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

MODELS M.2-IDIO-8H, M.2-IDO-8H, M.2-IDIO-4H, MPCIE-IDIO-8H MPCIE-IDO-8H, MPCIE-IDIO-4H, M.2-IDIO-8L, M.2-IDO-8L, M.2-IDIO-4L, MPCIE-IDIO-8L MPCIE-IDO-8L, MPCIE-IDIO-4L, M.2-IDIO-8HL, M.2-IDO-8HL, M.2-IDIO-4HL, MPCIE-IDIO-8HL MPCIE-IDO-8HL, AND MPCIE-IDIO-4HL



ACCES I/O Products, Inc.
10623 Roselle Street
San Diego CA 92121-1506 USA

858 550 9559
800 326 1649
sales@accesio.com

https://accesio.com/M.2-IDIO-8HL
https://accesio.com/mPCIe-IDIO-8HL
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 a stand-alone installer downloaded from the product page Manuals / Software tab on our website.

Run the installer you downloaded 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.

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

FEATURES

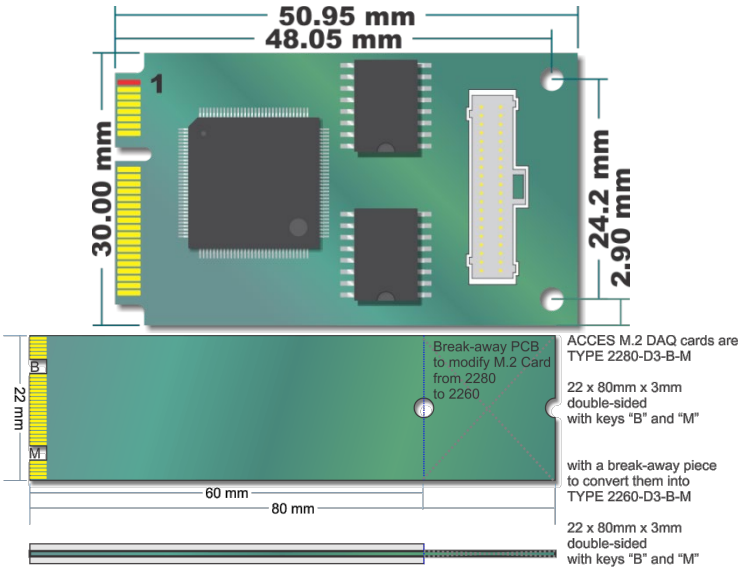
- 8 or 4 optically-isolated non-polarized inputs
- 8 or 4 FET outputs
  - High-side (H) or Low-side (L) or half of each (HL)
- 8 or 4 LVTTL I/O lines programmable as inputs or outputs in groups of 4 lines (pulled up to 3.3V via 10kΩ)
- 9" cable (228mm), standard
- Isolation Module
- All inputs support Change-of-State (CoS) IRQs

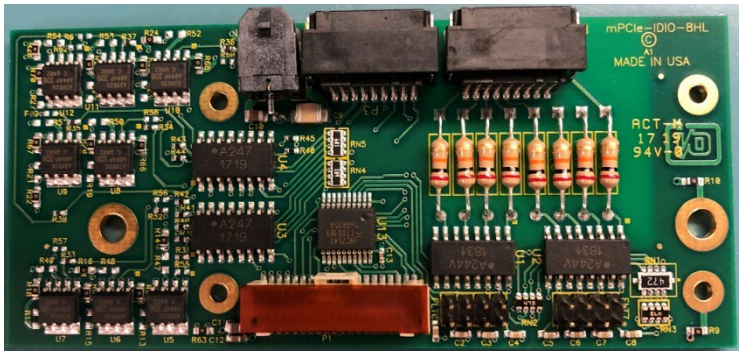
These cards are well suited to complex environments, mitigating otherwise challenging ground-loops, high-common-mode, and transient voltage spikes common in electrically-noisy industrial or factory locations. The broad voltage compatibility and high current outputs allows use in a wide range of applications.

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.

The outputs are High-Side Power MOSFETs capable of 1A continuous-current load.

Switching a FET from the ON to OFF or from OFF to ON is a digital operation, and is therefore relatively fast, best measured in microseconds.





Chapter 3: Hardware

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). Both include a required 9" (229mm) 40-conductor and Isolation Module. The Isolation Module is 1.614" x 3.614" with two 18-pin Molex connectors. All units are RoHS compliant.

INCLUDED IN YOUR PACKAGE

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

Available accessories include:	
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, or alternate cable lengths, to name a few. Pull down resistors on the LVTTL I/O lines (x8) is another application specific need (these are pulled up in the default configuration).

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 group of four jumpers as shown above apply to input channels 0 down through 3; the second group 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 (12-48VDC or AC RMS)
IN B #	Non-Polarized Isolated Input "B" Side (12-48VDC or AC RMS)
OUT / LOAD	FET Output / LOAD pin
RETURN	OUT - for all FETs (Ext Supply Return Terminal)
VBB	Ext Supply (6-48VDC) for FETs
LVTTL I/O #	Digital I/O pin, pulled up to 3.3V via 10kΩ (3.3VDC, +5VDC tolerant)
GND**	Mandatory Ground return connection for LVTTL I/O lines

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

** The GND connection in pin 9 is required to use the LVTTL I/O lines on pins 10-13 and 28-31. Connect this point to the ground reference of the external device. Damage will result if this pin is not connected when trying to use the LVTTL DIO lines, voiding the warranty.

J1 Power			
Pin	Function	Pin	Function
1	RETURN	2	VBB

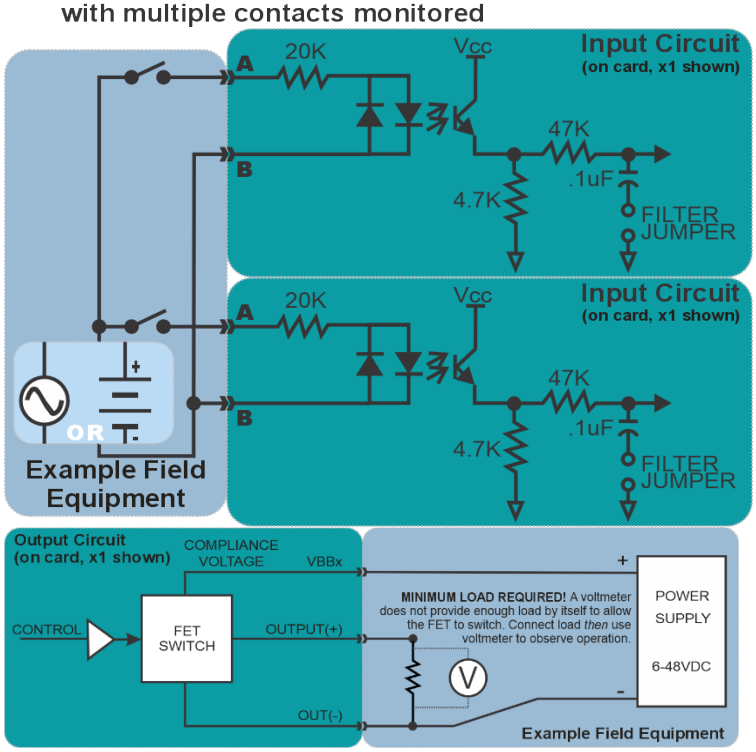
Pin	Function	Pin	Function
1	INA0	2	INB0
3	INA1	4	INB1
5	INA2	6	INB2
7	INA3	8	INB3
9	INA4	10	INB4
11	INA5	12	INB5
13	INA6	14	INB6
15	INA7	16	INB7
17	N/C	18	N/C

P2 Isolated Inputs

Pin	Function	Pin	Function
1	OUT7/LOAD7	2	OUT6/LOAD6
3	OUT5/LOAD5	4	OUT4/LOAD4
5	OUT3/LOAD3	6	OUT2/LOAD2
7	OUT1/LOAD1	8	OUT0/LOAD0
9	GROUND	10	GROUND
11	LVTTL 0	12	LVTTL 1
13	LVTTL 2	14	LVTTL 3
15	LVTTL 4	16	LVTTL 5
17	LVTTL 6	18	LVTTL 7

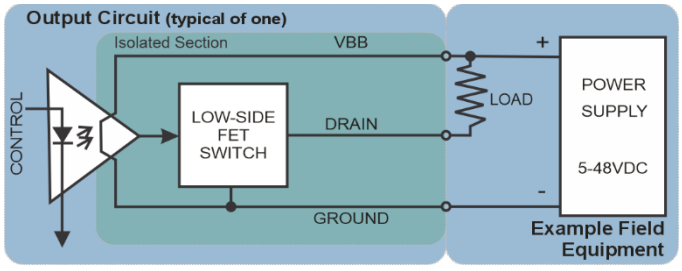
P3 Isolated FET Outputs and LVTTL I/O's

Example: Shared AC or DC power with multiple contacts monitored



Note: High-side FETs have two output states: Off, where the output is high impedance (no current flows between the VBB and the output — except for the FET's leakage current, amounting to a few µA), and On, where VBB is connected to the output pin.

Therefore, if no load is connected the FET output will have a high floating voltage (due to the leakage current and no path to the VBB switching voltages return). To mitigate this, please add a load to ground at the output.



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-IDIO-8, or a PCI-IDIO-8 – or even a 104-IDIO-8!

I/O Registers at BAR [2]		
Register offset (decimal)	Write Operation	Read Operation
FETs [+ 0]	FET 0-7 output	FET 0-7 read-back
Isolated Inputs [+ 1]	*unused*	Bits 0-7 input
TTL 0-3 and 4-7 [+ 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
FET #	rW	7	6	5	4	3	2	1	0

Writing one byte to +0 will control all 8 FETs. Setting a bit to 1 energizes the corresponding FET, while clearing a bit to 0 turns the FET off. Reading a byte will provide the currently commanded FET 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.

+ 16	Dir	D7	D6	D5	D4	D3	D2	D1	D0
Input #	RW	7	6	5	4	3	2	1	0

Writing to this register will output the bits to the TTL output pins. Any bit configured as input will ignore the operation. Reading this register will return the state of the input pins, and/or will read back the state of the any pin configured as outputs.

+ 17	Dir	D7	D6	D5	D4	D3	D2	D1	D0
TTL DIR	rW							TTL4-7	TTL0-3

Writing a "1" to bit D0 or D1 will configure the corresponding TTL bits as output. Writing a "0" will configure the port for use as inputs. All pins are configured as inputs at power-up or reset.

Reading this register will give the current input vs output configuration.

+ 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 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, VxWorks, 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
QueryCardInfo()	Determine what 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:

Model	Vendor ID	Device ID
mPCIe-IDIO-8HL	0x494F (ASCII for "IO")	0x0110
mPCIe-IDIO-8H	0x494F	0x0111
mPCIe-IDIO-8L	0x494F	0x0112

Available Downloads

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

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

Note: Device's connector violates component height restrictions

M.2 PCI Express	2280/2260 B+M-key

Isolated Digital Inputs

Number		8
Type		Non-polarized, optically isolated from each other and from the computer
Voltage		0-8V low, 12-48V high
Isolation		500V channel-to-ground and channel-to-channel
Resistance		20KΩ in series with opto-coupler
Filter Response	Rise-time	4.7 ms
	Fall-time	4.7 ms
No-Filter Response	Rise-time	10 µs
	Fall-time	30 µs
Filter Jumpers		When "ON" enables filter for isolated inputs

FET Outputs

Number	8
Type	High/Low Side Power MOSFET Switch. Protected against short-circuit, over-temp, ESD; drives inductive loads.
Voltage Range	H (High-side) 6-48VDC (customer supplied) L (Low-side) 5-48VDC (customer supplied)
Current Rating	High Side 1.0A maximum Low Side 0.5A maximum
Turn On time	90µsec (typical)
Turn Off time	110µsec (typical)

Digital I/O Lines — 8 LVTTL in groups of 4

Digital Inputs	Logic High Logic Low	2.0V to VCCIO (3.3VDC, 5VDC tolerant) 0V to 0.8V
Digital Outputs	Logic High Logic Low	2.0V (min) 24mA source 0.55V (max) 24mA sink

Environmental

Temperature	Operating	0°C to 70°
	Storage	-65° to 150°C
Humidity		5% to 95%, non-condensing
Power required	From MPCIE bus	+3.3VDC @ 360mA (typical)

Environmental

Temperature	Operating	0°C 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

Card 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 after breakaway)
	Width	22 mm
I/O connector	On-card	Molex 501190-4017 40-pin latching
	mating	Molex 501189-4010

P2 & P3 I/O connectors	18-pin latching
On-module	Molex 5054481871
Mating	Molex 5054321801
J1 Power connector	2-pin latching
On-module	Molex 0430450200
Mating	Molex 430250200

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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