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

MODELS M.2-II-16, M.2-II-8, M.2-II-4, MPCIE-II-16, MPCIE-II-8, AND MPCIE-II-4



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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.

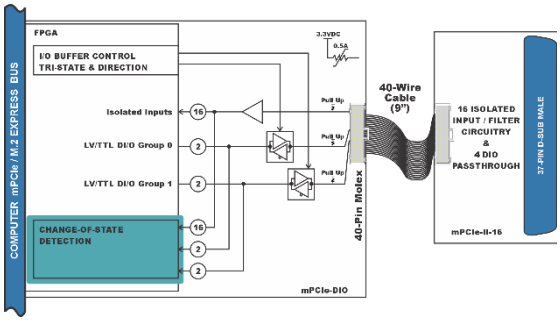
Please note: during the installation you may be prompted regarding the installation of non-WHQL-certified drivers; please carefully confirm the digitally signed source of the drivers and accept the installation.

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



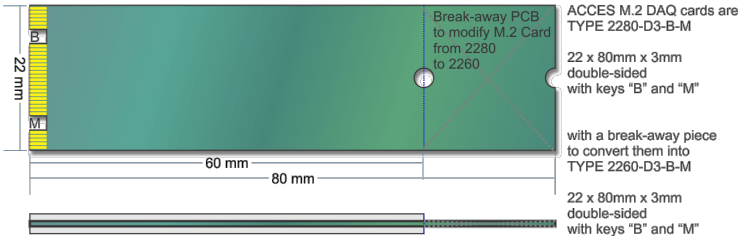
M.2 and PCI Express Mini Card are low-profile, small-footprint busses standard originally intended for adding peripherals to notebook computers. They have become the de-facto standards for high-performance, small form-factor devices in many applications.

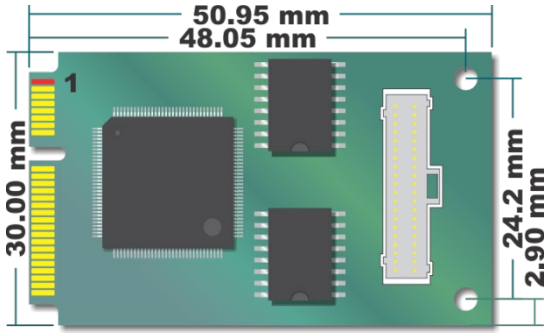
This device consists of an M.2 or mPCIe interface board that connects to a Mobile-ITX-sized, panel-mountable, DB-37M Isolation Module via an included 9" cable.

FEATURES

- 16, 8, or 4 optically-isolated non-polarized inputs
- 4 LVTTL I/O lines programmable as inputs or outputs in groups of 2 lines
- 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 input voltage compatibility 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 10,000Hz], as well as standard 12/24 AC control transformer signals.

Chapter 3: Hardware

This manual applies to the following models:	
M.2- or mPCIe-II-16	16 Isolated Input mPCIe Card
M.2- or mPCIe-II-8	8 Isolated Input mPCIe Card
M.2- or mPCIe-II-4	4 Isolated Input 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 Mobile-ITX sized (1.772" x 2.952") for broad installation compatibility. All units are RoHS compliant.

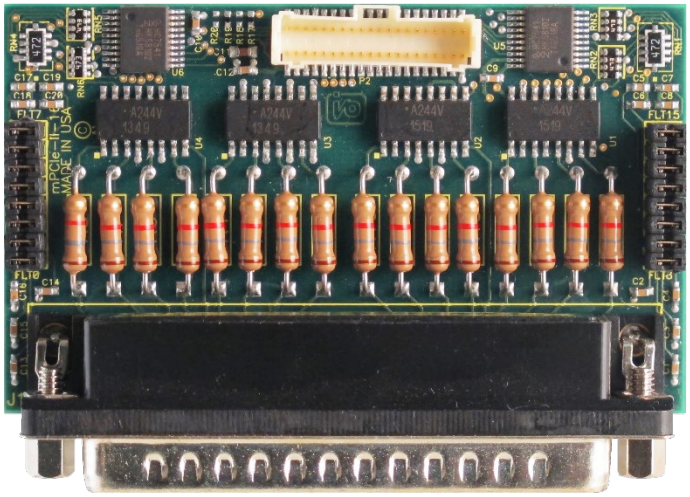
INCLUDED IN YOUR PACKAGE

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

Available accessories include:	
ADAP37F, STB-37	37-pin Screw Terminal Accessories
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 regarding additional accessories, options, and specials to best fit your specific needs, such as extended temperature, conformal coating, or alternate cable lengths.

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 jumpers (at the far left as shown in the above photograph) apply to input channels 0 down through 7; the second column (at the far right) configures filtering for channels 8 through 15.

Chapter 5: PC Interface

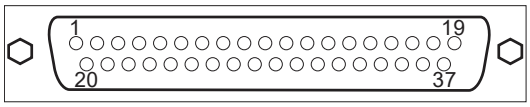
This product interfaces with a PC using either a PCI Express M.2 or PCI Express Mini Card (mPCIe) connection; a small-form-factor, high-performance, rugged peripheral interconnect technology first introduced for use in laptops and other portable computers.

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.

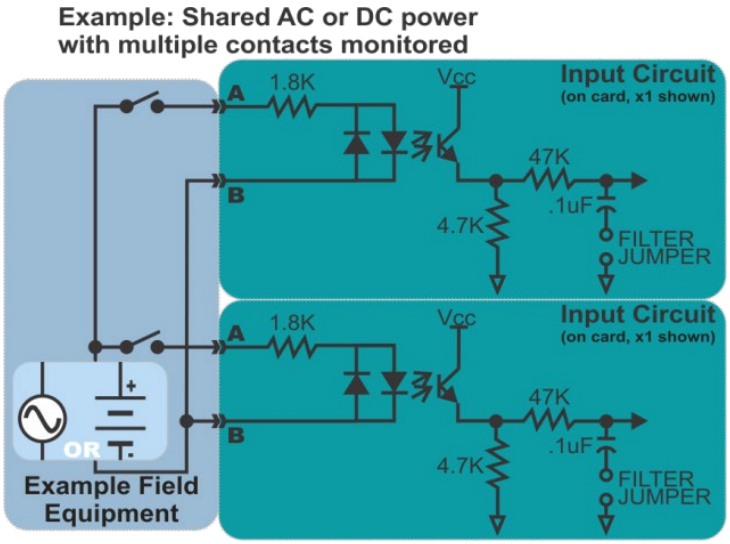
Although M.2 is a broadly adopted industry standard, the actual connection to the computer shares a specification with mSATA: both mSATA and M.2 use the same edge-connector. In fact, well-designed PCs can automatically detect and configure their onboard connectors to work with either M.2 or mSATA devices – 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



The isolation module uses a 37-pin D-sub miniature male connector that is panel mountable using the provided screwlocks. The included cable connecting between the isolation module and the mPCIe-DIO card is 9" long. Custom hardware interfaces can be produced to fit your specific application requirement.



Signal Definitions	
Signal	**Meanings**
IN A #	Non-Polarized Isolated Input "A" Side pin, channel #
IN B #	Non-Polarized Isolated Input "B" Side pin, channel #
LVTTL I/O #	Digital I/O pin, channel # (3.3VDC, +5VDC tolerant)
GND	Digital Ground for use with LVTTL I/Os

DB-37 Male Pinout			
1	IN A 7		
2	IN A 6	**20**	IN B 7
3	IN A 5	**21**	IN B 6
4	IN A 4	**22**	IN B 5
5	IN A 3	**23**	IN B 4
6	IN A 2	**24**	IN B 3
7	IN A 1	**25**	IN B 2
8	IN A 0	**26**	IN B 1
9	GND	**27**	IN B 0
10	LVTTL 0	**28**	LVTTL 2
11	LVTTL 1	**29**	LVTTL 3
12	IN A 15	**30**	IN B 15
13	IN A 14	**31**	IN B 14
14	IN A 13	**32**	IN B 13
15	IN A 12	**33**	IN B 12
16	IN A 11	**34**	IN B 11
17	IN A 10	**35**	IN B 10
18	IN A 9	**36**	IN B 9
19	IN A 8	**37**	IN B 8

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 PCI-II-16.

I/O Registers at BAR [2]			
Register	offset	Write Operation	Read Operation
Isolated Inputs	+0	*unused*	Bits 0-7 input
Isolated Inputs	+1	*unused*	Bits 8-15 input
TTL 0-4	+16	Digital Output	Digital Input
TTL Control	+17	Configure Port I/O	Read I/O Config.
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
Input #	R	7	6	5	4	3	2	1	0

Reading from +0 returns 8 bits. Each set bit indicates current was detected at the corresponding isolated input [0 through 7].

+ 1	Dir	D7	D6	D5	D4	D3	D2	D1	D0
Input #	R	16	14	13	12	11	10	9	8

Reading from +1 returns 8 bits. Each set bit indicates current was detected at the corresponding isolated input [8 through 15].

+ 16	Dir	D7	D6	D5	D4	D3	D2	D1	D0
TTL #	RW	x	x	3	2	x	x	1	0

+16 reads and writes the four bits of LVTTL digital I/O. Bits 0&1 read/write the first two digital bits while bits 4&5 read/write the second two digital bits. Data written to bits configured as input are ignored.

+ 17	Dir	D7	D6	D5	D4	D3	D2	D1	D0
TTL Dir	RW	x	x	x	x	x	x	2&3	0&1

Writing +17 controls the I/O direction for the two LVTTL I/O groups: group 0 [digital bits 0&1] direction is controlled with bit 0; group 1 [digital bits 2&3] direction is controlled with bit 1. Setting a bit to "1" configures that I/O group for output; clearing a bit to "0" configures the group for input.

Reading +17 reads the current digital I/O group direction.

All I/O groups are configured as inputs at power-up or reset.

+ 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 "0xFF" to clear the pending IRQ.

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].

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
`WaitForIRQ()`	Block the thread until the device reports a change-of-state has occurred on a pin of an enabled I/O group (or the wait is aborted).

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 Plug-and-Play Data	
Vendor / Device ID	Card Type
0x494F / 0x0100	M.2- or mPCIe DIO Base
0x494F / 0x0107	M.2- or mPCIe-II-16
0x494F / 0x0108	M.2- or mPCIe-II-8
0x494F / 0x0109	M.2- or mPCIe-II-4

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	accesio.com/mPCIe-II-16 Family
	accesio.com/M.2-II-16 Family
This manual	accesio.com/MANUALS/M.2-_mPCIe-II-16.pdf
Windows Software Install Package	accesio.com/files/packages/M.2-_mPCIe-II-16 Family 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	16 (or 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 10,000Hz)
Isolation	500V channel-to-ground and ch-to-ch
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

Digital I/O Lines

Number		4	(all lines pulled up to VCCIO via 10KΩ)
Digital Inputs 4 or 2 LVTTL	Logic High		2.0V to VCCIO (3.3VDC, 5VDC tolerant)
	Logic Low		0V to 0.8V
Digital Outputs 4 or 2 LVTTL	Logic High		2.0V (min) 24mA source
	Logic Low		0.55V (max) 24mA sink

Environmental

Temperature	Operating	0° to 70°C (order "-T" for -40° to 85°C)
	Storage	-65° to 150°C
Humidity		5% to 95%, non-condensing
Power required		+3.3VDC @ 360mA (typical)

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		38.2 grams (+11.2g 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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