms
Non-Filter Response	
Rise-time	10 µs
Fall-time	30 µs

Relay Outputs

Number	8 (or 4)
Type	5 Form C (SPDT) and 3 Form A (SPST), Ag with Au clad, single crossbar for mPCIe-IIRO-8; 4 Form C for mPCIe-IIRO-4
AC Load	0.5A at 125 VAC (62.5 VA max)
DC Load	1A at 24 VDC (30W max)
Switching Voltage	125 VAC, 60 VDC, max
Switching Current	1A max
Contact Resistance	100 mΩ, max
Contact Life	5 million operations, min
Operating time	5 ms, max
Release time	5 ms, max

Environmental

Temperature	Operating	0°C to 70°C (order "-T" for -40° to 70°C)
	Storage	-65° to 150°C
Humidity		5% to 95%, non-condensing
Power required		+3.3VDC @ 730mA typical, all relays energized

Physical

mPCIe board characteristics		
Weight		6.2 grams (mPCIe) 5.4 grams (M.2)
Size, mPCIe	Length	50.95mm (2.006")
	Width	30.00mm (1.181")
Size, M.2	Length	80 mm or 60 mm
	Width	22 mm
I/O connector	On-card	Molex 501190-4017 40-pin latching
	mating	Molex 501189-4010
Isolation Module characteristics		
Weight		51.4 grams (+ 11.2 grams for the 9" cable)
Size (Mobile-ITX sized)	Length	2.952"
	Width	1.772"
I/O connector	On-module	Male, D-Sub Miniature, 37-pin
	mating	Female, D-Sub Miniature, 37-pin

Chapter 9: Certifications

CE & FCC

These devices are designed to meet all applicable EM interference and emission standards. However, as they are intended for use installed on motherboards, and inside the chassis of industrial PCs, important care in the selection of PC and chassis is important to achieve compliance for the computer as a whole.

UL & TUV

No AC or DC voltages above 31V are consumed or produced during normal operation of this device. This product is therefore exempt from any related safety standards. Use it with confidence!

ROHS / LEAD-FREE STATEMENT

All models are produced in compliance with RoHS and various other lead-free initiatives.

WARNING

A SINGLE STATIC DISCHARGE CAN DAMAGE YOUR CARD AND CAUSE PREMATURE FAILURE! PLEASE FOLLOW ALL REASONABLE PRECAUTIONS TO PREVENT A STATIC DISCHARGE SUCH AS GROUNDING YOURSELF BY TOUCHING ANY GROUNDED SURFACE PRIOR TO TOUCHING THE CARD.

ALWAYS CONNECT AND DISCONNECT YOUR FIELD CABLING WITH THE COMPUTER POWER OFF. ALWAYS TURN COMPUTER POWER OFF BEFORE INSTALLING A CARD. CONNECTING AND DISCONNECTING CABLES, OR INSTALLING CARDS, INTO A SYSTEM WITH THE COMPUTER OR FIELD POWER ON MAY CAUSE DAMAGE TO THE I/O CARD AND WILL VOID ALL WARRANTIES, IMPLIED OR EXPRESSED.

WARRANTY

Prior to shipment, ACCES equipment is thoroughly inspected and tested to applicable specifications. However, should equipment failure occur, ACCES assures its customers that prompt service and support will be available. All equipment originally manufactured by ACCES which is found to be defective will be repaired or replaced subject to the following considerations:

GENERAL

Under this Warranty, liability of ACCES is limited to replacing, repairing or issuing credit (at ACCES' discretion) for any products which are proved to be defective during the warranty period. In no case is ACCES liable for consequential or special damage arriving from use or misuse of our product. The customer is responsible for all charges caused by modifications or additions to ACCES equipment not approved in writing by ACCES or, if in ACCES' opinion the equipment has been subjected to abnormal use. "Abnormal use" for purposes of this warranty is defined as any use to which the equipment is exposed other than that use specified or intended as evidenced by purchase or sales representation. Other than the above, no other warranty,

expressed or implied, shall apply to any and all such equipment furnished or sold by ACCES.

TERMS AND CONDITIONS

If a unit is suspected of failure, contact ACCES' Customer Service department. Be prepared to give the unit model number, serial number, and a description of the failure symptom(s). We may suggest some simple tests to confirm the failure. We will assign a Return Material Authorization (RMA) number which must appear on the outer label of the return package. All units/components should be properly packed for handling and returned with freight prepaid to the ACCES designated Service Center, and will be returned to the customer's/user's site freight prepaid and invoiced.

COVERAGE

FIRST THREE YEARS: Returned unit/part will be repaired and/or replaced at ACCES option with no charge for labor or parts not excluded by warranty. Warranty commences with equipment shipment.

FOLLOWING YEARS: Throughout your equipment's lifetime, ACCES stands ready to provide on-site or in-plant service at reasonable rates similar to those of other manufacturers in the industry.

EQUIPMENT NOT MANUFACTURED BY ACCES

Equipment provided but not manufactured by ACCES is warranted and will be repaired according to the terms and conditions of the respective equipment manufacturer's warranty.

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