ADDI-DATA®
PARTNER FÜR PRÄZISION

TECHNICAL

DESCRIPTION

APCIe-3660

Noise and vibration measurement board, optically isolated

DIN EN ISO 9001:2015 certified

Edition: 02.01-12/2018

Product information

This manual contains the technical installation and important instructions for correct commissioning and usage, as well as production information according to the current state before printing.
The content of this manual and the technical product data may be changed without prior notice.
ADDI-DATA GmbH reserves the right to make changes to the technical data and the materials included herein.

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Warning!

The following risks result from the improper implementation of the board and from use contrary to the regulations:

Personal injury

Damage to the board, the PC and peripherals

Pollution of the environment.

- Protect yourself, others and the environment!
- Read the safety precautions (yellow leaflet) carefully!

  If this leaflet is not enclosed with the documentation, please contact us and ask for it.
- Observe the instructions of this manual!

  Make sure that you do not forget or skip any step!
  We are not liable for damages resulting from the wrong use of the board.
- Pay attention to the following symbols:

NOTICE!
Designates hints and other useful information.

NOTICE!
Designates a possibly dangerous situation.
If the instructions are ignored, the board, the PC and/or peripherals may be **destroyed**.

WARNING!
Designates a possibly dangerous situation.
If the instructions are ignored, the board, the PC and/or peripherals may be **destroyed** and persons may be **endangered**.

Contents

Figures

Tables

Chapter overview

In this manual, you will find the following information:

Chapter	Content
1	Important information on the application, the user and on handling the board
2	Brief description of the board (features, block diagram)
3	Detailed information on the insertion of the board, connection of the accessories (including pin assignment) and driver installation **Tip:** Print out this chapter to have help at hand for inserting and installing the board.
4	Description of the individual functions of the board
5	Standard software: Information on the API software functions
6	Procedure for returning (repairing, etc.) or disposing of the board
7	List of technical data and limit values of the board
8	Appendix with glossary and index
9	Contact and support address

1 Definition of application, user, handling

1.1 Definition of application

1.1.1 Intended use

The board **APCIe-3660** must be inserted in a PC with PCI Express slots which is used as electrical equipment for measurement, control and laboratory pursuant to the standard EN 61010-1 (IEC 61010-1).

The used personal computer (PC) must fulfil the requirements of IEC 60950-1 or EN 60950-1 and EN 55022 or IEC/CISPR 22 and EN 55024 or IEC/CISPR 24.

The use of the board **APCIe-3660** in combination with external screw terminal panels requires correct installation according to the series IEC 61439 or EN 61439 (Low-voltage switchgear and controlgear assemblies).

1.1.2 Usage restrictions

The board **APCIe-3660** must not be used as a safety-related part (SRP).

The board **APCIe-3660** must not be used for safety-related functions, for example for emergency stop functions.

The board **APCIe-3660** must not be used in potentially explosive atmospheres.

The board **APCIe-3660** must not be used as electrical equipment according to the Low Voltage Directive 2014/35/EU.

1.1.3 Limits of use

All safety information and the instructions in the manual must be followed to ensure proper intended use.

Uses of the board beyond these specifications are considered as improper use. The manufacturer is not liable for damages resulting from improper use.

The board must remain in its anti-static packaging until it is installed.

Please do not delete the identification numbers of the board or the warranty claim will be invalid.

1.2 User

1.2.1 Qualification

Only persons trained in electronics are entitled to perform the following works:

- Installation
- Commissioning
- Use
- Maintenance.

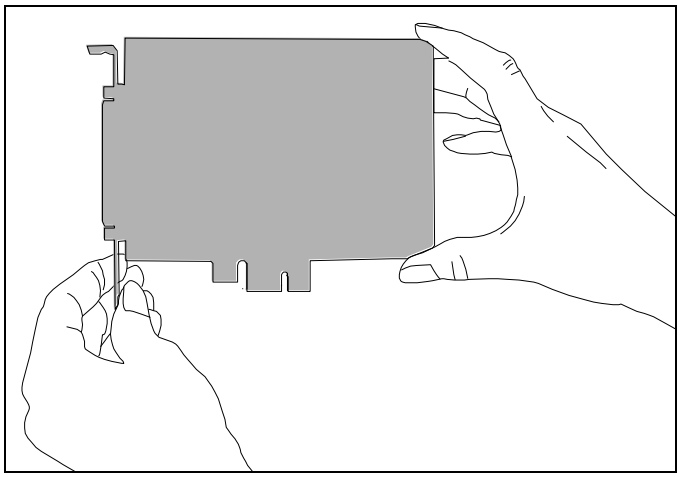
1.2.2 Country-specific regulations

Do observe the country-specific regulations regarding

- the prevention of accidents
- electrical and mechanical installations
- Electromagnetic compatibility (EMC).

1.3 Handling of the board

Fig. 1-1: APCIe-3660: Correct handling



Hold the board cautiously at the outer end and at the slot bracket.
Do not touch the surface of the board!

1.4 Questions and updates

If you have any questions, do not hesitate to call us or to send us an e-mail:

Phone: +49 7229 1847-0
E-mail: info@addi-data.com

Manual and software download from the Internet

The latest versions of the technical manual and the standard software for the board **APCIe-3660** can be downloaded for free at: www.addi-data.com.

NOTICE!
Before using the board and in case of malfunction during operation, check if there is an update (manual, driver) available. Current data can be found on our website or contact us directly.

2 Brief description

2.1 Technical features

Table 2-1: Technical features: Overview

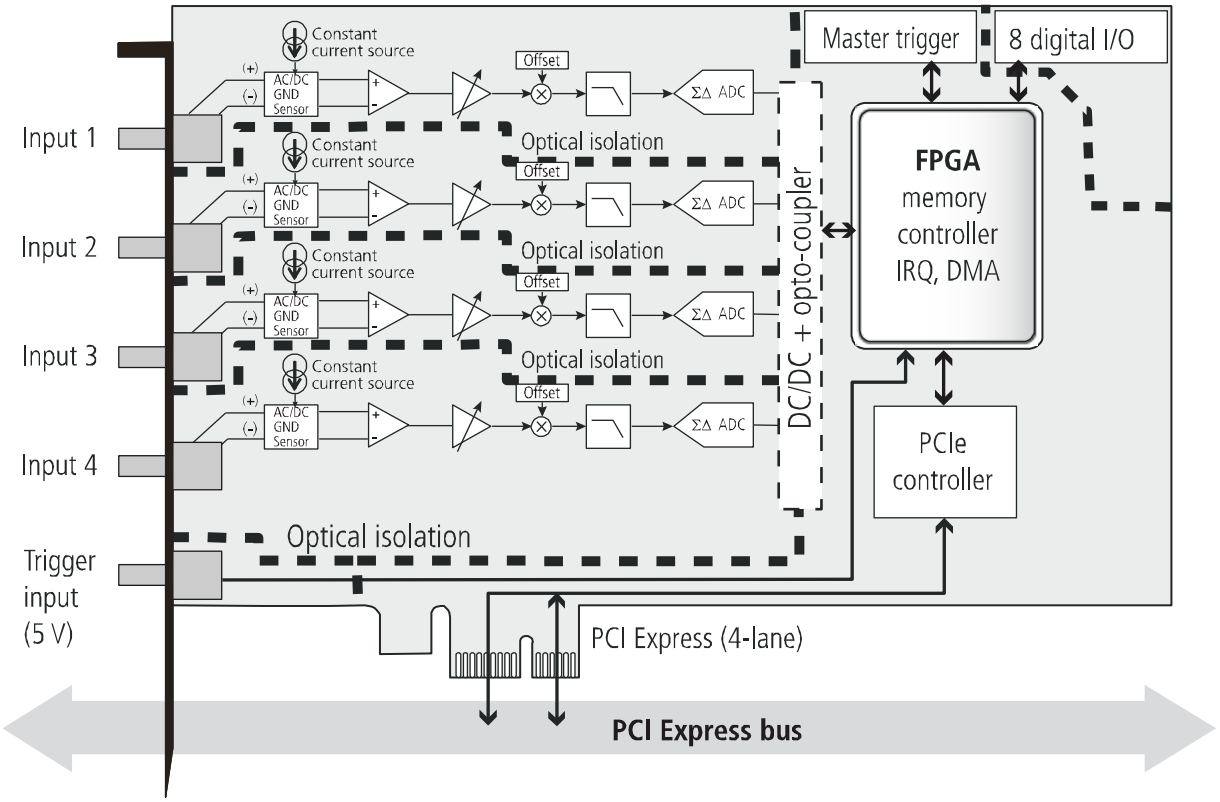
Technical features	APCIe-3660
Analog inputs: Single-ended (SE) or differential (diff.)	4
Resolution	24-bit
Digital inputs/outputs: 24 V, optically isolated	4 inputs 4 outputs

Other features:

- 4-lane PCI Express board
- Connection via SMB connectors
- 4 current sources for the connection of IEPE sensors (e.g. ICP sensors)
- Simultaneous acquisition of all channels
- Digital 24 V trigger input
- Input range (SE: ± 10 V, ± 1 V; diff.: ± 5 V, ± 0.5 V) and gain (x1, x10) can be programmed for each channel
- Sampling frequency: between 125 kHz and 4 MHz (programmable for each channel)
- Coupling: AC, DC, GND (programmable for each channel)
- Optical isolation between the channels (1000 V)
- Anti-aliasing filter
- Overvoltage protection
- Extended operating temperature range: -20 °C to +85 °C

2.2 Block diagram

Fig. 2-1: APCIe-3660: Block diagram



3 Insertion and installation of the board

3.1 Insertion of the APCIe board

Risk of injury!
Please follow the safety precautions! An improper handling of the board may cause property damage and injury.

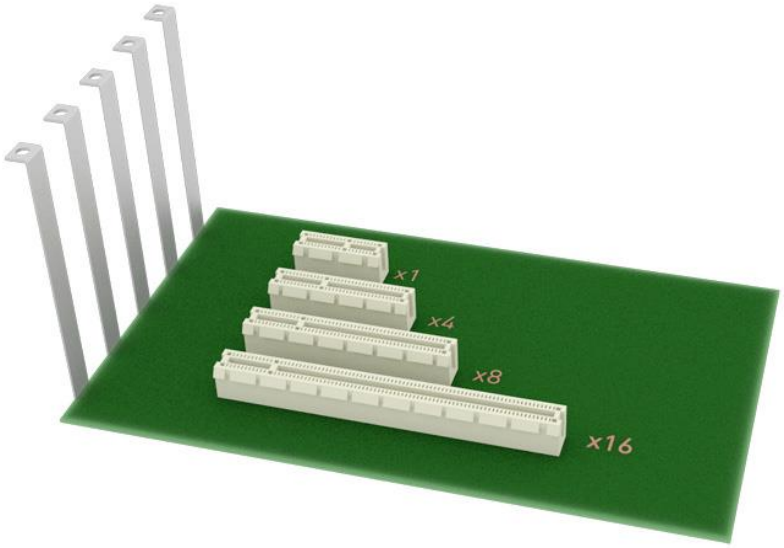
3.1.1 Opening the PC

- Switch off the PC and all the units connected to it.
- Pull the PC mains plug from the socket.
- Open the PC as described in the manual of the PC manufacturer.

3.1.2 Selecting a slot

- Select a free 4-lane (x4), 8-lane (x8) or 16-lane (x16) PCI-Express slot for the board.

Fig. 3-1: PCI Express slot types

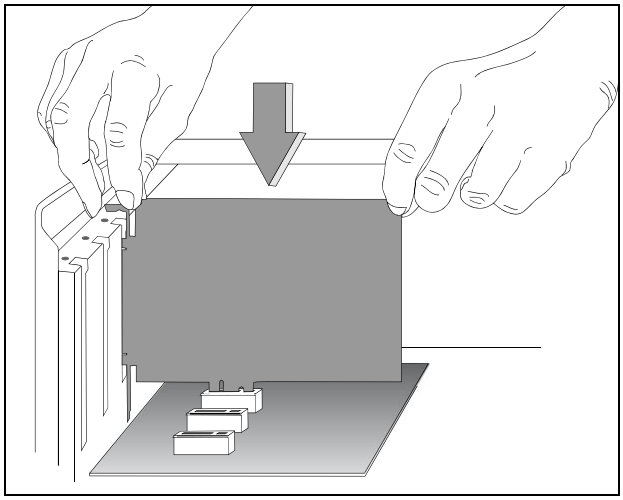


- Unscrew the back cover from the selected slot. For this, follow the operating instructions provided by the PC manufacturer!
  Keep the back cover in a safe place. You will need it if you remove the board.
- Provide for potential equalisation.
- Take the board out of its protective packaging.

3.1.3 Inserting the board

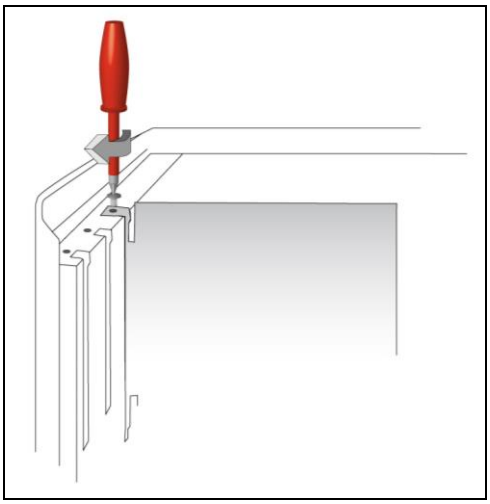
- Insert the board vertically from above into the selected slot.

Fig. 3-2: Slot: Insert the board



- Fasten the board to the rear of the PC housing using the screw which held the back cover in place.

Fig. 3-3: PC housing: Fasten the board



- Tighten all loose screws.

3.1.4 Closing the PC

- Close the PC as described in the manual of the PC manufacturer.

3.2 Connecting the accessories

3.2.1 Connection of the screw terminal panel

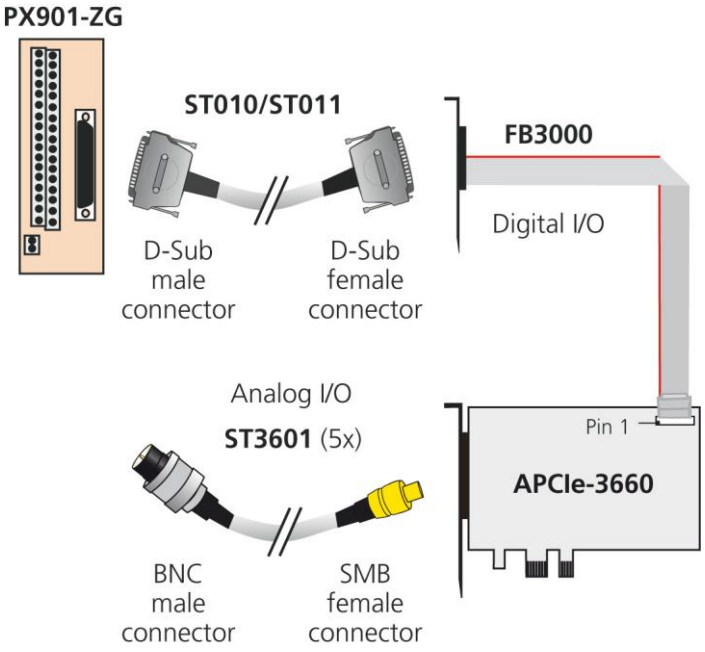
Between the board **APCIe-3660** and the peripherals, analog signals are exchanged via the cable **ST3601**, which needs to be connected to the coaxial SMB male connectors of the board. In terms of electromagnetic compatibility (EMC), these cables have the following properties:

- Metallised connector housing
- Shielded cable.

For the digital inputs and outputs of the board, the ribbon cable **FB3000** is connected to the 16-pin header of the board. This ribbon cable also has a 37-pin D-Sub male connector for the connection of the cable **ST010** or **ST011**, i.e. a second slot is required.

To operate the digital outputs of the board, an external supply voltage is required (see Chapter 7.4.4). The screw terminal panel **PX901-ZG** enables this supply voltage to be connected.

Fig. 3-4: APCIe-3660: Connection of the screw terminal panel



NOTICE!

Plug the FB3000 cable into the connector by inserting the red (or blue or black) cable line into pin 1.

3.2.2 Pin assignment

Fig. 3-5: Coaxial SMB male connector at the slot bracket (analog inputs)

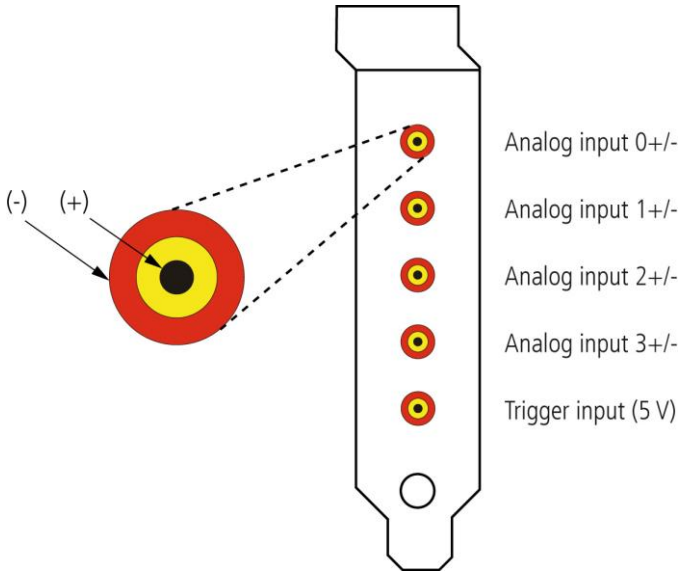


Fig. 3-6: 37-pin D-Sub male connector (digital I/O)

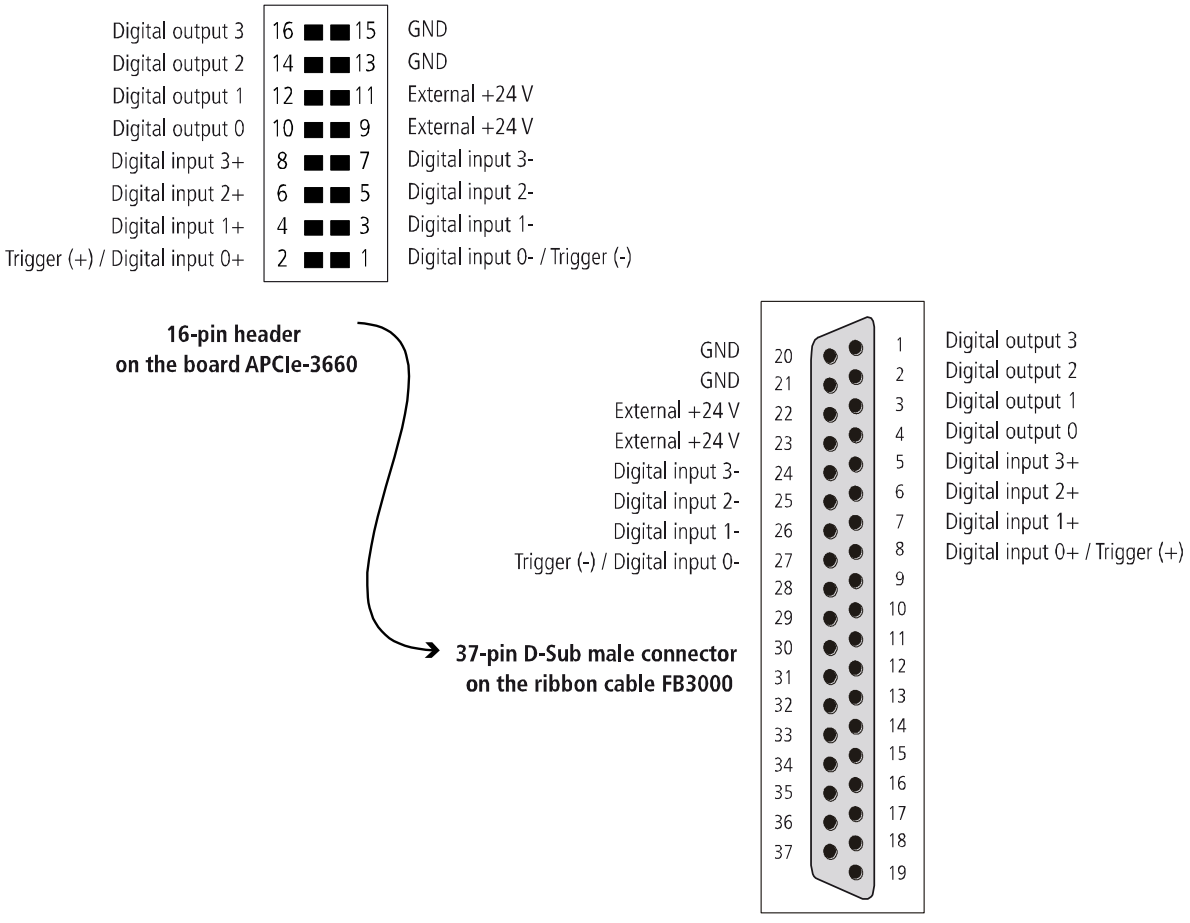


Table 3-1: Pin description (digital I/O)

Pin No. (16-pin header)	Pin No. (37-pin D-Sub male connector)	Pin function
1	27	Digital input 0- / Trigger input (-)
2	8	Digital input 0+ / Trigger input (+)
3	26	Digital input 1-
4	7	Digital input 1+
5	25	Digital input 2-
6	6	Digital input 2+
7	24	Digital input 3-
8	5	Digital input 3+
9	23	24 V voltage supply (digital outputs)
10	4	Digital output 0
11	22	24 V voltage supply (digital outputs)
12	3	Digital output 1
13	21	GND (digital outputs)
14	2	Digital output 2
15	20	GND (digital outputs)
16	1	Digital output 3

3.2.3 Connection example

Fig. 3-7: Connection example (digital inputs)

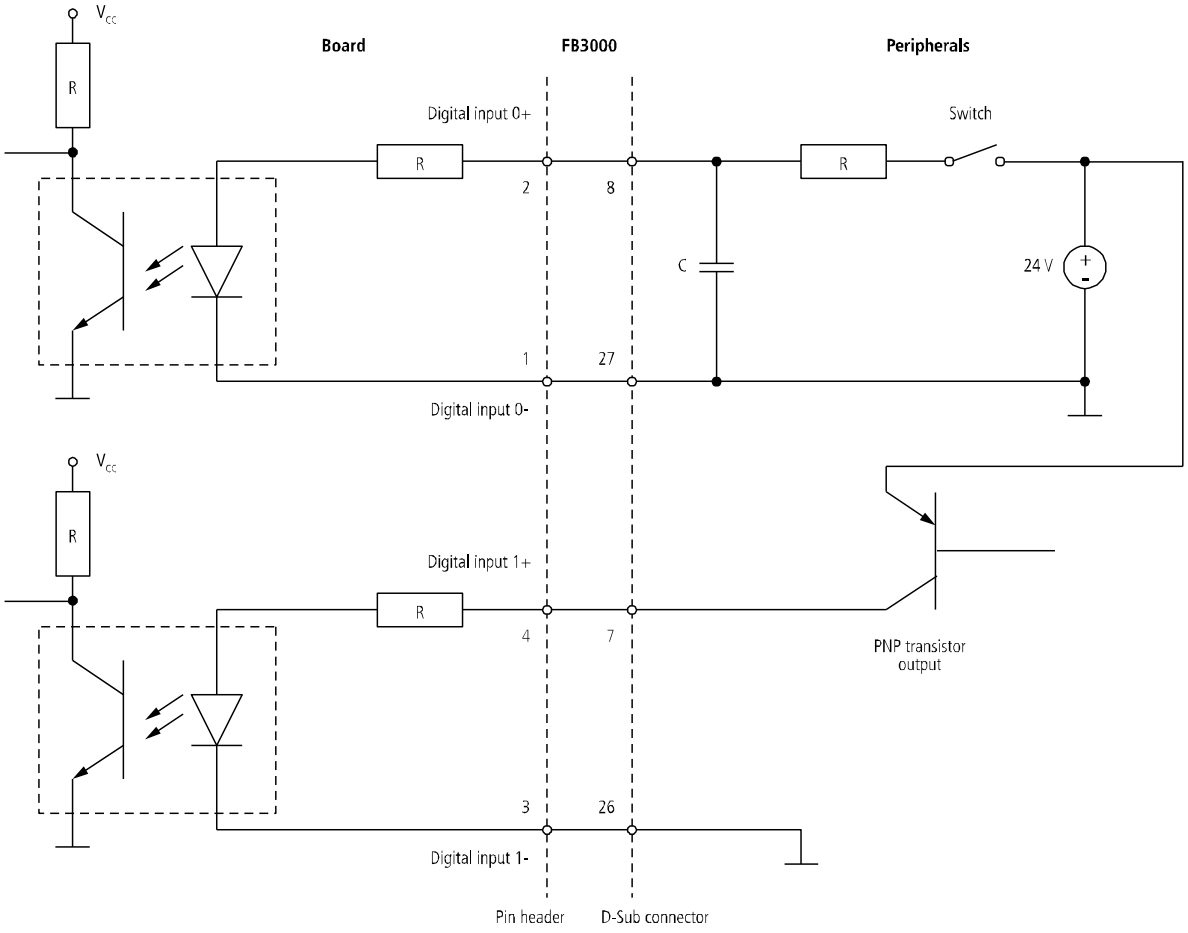
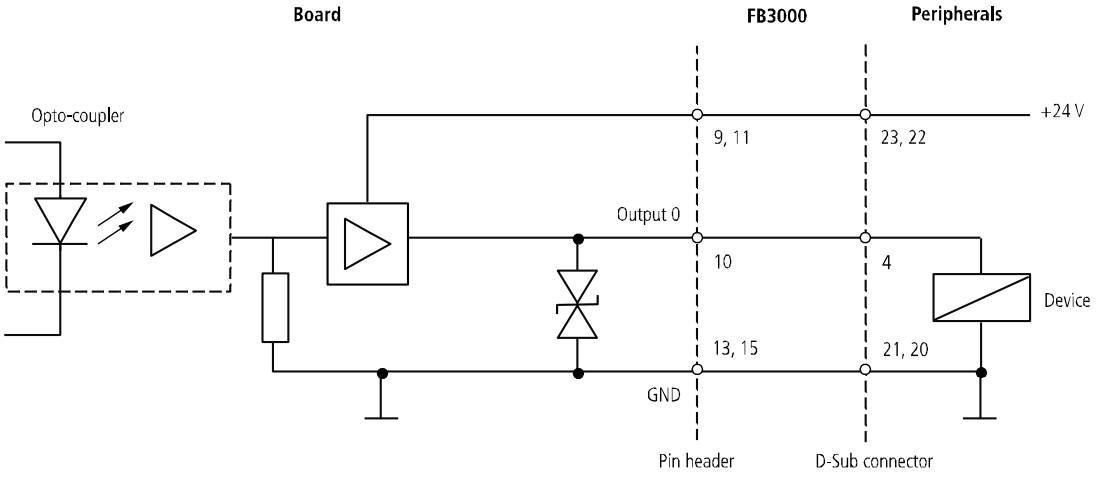


Fig. 3-8: Connection example (digital outputs)



NOTICE!
Please note that an external voltage source is required for the digital outputs (see Chapter 7.4.4).

3.3 Driver installation

Information on how to select and download the appropriate driver can be found in the document "Quick installation PC boards" (see PDF link).

The installation of drivers of the type "ADDI-DATA Multiarchitecture Device Drivers 32-/64-Bit for x86/AMD64" as well as the installation of the corresponding samples is described in the installation instructions (see PDF link).

4 Function description

4.1 Analog inputs

Up to 4 single-ended or differential signals can be connected to the **APCIe-3660** board.

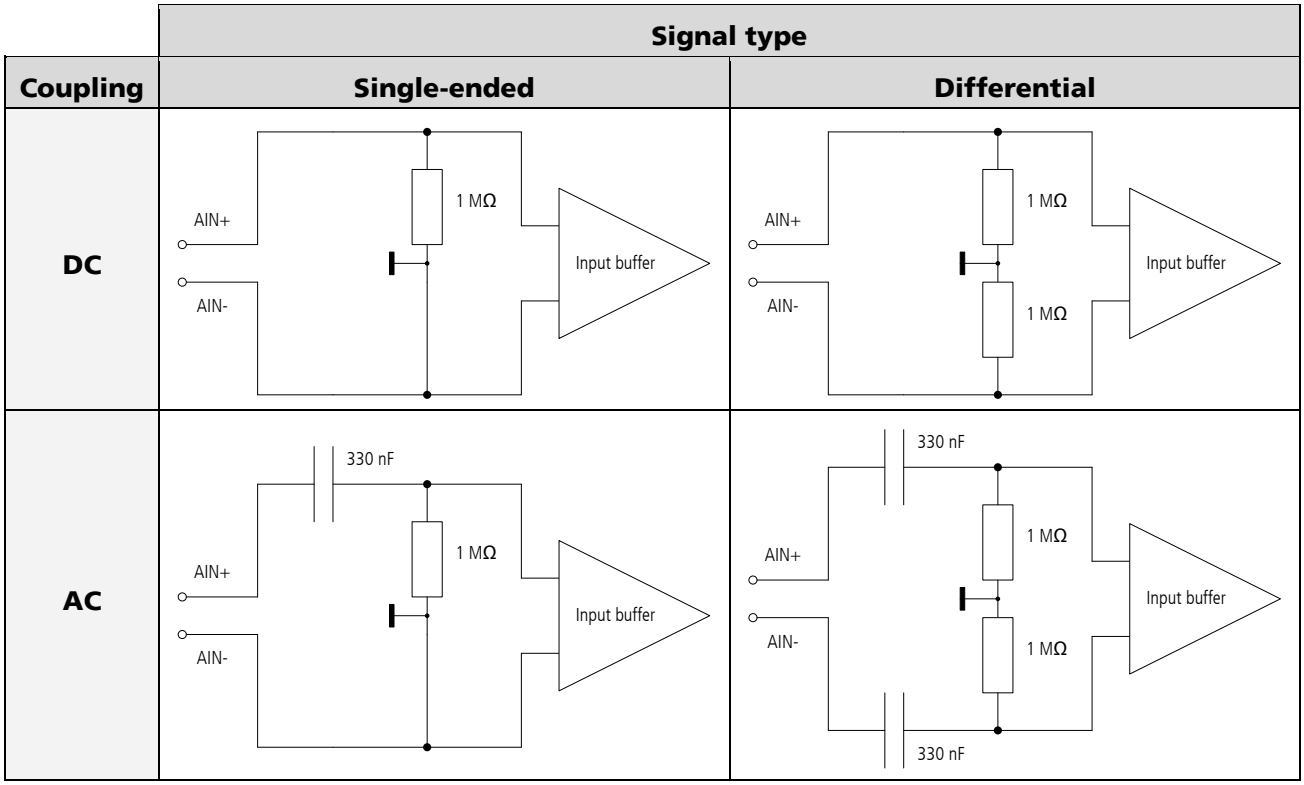
4.1.1 Coupling mode

In DC mode, the cut-off frequency of the low-pass filter corresponds to the Nyquist frequency and thus depends on the sampling frequency (see Chapter 4.1.5).
In AC mode, a high-pass filter with a cut-off frequency (-3 dB) of 0.16 Hz is connected in addition.

4.1.2 Signal type

Each input can be set as either single-ended (SE) or differential (diff.) input.

Fig. 4-1: Analog input circuits



4.1.3 Input range

The analog input range and the gain can be selected through software for each channel. This enables different voltages with the channels so that the resolution of the A/D converter can be used to full capacity.

Table 4-1: Input ranges

Gain	Input range (V)	
	Single-ended	Differential
x1	± 10	± 5
x10	± 1	± 0.5

4.1.4 Sampling frequency

The sampling frequency can be selected through software for each channel.

Table 4-2: Sampling frequencies and resolution

Sampling frequency	Resolution
125 kHz	24-bit
250 kHz	24-bit
500 kHz	24-bit
1 MHz	24-bit
2 MHz	23-bit
4 MHz	23-bit

4.1.5 Anti-aliasing filter

Low-pass filters are used either before or during the digitisation process to eliminate all frequency components above the Nyquist frequency. This guarantees that the digital value or the digital result is free of all undesired frequencies (aliasing frequencies). With the **APCIe-3660**, both digital and analog low-pass filters are used to eliminate these aliasing frequencies.

1) Digital ADC filter

Each of the delta-sigma ADCs on the **APCIe-3660** contains an integrated digital filter whose cut-off frequency changes according to the sampling frequency. Thus, the filter structure automatically adjusts to the Nyquist frequency. The digital filter has only a slight effect on frequencies within the bandwidth.

Table 4-3: ADC filter: Properties

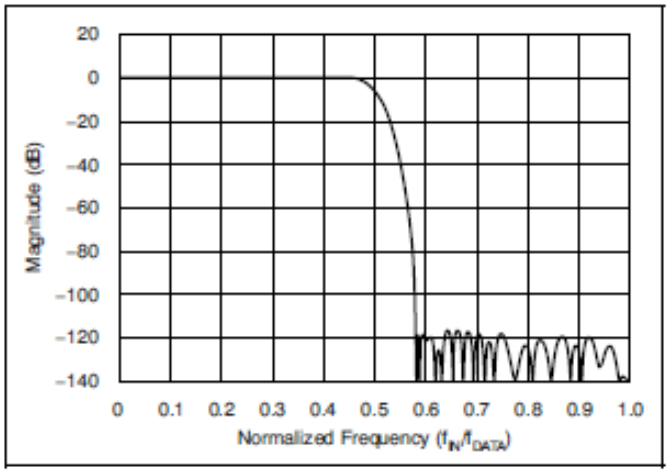
Parameter	Test conditions	Minimum value	Type	Maximum value	Unit
Passband	-	0	-	$0.424f_{DATA}$	Hz
Passband ripple	-	-	-	± 0.00002	dB
Passband/ Stop-band transition	Attenuation: -0.1 dB	-	$0.432f_{DATA}$	-	Hz
	Attenuation: -3 dB	-	$0.488f_{DATA}$	-	Hz
Stop-band	-	$0.576f_{DATA}$	$f_{CLK} – 0.576f_{DATA}$		Hz
Stop-band attenuation	-	-	86	-	dB

f_{DATA} = see Table 4-4
f_{CLK} = 32 MHz

Table 4-4: ADC filter: Sampling frequencies

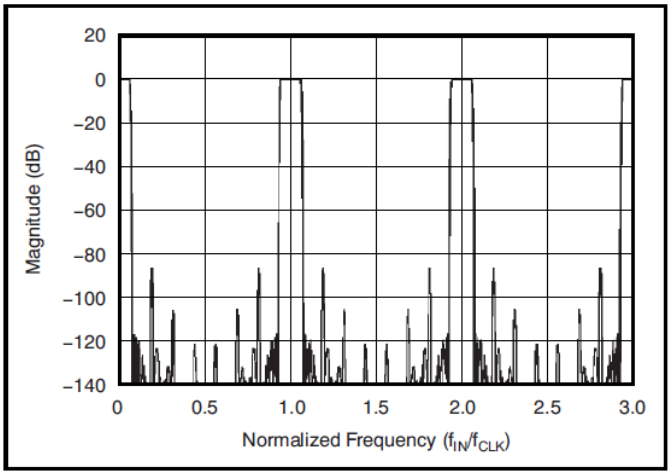
Sampling frequency	Bandwidth (-3 dB)	Oversampling ratio
125 kHz	59.375 kHz	256
250 kHz	118.75 kHz	128
500 kHz	237.5 kHz	64
1 MHz	475 kHz	32
2 MHz	950 kHz	16
4 MHz	1900 kHz	8

Fig. 4-2: ADC filter: Frequency response[1]



[1] Source: http://www.ti.com/lit/ds/symlink/ads1675.pdf, S. 21 (11/07/2017)

Fig. 4-3: ADC filter: Extended frequency response[2]



2) Analog filter

Each input channel on the **APCIe-3660** is equipped with a three-pole low-pass filter. The cut-off frequency of the analog filter is 3 MHz. This high cut-off frequency guarantees a very flat amplitude response and minimal phase errors with the signals concerned. Thanks to the design of the analog filter, a good attenuation of high aliasing frequencies is achieved, with a low in-band frequency sensitivity being maintained at the same time.
At lower sampling frequencies, potential aliasing frequencies are not completely filtered out, but in most cases the residual aliasing frequencies are noise rather than well-defined harmonics.

3) Programmable digital filters

To filter out potential aliasing frequencies that cannot be eliminated by the analog filter at lower sampling frequencies, the **APCIe-3660** has two programmable digital filters (Low Latency and Wide Bandwidth). These filters are selectable through software.

4.1.6 Dynamic performance

Table 4-5: Dynamic performance (-0.5 dBFS)

1 kHz sine input amplitude = -0.5 dBFS		Gain (x1)				Gain (x10)			
		DC		AC		DC		AC	
		Diff.	SE	Diff.	SE	Diff.	SE	Diff.	SE
125 kSPS	THD (dB)	-92.62	-80.64	-92.64	-80.94	-96.34	-96.36	-96.35	-96.30
	SNR (dB)	96.89	86.20	96.22	86.24	86.46	96.90	86.35	95.89
	SINAD (dB)	91.24	79.58	91.06	79.81	86.04	93.61	85.94	93.08
	SFDR (dB)	92.68	84.03	92.71	84.32	86.50	96.74	86.47	96.80
	ENOB (Bit)	15.035	13.097	15.005	13.136	14.170	15.429	14.154	15.339

[2] Source: http://www.ti.com/lit/ds/symlink/ads1675.pdf, S. 22 (11/07/2017)

250 kSPS	THD (dB)	-93.07	-80.89	-93.04	-81.15				
	SNR (dB)	92.99	85.86	92.85	85.81				
	SINAD (dB)	90.02	79.69	89.93	79.87				
	SFDR (dB)	93.45	84.63	93.45	84.89				
	ENOB (Bit)	14.832	13.115	14.817	13.145				
500 kSPS	THD (dB)	-93.03	-80.81	-93.00	-81.14				
	SNR (dB)	91.71	85.55	91.66	85.81				
	SINAD (dB)	89.31	79.55	89.27	79.86				
	SFDR (dB)	92.95	84.15	92.92	84.88				
	ENOB (Bit)	14.713	13.093	14.706	13.144				
1 MSPS	THD (dB)	-91.46	-92.55	-91.50	-92.99				
	SNR (dB)	90.23	80.56	90.22	80.54				
	SINAD (dB)	87.79	80.29	87.80	80.30				
	SFDR (dB)	91.84	92.91	91.90	93.41				
	ENOB (Bit)	14.461	13.215	14.463	13.216				
2 MSPS	THD (dB)	-91.49	-92.56	-91.54	-93.05				
	SNR (dB)	88.64	76.90	88.63	76.91				
	SINAD (dB)	86.82	76.78	86.84	76.80				
	SFDR (dB)	91.37	92.42	91.42	92.94				
	ENOB (Bit)	14.301	12.633	14.302	12.636				
4 MSPS	THD (dB)	-91.55	-92.43	-91.40	-92.98				
	SNR (dB)	83.94	68.38	83.88	68.38				
	SINAD (dB)	83.24	68.36	83.17	68.37				
	SFDR (dB)	91.52	92.37	91.37	92.98				
	ENOB (Bit)	13.706	11.234	13.693	11.235				

Table 4-6: Dynamic performance (-1 dBFS)

1 kHz sine input amplitude = -1 dBFS		Gain (x1)				Gain (x10)			
		DC		AC		DC		AC	
		Diff.	SE	Diff.	SE	Diff.	SE	Diff.	SE
125 kSPS	THD (dB)		-92.74		-93.22				
	SNR (dB)		97.86		98.58				
	SINAD (dB)		91.57		92.11				
	SFDR (dB)		92.74		93.31				
	ENOB (Bit)		15.090		15.179				
250 kSPS	THD (dB)								
	SNR (dB)								
	SINAD (dB)								
	SFDR (dB)								
	ENOB (Bit)								
500 kSPS	THD (dB)								
	SNR (dB)								
	SINAD (dB)								
	SFDR (dB)								
	ENOB (Bit)								
1 MSPS	THD (dB)								
	SNR (dB)								
	SINAD (dB)								
	SFDR (dB)								
	ENOB (Bit)								
2 MSPS	THD (dB)								
	SNR (dB)								
	SINAD (dB)								
	SFDR (dB)								
	ENOB (Bit)								
4 MSPS	THD (dB)								
	SNR (dB)								
	SINAD (dB)								
	SFDR (dB)								
	ENOB (Bit)								

Table 4-7: Crosstalk with (non)adjacent channels

	f_{IN} = 1 kHz		f_{IN} = 100 kHz	
	Gain (x1)	**Gain (x10)**	**Gain (x1)**	**Gain (x10)**
Short-circuited input				
Load (1 kΩ)				
Result*				

* for the different sampling frequencies if frequency-dependent

Table 4-8: Other dynamic properties

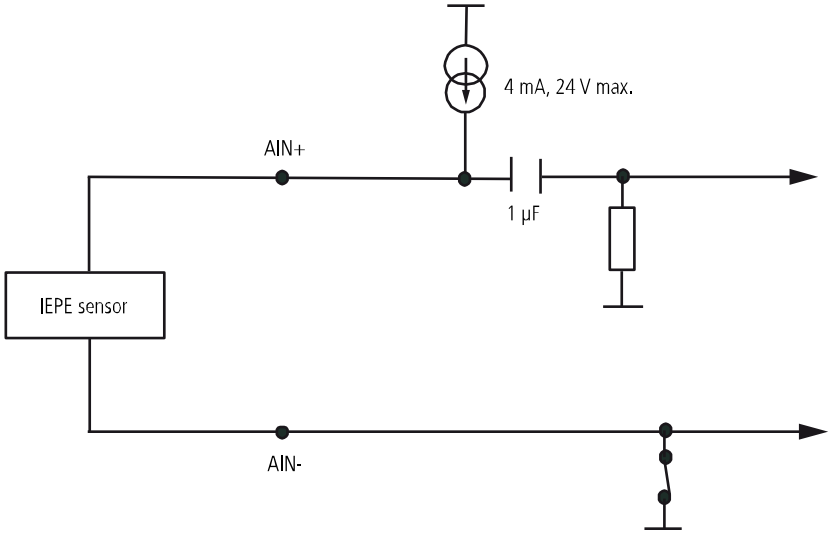
Parameter	Gain (x1)	Gain (x10)
Common-mode range		
Common-mode rejection ratio (CMRR)		
Range error		
Offset error		
Offset drift		

4.1.7 Current sources

On the **APCIe-3660**, four current sources (one per analog input) are available for the IEPE sensor supply. The current sources are located at the positive analog inputs:

The current sources remain automatically switched off in DC mode and can only be switched on in AC mode. When a current source is activated, the respective positive input switches into AC mode and the negative input switches to GND so that the circuit can be generated over the IEPE sensor.

Fig. 4-4: IEPE sensor supply with the APCIe-3660



4.1.8 Calibration

At each analog input, the gain and the offset errors can be corrected through a calibration carried out by ADDI-DATA.

4.1.9 Input modes

The acquisition can be carried out in the following modes:

1) Simple mode

2) Cyclic mode (auto stop)

3) Cyclic mode (ring buffer)

1) Simple mode

In this mode, the value of the selected analog input can be read.

2) Cyclic mode (auto stop)

In auto stop mode (single acquisition), the acquisition is stopped when the number of values you have previously defined for the onboard memory is reached.

You can define a reference value through software. This defines the number of values for the onboard memory. When this value is reached, a compare interrupt is released and the board driver initialises the DMA transfer of the values from the onboard memory to the PC memory. Once the transfer is completed, the user interrupt routine is called up. When the onboard memory is full, an auto stop interrupt is released.

The following errors may occur in this mode:

- FIFO error
- PC buffer overflow (if the PC memory is smaller than the onboard memory and the user application has not read the data fast enough).

3) Cyclic mode (ring buffer)

In ring buffer mode (continuous acquisition), the acquisition is stopped only by a board error (such as FIFO error or onboard memory overflow) or by the software.

You can define a reference value through software. This defines the number of values for the onboard memory. When this value is reached, a compare interrupt is released and the board driver initialises the DMA transfer of the values from the onboard memory to the PC memory. Once the transfer is completed, the user interrupt routine is called up.

The following errors may occur in this mode:

- FIFO error
- Onboard memory overflow (if the driver does not transfer the data fast enough into the PC memory).
- PC buffer overflow (if the PC memory is smaller than the onboard memory and the user application has not read the data fast enough).

4.2 Trigger input (SMB connector) or digital inputs

The trigger input or the digital inputs acquire external signal states. The input information is loaded as a numeric value in a memory cell of the system via the driver function. This numeric value represents the status of the input signals.

The inputs correspond to the 24 V industry standard (IEC1131-2):

- Logic “1” corresponds to an input voltage ≥ 19 V.
- Logic “0” corresponds to an input voltage ≤ 14 V.

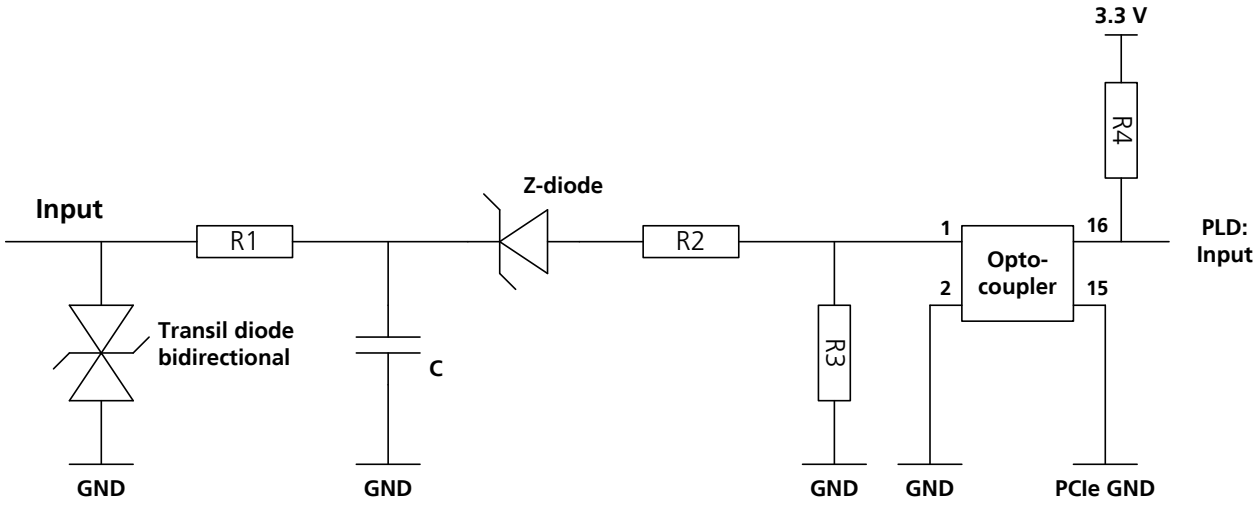
The current demand for each input is 10.5 mA at nominal voltage. The maximum input voltage is 30 V.

NOTICE!
The mains supply for the external power supply of the board must deliver at least the power that is required for your application.

The input signals are filtered by TVS diodes, Z-diodes, RC filters and opto-couplers. In this way, the effect of inductive and capacitive noise is reduced.

The board does not require initialisation to directly read the digital input information. The data is immediately available after “Power ON”.

Fig. 4-5: Digital input stage



4.3 Digital outputs

For the digital outputs, positive logic is used:

- Logic "1": Set output through software
- Logic "0": Reset output

The maximum supply voltage is 35 V. Each output can switch a current of 50 mA. The total current of all outputs is limited to 300 mA by a polyswitch fuse element.

NOTICE!
The mains supply for the external power supply of the board must deliver at least the power that is required for your application.

Characteristics of the 24 V outputs:

- Short-circuit protection relating to ground: The output is switched off.
- Protection against overtemperature: The output driver is switched off.

TVS diodes and opto-couplers filter noise on the peripheral side. In this way, the effect of inductive and capacitive noise on the system bus side is reduced or eliminated.

The board does not require initialisation to output the digital information. The outputs are reset to "0" after "Power ON Reset" and can be immediately programmed.

5 Standard software

The API software functions supported by the board are listed in an HTML document. A description of how to access the respective file can be found in the document “Quick installation PC boards” (see PDF link), in the chapter “Standard software”.

6 Return or disposal

6.1 Return

If you need to return your board, you should read the following checklist before.

Checklist for returning the board:

- Specify the reason for returning your board (e.g. exchange, modification, repair), the serial number of the board, the contact person in your company including his/her telephone extension and e-mail address, as well as the mailing address for a potential new delivery. You do not have to indicate the RMA number.

Fig. 6-1: Serial number

- Note down the serial number of the board.
- Place the board in an ESD protective cover. Then pack it in a cardboard box so that it is well-protected for shipping. Send the packed board together with your details to:

  ADDI-DATA GmbH
  Airpark Business Center
  Airport Boulevard B210
  77836 Rheinmünster
  Germany
- If you have any questions, do not hesitate to contact us:

  Phone: +49 7229 1847-0
  E-mail: info@addi-data.com

6.2 Disposal of ADDI-DATA waste equipment

ADDI-DATA organises the disposal of ADDI-DATA products that were put on the German market after 13 August 2005.
If you want to return waste equipment, please e-mail your request to: rohs@addi-data.com.

Boards that were delivered after 13 August 2005 can be recognised by the following label:

Fig. 6-2: Disposal: Label

This symbol indicates the disposal of waste electrical and electronic equipment. It is valid in the European Union and in other European countries that have a separate collection system. Products carrying this symbol must not be treated as household waste.
For more detailed information on the recycling of these products, please contact your local citizens' office, your household waste collection service, the shop where you bought this product or the distributor you purchased this product from.

If you dispose of this product correctly, you will help to prevent damage that could be caused to the environment and to human health by inappropriate disposal. The recycling of materials will help to conserve our natural resources.

Disposal in other countries than Germany
Please dispose of the product according to the country-specific regulations.

7 Technical data and limit values

7.1 Electromagnetic compatibility (EMC)

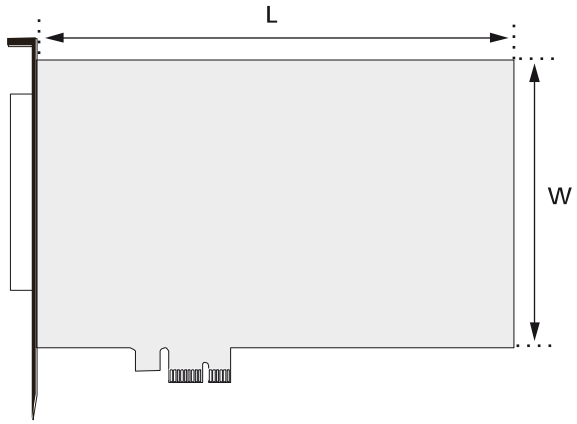
The board **APCIe-3660** is suited for installation in personal computers (PCs) which comply with the European EMC directive.

The board **APCIe-3660** complies with the European EMC directive. The tests were carried out by a certified EMC laboratory in accordance with the standard from the EN 61326 series (IEC 61326).
The limit values as set out by the European EMC directive for an industrial environment are complied with.

The respective EMC test report is available on request.

7.2 Mechanical structure

Fig. 7-1: APCIe-3660: Dimensions



Dimensions (L x W):	168 x 99 mm	
Weight:	approx. 160 g	
Insertion into:	PCI Express slot	
Connection to peripherals:		
Front connector:	4 x coaxial SMB male connector (analog inputs) 1 x coaxial SMB male connector (trigger)	
Additional connector:	16-pin header (digital I/O)	
Accessories:[3]	see Chapter 3.2	
for analog I/O:	Cable:	**ST3601**
for digital I/O:	Cable:	**ST010, ST011, FB3000**
	Screw terminal panel:	**PX901-ZG**

[3] Not included in standard delivery

NOTICE!
The connection lines must be installed in such a way that they are protected against mechanical loads.

7.3 Version

The board **APCIe-3660** is available in the following version:

Table 7-1: Version

Version	Features
APCIe-3660-4	4 analog inputs, 4 current sources for the connection of IEPE sensors, 4 digital inputs, 4 digital outputs

The specific version name can be found on the type label at the slot bracket of your board.

7.4 Limit values

Height:	2000 m over NN
Operating temperature:	-20 °C to +85 °C (with forced ventilation)
Storage temperature:	-20 °C to +85 °C
Relative air humidity at indoor installation:	50 % at +40 °C 80 % at +31 °C
Minimum PC requirements:	
System bus:	4-/8-/16-lane PCI Express according to PCI Express Base Specification, Revision 1.0a (PCI Express 1.0a)
Link speed:	2.5 Gbit/s
Required space:	- analog inputs: 1 PCI Express slot - digital I/O: 1 PCI Express slot (for **FB3000** cable)
Operating system:	Windows 8, Windows 7, Windows XP, Linux
Safety:	
Optical isolation:	1000 V
Energy demand:	
Operating voltage from the PC:	3.3 V and 12 V
Current consumption (typ., without load)	see the following table

Table 7-2: Current consumption

	APCIe-3660
+3.3 V from the PC	170 mA ± 10 %
+12 V from the PC	1.3 A ± 10 %

7.4.1 Analog inputs

Number of inputs:	4 (simultaneous)
Signal type:	single-ended or differential (software-selectable)
Optical isolation:	1000 V
Coupling:	AC, DC (software-selectable)
Resolution:	see Table 4-2
Gain:	x1, x10 (software-selectable)
Sampling frequency f_s:	see Table 4-2 (software-selectable)
Data transfer:	DMA, I/O, IRQ
Input stage:	
Input impedance:	1 MΩ
Input range:	see Table 4-1
AC cut-off frequency (-3 dB):	0.16 Hz typ.
Overvoltage protection:	Max. DC: ± 12 V, 190 mA Max. peak current (pulse at 1 ms, 10 % duty cycle): ± 12 V, 500 mA
Filter properties:	see Chapter 4.1.5
Dynamic properties:	see Chapter 4.1.6
Sensor supply:	
Current source:	4 mA typ. to 26 V max.
Coupling:	AC (input +) GND (input -)

7.4.2 Trigger input (SMB connector)

Number of inputs:	1
Nominal voltage:	24 V
Filter/protective circuit:	input filter, TVS diode, RC filter, Z-diode, opto-coupler
Optical isolation:	1000 V (via opto-coupler)
Input voltage:	0-30 V
Input current (at nominal voltage):	10.5 mA typ.
Logic input levels:	UH_{max}: 30 V UH_{min}: 19 V UL_{max}: 14 V UL_{min}: 0 V

7.4.3 Digital inputs

Number of inputs:	4
Nominal voltage:	24 V
Filter/protective circuit:	input filter, TVS diode, RC filter, Z-diode, opto-coupler
Optical isolation:	1000 V (via opto-coupler)
Input voltage:	0-30 V

Input current (at nominal voltage):	10.5 mA typ.
Max. input frequency (at nominal voltage):	1 MHz
Logic input levels:	UH_{max}: 30 V UH_{min}: 19 V UL_{max}: 14 V UL_{min}: 0 V

7.4.4 Digital outputs

Number of outputs:	4
Output type:	high-side (load to ground according to IEC 1131-2)
Nominal voltage:	24 V
Filter/protective circuit:	TVS diode, opto-coupler
Optical isolation:	1000 V (via opto-coupler)
Supply voltage:	4.75 V to 35 VDC
Current limit:	0.2 A
Output current per output:	50 mA typ.

8 Appendix

8.1 Glossary

ADC
= A/D converter

A/D converter
An A/D converter is an electronic device, often an integrated circuit that produces a digital output directly proportional to an analog signal output.

Data bus
The data bus basically consists of several lines (or pins) through which the processor sends and receives data. The volume of data that can be transmitted simultaneously depends on the number of data lines. In other words: The more pins the bus has, the more efficient it is.

DMA
= Direct Memory Access

For direct memory access, i.e. direct data exchange with the PC memory, a DMA controller is used.

Driver
A driver is a series of software instructions written specifically to manage particular devices.

EMC
= Electromagnetic Compatibility

The definition of the VDE regulation 0870 states: Electromagnetic compatibility is the ability of an electrical installation to function satisfactorily within its electromagnetic environment without unduly affecting its environment and the equipment it contains.

ESD
= Electrostatic Discharge

On non-conductive surfaces, an electric charge is conducted away very slowly. If the dielectric strength is overcome, there is a fast potential equalisation between the surfaces involved. The often very sudden equalisation process is referred to as electrostatic discharge (ESD). Currents of up to 20 A may occur in this process.

Ground line
Ground lines should not be seen as potential-free return lines. Different ground points may have small potential differences. This is always true with large currents and may cause inaccuracy in high-resolution circuits.

ICP
= Integrated Circuit Piezoelectric

ICP is a proprietary name for the industry standard IEPE.

IEC
= International Electrotechnical Commission

The IEC is a UN body affiliated to the ISO (International Standards Organisation) which sets standards for electrotechnical parts and components.

IEPE
= Integrated Electronics Piezo Electric

IEPE is a non-proprietary industry standard, which is used for piezoelectric acceleration, force and pressure sensors as well as for measuring microphones with built-in impedance converter electronics.

Input impedance
The input impedance is the ratio between voltage and current at the input terminals when the output terminals are open.

Input level
The input level is the logarithmic ratio between two electrical values of the same type (voltage, current or power) at the signal input of any receiving unit. This unit is often configured as a logical level related to the input of the circuit.

The input voltage corresponding to logic “0” is between 0 V and 15 V and the voltage corresponding to logic “1” is between 17 V and 30 V.

Interrupt
= IRQ

An external event indicating that the CPU should suspend its current task to service a designated activity.

Level
Logic levels are defined for processing and displaying information.
In binary switches, voltages are used for digital values. Here, the two voltage ranges “H” (high) und “L” (low) represent the information.
The “H” range is closer to plus infinity; the “H” level corresponds to digital 1. “L” denotes the range closer to minus infinity; the “L” level corresponds to digital 0.

Limit value
Exceeding the limit values, even for a short time, can easily result in the destruction of the component or the (temporary) loss of functionality.

Nyquist frequency
= half the sampling frequency

Operating voltage
The operating voltage is the voltage to the device in sustained operation. It must not exceed the maximum sustained voltage, and all unfavourable operating conditions, such as possible mains power surges for over a minute when the device is switched on, must be taken into account.

Optical isolation
Optical isolation means that two networks are only connected through an optoelectric transmitter and receiver with no electrical continuity between the two networks.

PCI Express
This is a parallelisable serial process for switched point-to-point connections. Unlike PCI bus, PCIe is not a parallel bus but a serial point-to-point connection. Data transfer is via so-called lanes comprising a line pair for transmission and a second pair for receiving. Individual components are connected via switches.
PCIe is also hot-plug compatible, which allows (defective) expansion boards to be replaced in operation – a feature much in demand in the server area.

Protective circuit
A protective circuit is set up on the actuator side to protect the control electronics and provide adequate EMC safety. The simplest protective circuit involves connecting a resistor in parallel.

Resolution
The resolution indicates how precisely a signal or value is held within the computer.

Short-circuit
A short-circuit is an electrical circuit in a device of lower resistance than that of a normal circuit, typically resulting from the unintended contact of components, and consequent accidental diversion of the current.

Trigger
A trigger is a pulse or signal for starting or stopping a special task. Triggers are often used for controlling data acquisition.

TVS
= Transient Voltage Suppression

8.2 Index

9 Contact and support

Do you have any questions? Write or call us:

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Airport Boulevard B210
77836 Rheinmünster

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E-mail: info@addi-data.com

Manual and software download from the Internet:

www.addi-data.com